

# **Community-based and Innovative Technological Approaches to Improve Child Nutrition in India**

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## ABSTRACT

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**Background:** India is home to the largest number of underweight and stunted children in the world, but its national Integrated Child Development Services (ICDS) programme has had negligible impact on the nutritional status of young infants.

**Aim:** To use two innovative approaches – the Optifood tool and mobile phones – to strengthen counselling components of the ICDS programme to improve complementary feeding (CF) practices of 9-11 month old infants, in a rural district in Haryana state, Northern India.

**Methods:** Optifood, a novel tool using linear programming analyses to formulate and evaluate food-based recommendations (FBRs), was used to strengthen existing ICDS FBRs. These FBRs were tested with mothers of young infants in a week-long trial, and promoted in a 6-week pilot test of a mobile phone-delivered (mHealth) intervention with 12 health workers and 60 mothers of 9-11 month old infants, using a before and after comparison. Evaluation of outcomes was based on Optifood analyses, 24-hour dietary recalls, food frequency questionnaires, open-ended structured questionnaires, an intervention development workshop, focus group discussions, and in-depth interviews.

**Results:** Local food-based approaches are unable to meet recommended nutrient intakes (RNIs) for seven key nutrients. However, FBRs alone could ensure dietary adequacy (i.e.  $\geq 65\%$  Recommended Nutrient Intake) for at least six nutrients for most infants. In the trial to test FBRs, the proportion of mothers feeding their infants legumes, vegetables and fruit at endline was significantly greater ( $p < 0.05$ ) than at baseline; no significant increases in the proportion of mothers feeding their infants grains, dairy, fats or egg were reported. Mothers reported 19 barriers to following the promoted FBRs, which were used to develop motivating statements for their promotion in a mHealth intervention. The mHealth pilot test findings suggest that the intervention was convenient, feasible and acceptable. Based on self-report, health workers adhered to the planned contact of 20 mobile phone calls during the study period. Compared to baseline, there were significant increases ( $p < 0.05$ ) in the following at endline: (i) infants' median servings per week of grains, legumes, fruit, and added fats; (ii) proportion of mothers reporting feeding eggs, undiluted milk and green leafy vegetables; (iii) proportion of infants meeting promoted FBRs for all foods except dairy; and (iv) maternal knowledge regarding food consistency.

**Conclusions:** This is the first study to use linear programming analyses to strengthen existing governmental FBRs, and to use mobile phones for CF counselling. Findings suggest that additional, complementary intervention(s) are required to improve the micronutrient status of infants. While evidence from a randomised controlled trial is needed, study findings provide valuable insights into the utility of evidence-based FBRs and mobile phones to enhance the impact of ICDS and CF programming and research strategies in the study setting, and potentially globally.

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## GLOSSARY OF TERMS

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24-HR	24-hour dietary recalls
AI	Adequate Intake
AWW	Anganwadi Worker
AWC	Anganwadi Centre
BC	Behaviour Change
CF	Complementary Feeding
CI	Confidence interval
FBR	Food-Based Recommendations
FFQ	Food Frequency Questionnaire
FG	Food Group
FGD	Focus Group Discussion
FSG	Food Sub-Group
HAZ	Height-for-Age Z-score
ICDS	Integrated Child Development Services
IDI	In-Depth Interviews
IMCI	Integrated Management of Childhood Illnesses
IMNCI	Integrated Management of Neonatal and Childhood Illness
INR	Indian Rupee
IQR	Interquartile Range
IYCF	Infant and Young Child Feeding
iZiNCG	International Zinc Nutrition Consultative Group
LAZ	Length-for-Age Z-score
m-FBRs	Minimum number of Food-Based Recommendations needed to improve diet quality
MeSH	Medical Subject Headings
mHealth	Mobile phone technology approaches for health interventions
NFHS	National Family Health Survey

NGO	Non-Governmental Organisation
OR	Odds Ratio
PHC	Primary Health Centre
RNI	Recommended Nutrient Intake
s-FBRs	Strengthened set of existing governmental Food-Based Recommendations
SD	Standard Deviation
SMD	Standard Mean Difference
TIPs	Trial of Improved Practices
UNICEF	United Nations Children's Fund
USDA	United States Department of Agriculture
WAZ	Weight-for-Age Z-score
WLZ	Weight-for-Length Z-score
WHZ	Weight-for-Height Z-score



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# 1. STUDY BACKGROUND

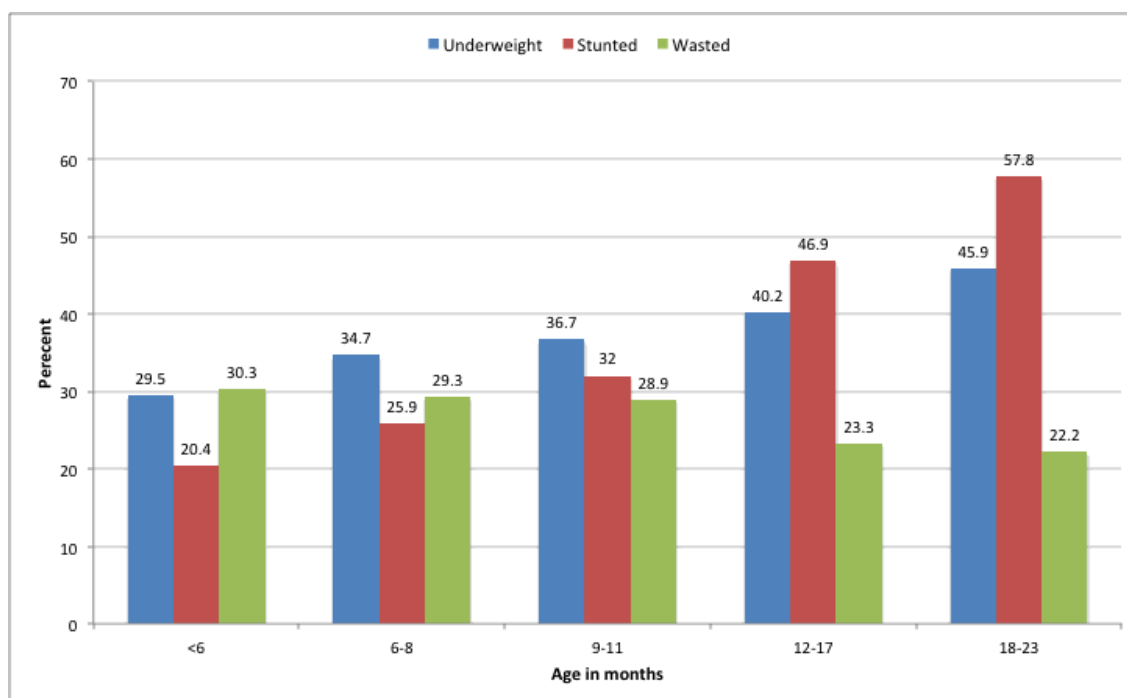
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## CHILD MALNUTRITION IN INDIA

India bears the largest burden of ill child health and nutrition in the world.<sup>1-5</sup> At 22%, India's proportion of under-five deaths is substantially higher than any other country in the world, the next highest at 8% accounted for by Nigeria.<sup>1</sup> Of the 25 million infants born in India each year, 1.7 million die within their first year of life.<sup>2,4</sup> Nearly half (45%) of under-five mortality in India is due to pneumonia and diarrhoea in children aged 1-59 months.<sup>1,2,6</sup> The other half of child deaths in India occur within the first month of life and are due to infection, birth asphyxia and prematurity.<sup>2,5</sup> It is estimated that undernutrition contributes to 61% of all diarrheal deaths and 53% of pneumonia deaths.<sup>1,6</sup> Moreover, studies estimate that undernutrition is responsible for 33-50% of all under-five child deaths worldwide.<sup>5,7,8</sup>

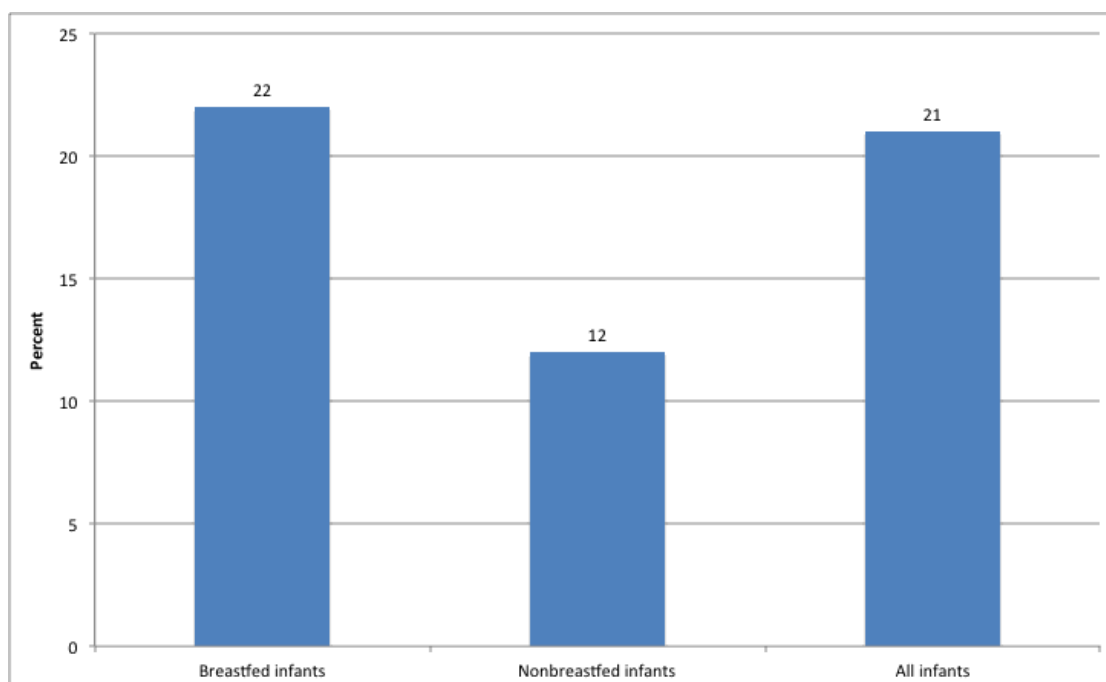
Data from the 2005-06 National Family Health Survey further highlight India's grave child malnourishment problem (Figure 1.1). Data for 18-23 month old Indian infants show that nearly 58 percent are stunted (height-for-age Z-scores, HAZ, <-2 SD), 46 percent are underweight (weight-for-age Z-scores, WAZ, <-2 SD) and over 22 percent are wasted (weight-for-height Z-scores, WHZ, <-2 SD).<sup>9</sup> Additionally, though data from the 2005-06 National family Health Survey shows that less than 1 percent of children under the age of 5 years are overweight (WAZ > +2 SD), a recent meta-analysis shows that an increasingly significant proportion of overweight and obese Indian children now coexist with those who are undernourished.<sup>10</sup> Studies have also shown that infants should be exclusively breastfed from 0-6 months of age to protect them from morbidity and malnutrition.<sup>11</sup> In India, the introduction of animal milk to the child's diet between 3-5 months leads to increased underweight, stunting and infections.<sup>5</sup> However, even exclusively breastfed children will have increased morbidity, stunting and underweight if they are not fed an adequate amount and quality of complementary foods from 6 months of age onwards.<sup>5,7</sup>

**Figure 1.1: Nutritional status of Indian children aged 0-23 months<sup>9</sup>**



Data from the National Family Health Survey also highlight how poor complementary feeding (CF) practices likely contribute to India's high burden of child malnutrition.<sup>5,9</sup> The survey used 24-hour dietary recall data to estimate the proportion of children fed appropriately by calculating the number of food groups and number of times the children were fed. Results show that only 21% of all children age 6-23 months are fed with all the recommended appropriate feeding practices, which take into account both diet diversity and meal frequency (Figure 1.2).<sup>9</sup> These results are of concern because Menon et al. have found that Indian infants being underweight is significantly associated with not consuming any solid or semi-solid foods from 6-9 months of age.<sup>12</sup> Additionally, for Indian children aged 6-23 months, the diet diversity score and achieving minimum diet diversity (i.e. consuming at least 4 food groups) are most strongly and significantly associated with underweight, stunting, HAZ and WAZ.<sup>12</sup>

**Figure 1.2: Proportion of Indian infants aged 6-23 months fed with recommended practices<sup>9</sup>**



<sup>a</sup> Criteria for breastfed children: (i) children aged 6-23 months should be fed from 3 or more different food groups; (ii) infants aged 6-8 months should be fed at least twice a day; and (iii) children aged 9-23 months should be fed at least 3 times a day; <sup>b</sup> Criteria for non-breastfeeding children aged 6-23 months: (i) they should be fed milk or milk products every day; (ii) they should be fed from at least 4 food groups; and (iii) they should be fed 4 or more times a day.

### **NATIONAL APPROACH TO TACKLE UNDER-TWO MALNUTRITION IN INDIA**

Launched in 1975, the Integrated Child Development Services (ICDS) programme is India's policy response to combat early childhood malnutrition. Services are provided in an Anganwadi centre, often located in the village itself, by an Anganwadi worker (AWW). The AWW is charged with providing a population of 1000 with eight key services including (i) supplementary feeding; (ii) immunization; (iii) health check-ups; (iv) referrals; (v) health education to women; (vi) nutrition counselling to women; (vii) micronutrient supplementation for children aged 3-6 years; and (viii) preschool education for children aged 3-6 years. Over the past three decades, the ICDS program has expanded to include additional interventions such as adolescent girls' nutrition, income-generation schemes for women, and health, awareness and skills development.<sup>13</sup>

Evaluations of ICDS show that Anganwadi centres have had little to no impact on the nutritional status of children, particularly in those under the age of 3 years.<sup>14</sup> To date, there have been severe limitations for AWWs in promoting nutrition messages to mothers of

young infants.<sup>15</sup> This is of particular concern since the period of 6-24 months of age is one of the most critical times for growth faltering during childhood, and deficits acquired at this age are rarely compensated.<sup>16, 17</sup> AWWs spend nearly 40% of their time on food supplementation-related activities for children aged 3-6 years and 39% on preschool education, leaving little to no time for other tasks.<sup>18, 19</sup> In particular, home visits to promote growth monitoring and to advise mothers on health and nutrition matters is the AWW's most neglected task.<sup>13, 20</sup> An AWW's job performance is also affected by demotivating factors – for example, AWWs are generally held in very low regard in their communities, and are paid highly irregularly.<sup>13, 19</sup>

Overall, a wide variety of issues across the health systems, policies and community levels prevent the ICDS programme from achieving its full potential to reduce child malnutrition in India. In particular, numerous evaluations<sup>13-15, 18-20</sup> of the ICDS programme have identified the following three community-level barriers to improving child nutritional status: (i) inability to improve inadequate feeding and caring practices; (ii) not reaching children under 3 years of age; and (iii) extraordinary AWW workload. The most recent evaluation of the ICDS programme found that there is no statistically significant difference in the nutritional status of Indian children aged 7 to 60 months receiving ICDS services compared with children not receiving ICDS services, even after stratifying results by monthly household expenditure, occupation and asset holding.<sup>21</sup>

Accordingly, researchers and policy analysts alike have recommended a number of modifications to the ICDS framework to reduce child malnutrition in India.<sup>5, 13</sup> For example, a key recommendation is for the national programme to find ways to balance AWW workload while radically shifting the focus of its activities to improve the nutritional status of children under the age of 3 years.<sup>5, 13, 19</sup> These findings underscore the importance of identifying strategies to support AWWs and help reduce their large workload, so they are able to reach mothers of young infants with effective CF messages.

## **FOOD-BASED RECOMMENDATIONS AND LINEAR PROGRAMMING TO IMPROVE CF PRACTICES**

The ICDS programme's nutrition education strategy for mothers is based on the World Health Organisation's Integrated Management of Neonatal and Childhood Illnesses guidelines.<sup>22-24</sup> Specific food-based recommendations (FBRs) developed for promotion by AWWs provide guidance on appropriate consistency, frequency and quantity of

complementary foods for infants aged 6 to 8 months, 9 to 11 months, and 12 to 23 months. However, these FBRs are general since they were developed for promotion in all regions within India (Appendix 1.1). Although AWWs are encouraged to make these ICDS FBRs specific to their setting, messages in the FBRs are not tailored to local contexts taking into account food patterns and availability. Additionally, it is not known whether these FBRs ensure nutrient adequacy for the target population if they are adopted.

Linear programming is one approach that can be used to formulate and evaluate the cost and nutritional impact of FBRs, and is the basis of Optifood, a novel nutrition tool which will soon be available on the WHO website.<sup>25-27</sup> The linear programming approach takes into account the most common nutritional problems, as well as factors including cultural food consumption patterns, acceptable foods (available, affordable, and frequently consumed), realistic food portion sizes, and the impact of recommendations on other nutrients and the environment,<sup>28</sup> and formulates locally appropriate FBRs while ensuring that diets based on them come as close as possible to simultaneously meeting theoretical nutrient requirements for the target group.<sup>26, 29</sup> In addition, nutrients that are likely to remain low in diets based only on local food (i.e. “problem nutrients”) are identified. Optifood analyses use a mathematical optimisation process that concurrently takes into account the target population’s dietary patterns and their estimated requirements for energy and 12 key nutrients, and selects the nutritionally best diet from all possible alternative diets given the model’s parameters – a process which is too complex to do manually.<sup>25, 26</sup> Optifood also tests the dietary adequacy of FBRs and allows for quick comparisons across many alternative sets of FBRs, thus providing the user with evidence to objectively select a set of FBRs for a target population, and justifying the need for alternative strategies when necessary to ensure a nutritionally adequate diet.<sup>30</sup> A detailed description of Optifood is published elsewhere (Appendix 1.2).<sup>27</sup>

Although linear programming has been used to date in a developing country context to identify nutrients whose recommended nutrient intakes (RNIs) cannot be met using local foods (i.e., “problem nutrients”),<sup>26</sup> develop FBRs for young children in Indonesia,<sup>30</sup> test formulated food products in Cambodia,<sup>31</sup> design ready-to-use therapeutic foods in East Africa<sup>32</sup> and assess the economic value of fortified supplements,<sup>33</sup> this approach has not yet been used to evaluate and enhance FBRs promoted within existing governmental nutrition programmes.

## BEHAVIOUR CHANGE STRATEGIES TO IMPROVE CF

### Approaches used to date

Behaviour change communication, delivered via counselling, community support groups and mass media, is a key strategy for reaching mothers to increase their implementation of behaviours known to promote healthy infant dietary intake and growth. There is substantial evidence that behaviour change interventions incorporating counselling approaches and evidence-based, context-specific messages can successfully improve infant feeding practices and growth.<sup>16, 34-48</sup> Allen and Gillespie found that effective nutrition interventions use messages that are clearly understood, feasible to adopt within the target population's resources, and not in contradiction with prevailing beliefs.<sup>49</sup> Furthermore, it is critical to reach mothers of young infants through acceptable channels, and to deliver messages both consistently and with sufficient intensity to motivate them to try, and subsequently continue to implement new behaviours.<sup>49, 50</sup>

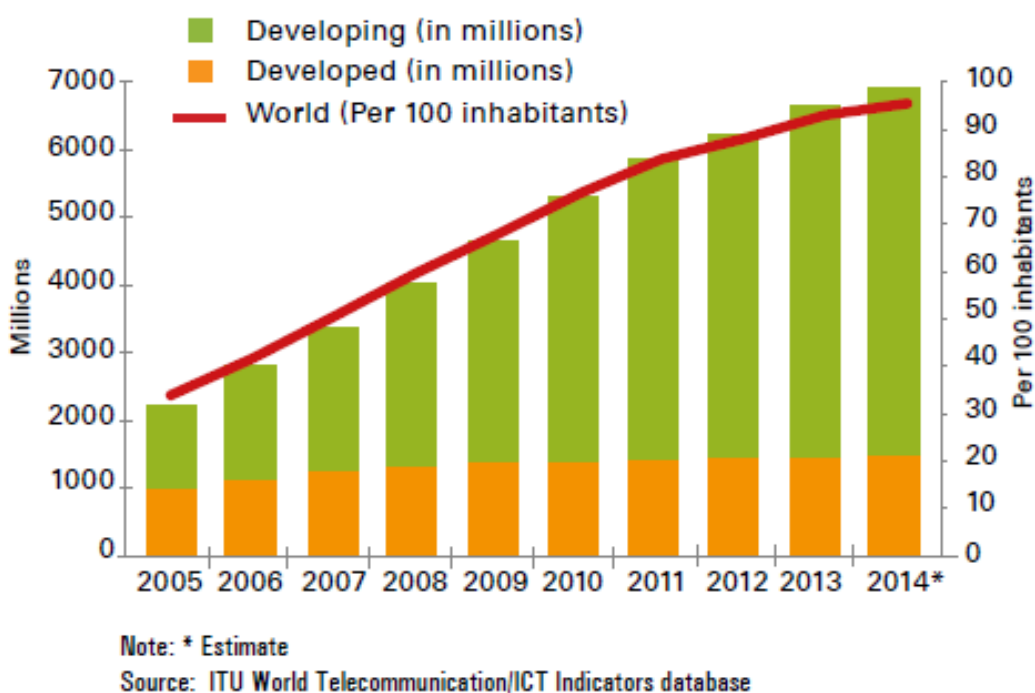
Additional evidence suggests the need for interventions to target mothers with multi-faceted approaches to successfully change CF behaviours and improve infant growth. Briscoe and Aboud's review found that the most successful behaviour change interventions in developing countries targeting child health behaviours, including CF, used at least three of the following six technique categories: (i) information, e.g. how to prepare and feed infants certain foods; (ii) performance, e.g. identification of signals of infant hunger; (iii) problem solving, e.g. providing caregivers with solutions to overcome infant's refusal of food; (iv) social support, e.g. mothers' groups; (v) materials, e.g. providing infant food in a cooking class; and (vi) media-delivered information, e.g. posters or radio broadcasts.<sup>51</sup> These techniques can further be categorised into the following three central components influencing behaviour change in Michie et al.'s behaviour change wheel: (i) *capability*, i.e. "an individual's physical and psychological ability to enact the behaviour;" (ii) *motivation*, i.e. "all brain processes that energise and direct" an individual's behaviour; and (iii) *opportunity*, i.e. all physical and social "factors lying outside the individual that make performance of the behaviour possible or prompt it."<sup>52</sup> Specifically, information, materials and media are three intervention techniques that aim to influence mothers' *capabilities* to engage in healthy behaviours. Integrating social support would provide mothers with *opportunities* to influence their *motivations* and support problem-solving, thus influencing their *capabilities*. The performance component of a successful behaviour change intervention includes modelling, e.g. food demonstrations, which influences a mother's *motivation* and *capability* to "energise and direct" that behaviour into enacting it, e.g.

preparing nutritious complementary foods. This evidence is consistent with Bhandari et al.'s study in India showing that repeated counselling with caregivers using multiple channels and approaches resulted in improvements in CF behaviours and child growth.<sup>53</sup>

### mHealth approaches

The growing popularity of mobile phones worldwide suggests that in addition to traditional delivery channels, behaviour change interventions targeting CF behaviours could use this technology to reach caregivers of infants. According to the International Telecommunication Union, developing countries account for nearly 80% of the 6.7 billion mobile-phone subscriptions in the world in 2013 (Figure 1.3).<sup>54</sup> India's mobile teledensity, defined as mobile connections per 100 people, was 72.2% in January 2014 — there were nearly 773 million active mobile phone connections among the total wireless subscriber base of over 893 million.<sup>55</sup>

**Figure 1.3: Mobile phone subscriptions, total and per 100 inhabitants, from 2005-2014**



The spread of mobile phone technology, decreasing mobile phone costs and increasing network coverage in India provides new opportunities for delivering mHealth interventions to vulnerable populations who are unable to access care. Though the definition has not been standardised, mHealth can be defined as the use of mobile communication technologies to promote health by supporting healthcare practices, e.g. delivery of health



information.<sup>56</sup> It has been shown that mobile phone-delivered health services have the potential to increase health education and improve the affordability of interventions for health promotion.<sup>57-59</sup> Evidence from a recent systematic review of community health workers and mobile technology suggests that the use of mobile phones shows promise in improving both the range and quality of services provided by community health workers.<sup>60</sup> An mHealth approach within the ICDS programme has the potential to improve CF practices, decrease AWWs' workload and reach mothers they are usually not able to interact with due to distance and busy schedules.

However, mobile phones have never been used for CF counselling, signalling a need for formative research in this area. A review of mHealth approaches in developing countries reported that the most commonly documented use of mHealth is one-way mobile phone-delivered text message and phone reminders to encourage healthy behaviours, follow-up appointments, and data gathering.<sup>61</sup> However, text-based mobile technology approaches such as text messages and data capture rely on high connectivity and literacy levels in target settings. Nevertheless, settings with limited connectivity and low literacy rates could benefit from mHealth approaches using the traditional use of mobile phones, i.e. phone calls.

Mobile phones are potentially a promising delivery channel to reinforce CF messages and to increase contact between mothers of young infants and AWWs, given their large workload. Mobile phone calls between AWWs and mothers could improve AWW workload by reducing time they spend travelling to conduct routine home visits, and could be a convenient way for both AWWs and mothers to contact each other. However, due to the lack of literature on using mobile phones for two-way contact to improve CF practices, it is unclear if AWW-delivered CF counselling to mothers via mobile phones is feasible and acceptable within the ICDS programme. There are additional concerns about the feasibility of using mobile technology as a delivery channel for CF messages in this context, including: (i) mothers and AWWs may not be able to retain mobile phone ownership; i.e. husbands or other family members may take the mobile phone; (ii) mobile phones may increase AWW workload because of the need to make or respond to phone calls in addition to performing their other duties; (iii) using mobile phones to reinforce messages may not be acceptable to AWWs, mothers or their family members; (iv) participants may prefer to use mobile phone credit for personal calls; (v) mobile phones may get lost, stolen or sold for money; (vi)

intermittent access to electricity may be a barrier to charging mobile phones; and/or (vii) mobile phone contact with AWWs may have no impact on CF practices.

## **AIM AND OBJECTIVES**

Accordingly, this thesis undertook two sub-studies based on two innovations – Optifood and mobile phones – aiming to strengthen CF components of the ICDS programme to improve CF practices of 9-11 month old infants in a rural district in Haryana state, Northern India. Research presented in this thesis used Optifood to formulate culturally appropriate FBRs for these infants, which were subsequently adapted for promotion in a mHealth intervention based on rigorous community-based formative research. Additional formative research informed the design of a mHealth intervention, which was pilot tested to explore the feasibility of AWWs using mobile phones to reinforce CF messages with mothers.

Specific objectives of this thesis are as follows:

1. To use Optifood to determine if local foods can provide nutritionally adequate diets for infants, and to create and strengthen existing FBRs to improve CF practices of infants.
2. To test the set of FBRs with mothers of young infants and to identify barriers and facilitating factors for their promotion in a community-based mHealth intervention to improve CF practices of infants through strengthening ICDS-delivered counselling.
3. To design a community-based nutrition counselling intervention to improve CF practices of infants using mobile phones.
4. To assess the feasibility of strengthening ICDS-delivered counselling to improve infant CF practices through a community-based pilot mHealth intervention.
5. To understand AWW and mothers' views, experiences and perceived impact of a mHealth counselling intervention to improve infant CF practices.

## **STUDY SETTING**

Research described in the thesis took place in Kheri Kalan Primary Health Centre (PHC), a rural area in Faridabad district in Haryana state, Northern India. The majority of households in Haryana (88.3 percent) practice Hinduism, 6.4 percent of households are Muslim, and 5 percent of households are Sikh.<sup>9</sup> Women's autonomy in the household in Haryana is low, with 38.4 percent of married women reporting usually participating in household decisions.<sup>9</sup> Kheri Kalan PHC is made up of 6 subcentres, each with a population of about

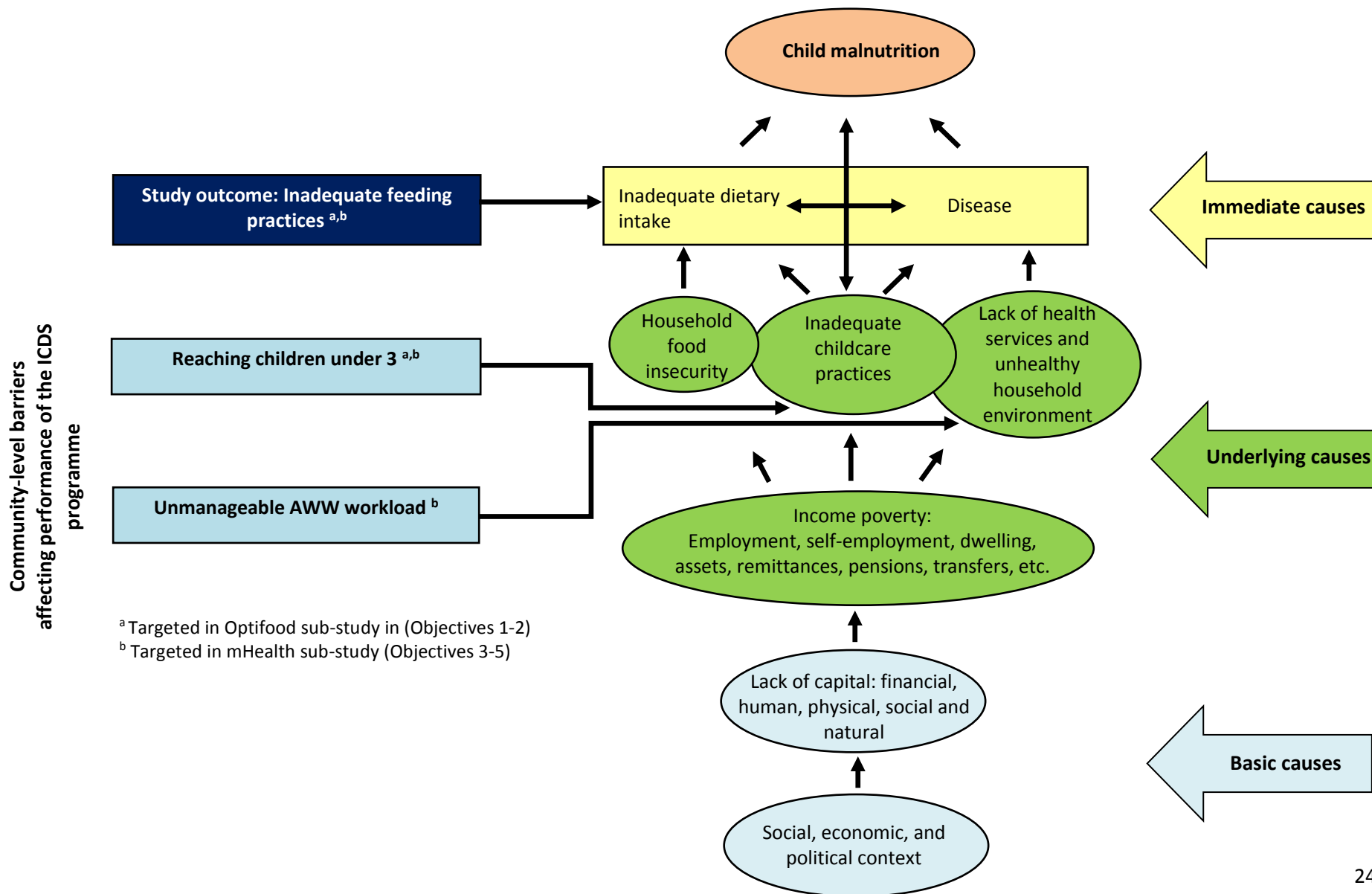
5000. Literacy in the population is low – 15% of men and 50% of women have never attended school. Nearly 40% of under-five children in this area are underweight, and 46% are stunted.<sup>9</sup>

## **CONCEPTUAL FRAMEWORK**

Although evaluations of the ICDS programme have identified barriers to implementation across health systems, policy and community levels,<sup>13, 14, 20</sup> this thesis focused on strengthening community-based delivery of CF counselling within the ICDS programme. The scope was designed to focus on addressing community-level barriers. Specifically, the thesis aimed to improve inadequate feeding practices in 9-11 month old infants by addressing the following two community-level barriers to implementation of the ICDS programme: (i) reaching children under 3 years of age, and (ii) unmanageable AWW workload.

Figure 1.4 links the two barriers the study aims to address in order to influence its primary outcome, to the immediate and underlying causes of child malnutrition in a framework adapted from one developed by the United Nations Children’s Fund (UNICEF) in 1990 and updated by Black et al. in 2008 for the Lancet Series on Maternal and Child Undernutrition.<sup>7, 62</sup> This framework provides an overview of the nature and immediate, basic and underlying determinants of undernutrition, including disease, inadequate dietary intake, poverty and environmental, economic, and socio-political contextual factors. Both Optifood and mHealth sub-studies in the thesis aimed to improve inadequate feeding practices in the ICDS programme, which are linked to inadequate childcare practices, an immediate cause of child undernutrition, by reaching children under 3 years of age, which is a barrier linked to inadequate childcare practices, also an underlying cause of malnutrition. The mHealth sub-study also aimed to influence another underlying cause of child undernutrition – lack of health services – by reducing the AWW’s unmanageable workload.

Figure 1.4: Conceptual Framework <sup>7,62</sup>



## STRUCTURE OF THESIS

This thesis is comprised of eight chapters including this chapter, five research papers, and two additional chapters:

- Chapter 1 — Introduction
- Chapter 2 — Systematic literature review
- Chapter 3-7 — Papers 1-5
- Chapter 8 –Summary and conclusions

**Chapter 1** introduces the thesis, its rationale, conceptual framework, and overall structure.

**Chapter 2** presents a systematic literature review investigating whether nutrition counselling with mothers, one of the main ICDS strategies to improve child nutritional status, has an impact on CF practices or physical growth.

The next five chapters comprise five research papers: two papers reporting results from the Optifood sub-study (Objectives 1-2), and three papers reporting results from the mHealth sub-study (Objectives 3-5). The paper in **Chapter 3** describes how Optifood was used to create and enhance existing FBRs to improve CF practices of infants in the study setting. In this chapter, Optifood was first used to identify nutrients whose RNIs cannot be met using local foods as consumed by rural 9-11 month old infants in the study setting (i.e., “problem nutrients”). Optifood was used to select the minimum number of FBRs that are likely to ensure adequacy at the population level for the maximum number of nutrients (m-FBRs) for these infants. Lastly, Optifood analyses were used to strengthen the FBRs currently being promoted within the ICDS programme in the study setting (s-FBRs) by making them more specific to the target population.

The paper presented in **Chapter 4** describes the testing of s-FBRs with mothers of young infants in a week-long community-based trial and identifies barriers and facilitating factors for their promotion in mHealth counselling intervention. This paper reports mothers’ and infants’ adherence to the s-FBRs during the trial, and presents the barriers and motivating messages finalised to aid with promotion of the s-FBRs. Lastly, the paper reports infants’ adherence to the s-FBRs and describes the changes in energy and nutrient intakes and dietary diversity before and after the trial.

**Chapter 5** describes the community-based participatory formative research to develop and design a mobile phone-based nutrition counselling intervention to improve CF practices of infants in the study setting. Specifically, this chapter reports findings from focus group discussions (FGDs) with mothers, mothers-in-law and AWWs exploring their views regarding the feasibility, acceptability and best means of using mobile phones to facilitate the process of delivering CF counselling within the ICDS programme. The chapter also describes how key FGD findings and stakeholder views from an intervention development workshop were used to finalise the design of the mobile phone-delivered intervention for pilot testing.

The next two chapters present quantitative and qualitative results from the pilot test of the mHealth intervention to strengthen ICDS-delivered counselling to improve CF practices of infants. **Chapter 6** reports the proportion of mothers receiving group and MP-delivered CF counselling from AWWs, and the effect of the mHealth intervention on self-reported infant dietary practices and maternal CF knowledge. **Chapter 7** describes AWW and mothers' views, experiences and perceived impacts of the mHealth intervention as reported in in-depth interviews at the end of the pilot study.

**Chapter 8** synthesises findings across study objectives and presents the main strengths and limitations of the thesis. Implications of study findings are explored for improving CF practices in Indian infants. Finally, recommendations for further research are made.

Two papers presented in Chapters 6 and 7 are currently under review with a peer-reviewed journal, and the remaining three papers presented in Chapters 3-5 are being finalised for submission to peer-reviewed journals. Figures, tables, references and supplemental material can be found at the end of each paper. The appendices contain supplemental material referred to in Chapter 1 and copies of all ethical approvals and study instruments.

## **STATEMENT OF CONTRIBUTION**

The PhD candidate joined the Optifood sub-study in 2010, and designed and obtained funding for the mHealth sub-study in 2011. She was responsible for developing the outline of the work presented in this thesis in discussion with the principal investigators of the studies. Specifically, the candidate undertook the following work as the research coordinator for both sub-studies presented in this thesis:

- Co-designed the mHealth study and led the grant proposal to obtain funding for the sub-study.
- Contributed to the design of all quantitative data collection tools used in this thesis.
- Led the design of all qualitative data collection tools used in this thesis.
- Set up the Optifood and mHealth sub-studies and conducted fieldwork over the course of one year, including both qualitative and quantitative data collection, with the help of Indian co-PIs and research assistants.
- Analysed all qualitative and quantitative data presented in this thesis.
- Drafted five research papers presented in this thesis (Chapters 3-7) and revised them based on feedback from co-authors.
- Wrote the three general chapters of the thesis (Chapters 1, 2 and 8).

## **COLLABORATING PARTNERS**

### **World Health Organization, Switzerland**

Dr. Bernadette Daelmans in the Department of Maternal, Newborn, Child and Adolescent Health at the World Health Organisation in Geneva provided technical oversight to the Optifood sub-study presented in this thesis.

### **Centre for Health Research and Development, India**

Dr. Nita Bhandari, Dr. Sarmila Mazumder and Dr. Sunita Taneja at the Centre for Health Research and Development (CHRD) were co-principal investigators of both the Optifood and mHealth sub-studies presented in this thesis. Dr. Sarmila Mazumder was also part of the PhD candidate's advisory committee.

CHRD is based in New Delhi, India, and is the regional centre of the Society for Applied Studies in Kolkata. CHRD specialises in community-based research, assessment and action, and product evaluation. CHRD staff have been working for several years on community-based research related to child health and nutrition, development of interventions, their evaluation and development of strategies for delivery of the programs. The organisation also has extensive experience in interacting with other agencies to disseminate the knowledge it generates, helping to visualise challenges in scale up, building consensus on policies and implementation strategies, and collaborating with others to building skills in community research and action and improving delivery of child health programs.

## **PERSONAL CAPACITY RELEVANT TO THE THESIS**

The PhD candidate spent her childhood in Rajasthan State, Northern India, and is fluent in Hindi. She has a Master in Public degree in Health Behaviour and Health Education, which provided her with theoretical grounding in designing interventions. Additionally, she gained practical experience in qualitative and participatory research through working on a year-long community-based participatory action research project with Burmese refugees in America. She took statistics, qualitative research and nutrition modules at LSHTM to strengthen her skills to collect and analyse data, and to write up results from the research study.



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## **2. SYSTEMATIC LITERATURE REVIEW: IMPACT OF NUTRITION COUNSELLING WITH MOTHERS ON COMPLEMENTARY FEEDING PRACTICES AND CHILD GROWTH**

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### **PREFACE**

This chapter provides the rationale for promoting improved CF practices through counselling in the thesis. It presents a systematic literature review investigating whether nutrition counselling with mothers improves CF practices or child growth. Nutrition counselling is currently used in India's ICDS programme as one of the main strategies to reduce child malnutrition. Thus, critically examining the evidence regarding the use of counselling to improve CF practices and child nutritional status is relevant to this thesis. It provides insights into whether new technologies used to strengthen CF counselling components of the ICDS programme could have an impact on infant dietary practices or growth.

## INTRODUCTION

Undernutrition contributes to almost 3.1 million deaths of children under the age of five years annually in the world, which represent almost 45% of all deaths in this age group.<sup>1</sup> According to recent global estimates, 314 million children under the age of 5 years were stunted (height-for age Z-scores, HAZ, <-2 SD) and 258 million were underweight in 2011.<sup>2</sup> In particular, developing countries have a high burden of child malnutrition — in 2011, 19.4% of children under the age of five years were underweight (weight-for age Z-scores, WAZ, <-2 SD), and nearly 30% were stunted.

Inappropriate complementary feeding (CF) practices have been identified as one of the major causes of malnutrition in young children in developing countries.<sup>3-5</sup> The World Health Organisation (WHO) defines CF as the timely introduction of clean and nutrient-rich foods in addition to breastmilk when infants are 6 months of age.<sup>6</sup> WHO recommends that complementary foods are fed to infants from 6 to 18-24 months of age, and that they should be timely, adequate, appropriate, and given in sufficient quantity.<sup>6</sup> Recent evidence shows that when combined with disease prevention interventions, complementary feeding interventions targeting children under the age of 2 years in developing countries are the most effective in improving child nutritional status and promoting healthy growth and development.<sup>7</sup>

Several systematic reviews over the past decade have assessed the impact of CF interventions, including educational interventions such as counselling, on child diets and growth. Caulfield et al. reviewed literature from 1970 to 1997, and found that context-specific and evidence-based CF interventions can have a positive impact on child growth and dietary intake.<sup>8</sup> Subsequent reviews have focused on the time period from 2006 to 2012. Shi and Zhang's review of CF educational interventions reported positive effects on caretakers' CF knowledge and behaviours, as well as on children's growth and dietary intakes.<sup>9</sup> Dewey and Adu-Afarwah found that CF interventions using educational approaches had a modest effect on weight and linear growth, with larger effect sizes in programmes compared to efficacy trials.<sup>10</sup> Bhutta et al.'s review identified CF educational strategies as an effective intervention to reduce child undernutrition.<sup>11</sup> Imdad et al.'s review found that CF counselling alone has a significant impact on improving linear growth and weight.<sup>12</sup> The most recent review by Lassi et al. found that CF education interventions without any other strategies significantly improved HAZ scores, WAZ scores and significantly reduced the rates of stunting.<sup>13</sup>

This systematic review updates previous reviews of CF interventions using educational strategies by including literature published between 2012 and 2014, and aims to assess the impact of CF counselling interventions on child growth and CF practices.

## **METHODS**

### **Search strategy**

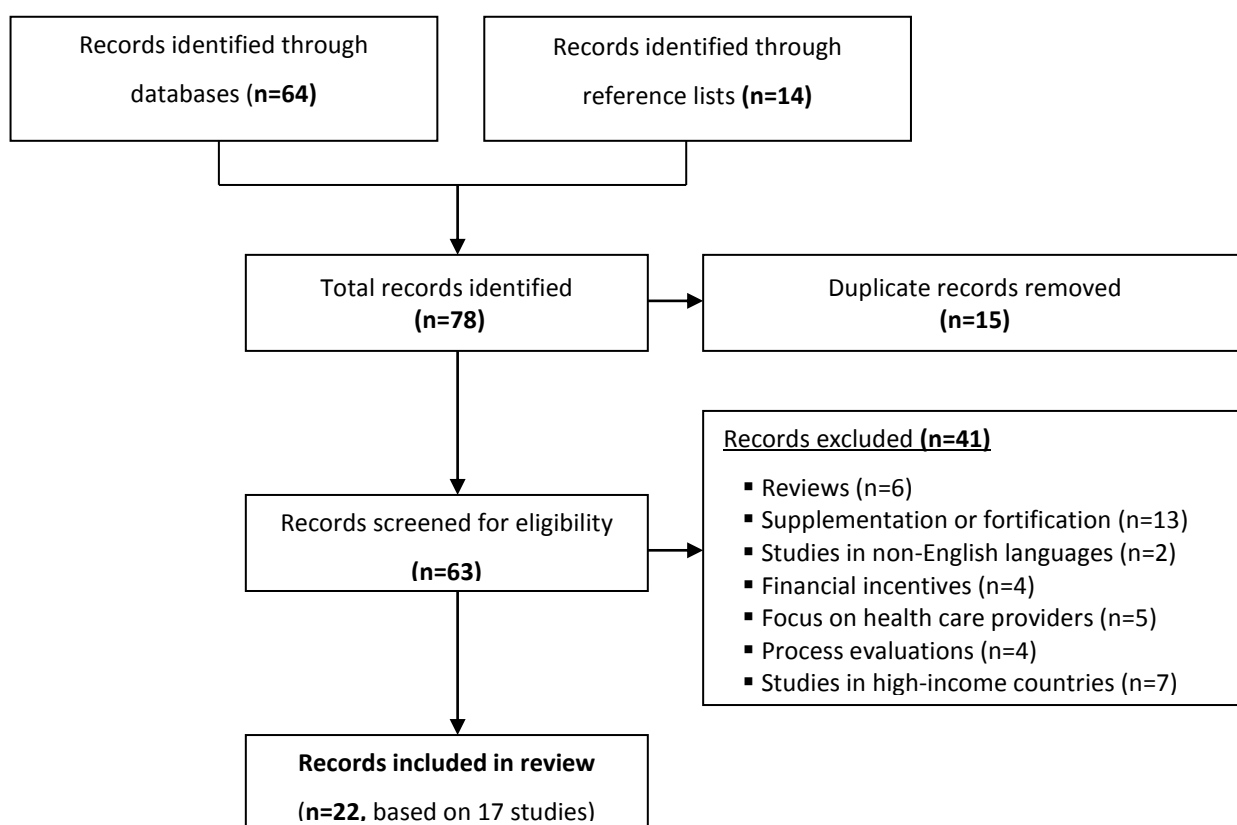
A systematic review to critically examine whether nutrition counselling improves CF practices or growth was carried out using PubMed, Cochrane Library, Google Scholar and WHO global databases using combinations of the following Medical Subject Headings (c) key words: 'nutrition,' 'growth,' 'weight,' 'length,' 'height,' 'diet,' 'education,' 'counselling,' and 'complementary feeding.' The search strategy was based on the Child Health Epidemiology Reference Group Systematic Review Guidelines.<sup>14</sup> Further parameters were set to search for both randomised (individual or cluster) and non-randomised controlled trials and programs relating to children aged 0-24 months published from 1990 onward. The last date of the search was 28 February, 2014. Reference lists of identified articles, existing reviews and meta-analyses, were also reviewed for studies that were not identified in the initial search.

### **Inclusion/exclusion criteria**

The main criteria for the study search and selection were epidemiological studies in developing countries using nutrition counselling as an intervention strategy to improve CF practices with mothers who had a child < 24 months of age. According to World Bank classification, developing countries were defined as countries with Gross National Income per capita per capita below US\$11,905.<sup>15</sup> The exclusion criteria were literature reviews, interventions with food supplementation and/or financial incentives, and those only focusing on process evaluations or the impact of the intervention on health care providers. In addition, studies in languages other than English and those focusing on cost-benefit analyses were excluded. Figure 2.1 outlines the study search and selection process.



**Figure 2.1: Systematic literature review – Search and selection strategy**



### **Data extraction and synthesis**

Titles and abstracts in electronic records were first scanned to identify potentially eligible studies. From those selected, the full papers were read to extract data on study characteristics and outcomes from all records included in the review. Each intervention was identified according to whether: (i) there were main behaviour change (BC) intervention components present, including individual counselling, group counselling, and/or Information, Education and Communication (IEC) materials including leaflets, posters, etc.; (ii) there were BC sub-components present, including food demonstrations and/or growth monitoring; and (iii) theory was used to guide the intervention.

The outcomes reported in this review were as follows: (i) energy and micronutrient intakes and adequacy; (ii) consumption of animal source foods; (iii) frequency and variety of complementary food intake; (iv) attained weight (Kg); (v) attained length (cm); and (vi) changes in WAZ, HAZ, length-for-age Z-scores (LAZ), weight-for-height Z-scores (WHZ), and weight-for-length Z-scores (WLZ).

Standard mean differences (SMDs) and odds ratios (ORs), along with corresponding 95% confidence intervals (CIs), were calculated in Stata 12 software for the outcome variables to determine effect size using the `esizei` and `cci` commands, respectively.<sup>16</sup>

## **RESULTS**

The search identified 78 records – 64 from databases, and 14 from reference lists. Removing duplicates resulted in 63 records, which were reviewed based on the inclusion and exclusion criteria outlined above. A total of 22 papers reporting results from 17 studies were eligible for inclusion in the review.

### **Study characteristics**

Table 2.1 provides an overview of the study sites, study type, setting, participants, and intervention approaches. The review focused on 17 studies in 10 countries in Asia (n=5 countries), Africa (n=3 countries) and South America (n=2 countries). The specific countries were China, Bangladesh, Brazil, India, Iran, Malawi, Nigeria, Pakistan, Peru and South Africa. All studies had different designs and slightly varying objectives, but over half of the studies (n=9) were randomised controlled trials (RCTs), and all studies focused on improving CF practices through nutrition counselling.

All studies used health communication and counselling strategies to reach mothers with knowledge and information on appropriate complementary practices. Of the 17 studies, two recruited some mothers with children older than 24 months. One study in Iran aimed to improve growth indices in Iranian nomadic children aged 0-59 months,<sup>17</sup> whereas the other study in India aimed to improve nutritional quality of diets of children aged 6-36 months in urban slums.<sup>18</sup> Although both these studies did not stratify their results by children's age, they were included in the review since they fulfilled the inclusion criteria.

**Table 2.1: Systematic literature review study characteristics**

Author(s) & Publication Date	Setting	Study type	Study participants	Main BC Component <sup>1</sup>			BC Sub-components <sup>2</sup>		Theory stated	Description of Intervention
				IC	GC	IEC	FD	GM		
Aboud <i>et al.</i> (2008)	Bangladesh	RCT <sup>3</sup>	108 children 12–24 months of age were in the intervention and 95 children were enrolled in the control. Children were followed until 5 months post-intervention.		X	X			X	Weekly education sessions on child nutrition, child self-feeding and parent’s responsive feeding
Roy <i>et al.</i> (2007)	Bangladesh	RCT	605 normal and mildly malnourished infants aged 6-9 months in 121 community nutrition Centres in 4 regions followed for 12 months.		X	X	X			Education including print BC and communication materials to promote knowledge of nutrition and the prevention, recognition, and control of diarrhoea and acute respiratory tract infection. Also included demonstrations of the preparation of energy- and protein-rich local complementary foods rich in micronutrients, such as <i>khichri</i> .
Bortolini <i>et al.</i> (2012); Louzada <i>et al.</i> (2012); Vitolo <i>et al.</i> (2012)	Brazil	RCT	200 infants in intervention group and 300 infants in control group enrolled at birth and visited at 12 to 16 months, 3 to 4 years, and 7 to 8 years	X		X				Study fieldworkers counselled mothers in a total of 10 home visits within the first year of children’s lives. Home visits included a visit within 10 days of the child’s birth, monthly up to 6 months, and with subsequent visits at 8, 10 and 12 months.
Santos <i>et al.</i> (2001)	Brazil	RCT	28 health centres were paired and randomised to treatment. 218 children <18 months in intervention and 206 controls were visited 8, 45 and 180 days after initial consultation.	X		X				Health care providers provided individual counselling in a single visit.

<sup>1</sup> Behaviour change (BC) components are abbreviated as follows: (i) IC: individual counselling; (ii) GC: group counselling; and IEC: information, education and communication materials (including leaflets, posters, etc.); <sup>2</sup> BC sub-components are abbreviated as follows: (i) FD: food demonstrations; and (ii) GM: growth monitoring; <sup>3</sup> RCT is defined as a randomised controlled trial

Table 2.1 continued: Systematic literature review study characteristics

Author(s) & Publication Date	Setting	Study type	Study participants & design	Main BC Component <sup>1</sup>			BC Sub-components <sup>2</sup>		Theory stated	Description of Intervention
				IC	GC	IEC	FD	GM		
Shi, Li <i>et al.</i> (2010); Zhang <i>et al.</i> (2013)	China	RCT <sup>3</sup>	599 infants enrolled at 2-4 months of age and followed up until 18 months of age	X	X	X	X	X		(i) group sessions on food selection, preparation and hygiene, childhood nutrition and physical growth, as well as responsive feeding style (ii) CF recipe demonstration using locally available, affordable, acceptable and nutrient-dense foods including egg, tomato, beans, meat, chicken and liver (iii) booklets with CF guidance and recipes; and (iv) home visits 1x/ 3 months to identify CF problems and provide individual counselling
Bhandari <i>et al.</i> (2004, 2005)	India	RCT	552 in intervention (four communities) and 473 in control (four communities) followed from 0-18 months.	X	X	X	X			Nutrition counselling, monthly home visits, group training, feeding demonstration, community mobilisation.
Salehi <i>et al.</i> (2004)	Iran	RCT	406 children aged 0–59 months from intervention and 405 controls. Intervention lasted for 12 months.	X		X	X	X	X	Training influential people, girls and tribal teachers to encourage use of eggs, vegetables and legumes, including recipe demonstrations
Zaman <i>et al.</i> (2008)	Pakistan	RCT	Single-blind RCT with ad 375 children aged 6–24 months recruited 40 paired health centres. Follow-up at 2 weeks, 45 days, and 180 days	X		X				Training health workers using the 'Counsel the Mother' module of the WHO/United Nations Children's Fund IMCI training course to counsel mothers at health centres. Feeding counselling card developed in local language to aid in counselling and to act as a reminder at mothers' homes.
Penny <i>et al.</i> (2005)	Peru	RCT	187 children from six communities in intervention and 190 children from six communities in control group followed from 0-18 months.	X	X	X	X	X	X	Nutrition counselling, group training, demonstration of recipe preparation, recommended recipes: thick puree, adding liver, egg, fish to infant diet

<sup>1</sup> Behaviour change (BC) components are abbreviated as follows: (i) IC: individual counselling; (ii) GC: group counselling; and IEC: information, education and communication materials (including leaflets, posters, etc.); <sup>2</sup> BC sub-components are abbreviated as follows: (i) FD: food demonstrations; and (ii) GM: growth monitoring; <sup>3</sup> RCT is defined as a randomised controlled trial

**Table 2.1 continued: Systematic literature review study characteristics**

Author(s) & Publication Date	Setting	Study type	Study participants	Main BC Component <sup>1</sup>			BC Sub-components <sup>2</sup>		Theory stated	Description of Intervention
				IC	GC	IEC	FD	GM		
Brown <i>et al.</i> (1991,1992)	Bangladesh	non-RCT <sup>3</sup>	117 infants (62 treatment, 55 control subjects) aged 4-14 months were followed for 5 months.	X			X			Participatory individual nutrition counselling including recipe demonstrations
Guldan <i>et al.</i> (2000)	China	non-RCT	250 infants from two intervention townships and 245 infants from two control townships. Recruited at birth and evaluated at 4-12 months	X			X	X		Monthly growth monitoring, nutrition counselling to pregnant women, complementary food recipes
Kilaru <i>et al.</i> (2005)	India	non-RCT	69 infants aged 5–11 months each from the intervention and control groups were followed until 24 months of age.	X				X		Monthly nutrition education, growth chart
Palwala <i>et al.</i> (2009)	India	non-RCT	414 infants aged 6-36 months in five slums were recruited for the 3-month intervention. No control group.	X	X	X				Nutrition education in group setting, followed by weekly home visits for monitoring and reinforcement of messages.
Sethi <i>et al.</i> (2003)	India	non-RCT	35 mothers of 5-19 month old infants. No control group.	X	X	X		X		Individual counselling, participatory learning methods, focus group discussions with mothers, songs and street plays on child nutrition.
Hotz & Gibson (2005)	Malawi	non-RCT	Breastfed children aged 9–23 months from three intervention villages (n=87) and one control village (n=42).	X	X	X	X			Four nutrition education sessions, individual counselling, use of soaked pounded maize flour, enriching maize porridge with egg, banana, oil, etc.

<sup>1</sup> Behaviour change (BC) components are abbreviated as follows: (i) IC: individual counselling; (ii) GC: group counselling; and IEC: information, education and communication materials (including leaflets, posters, etc.); <sup>2</sup> BC sub-components are abbreviated as follows: (i) FD: food demonstrations; and (ii) GM: growth monitoring; <sup>3</sup> RCT is defined as a randomised controlled trial

**Table 2.1 continued: Systematic literature review study characteristics**

Author(s) & Publication Date	Setting	Study type	Study participants	Main BC Component <sup>1</sup>			BC Sub-components <sup>2</sup>		Theory stated	Description of Intervention
				IC	GC	IEC	FD	GM		
Sule <i>et al.</i> (2009)	Nigeria	non-RCT <sup>3</sup>	Data were collected from 150 mothers of children aged 0-18 months at baseline and 6 months post-intervention		X	X	X			Group counselling, food demonstrations at health centres
Ladzani <i>et al.</i> (2000)	South Africa	non-RCT	Mothers with newborns followed to 24 months of age. Baseline study with 250 households randomly sampled from each of the 3 intervention (n=590) and control villages (n=450). Follow-up study with randomly sampled households not included in baseline study in same intervention villages (n=600) and control villages (n=663).	X	X		X			Individual and group nutrition counselling, targeting families of underweight children with home visits and targeted advice, and food demonstrations using vegetable gardens

<sup>1</sup> Behaviour change (BC) components are abbreviated as follows: (i) IC: individual counselling; (ii) GC: group counselling; and IEC: information, education and communication materials (including leaflets, posters, etc.); <sup>2</sup> BC sub-components are abbreviated as follows: (i) FD: food demonstrations; and (ii) GM: growth monitoring; <sup>3</sup> RCT is defined as a randomised controlled trial

## **Effectiveness**

Results from randomised controlled trials (RCTs) are presented separately from results from other studies (non-RCTs) in the sub-sections below because it is recognised that RCTs provide a higher standard of evidence compared to observational studies.<sup>19</sup> The effects of the interventions on energy and micronutrient intakes, patterns of food consumption and physical growth are described below:

### ***Effect of nutrition counselling interventions on energy and micronutrient intakes***

*RCTs:* Data from the 5 studies reporting energy and micronutrient intakes are mixed, with only 3 studies reporting increases in energy and micronutrient intakes. Of these 3 studies, only 2 trials in Peru and India reported statistically significant results.<sup>4, 20</sup> Both studies targeted mothers with food demonstrations and counselling based on WHO Integrated Management of Childhood Illness (IMCI) guidelines. The Peruvian study showed a statistically significant increase in the proportion of infants meeting daily energy, zinc and iron intake requirements (OR 1.57, 95% CI 1.01 to 2.42; OR 2.00, 1.13 to 3.57; OR 5.97, 1.30 to 27.37, respectively).<sup>20</sup> The study in India did not assess micronutrient intakes, but resulted in statistically significant increases in daily energy intakes (SMD 0.93, 95% CI 0.78 to 1.07).<sup>4</sup> No RCTs in the review reported data on Vitamin A intakes (Tables 2.2 and 2.3).

*Non-RCTs:* Both studies in Bangladesh and Malawi reporting energy and micronutrient intakes provided insufficient data to calculate effect size(s), but reported statistically significant increases in energy intake adequacy and no statistically significant increases in micronutrient intake adequacy (Tables 2.2 and 2.3).<sup>21, 22</sup>

**Table 2.2: Effect of nutrition counselling interventions on energy intake and adequacy<sup>1</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect Size (SMD/OR) <sup>2</sup>	95% confidence interval (CI)
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
Bhandari <i>et al.</i> (2004, 2005)	India	RCT <sup>3</sup>	kJ intake/24 hours, mean (SD)	435	3807 (1527)*	394	2577 (1058)	0.93 (SMD)	0.78, 1.07
Penny <i>et al.</i> (2005)	Peru	RCT	Proportion of infants meeting 80% of daily recommended energy intake, n (%)	168	104(61.9)***	167	85(51.0)	1.57 (OR)	1.01, 2.42
Santos <i>et al.</i> (2001)	Brazil	RCT	kJ intake/24 hours, mean (SD)	34	3828 (1231)	32	3547 (1058)	0.24 (SMD)	-0.24, 0.73
Salehi <i>et al.</i> (2004)	Iran	RCT	kJ intake/24 hours, mean (SD)	406	5583 (790)	405	5646 (1397)	-0.06 (SMD)	-0.19, 0.08
Brown <i>et al.</i> (1991,1992)	Bangladesh	Non-RCT	% energy adequacy <sup>4</sup>	62	55.5*	55	46.4	-	-
Hotz & Gibson (2005)	Malawi	Non-RCT	% energy adequacy <sup>4</sup>	16	142**	11	102	-	-

\* p<0.001, \*\*p<0.01, \*\*\* p<0.05; <sup>1</sup>Units specified in column labelled "outcome variable"; <sup>2</sup>Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup> RCT is defined as a randomised controlled trial; <sup>4</sup>Calculated by comparing median intakes to recommended intakes from the complementary diet, assuming average breast milk consumption; <sup>5</sup>Cell(s) with no data denote studies with insufficient or inappropriate (continuous) data to calculate variable(s)



**Table 2.3: Effect of nutrition counselling interventions on micronutrient intake<sup>1</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect size (SMD/OR) <sup>2</sup>	95% confidence interval (CI)
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
<b>EFFECT ON ZINC INTAKE</b>									
Penny <i>et al.</i> (2005)	Peru	RCT <sup>3</sup>	Proportion of infants meeting 80% of daily recommended zinc intakes, n (%)	163	38 (23.3) <sup>***</sup>	167	22 (13.1)	2.00 (OR)	1.13, 3.57
Santos <i>et al.</i> (2001)	Brazil	RCT	Daily zinc intake (mg), mean (SD)	34	4.6 (2.6)	32	4.2 (2.7)	0.15 (SMD)	-0.33, 0.63
Hotz & Gibson (2005)	Malawi	Non-RCT	% zinc intake adequacy assuming low bioavailability <sup>2</sup>	16	42*	11	31	-	-
<b>EFFECT ON IRON INTAKE</b>									
Bortolini <i>et al.</i> (2012)	Brazil	RCT	Daily intake of iron (mg), mean (SD)	155	5.1 (2.4)	215	5.4 (2.7)	-0.12 (SMD)	-0.32, 0.09
			Daily intake of heme iron (mg), mean (SD)	133	1.5 (1.1)	160	1.2 (1.0)	0.29 (SMD)	0.06, 0.52
			Daily intake of non-heme iron (mg), mean (SD)	155	3.8 (1.9)	215	4.5 (2.5)	-0.31 (SMD)	-0.52, -0.10
Penny <i>et al.</i> (2005)	Peru	RCT	Proportion of infants meeting 80% of daily recommended iron intake, n (%)	163	11 (6.7) <sup>***</sup>	167	2 (1.2)	5.97 (OR)	1.30, 27.37
Santos <i>et al.</i> (2001)	Brazil	RCT	Daily iron intake (mg), mean (SD)	34	2.6 (1.8)	32	2.8 (2.4)	-0.09 (SMD)	-0.58, 0.39
Brown <i>et al.</i> (1991,1992)	Bangladesh	Non-RCT	% iron intake adequacy assuming low bioavailability <sup>4</sup>	62	73 <sup>3</sup>	55	73 <sup>3</sup>	-	-
Hotz & Gibson (2005)	Malawi	Non-RCT	% iron intake adequacy assuming low bioavailability <sup>4</sup>	16	15*	11	10	-	-
<b>EFFECT ON VITAMIN A INTAKE</b>									
Brown <i>et al.</i> (1991,1992)	Bangladesh	Non-RCT	% Vitamin A intake adequacy <sup>4</sup>	62	74 <sup>5</sup>	55	74 <sup>5</sup>	-	-
Hotz & Gibson (2005)	Malawi	Non-RCT	% Vitamin A intake adequacy <sup>4</sup>	16	23	11	37	-	-

\* p<0.001, \*\*\* p<0.05; <sup>1</sup> Units specified in column labelled "outcome variable"; <sup>2</sup> Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup> RCT is defined as a randomised controlled trial; <sup>4</sup> Calculated by comparing median intakes to recommended intakes from the complementary diet, assuming average breastmilk consumption; <sup>5</sup> No significant differences noted between intervention and control groups, so nutrient adequacies are presented as an average of both groups over all observations; <sup>6</sup> Cell(s) with no data denote studies with insufficient or inappropriate (continuous) data to calculate variable(s)

### ***Effect of nutrition counselling interventions on patterns of food consumption***

*RCTs:* Of the 6 trials reporting outcomes on food frequency and diet variety, 4 trials in Bangladesh,<sup>23</sup> Brazil,<sup>24, 25</sup> China<sup>26, 27</sup> and India<sup>4</sup> reported statistically significant increases in variety and/or frequency of food intakes. The trial in Brazil reported statistically significant reductions in lipid- and sugar-dense foods (OR 2.35, 95% CI 1.55 to 3.57 and OR 2.82, 95% CI 1.72 to 4.62, respectively),<sup>25</sup> the Indian trial reported statistically significant increases in the number of meals per day (SMD 0.40, 95% CI 0.26 to 0.54), and the trial in Bangladesh reported an increase in the proportion of mothers feeding infants at least 3 complementary foods per day (OR 23.72, 95% CI 15.10. 37.24).<sup>23</sup> The trial in China reported statistically significant increases in the Infant and Child Feeding Index (ICFI) score of infants aged 9 months (SMD 1.00, 95% CI 0.79 to 1.19), 12 months (SMD 0.87, 95% CI 0.68 to 1.06), 15 months (SMD 1.04, 95% CI 0.85 to 1.23), and 18 months (SMD 0.73, 95% CI 0.73 to 1.10). The ICFI includes breastfeeding, bottle-feeding, dietary diversity, variety of food groups and frequency of consumption of different food groups.

All 7 studies reported increases in egg consumption, of which 4 studies including Bangladesh (OR 3.18, 95% CI 2.05 to 4.92),<sup>23</sup> Brazil (OR 2.62, 95% CI 1.57 to 4.39),<sup>28</sup> China (OR 7.03, 95% CI 2.04 to 24.18),<sup>26</sup> and Pakistan (OR 2.49, 95% CI 1.03 to 6.03)<sup>29</sup> were statistically significant. Of the 5 studies reporting increases in meat, poultry and/or fish intakes, 4 studies resulted in statistically significant increases, including 2 studies in Brazil (OR 3.33, 95% CI 2.04 to 5.44; OR 0.27, 95% CI 0.04 to 0.50),<sup>28, 30</sup> one study in China (OR 22.45, 95% CI 10.57 to 47.67),<sup>26</sup> and one study in Pakistan (OR 2.3, 95% CI 1.00 to 5.34) (Tables 2.4, 2.5 and 2.6).<sup>29</sup>

*Non-RCTs:* Of the 5 studies reporting feeding frequency outcomes, one study in India showed statistically significant results (OR 3.41, 95% CI 1.88 to 6.17).<sup>31</sup> Of the 3 studies reporting increases in the intake of animal source foods, a community-based intervention in China showed a statistically significant increase in the proportion of infants consuming meat (OR 3.02, 95% CI 1.70 to 5.36),<sup>5</sup> and another intervention in Bangladesh showed statistically significant increases in the proportion of infants consuming egg or meat (OR 14.40, 95% CI 5.54 to 37.43) (Tables 2.4, 2.5 and 2.6).<sup>21</sup>

**Table 2.4: Effect of nutrition counselling interventions on only egg consumption<sup>1</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect size (OR) <sup>1</sup>	95% confidence interval (CI)
				Sample size (n)	n (%)	Sample size (n)	n (%)		
Aboud et al. (2008)	Bangladesh	RCT <sup>2</sup>	Egg intake observed at midday meal	106	10 (9.4)	88	6 (6.8)	1.42	0.50, 4.09
Roy et al. (2007)	Bangladesh	RCT	Proportion of infants consuming $\geq 3$ eggs/week	290	88(29.8)**	282	34(11.9)	3.18	2.05, 4.92
Santos <i>et al.</i> (2001)	Brazil	RCT	Proportion of mothers following a specific recommendation to give egg yolk	218	58 (38.9)*	206	25 (18.4)	2.62	1.57, 4.39
Shi, Li <i>et al.</i> (2010)	China	RCT	Ever been fed egg in the last 3 months	256	253 (98.8)***	234	216 (92.2)	7.03	2.04, 24.18
Zaman <i>et al.</i> (2008)	Pakistan	RCT	Proportion of mothers offering eggs to infant	126	60 (47.6)**	131	35 (26.7)	2.49	1.03, 6.03
Guldan <i>et al.</i> (2000)	China	Non-RCT	Proportion of infants consuming eggs daily	220	71 (66)	203	62 (62)	1.08	0.72, 1.63
Palwala <i>et al.</i> (2009)	India	Non-RCT	Proportion of children receiving egg since intervention	398	Increased by 11 (2.8)	-	-	-	-

\* p<0.001, \*\*p<0.01, \*\*\* p<0.05; <sup>1</sup> OR is defined as odds ratio; <sup>2</sup> RCT is defined as a randomised controlled trial; <sup>3</sup> Cell(s) with no data denote studies with insufficient data to calculate variable(s)

**Table 2.5: Effect of nutrition counselling interventions on meat, poultry, egg and/or fish consumption<sup>1</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect size (SMD/OR) <sup>2</sup>	95% confidence interval (CI)
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
Aboud et al. (2008)	Bangladesh	RCT <sup>3</sup>	Fish intake observed at midday meal, n(%)	106	39 (36.8)	88	39 (44.3)	0.73 (OR)	0.41, 1.30
Bhandari <i>et al.</i> (2004, 2005)	India	RCT	Proportion of infants consuming egg or meat, n(%)	435	2 (0.5)	394	-	-	-
Bortolini <i>et al.</i> (2012)	Brazil	RCT	Daily intake of meat (g), mean (SD)	131	54.3 (28.5) ***	159	47.3 (23.9)	0.27 (SMD)	0.04, 0.50
Penny <i>et al.</i> (2005)	Peru	RCT	Proportion of infants consuming liver, chicken or fish, or egg, n(%)	171	109 (64)	167	96 (57)	1.34 (OR)	0.87, 2.08
Santos <i>et al.</i> (2001)	Brazil	RCT	Proportion of mothers following a specific recommendation to give shredded chicken/mincemeat, n(%)	218	50 (33.6)*	206	18 (13.2)	3.33 (OR)	2.04, 5.44
Shi, Li <i>et al.</i> (2010)	China	RCT	Ever been fed meat, poultry and/or fish in the last 3 months n(%)	256	248 (96.9)*	234	136 (58.2)	22.45 (OR)	10.57, 47.67
Zaman <i>et al.</i> (2008)	Pakistan	RCT	Proportion of mothers offering meat/poultry to infant, n(%)	126	76 (60.3)***	131	52 (39.7)	2.3 (OR)	1.00, 5.34
Brown <i>et al.</i> (1991, 1992)	Bangladesh	Non-RCT	Proportion of infants consuming egg or meat, n(%)	62	42(68)***	55	7(13)	14.22 (OR)	5.50, 36.77
Guldan <i>et al.</i> (2000)	China	Non-RCT	Proportion of infants consuming meat daily, n(%)	220	25 (23)**	203	9 (9)	3.02 (OR)	1.70, 5.36
Palwala <i>et al.</i> (2009)	India	Non-RCT	Proportion of children receiving meat since intervention, n(%)	398	Increased by 9 (2.3 )	-	-	-	-

\* p<0.001, \*\*p<0.01, \*\*\*p<0.05; <sup>1</sup> Units specified in column labelled "outcome variable"; <sup>2</sup> Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup> RCT is defined as a randomised controlled trial; <sup>4</sup> Cell(s) with no data denote studies with insufficient data to calculate variable(s)

**Table 2.6: Effect of nutrition counselling interventions on variety and frequency of food<sup>1</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable <sup>1</sup>	INTERVENTION		CONTROL		Effect size (SMD/OR) <sup>2</sup>	95% confidence interval
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
Bhandari <i>et al.</i> (2004, 2005)	India	RCT <sup>3</sup>	Number of meals/day	435	5.9 (1.2)**	394	5.4 (1.3)	0.40 (SMD)	0.26, 0.54
Louzada <i>et al.</i> (2012)	Brazil	RCT	Consumption of fruits & vegetables (g) in 12-16 month old girls	150	96.2 (64.1)	150	94.8 (86.7)	0.02 (SMD)	-0.21, 0.24
			Consumption of fruits & vegetables (g) in 12-16 month old boys	210	81.2 (66.5)	210	90.6 (82.5)	-0.13 (SMD)	-0.32, 0.07
			Consumption of lipid-dense foods (kJ) in 12-16 month old girls	150	51.8 (152.2)***	150	180.7 (368.6)	-0.46 (SMD)	-0.69, -0.23
			Consumption of lipid-dense foods (kJ) in 12-16 month old boys	210	95.4 (200.8)***	210	196.2 (375.3)	-0.33 (SMD)	-0.53, -0.14
			Consumption of sugar-dense foods (kJ) in 12-16 month old girls	150	36.8 (86.2)	150	74.4 (151.0)	-0.31 (SMD)	-0.53, -0.08
			Consumption of sugar-dense foods (kJ) in 12-16 month old boys	210	53.5 (169.4)	210	60.2 (130.5)	-0.04 (SMD)	-0.24, 0.15
Roy <i>et al.</i> (2007)	Bangladesh	RCT	Proportion of mothers feeding $\geq$ 3 complementary foods/day, n (%)	290	260 (88.5) *	282	69 (24.5)	23.72 (OR)	15.10, 37.24
Shi, Li <i>et al.</i> (2010)	China	RCT	Number of meals/day	256	4.17*	234	2.90 (1.85)	-	-
Vitolo <i>et al.</i> (2012)	Brazil	RCT	Not consuming lipid-dense foods in the previous month, n (%)	161	104 (64.6) ***	229	100 (43.7)	2.35 (OR)	1.55, 3.57
			Not consuming sugar-dense foods in the previous month, n (%)		134 (83.2) ***		146 (63.8)	2.82 (OR)	1.72, 4.62
Zhang <i>et al.</i> (2013)	China	RCT	ICFI score <sup>4</sup> at 9 months of age	226	8.09 (1.55)*	210	6.50 (1.65)	1.00 (SMD)	0.79, 1.19
			ICFI score at 12 months of age	240	7.85 (1.68)*	229	6.31 (1.87)	0.87 (SMD)	0.68, 1.06
			ICFI score at 15 months of age	252	8.38 (1.70)*	229	6.68 (1.55)	1.04 (SMD)	0.85, 1.23
			ICFI score at 18 months of age	250	8.70 (1.61)*	241	7.28 (1.49)	0.91 (SMD)	0.73, 1.10
Sule <i>et al.</i> (2009)	Nigeria	Non-RCT	Proportion of mothers feeding $\geq$ 3 complementary foods/day, n (%)	150	35 (53)	150	36 (48)	1.22 (OR)	0.78, 1.92
Kilaru <i>et al.</i> (2005)	India	Non-RCT	Proportion of mothers feeding $\geq$ 3 complementary foods/day, n (%)	173	135 (78)*	69	35 (51)	3.41 (OR)	1.88, 6.17
Sethi <i>et al.</i> (2003)	India	Non-RCT	Proportion of mothers feeding $\geq$ 3 complementary foods/day, n (%)	30	Increased by 17 (56.7)	-	-	-	-
Guldan <i>et al.</i> (2000)	China	Non-RCT	Number of meals/day	220	1.6 (1.3)***	203	1.3 (1.1)	0.25 (SMD)	0.06, 0.44
Ladzani <i>et al.</i> (2000)	South Africa	Non-RCT	Proportion of mothers feeding $\geq$ 3 times/day, n (%)	600	580 (96.6)	663	635 (95.7)	1.28 (OR)	0.71, 2.29

\* p<0.001, \*\*p<0.01, \*\*\*p<0.05; <sup>1</sup> Data presented as mean (SD) unless specified otherwise in column labelled "Outcome variable"; <sup>2</sup> Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup> RCT is defined as a randomised controlled trial; <sup>4</sup> The Infant and child feeding index (ICFI) has a maximum score of 11 and includes breastfeeding, bottle-feeding, dietary diversity, food frequency, variety of foods groups and frequency of intake of food groups; <sup>5</sup> Cell(s) with no data denote studies with insufficient or inappropriate (continuous) data to calculate variable(s)

### ***Effect of nutrition counselling interventions on physical growth***

*RCTs:* Data for the impact of nutrition counselling interventions on growth are mixed. Of the 7 studies reporting growth outcomes, 4 studies in Iran, Peru, Bangladesh and China showed statistically significant increases in mean WAZ (SMD 0.43, 95% CI 0.29 to 0.57; SMD 0.33, 0.12 to 0.55; SMD 0.62, 0.45 to 0.79; and SMD 0.30, 95% CI 0.11 to 0.48, respectively) and mean LAZ/HAZ (SMD 0.26, 95% CI 0.12 to 0.39; SMD 0.47, 0.25 to 0.68; SMD 0.26, 0.10 to 0.43; and SMD 0.13, 95% CI -0.05 to 0.31, respectively) in the target populations.<sup>17, 20, 23, 27</sup> The studies in Bangladesh and China also showed a statistically significant increase in mean WHZ/WLZ (SMD 0.56, 95% CI 0.39 to 0.72; and SMD 0.29, 95% CI 0.11 to 0.47, respectively).<sup>23, 27</sup> Of the 5 studies reporting increases in attained weight and length, only 2 community-based interventions in China and Iran statistically significantly increased attained weight (SMD 0.21, 95% CI 0.03 to 0.39 and SMD 0.59, 0.45 to 0.73, respectively) and attained length (SMD 0.22, 95% CI 0.04 to 0.40 and SMD 0.33, 0.19 to 0.46, respectively) in infants (Tables 2.7, 2.8, 2.9 and 2.10).<sup>17, 26</sup>

*Non-RCTs:* Of the 5 studies reporting growth outcomes, 2 studies in Bangladesh and China reported a statistically significant increase in mean WAZ,<sup>5, 21</sup> but did not provide sufficient data to calculate effect sizes. The study in China also reported a statistically significant increase in mean HAZ/LAZ, but did not provide sufficient data to calculate the effect size. None of the studies reviewed showed statistically significant improvements in mean WHZ/WLZ. One study in India reported increased weight velocity per month, but results were statistically insignificant (Tables 2.7, 2.8, 2.9 and 2.10).<sup>31</sup>

**Table 2.7: Effect of nutrition counselling interventions on WAZ<sup>1,2</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect size (OR/ SMD) <sup>2</sup>	95% confidence interval (CI)
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
Aboud et al. (2008)	Bangladesh	RCT <sup>3</sup>	WAZ, mean (SD)	106	-1.87 (0.90)	88	-1.86 (0.90)	-0.01 (SMD)	-0.29, 0.27
Bhandari et al. (2004, 2005)	India	RCT	Proportion of infants with Z-scores $\leq -2$ , n (%)	435	215 (52.1)	394	187 (48.6)	1.15 (OR)	0.88,1.51
Penny et al. (2005)	Peru	RCT	WAZ, mean (SD)	171	-0.33 (0.90)*	167	-0.62 (0.83)	0.33 (SMD)	0.12,0.55
Roy et al. (2007)	Bangladesh	RCT	WAZ, mean (SD)	290	-1.43 (0.73)*	282	-1.90 (0.79)	0.62 (SMD)	0.45,0.79
Salehi et al. (2004)	Iran	RCT	WAZ, mean (SD)	406	0.80 (1.0)*	405	0.35 (1.10)	0.43 (SMD)	0.29,0.57
Santos et al. (2001)	Brazil	RCT	WAZ, mean (SD)	218	-0.17 (0.53)	206	-0.30 (0.53)	0.25 (SMD)	0.05,0.44
Zaman et al. (2008)	Pakistan	RCT	WAZ, mean (SD)	52	-1.22 (1.22)	53	-1.68 (1.27)	0.37 (SMD)	-0.02,0.76
Zhang et al. (2013)	China	RCT	WAZ, mean (SD) at 9 months of age	211	0.47 (0.94)***	227	0.40 (1.02)	0.07 (SMD)	-0.12, 0.26
			WAZ, mean (SD) at 12 months of age	256	0.06 (1.00)	234	0.07 (0.92)	-0.01 (SMD)	-0.19, 0.17
			WAZ, mean (SD) at 15 months of age	251	-0.07 (1.06)	232	-0.08 (0.94)	0.01 (SMD)	-0.17, 0.19
			WAZ, mean (SD) at 18 months of age	248	0.18 (0.90)**	228	-0.09 (0.93)	0.30 (SMD)	0.11, 0.48
Brown et al. (1991,1992)	Bangladesh	non-RCT	WAZ, mean	62	-0.19*	55	-0.65	-	-
Guldan et al. (2000)	China	non-RCT	WAZ, mean	220	-1.17**	203	-1.93	-	-
Sethi et al. (2003)	India	non-RCT	Proportion of infants with Z-scores $\leq -2$ , n(%)	31	1 (2.5)	31	11 (35.4)	0.06 (OR)	0.01, 0.51
Sule et al. (2009) <sup>2</sup>	Nigeria	non-RCT	Proportion of infants with Z-scores $\leq -2$ , n(%)	150	31 (22.8)	150	33 (23.3)	0.92 (OR)	0.53, 1.61

\* p<0.001, \*\*p<0.01; <sup>1</sup> Units specified in column labelled "outcome variable." SD data unavailable for Guldan et al. (2000) and Brown et al. (1991, 1992); <sup>2</sup> Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup>RCT is defined as a randomised controlled trial; <sup>4</sup> Cells with no data denote studies with insufficient data to calculate effect size and 95% CIs.

**Table 2.8: Effect of nutrition counselling interventions on HAZ/LAZ<sup>1,2</sup>**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect size (OR/SMD) <sup>2</sup>	95% confidence interval (CI)
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
Bhandari <i>et al.</i> (2004, 2005)	India	RCT <sup>3</sup>	Proportion of infants with Z-scores ≤ -2, n(%)	435	171 (41.4)	394	164 (42.6)	0.95 (OR)	0.72, 1.25
Penny <i>et al.</i> (2005)	Peru	RCT	Mean HAZ/LAZ, mean (SD)	171	-0.81 (0.80)*	167	-1.19 (0.83)	0.47 (SMD)	0.25, 0.68
Roy <i>et al.</i> (2007)	Bangladesh	RCT	Mean HAZ/LAZ, mean (SD)	290	-1.90 (0.93)**	282	-2.15 (0.99)	0.26 (SMD)	0.10, 0.43
Salehi <i>et al.</i> (2004)	Iran	RCT	Mean HAZ/LAZ, mean (SD)	406	0.97 (1.70)**	405	0.56 (1.50)	0.26 (SMD)	0.12, 0.39
Santos <i>et al.</i> (2001)	Brazil	RCT	Mean HAZ/LAZ, mean (SD)	218	-0.59 (0.88)	206	-0.46 (0.60)	-0.17 (SMD)	-0.36, 0.02
Zaman <i>et al.</i> (2008)	Pakistan	RCT	Mean HAZ/LAZ, mean (SD)	52	-1.65 (1.03)	53	-1.68 (1.15)	0.03 (SMD)	-0.36, 0.41
Zhang <i>et al.</i> (2013)	China	RCT	Mean HAZ/LAZ, mean (SD) at 9 months of age	211	-0.20 (0.97)***	227	-0.03 (1.19)	-0.16 (SMD)	-0.34, 0.03
			Mean HAZ/LAZ, mean (SD) at 12 months of age	256	-0.43 (0.99)	234	-0.50 (1.03)	0.07 (SMD)	-0.11, 0.25
			Mean HAZ/LAZ, mean (SD) at 15 months of age	251	-0.39 (0.99)	232	-0.40 (0.94)	0.01 (SMD)	-0.17, 0.19
			Mean HAZ/LAZ, mean (SD) at 18 months of age	248	-0.37 (0.89)**	228	-0.50 (1.06)	0.13 (SMD)	-0.05, 0.31
Guldan <i>et al.</i> (2000)	China	non-RCT	Mean HAZ/LAZ, mean	220	-1.32***	203	-1.96	-	-
Sule <i>et al.</i> (2009) <sup>2</sup>	Nigeria	non-RCT	Proportion of infants with Z-scores ≤ -2, n(%)	150	18 (13.2)	150	19 (13.4)	0.98 (OR)	0.50, 1.91

\* p<0.001, \*\*p<0.01, \*\*\* p<0.05; <sup>1</sup> Units specified in column labelled "outcome variable." SD data unavailable for Guldan *et al.* (2000); <sup>2</sup> Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup>RCT is defined as a randomised controlled trial; <sup>4</sup> Cells with no data denote studies with insufficient data to calculate effect size and 95% CIs.



**Table 2.9: Effect of nutrition counselling interventions on WHZ/WLZ**

Author(s) & Publication Date	Setting	Study type	Outcome variable	INTERVENTION		CONTROL		Effect size (OR/SMD) <sup>2</sup>	95% confidence interval (CI)
				Sample size (n)	Outcome <sup>1</sup>	Sample size (n)	Outcome <sup>1</sup>		
Penny <i>et al.</i> (2005)	Peru	RCT <sup>3</sup>	Mean WHZ/WLZ, mean (SD)	171	0.15 (0.87)	167	0.05 (0.79)	0.12 (SMD)	-0.09, 0.33
Roy <i>et al.</i> (2007)	Bangladesh	RCT	Mean WHZ/WLZ, mean (SD)	290	-0.64 (0.87)*	282	-1.14 (0.93)	0.56 (SMD)	0.39, 0.72
Salehi <i>et al.</i> (2004)	Iran	RCT	Mean WHZ/WLZ, mean (SD)	406	0.28 (1.80)***	405	0.01 (1.60)	0.16 (SMD)	0.02, 0.30
Santos <i>et al.</i> (2001)	Brazil	RCT	Mean WHZ/WLZ, mean (SD)	218	0.22 (1.04)	206	-0.02 (0.80)	0.26 (SMD)	0.07, 0.45
Zaman <i>et al.</i> (2008)	Pakistan	RCT	Mean WHZ/WLZ, mean (SD)	52	-0.27 (1.29)	53	-0.71 (1.12)	0.36 (SMD)	-0.02, 0.75
Zhang <i>et al.</i> (2013)	China	RCT	Mean WHZ/WLZ, mean (SD) at 9 months of age	211	0.79 (1.05)***	227	0.62 (1.06)	0.16 (SMD)	-0.03, 0.35
			Mean WHZ/WLZ, mean (SD) at 12 months of age	256	0.34 (1.17)	234	0.41 (0.98)	-0.06 (SMD)	-0.24, 0.11
			Mean WHZ/WLZ, mean (SD) at 15 months of age	251	0.13 (1.20)	232	0.13 (1.05)	0.00 (SMD)	-0.18, 0.18
			Mean WHZ/WLZ, mean (SD) at 18 months of age	248	0.49 (1.07)**	228	0.19 (0.97)	0.29 (SMD)	0.11, 0.47
Sule <i>et al.</i> (2009)	Nigeria	non-RCT	Proportion of infants with Z-scores ≤ -2, n(%)	150	27 (19.9)	150	30 (21.1)	0.93 (OR)	0.53, 1.63

\* p<0.001, \*\*p<0.01, \*\*\* p<0.05; <sup>1</sup>Units specified in column labelled "outcome variable."; <sup>2</sup>Effect sizes are defined as follows: (i) OR = odds ratio and (ii) SMD = standard mean difference; <sup>3</sup> RCT is defined as a randomised controlled trial

**Table 2.10: Effect of nutrition counselling interventions on attained weight and length<sup>1</sup>**

Author(s) & Publication Date	Setting	Study type	INTERVENTION		CONTROL		Effect size (SMD <sup>1</sup> )	95% confidence interval (CI)
			Sample size (n)	Mean (SD)	Sample size (n)	Mean (SD)		
<b>Effect on attained weight (Kg)</b>								
Shi, Li <i>et al.</i> (2009)	China	RCT <sup>2</sup>	256	3.26 (1.26)***	234	3.02 (1.01)	0.21	0.03, 0.39
Aboud <i>et al.</i> (2008)	Bangladesh	RCT	106	8.95 (1.1)	88	8.94 (1.0)	0.01	-0.27, 0.29
Bhandari <i>et al.</i> (2004, 2005)	India	RCT	435	7.83 (1.10)	394	7.83 (1.04)	0.00	-0.14, 0.14
Salehi <i>et al.</i> (2004)	Iran	RCT	406	1.16 (1.20)*	405	0.42 (1.3)	0.59	0.45, 0.73
Santos <i>et al.</i> (2001)	Brazil	RCT	218	1.56 (0.66)	206	1.49 (0.65)	0.11	-0.08, 0.30
Kilaru <i>et al.</i> (2005)	India	non-RCT	173	0.249 Kg/ month	69	0.221 Kg/ month	-	-
<b>Effect on attained length (cm)</b>								
Shi, Li <i>et al.</i> (2009)	China	RCT	256	14.16 (3.48)***	234	13.47 (2.69)	0.22	0.04, 0.40
Bhandari <i>et al.</i> (2004, 2005)	India	RCT	435	70.36 (3.14)***	394	70.10 (2.74)	0.09	0.05, 0.22
Salehi <i>et al.</i> (2004)	Iran	RCT	406	3.30 (5.30)*	405	1.67 (4.70)	0.33	0.19, 0.46
Santos <i>et al.</i> (2001)	Brazil	RCT	218	5.64 (2.52)	206	6.10 (1.79)	-0.21	-0.40, -0.02

\* p<0.001, \*\*\* p<0.05; <sup>1</sup> Cells with no data denote studies with insufficient data to calculate effect size and 95% CIs.

## DISCUSSION

Evidence from this review suggests that targeting caregivers' CF practices through nutrition counselling interventions can result in improved CF practices and growth outcomes in some contexts. Although studies in the review used varying intervention approaches, all interventions (n=17) had main BC intervention components, i.e. group and/or individual counselling and IEC materials, and most interventions (n=11) had a BC sub-component, i.e. food demonstrations and/or growth monitoring. Of the 7 studies reporting energy and micronutrient intakes,<sup>4, 20-22</sup> 4 studies reported statistically significant improvements.<sup>4, 20-22</sup> All studies reporting food frequency and diet variety outcomes reported statistically significant improvements (n=11).<sup>4, 5, 23-27, 31-34</sup> Of the 13 studies reporting growth outcomes,<sup>4, 5, 17, 20, 21, 23, 27-29, 31-33, 35</sup> 7 studies reported statistically significant improvements in WAZ, HAZ/LAZ, WHZ/WLZ, and/or attained length and weight.<sup>4, 5, 17, 23, 26, 27</sup>

Studies in this review suggest that CF counselling interventions can improve energy intakes, but have a limited impact on micronutrient intakes. A RCT in India showed statistically significant increases in daily kJ intake (SMD 0.93, 95% CI 0.78 to 1.07), which raises concerns that complementary foods may have displaced breastmilk intake.<sup>4</sup> Similar concerns apply to a non-RCT in Malawi with insufficient data to calculate effect size reporting that compared to baseline, there was a statistically significant increase in infant diets meeting energy adequacy (102%, n=11 vs. 142%, n=16).<sup>22</sup> Both studies in India and Malawi do not report whether the children were wasted (WHZ <-2SD), so it is unclear whether there was an energy gap to be filled. Although a large community-based RCT in Peru using IMCI guidelines reported statistically significant increases in the proportion of infants meeting 80% of daily recommended intakes for energy, zinc and iron, nearly half of the infants in this trial (49%, n=82) did not meet 80% of the daily recommended energy intake, and even fewer infants did not meet 80% of the daily zinc or iron intakes (77%, n=125 for zinc and 93%, n=152 for iron) at baseline despite the dietary improvements.<sup>20</sup> Similarly, infant diets in one non-RCT in Malawi met less than half of the daily recommended intakes for zinc and iron at baseline (42% for zinc and 15% for iron, n=16) despite the study showing statistically significant improvements in intakes for these nutrients. These results suggest that interventions require additional strategies to CF counselling to meet recommended micronutrient intakes.

Studies in this review suggest that the effect of CF counselling interventions on growth may vary depending on intervention strategies and the types of food promoted and consumed. One

RCT in India showed no effect on weight gain, but showed a small improvement in attained length (SMD 0.09, 95% CI 0.05 to 0.22).<sup>4</sup> However, this intervention also promoted sanitation and hygiene messages in the intervention, strategies which are reported to improve linear growth.<sup>36</sup> Improvements in HAZ/LAZ and length in two studies in Bangladesh<sup>23</sup> and China<sup>27</sup> could be attributed to increases in the consumption of animal source foods, given evidence showing that the consumption of meat is associated with linear growth<sup>37</sup> and a reduced likelihood of stunting.<sup>38</sup> Key CF messages in two studies in Bangladesh and Peru included regularly feeding infants with an animal source food (child liver, egg or fish in Peru and egg in Bangladesh), and also resulted in increases in mean HAZ/LAZ.<sup>20, 23</sup> Although the availability, acceptability and utilisation of feeding animal source foods to children depends on the social, cultural and economic factors, these findings suggest the importance of nutrient-rich animal source foods on child growth.

Results from both RCTs and non-RCTs in this review confirm results from previous reviews reporting the positive impact of CF educational strategies on infant growth and dietary intake, which is unsurprising given that findings from only 2 additional RCTs<sup>24, 25, 27, 30</sup> have been published since the most recent systematic review on the impact of CF educational interventions.<sup>13</sup> Of the new studies published since the last review, one trial in Brazil measuring dietary intake showed significant improvements in this outcome,<sup>24, 25, 30</sup> and the second trial in China measuring both dietary intake and growth showed significant improvements in both outcomes.<sup>27</sup> Shi and Zhang's review of CF educational interventions reported positive effects on caretakers' CF knowledge and behaviours, as well as on children's growth and dietary intake.<sup>9</sup> Both Dewey and Adu-Afarwah, and Imdad et al. found that CF interventions using educational approaches had a significant impact on weight and linear growth.<sup>10, 12</sup> Bhutta et al.'s review for the Lancet Under-nutrition Series reported that CF counselling interventions had a significant effect on length,<sup>11</sup> and Lassi et al. found that CF educational interventions significantly reduced stunting rates and significantly improved WAZ and HAZ scores.<sup>13</sup> These results suggest that CF counselling can improve infant feeding practices and ultimately improve child growth.

Mixed results from this review and others could be attributed to a number of factors. Many studies enrolled children at varying ages, e.g. some interventions recruited newborns or infants less than 6 months old,<sup>4, 5, 17, 20, 21, 24-27, 30, 32-34, 39</sup> whereas others enrolled infants aged 6 months or older.<sup>18, 22, 23, 29, 35</sup> Studies took place in socioeconomic settings ranging from an

urban city in Brazil<sup>28</sup> to rural communities in Nigeria.<sup>32</sup> Interventions also varied in both design and intensity. For example, some studies used theory to guide intervention design and included all BC components including counselling, IEC materials, food demonstrations and growth monitoring,<sup>17, 20</sup> compared to interventions only using main BC strategies of counselling and IEC materials.<sup>18, 28-30</sup> Child nutritional status at baseline also varied in the studies in this review, with infants in some studies more malnourished<sup>18, 23</sup> than others.<sup>28</sup> A number of studies in this review had small sample sizes,<sup>21, 22, 28, 29, 33, 39</sup> provided insufficient data to calculate effect sizes for outcomes,<sup>4, 5, 18, 21, 22, 26, 33, 39</sup> and varied greatly in study quality. For example, some studies did not randomly assign treatment and lack of allocation concealment,<sup>5, 22</sup> used pre-tests and post-tests instead of longitudinal design,<sup>31, 33</sup> did not have a control group,<sup>18, 33</sup> did not take clustering effects into account when analysing clustered studies,<sup>17, 23, 28</sup> did not control for confounding factors,<sup>17</sup> and selectively reported outcomes.<sup>40, 41</sup>

In conclusion, results from this review are consistent with previous reviews reporting that nutrition counselling interventions have the potential to positively impact CF practices and physical growth. Further trials reporting consistent outcomes for dietary intake and growth, and with more consistent study designs, quality and duration are needed to investigate the impact of CF counselling on dietary intake and growth. However, there is sufficient evidence that CF counselling interventions strategies should be employed with mothers of young infants in developing countries in an effort to reduce undernutrition and mitigate its devastating long-term effects.<sup>42</sup>

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### **3. USING OPTIFOOD TO ASSESS INFANT DIET QUALITY AND STRENGTHEN EXISTING GOVERNMENTAL FOOD-BASED RECOMMENDATIONS**

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#### **PREFACE**

The article in the previous chapter presented findings from a systematic literature review showing that nutrition education interventions with counselling components have the potential to positively impact CF practices and physical growth. However, given the poor nutritional status and dietary intakes of Indian infants, the research paper presented in this chapter uses Optifood to determine if a nutritionally adequate diet can be selected using locally available foods as consumed in the study setting, and to strengthen existing ICDS FBRs. This is the first study to use linear programming analyses to evaluate and improve the nutritional adequacy of existing governmental FBRs for a target population.



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I designed the study with the co-authors of this paper. I drafted the data collection instruments and revised them based on inputs from all co-authors. I collected the data for this paper along with Sarmila Mazumder and local research team members. I did all of the data analysis with advice from Elaine Ferguson and Sunita Taneja. I wrote the first draft of the article. All co-authors provided comments on the draft article, many of which I incorporated during revisions to the article.

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**CANDIDATE'S SIGNATURE**

**Date:** 4 June 2014

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**SUPERVISOR'S SIGNATURE**

## MANUSCRIPT

### TITLE

Can local foods improve infant diet quality? Using Optifood, a novel nutrition tool, to assess infant diets and strengthen existing governmental recommendations to improve dietary intakes of 9-11 month old infants in Northern India

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### LIST OF ABBREVIATIONS

CF: Complementary Feeding

FBR: Food-Based Recommendation

ICDS: Integrated Child Development Services

IQR: Interquartile Range

iZiNCG: International Zinc Nutrition Consultative Group

m-FBRs: Minimum number of food-based recommendations needed to improve diet quality

NFHS: National Family Health Survey

PHC: Primary Health Centre

s-FBRs: Strengthened set of existing governmental food-based recommendations

USDA: United States Department of Agriculture

WHO: World Health Organisation

## CLINICAL TRIAL REGISTRY INFORMATION

The study is registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) with the identifier number NCT01646710.

### ABSTRACT AND KEY WORDS

**Background:** India has the highest rates of child malnutrition in the world. The timely introduction and appropriate quantities of complementary foods (CF) are critical to ensure optimal child nutritional status. Optifood, which is a programme based on linear programming analysis, can be used to formulate and evaluate sets of food-based recommendations (FBRs) to improve complementary feeding diets.

**Objectives:** (1) To identify nutrients whose recommended nutrient intakes (RNIs) cannot be met using local foods as consumed by rural 9-11 month old infants in Haryana State, India (i.e., “problem nutrients”); (ii) to select the minimum number of FBRs ensuring adequacy for the maximum number of nutrients (m-FBRs) for these infants; and (iii) to strengthen the FBRs currently being promoted in the study setting (s-FBRs).

**Methods:** Dietary intakes (24-hour dietary recall) of 60 randomly selected 9-11 month old infants living in Faridabad district in January to February 2012 were used to generate Optifood’s model parameters. Nutrient, cost and the number of individual FBRs in a set of FBRs were the criteria used to select m-FBRs and strengthen existing s-FBRs. All analyses were done in Optifood’s Modules 2 and 3.

**Results:** Seven of the 11 micronutrients modelled were “problem nutrients” (i.e., iron, zinc, thiamine, niacin, folate, and vitamins A and B6). m-FBRs had four messages, which were to feed yogurt once per day, vitamin C-rich fruit once per day, wheat flour twice per day, and red kidney beans four times per day. The seven messages of existing FBRs ensured dietary adequacy for no nutrients. They can be strengthened by emphasising: (i) vitamin C-rich fruits; (ii) buffalo milk; (iii) yogurt; (iv) wheat flour; and (v) red kidney beans. Both sets of FBRs ensured adequacy for six nutrients in infant diets (i.e., calcium, thiamine, riboflavin, folate and vitamins B12 and C).

**Conclusions:** A food-based approach alone, using local foods as consumed, will not achieve 100% of the 2004 WHO/FAO RNIs for 7 nutrients, indicating a complementary intervention(s) is needed to improve infant diets in Faridabad district. Both sets of FBRs – one with four messages, i.e. m-FBRs, and one with seven messages, i.e. s-FBRs – ensured adequacy for six

micronutrients. s-FBRs were selected for further study because they conform to existing FBRs and allow choice for resource constrained households.

**Key words:** Optifood, linear programming, complementary feeding, nutrition messages

## INTRODUCTION

The timely introduction, appropriate quantities and quality of complementary foods (CF) are critical to ensure optimal child nutritional status.<sup>1</sup> Young children between the ages of 6 and 24 months are particularly susceptible to undernutrition due to their high energy and nutrient requirements that cannot be met by breastmilk alone.<sup>2,3</sup> Furthermore, micronutrients play an essential role in child health and growth,<sup>1,4</sup> and can have long-term effects on brain development if deficiencies change the trajectory of neural development beyond a period when repair can occur.<sup>5</sup> In 2011, it is estimated that undernutrition and suboptimal feeding practices led to nearly half (45%) of global deaths of children under the age of five years.<sup>6</sup>

India bears the burden of almost one quarter (23%) of global infant deaths worldwide,<sup>7</sup> and has the highest rates of child malnutrition in the world.<sup>8,9</sup> Data from the 2005-06 Indian National Family Health Survey (NFHS) show that more than 48% of children (age <5 years) are stunted (height for age <-2 Z score), 43% are underweight (weight for age <-2 Z score), and approximately 20% are wasted (weight for height <-2 Z score).<sup>10</sup> A recent study shows that poor complementary feeding (CF) practices in India, in particular low diet diversity, are associated with child undernutrition.<sup>11</sup>

To improve CF practices, India's national Integrated Child Development Services (ICDS) programme currently promotes a set of food-based recommendations (FBRs) based on the Integrated Management of Neonatal and Childhood Illnesses guidelines developed by the World Health Organisation (WHO).<sup>2,12,13</sup> These FBRs were finalised based on expert consultation, and provide guidance on appropriate consistency, frequency and quantity of complementary foods for infants aged 6 to 8 months, 9 to 11 months, and 12 to 23 months. However, these FBRs are general and were developed for promotion in all regions within India without necessarily tailoring them for local contexts i.e., local food patterns and food availability. Furthermore, the cost implications of adopting them or their success at ensuring a nutritionally adequate diet, if successfully adopted, have not been evaluated.

Linear programming (LP) is an approach used to formulate and evaluate FBRs, and is the basis of Optifood, a novel nutrition tool which will soon be available on the WHO website.<sup>14-16</sup> Although LP has been used to identify nutrients whose recommended nutrient intakes (RNIs) cannot be met using local foods (i.e., "problem nutrients"), to develop FBRs for young children in Indonesia,<sup>17</sup> and test specific intervention foods in Cambodia,<sup>18</sup> it has not been used to evaluate and enhance FBRs promoted within existing governmental nutrition programs. Taking this into consideration, our study aimed to use Optifood to create and strengthen existing FBRs

to improve CF practices of 9-11 month old infants in a rural area in Haryana State, India. Specific objectives were to: (i) identify “problem nutrients” in diets of 9-11 month old infants in the study setting; (ii) to identify the minimal number of messages needed for FBRs (m-FBRs) to improve diet quality for these infants; and to use this information to (iii) strengthen FBRs currently being promoted in the study setting (s-FBRs).

## **MATERIALS AND METHODS**

### **Study Setting**

The study took place in Kheri Kalan Primary Health Centre (PHC), a rural area in Faridabad district in Haryana state, Northern India. Kheri Kalan PHC is made up of 6 subcentres, each with a population of about 5000. Literacy in the population is low – 15% of men and 50% of women have never attended school. Nearly 40% of under-five children in this area are underweight, and 46% are stunted.<sup>10</sup>

### **Study Design and Sampling**

A cross-sectional survey was conducted from January to February 2012 to assess the dietary intakes of 9-11 month old infants (n=60) from the study setting. Sociodemographic data were collected via an interviewer-administered sociodemographic questionnaire, and dietary data were collected with a 24-hour recall and food frequency questionnaire. A market survey was done to estimate food costs. These data were used to define model parameters that were used in the linear programming analysis. “Problem nutrients” were identified and FBRs were formulated and tested in linear programming models in Optifood.

For the survey, 10 infant-mother dyads were randomly selected from each of 6 subcentres in Kheri Kalan PHC (n=60). The sampling frame was the governmental birth registers at each subcentre from which participants were randomly selected using a computer generated random number list. The inclusion criteria were mothers having an infant aged 9-11 months who had not been ill in the past week.

### **Ethics approval**

Ethical approval for the study was obtained from the London School of Hygiene and Tropical Medicine Research Ethics Committee in the United Kingdom and from the Society for Applied Studies Ethics Review Committee in India. Informed consent was obtained from all participating mothers via written consent or a thumb print with the signature of a literate witness.



## **Methods**

### ***Data collection***

#### **Dietary Assessment Methods**

Dietary data were collected using an interviewer-administered food frequency questionnaire (FFQ) and a multiple (i.e. two) pass 24-hour recall.<sup>19</sup> The FFQ had previously been used in Indian studies,<sup>20</sup> and was modified by adding foods consumed by infants in the study area to total 61 foods (Appendix 3). The list of foods in the FFQ included all foods reported in the 24-hour recalls. For the FFQ, interviewers asked mothers about the number of times per week and the number of times per day each food was consumed by their infant in the past 7 days.

For the multiple (i.e. two) pass 24-hour recall, in the first pass, interviewers asked mothers to recall all food and beverages consumed by their child the previous day starting from the first item the child consumed when they woke up in the morning and ending with the last item they consumed in the evening. The time and place of consumption was also recorded in this pass. In the second pass, interviewers probed for any additions to foods consumed by infants and asked mothers to estimate the amount of each food or beverage their child consumed by showing the total volume, in water, of the item in the utensil used to feed the child and the volume leftover. The volume consumed by the child was recorded in the 24-hour recall form by subtracting the volume leftover from the total amount in the child's utensil. Mixed dishes consumed by infants, e.g. porridge, were recorded as a total volume served, volume leftover, and volume of individual ingredients that made up the recipe. All volumes were measured in graduated cylinders. Foods that were not measured in volumes were recorded in household measures, e.g. half a banana.

#### **Market Survey**

A market survey was conducted to obtain the cost per 100g edible portion of all foods modelled, and to collect samples of food for calculating yield factors of local foods. Research assistants went to 4 local markets in the study setting where they weighed the foods as purchased (Salter electronic scale model 3001; precision  $\pm 1$ g) and recorded the purchase price of 2 samples for each food per market. To create yield factors for local foods when necessary (i.e., n= 6 food items), research assistants collected 8 samples of each food item by purchasing 2 samples from each of the 4 local markets where the food prices were collected. Each food item was weighed as purchased and then weighed as eaten i.e., weighed after the inedible refuse was removed.

### ***Data preparation***

The data required to define Optifood's model parameters were: (i) a list of foods commonly eaten by 9-11 month old infants in the study setting; (ii) the average serving size per meal for each food listed except breastmilk which was the average serving size per day; (iii) the minimum and maximum number of times/week each food could be consumed in a realistic diet; (iv) low, average and high number of servings per week from food groups (FGs); (v) the low and high number of servings per week from food sub-groups (FSGs); (vi) food composition table (FCT) values for foods listed; (vii) cost per 100 grams edible portion for each food listed; and (viii) the target population's average energy requirements. The creation of these model parameters are described in detail below.

The list of foods modelled in Optifood was selected from a list of all foods consumed by the target population as reported in 24-hour dietary recalls. This list included non-condiment foods eaten by 5% or more of infants and nutrient dense foods consumed by fewer than 5% of infants.

Portion sizes for all foods consumed by each child were converted to grams using standard conversion factors for recorded volumes and household measures based on national guidelines, which were developed for a previous study in the study setting.<sup>20, 21</sup> The serving size (g/meal) for each food modelled was the median serving size calculated using data only from infants who consumed the food. The daily serving size of breastmilk modelled (i.e., 583 g/day) was based on the average intakes estimated for developing countries published by the WHO.<sup>22, 23</sup>

FFQ data were used to define the model parameters for ranges in numbers of servings per week for individual foods, FGs and FSGs. These dietary pattern values defined upper and lower constraints for the Optifood model, as well as the FG goals (i.e. 50<sup>th</sup> percentile). Foods from the FFQ, for each individual, were classified into the relevant FGs and FSGs, as defined in Optifood, and summed. The maximum number of servings per week for each food, except breastmilk, was defined by the 95<sup>th</sup> percentile of the consumer distribution; and the minimum number of servings per for these foods was zero. For breastmilk, the minimum and maximum constraint levels were 6.9 and 7.1 servings per week, respectively, to standardise the amount of breastmilk in all modelled diets. For FG and FSGs, the lower and upper constraint levels were defined by the 5<sup>th</sup> and 90<sup>th</sup> percentiles of the population distribution (consumers and non-consumers), respectively; and for FG the goal level was defined by the 50<sup>th</sup> percentile of the FG population distribution.

The nutrient contents per 100g for each food were mainly obtained from the National Institute of Nutrition's Nutritive Value of Indian Foods FCT.<sup>24</sup> Missing foods or nutrient values from this source, for non-breastmilk foods, were obtained or imputed from the United States Department of Agriculture (USDA) National Nutrient Database for Standard Reference, Release 23.<sup>25</sup> Missing nutrient values for breastmilk were obtained from the WHO's published values for developing countries.<sup>23</sup> Indian FCT values for raw foods were also adjusted for cooking losses, where appropriate, using USDA retention values.<sup>26</sup>

For foods not eaten as purchased, the edible portion was estimated using USDA yield factor data<sup>26</sup> where appropriate (n=39 foods); or by calculating local yield factors using the purchased and edible weights of foods purchased in local market for this purpose (n=6 foods). The local yield factor was calculated as: edible weight/purchased weight; and averaged across the eight samples collected for each food item. The cost per 100 grams edible portion, for each food item was then calculated as follow: [purchased price / (purchased weight x yield factor)] x 100; and averaged across the 8 samples per food item. This method is based on one used in a similar study in Indonesia.<sup>27</sup>

The energy and protein requirements for the target group were calculated using an estimated mean body weight and the FAO/WHO/UNI algorithms for calculating average energy requirements and recommended protein intakes of breastfed infants.<sup>28, 29</sup> The estimated mean body weight (i.e. 7.2 kg) was obtained from an anthropometric survey conducted in 2002 on 9-11 month old children (n=403) living in the study setting.<sup>20</sup>

### ***Data analysis in Optifood***

Optifood, its modules and related analyses are described elsewhere.<sup>16</sup> In brief, all analyses were done, using linear programming analyses, in three of the four Optifood modules (i.e., Modules 1, 2 and 3). Model constraints on food patterns (foods, FG and FSG; minimum and maximum constraint levels) and dietary energy content (equality constraint) were used to ensure that realistic diets were generated in all models. In module 3, when FBRs were tested, additional constraints were used to ensure all diets adhered to the set of FBRs tested. The model objective functions varied depending on the model (up to n=31 different objective functions). Module objective functions, constraints, and the modules in which each constraint was used are summarised in Appendix A.

For the analyses, after entering data to define the model parameters, they were first checked in Optifood's Module 1 to ensure realistic modelled diets were generated. Once satisfied that the model parameters generated realistic diets, all analyses were subsequently done in Optifood's Modules 2 and 3 to identify "problem nutrients," select promising FBRs for the m-FBRs, formulate the m-FBRs, and to test and strengthen existing FBRs promoted within the ICDS programme (s-FBRs).

In Module 2, two goal programming models were run to generate two diets, which are mathematically described elsewhere.<sup>16</sup> The outputs from only one of these two diets were used in this study, which were the outputs for the diet that came as close as possible to meeting the 2004 FAO/WHO RNIs for 11 nutrients.<sup>30</sup> This diet will be referred to below as the Module 2 "best" diet. Data from the "best" diet are used to identify problem nutrients and draft FBRs for testing in Module 3.

In our study, over 1000 Module 3 analyses were run to characterise "problem nutrients," test FBRs and formulate the m-FBRs, test the ICDS FBRs and formulate the s-FBRs, as detailed below. In each Module 3 analyses run, 26 diets were modelled where nutrient contents and cost were individually minimised (n=13 diets) and maximised (n=13 diets). The minimised and maximised nutrient content diets modelled the lowest and highest nutrient intake levels of the target population's nutrient intake distribution for each nutrient (i.e., the lower and upper tails of each nutrient intake distribution). These minimised and maximised nutrient content diets are subsequently referred to as the "worst-case scenario" and "best-case scenario" nutrient contents, respectively. The minimised cost diet is referred to as the lowest cost diet. Results from the maximised cost diet were not used.

Module 3 was run without any FBRs constraints to characterise "problem nutrients" and when formulating m-FBRs. The "problem nutrients" were characterised using the "best-case scenario" nutrient content results of these analyses, and "worst-case scenario" nutrient contents defined "baseline worst-case scenario" contents when formulating the m-FBRs.

To test and compare individual FBRs, in Module 3, additional constraints to define each FBR are introduced into the set of general constraints (i.e., general set of constraints on foods, FG, FSG and energy), and their "worst-case scenario" contents are generated. These individual FBRs were compared on the basis of their lowest cost diets and the number of "worst-case nutrient" contents that achieved nutrient adequacy at the population level. Nutrient adequacy at the population level was defined as a "worst-case scenario" nutrient content of

≥65% RNI (i.e., the simulated low tail of its intake distribution was ≥65% of its RNI). The fixed cutoff point approach was utilised to estimate the adequacy of nutrient intake in infants in this study setting. In the fixed cutoff point method, estimates of the prevalence of inadequate intake are based on a fixed proportion of the RNI.<sup>31</sup> The rationale is based on recognising that RNIs, which are designed to include almost all healthy individual, include large margins of safety that are often generous. Therefore, if applied as a criterion, a RNI would lead to an overestimate in the prevalence of nutrient inadequacy.<sup>32</sup> Subsequently, the proportion selected as a cutoff usually vary from two-thirds to three-quarters, and is 65% in this study.

Our study also ran a Module 3 systematic analysis when formulating m-FBRs and s-FBRs. In a systematic analysis, the “worst-case scenario” nutrient contents and lowest costs diets of all combinations of up to eight selected individually tested FBRs are generated to allow comparisons across all combinations of them (i.e., 240 different comparisons if eight FBRs were selected for a systematic analysis). Comparisons are based on lowest cost diets and the number of “worst-case nutrient” contents achieving dietary adequacy.

The reference data used to define nutrient adequacy in all analyses were the 2004 FAO/WHO RNIs,<sup>30</sup> assuming low bioavailability for zinc and 5% absorption for iron based on evidence of low bioavailability of these two nutrients in Indian diets.<sup>33, 34</sup> The 11 micronutrients modelled included folate, calcium, iron, zinc, thiamine, riboflavin, niacin, and vitamins A, B6, B12 and C.

#### **Identifying “Problem Nutrients”**

“Problem nutrients” were defined and categorised using outputs from Modules 2 and 3. From Module 2, “problem nutrients” were defined as those that were less than 100% of their RNIs in the “best” diet. These nutrients were categorised as *absolute* “problem nutrients” if their Module 3 “best-case scenario” nutrient contents were less than 100% of their RNIs without testing a FBR; otherwise these nutrients were classified as *partial* “problem nutrients.”

#### **Selecting FBRs for testing when formulating m-FBRs**

Module 2’s “best” diet results were used to select 3 types of FBRs for testing in Module 3 to formulate m-FBRs, which included individual nutrient-rich foods, FGs and FSGs. Individual foods were selected if they provided ≥5% of one or more nutrients in the Module 2 “best diet”. A FG was selected when the number servings per week in the Module 2 “best diet” was higher than the median observed diet. The FSG selected were those corresponding to one or more of the selected nutrient dense foods (e.g., green leafy vegetables when spinach and mustard leaves were selected)

### **Formulating m-FBRs**

The m-FBRs were formulated using a two-step process. In the first step, all individual FBRs selected for testing were evaluated in Module 3, and their “worst-case scenario nutrient” contents were compared to select a sub-set of individual FBRs for the Module 3 systematic analyses. The criteria for selecting this sub-set of FBRs were individual FBRs that likely ensured nutrient adequacy (i.e.  $\geq 65\%$  RNI) for at least one nutrient or individual FBRs that had the highest “worst-case scenario” content when, for all individual FBRs tested, the “worst-case scenario” nutrient contents were below 65% RNI. In the second step, m-FBRs were selected by running a systematic analysis and comparing the “worst-case scenario nutrient” contents and lowest cost diets of all combinations. The criteria for selecting the m-FBRs were that from all the FBRs tested, it had the highest number of “worst-case scenario” contents  $\geq 65\%$  RNIs for the lowest number of FBRs in the set. If more than one set of FBRs met these criteria, then the cheapest set of FBRs was selected as the m-FBRs.

### **Testing the ICDS FBRs and formulating s-FBRs**

FBRs currently promoted in the ICDS programme were tested in Module 3 to assess their nutrient and cost implications. These general FG-based FBRs were modelled in Optifood using the following constraints: (i) grains –  $\geq$  twice per day; (ii) dairy products –  $\geq$  twice per day; (iii) legumes –  $\geq$  4 times per week; (iv) fruit –  $\geq$  once per day; (v) added fats –  $\geq$  once per day; (vi) animal source foods –  $\geq$  twice per week; and (vii) vegetables –  $\geq$  once per day. The cost of the lowest cost diet was recorded and the number of worst-case scenario nutrient contents  $\geq 65\%$  RNI was counted from the modelled results.

To formulate s-FBRs, a Module 3 systematic analysis was done in which the ICDS FBRs (modelled as 1 FBR) were systematically combined with up to seven individual food or FSG level FBRs. This set of seven individual FBRs had to include at least one sub-FBR per ICDS FBR (e.g., milk within the ICDS FBR for dairy products, green leafy vegetables within the ICDS FBR for vegetables). These individual food and FSG-level FBRs were selected from those selected for the systematic analysis done to select the m-FBRs (see above). If the foods or FSGs selected for systematic analyses did not cover all seven FGs in the existing ICDS FBRs, then we selected the most nutritionally advantageous food for the FG lacking a sub-FBR, i.e. one providing  $>5\%$  for the highest number of nutrients in Module 2’s “best” diet. All food and FSG-level FBRs selected were tested individually and systematically in combinations to select the s-FBRs, i.e. a set of specific foods and FSGs to promote within the existing ICDS FBRs that would likely ensure nutrient adequacy ( $\geq 65\%$  RNI) for the maximum number of nutrients using the lowest number of sub-FG level FBRs in the existing ICDS FBRs.

s-FBRs were finalised for testing in a community-based trial by converting serving sizes to household measures using the following standard measures developed in a previous study in this setting<sup>20</sup>: (i) one small bowl = 150ml; (ii) one teaspoon = 5ml; (iii) one piece of roti (wheat flatbread) = 40g; (iv) one egg = 53g.

Figure 1 provides an overview of the process used in Optifood to formulate m-FBRs, test existing ICDS FBRs, and to strengthen them by formulating s-FBRs.

### **Sensitivity analyses**

Two sensitivity analyses were done to determine whether the study conclusions were sensitive to the RNIs selected for zinc and the nutrient composition used for breast milk. The reason for doing a sensitivity analysis, for the zinc RNI, was the 2004 FAO/WHO RNIs for zinc (assuming low bioavailability),<sup>30</sup> used in our analyses is higher than the more recent zinc RNIs recommended by the International Zinc Nutrition Consultative Group (iZiNCG) (8.5 mg per day vs. 5 mg per day).<sup>35</sup> The reason for doing a sensitivity analysis on the nutrient composition data used for breastmilk is the published Indian breastmilk composition values<sup>24</sup> used in our analyses has a lower Vitamin A Retinol Equivalents (RE) and folate composition compared to WHO breastmilk composition values for mature breastmilk,<sup>22</sup> (6.83 µg retinol equivalents/100g vs. 50 µg retinol equivalents/100g for Vitamin A RE; 4.8 µg dietary folate equivalents/100g vs. 8.5 µg dietary folate equivalents/100g for folate).

For each sensitivity analyses, the module 2 and 3 analyses were rerun after substituting the iZiNCG RNI for the WHO/FAO zinc RNI (first series of analysis) and the WHO breast milk food composition data for the Indian breastmilk food composition data (second series of analysis). Comparisons were made with the original results, in each sensitivity analysis series, for “problem nutrients,” and the number of “worst-case scenario” nutrient contents  $\geq 65\%$  RNIs when the m-FBRs and s-FBRs were tested (Module 3).

## **RESULTS**

### **Optifood Model Parameters**

#### ***Characteristics of respondents***

The calculated energy requirements of the target population were 554 kcal/day. This value was the energy equality constraint value used to ensure modelled diets met the target population’s average energy requirement. The mean (SD) age of mothers surveyed was 24.4

(4.0) years, and they had completed a mean (SD) of 6 (4.7) years of education. Overall, 31.6% of mothers were illiterate. The mean (SD) age of infants was 10.4 (0.9) months, and all but 6 infants were partially breastfed.

### ***Dietary Patterns***

#### **Modelled foods**

Overall, 54 food items were reported in the 24-hour dietary recalls. From this list of 54 foods, 45 foods were modelled for the target population (Table 1). Excluded food items were rarely consumed foods of low nutrient content (n=4; e.g., specialty Indian sweets) and condiments that were eaten only once or in small amounts (n=5; e.g., green chili). The most commonly consumed foods included wheat flour (81.7%), sugar (81.7%), sunflower oil (73.3%), buffalo milk (70.0%) and sweet biscuits (43.3%). Honey and almonds were the most expensive foods consumed at about 45 INR per 100g edible portion, and guava, wheat flour, semolina, and cow milk were the cheapest foods consumed at 3 INR or less per 100g edible portion (Table 1).

#### **Model constraints**

The lower and upper constraints used in all models for modelled foods, FGs and FSGs are described in Tables 1 and 2. The maximum number of servings per week for foods (i.e., the upper food constraints) ranged from two servings per week for eggs and papaya to 28 servings per week for buffalo milk, cows' milk, cane jaggery and white sugar (Table 1). The maximum number of servings per week for FSGs (i.e. the upper FSG constraints) ranged from two servings per week for cheese and eggs to 28 servings per week for sugar and fluid or powdered milk, and the maximum number of servings per week for FGs (i.e. the upper FG constraints) ranged from two servings per week for meat, fish and eggs to 32 servings per week for dairy products (Table 2). The lower constraints for all foods were zero, except human milk which was modelled at 6.9 servings per week and whole wheat flour which was once per week (Table 1). Lower FG and FSG constraints ranged from zero servings per week for fats, bakery items, fruits, legumes, nuts and seeds, vegetables, starchy roots and meat, fish, and eggs to three servings per week for whole grains and grain products (Table 2). The infants surveyed generally consumed 3-15 staples per week, and 2-20 snacks per week. The snacks were from the fruits, legumes, grains and bakery FGs (Tables 1).

### **Problem Nutrients**

Seven out of the 11 nutrients modelled were absolute "problem nutrients" (Table 3). These nutrients were iron, zinc, folate, thiamine, niacin, and vitamins A and B6. There were no partial



“problem nutrients”. Of these nutrients, the “best-case scenario” levels for thiamine, folate and vitamin B6 exceeded 65% RNI. However, for the other four nutrients, even their maximised “best-case scenario” nutrient levels remained below 60% of their RNIs; especially for iron and zinc levels which were <30% of their RNIs.

A secondary analysis undertaken to characterise problem macronutrients showed that protein and fat were not absolute or partial “problem nutrients” in infant diets.

### **FBRs selected for testing**

Compared to observed median intakes, the Module 2 “best” diet had higher numbers of servings per week for fruits, vegetables, dairy products, starchy roots, legumes and meat, fish and eggs (Table 5). The “best” diet had a lower number of servings per week of sugars, and recommended no consumption of bakery items and breakfast cereals than the median for observed diets (Table 5).

Eleven foods provided  $\geq 5\%$  of at least one nutrient in the Module 2 “best diet” (Table 6). Of these 11 foods, wheat flour, red kidney beans, buffalo milk and yogurt were good sources of five or more nutrients (Table 6); and buffalo milk and wheat flour were consumed by >70% of children survey (Table 1). The other nine foods were consumed by <35% of the children surveyed (Table 1).

Based on the FG patterns in the “best” diet (Table 5) and the list of foods that provided at least 5% of one or more nutrients in the “best” diet (Table 6), 15 individual FBRs were selected for screening in Module 3, including 11 food-level FBRs, two FSG-level FBRs, and two FG-level FBRs. Food-level FBRs included the following: (i) egg –  $\geq$  twice per week; (ii) wheat flour –  $\geq$  twice per day; (iii) red kidney beans -  $\geq 4x/week$ ; (iv) yogurt -  $\geq$  once per day; (v) buffalo milk -  $\geq$  twice per day; (vi) mustard leaves -  $\geq$  four times per week; (vii) guava -  $\geq$  five times per week; (viii) sapodilla -  $\geq$  four times per week; (ix) orange -  $\geq$  three times per week; (x) rusk -  $\geq$  once per day; (xi) potato -  $\geq$  once per day. FSG-level FBRs included the following: (i) vitamin C-rich fruit –  $\geq$  once per day; and (ii) green leafy vegetables –  $\geq$  once per day; and FG-level FBRs included the following: (i) dairy products –  $\geq$  twice per day; and (ii) legumes –  $\geq$  four times per week.

### **m-FBRs**

Of the individual FBRs screened in Module 3, wheat flour, yogurt, buffalo milk, guava and vitamin C rich fruits were selected for the systematic analysis used to select the m-FBRs. These

FBRs were selected because the “worst-case scenario” folate content of red kidney beans was the highest level of all FBRs tested (i.e., 52.6% RNI) and the “worst-case scenario” nutrient contents of wheat flour, yogurt, buffalo milk, guava and Vitamin C-rich fruit exceeded 65% RNI for one or more nutrients (Appendix B). The FBRs systematically tested to select the m-FBRs were the following six FBRs (i) red kidney beans –  $\geq$  four times per week; (ii) wheat flour –  $\geq$  twice per day; (iii) vitamin C-rich fruit –  $\geq$  once per day; (iv) guava –  $\geq$  five times per week; (v) yogurt –  $\geq$  once per day; and (vi) buffalo milk –  $\geq$  twice per day.

Based on the results from the systematic analyses in Module 3 (n=49 combinations modelled; Appendix B), the m-FBRs selected was a set of the following four individual FBRs: (i) yogurt –  $\geq$  once per day; (ii) vitamin C-rich fruit –  $\geq$  once per day; (iii) wheat flour –  $\geq$  twice per day; and (iv) red kidney beans –  $\geq$  four times per week. This set of FBRs had the minimum number of individual FBRs that likely ensured nutrient adequacy for the maximum possible number of nutrients i.e., six nutrients, at a cost of 6.4 INR per day (Table 6 and Appendix B). All other sets of FBRs tested: (1) ensured nutrient adequacy for 6 nutrients but had a higher number of individual FBRs in the set (n=2 sets of FBRs); (2) did not ensure nutrient adequacy of 6 nutrients (n=43 sets of FBRs); or (3) ensured nutrient adequacy for 6 nutrients with the same number of individual FBRs in the set (i.e., n=4 individual FBRs) but at a higher cost (n=3 sets of FBRs) (Appendix B). The nutrient and cost results for all individual and combinations of FBRs tested for m-FBRs are shown in Appendix B.

### **s-FBRs**

The “worst-case scenario” nutrient contents, for FBRs currently promoted in the ICDS programme were all less than 65% RNIs, ranging from 3.3% RNI for zinc to 58.2% RNI for vitamin C (Table 4). The seven food or FSG-level sub-FBRs selected to strengthen each of the main FG-level ICDS FBRs were as follow: (i) vitamin-C rich fruits – once per day; (ii) green leafy vegetables – once per day; (iii) buffalo milk – twice per day; (iv) yogurt – once per day; (v) red kidney beans – four times per week; (vi) eggs – twice per week; and (vii) wheat flour – twice per day. The systematic analysis showed that including vitamin C-rich fruits, yogurt and kidney beans as sub-FBRs within the main set of seven ICDS FBRs increases the number of “worst-case scenario nutrient” contents  $>65\%$  from zero to six nutrients (Table 4). However, because these three foods were consumed by less than 5% of surveyed infants (Table 1), the commonly consumed buffalo milk and wheat flour were also included in the s-FBRs selected. The nutrient and cost results for all individual and combinations of FBRs tested for s-FBRs are shown in Appendix C.

Finally, s-FBRs were adapted for testing with mothers of infants in the study setting by converting serving sizes selected in the s-FBRs to household measures including teaspoons and bowls. The adapted s-FBRs are summarised in Table 7.

### Sensitivity analyses

The sensitivity analyses showed the results for “problem nutrients” and m-FBRs and s-FBRs did not change when Optifood’s linear programming models are run with the iZiNCG instead of the 2004 WHO/FAO RNIs, assuming low zinc bioavailability. However, they do change when the WHO instead of the Indian breastmilk nutrient composition values are modelled. Specifically, folate was no longer a “problem nutrient,” and vitamin A became a *partial* instead of an *absolute* “problem nutrient” (Table 4) when the WHO instead of the Indian breast milk nutrient composition data were modelled; and both the m-FBRs and s-FBRs ensured nutrient adequacy for seven instead of the previous six nutrients because the “worst-case scenario” vitamin A content now exceeded 65% of its RNI (Table 4).

### DISCUSSION

Results show that diets based on local food sources will not likely achieve 100% of the 2004 WHO/FAO RNIs<sup>30</sup> for iron, zinc, thiamine, niacin, folate, and vitamins A and B6, signalling the need for a complementary intervention(s) to improve the nutritional status of 9-11 month old infants in this setting. Two sets of FBRs – one with four messages, i.e. m-FBRs, and one with seven messages, i.e. s-FBRs – would likely ensure adequacy at the population level for six of the 11 micronutrients modelled. m-FBRs promoted yogurt at least once per day, vitamin C-rich fruit at least once per day, wheat flour at least twice per day, and red kidney beans at least four times per week. s-FBRs emphasised the following foods and FSGs within the seven main FGs of the governmental ICDS FBRs: (i) vitamin-C rich fruits; (ii) buffalo milk; (iii) yogurt; (iv) wheat flour; and (v) red kidney beans.

Study results identifying vitamin A, iron and zinc as *absolute* “problem nutrients” are consistent with previous biochemical and/or dietary surveys in India.<sup>10, 34</sup> A survey in of 6-11 month old infants in Haryana State found that over 80% were anaemic (haemoglobin level <11.0 g/dl),<sup>10</sup> which is likely largely due to iron deficiency.<sup>34, 36</sup> Additionally, data from India’s National Nutrition Monitoring Bureau over the last three decades have consistently shown that more than 70% of pre-school children meet less than 50% of the recommended daily allowances for zinc, folate and vitamin A.<sup>34</sup> The overall prevalence of Bitot’s spots, an objective sign of vitamin A deficiency, among Indian children aged 1-5 years was about 0.8% (95% CI: 0.73-0.87),<sup>34</sup> which is higher than the cut-off level of 0.5% recommended by WHO.<sup>37</sup> In

contrast, there is no published data on the biochemical thiamine, niacin and vitamin B6 status of in 9-11 month old infants in India. Our modelling results signal a need to assess the biochemical status of these three micronutrients among 9-11 month old infants living in Faridabad district, Haryana state, India.

With the exception of vitamins A and B6, previous studies using linear programming analysis in Indonesia and Cambodia are consistent with our study results identifying iron, zinc, thiamine, niacin and folate as “problem nutrients” in infant diets.<sup>17, 18</sup> The reason for these inter-country differences for vitamin A likely partially relate to the breastmilk food composition data used. It is possible that the Indonesian and Cambodian studies modelled their results using USDA or alternative breastmilk food composition values with higher vitamin A content compared to Indian breastmilk. Our sensitivity analysis showed that vitamin A was no longer an absolute “problem nutrient” when the WHO instead of the Indian breastmilk food composition data were used, and the S-FBRs and m-FBRs could then ensure vitamin A adequacy (i.e., “worst-case scenario >65% RNI). These inter-country differences also likely relate to the foods modelled. Unlike our study, both the Indonesian and Cambodian studies modelled special fortified infant foods and flesh foods, including liver in Indonesia.<sup>17, 18</sup> However, FBRs in our study ensured dietary adequacy for calcium, thiamine and folate, whereas calcium adequacy was not ensured using FBRs in Indonesia, and thiamine and folate adequacy was not ensured using special study foods in Cambodia.<sup>17, 18</sup>

Study results show that FBRs currently promoted within the ICDS programme do not ensure nutrient adequacy at the population level (i.e. “worst-case scenarios”  $\geq 65\%$  RNI) for any nutrients modelled, however, they can be strengthened to ensure adequacy for six nutrients if they are promoted with specific nutrient-rich foods and FSGs within the general FG-level messages (i.e. s-FBRs). Both m-FBRs and s-FBRs ensured nutrient adequacy for six nutrients, but the advantages of promoting s-FBRs with mothers of young infants in this setting are that its messages are based on existing FBRs currently promoted within the ICDS programme, and, unlike m-FBRs, they encourage choice from a wide range of FGs. However, the feasibility of s-FBRs would first need to be assessed in a community-based trial before promoting them with mothers of young infants in this setting since they promote a larger number of messages compared to m-FBRs, and cost over 4 INR more than m-FBRs and over 8 INR more than existing ICDS FBRs. Few infants in the dietary survey were consuming some foods emphasised within this set of FBRs (e.g. vitamin-C rich fruit). Some message in s-FBRs also promote specific individual foods, thus providing mothers with less choice compared to FSG-level FBRs. If s-FBRs are deemed feasible for promotion in a trial, the ICDS programme in this setting would need to

revise its FBRs for 9-11 month old infants and train frontline health workers in the updated CF counselling strategy.

This study has several strengths. First of all, it is the first study of its kind to use linear programming to evaluate and strengthen existing national guidelines for CF counselling by modelling ICDS FBRs, and subsequently enhancing them by modelling and selecting specific nutrient-rich foods to emphasise within the general FG-level recommendations. Unlike traditional trial and error approaches, linear programming objectively allows rapid comparisons to be made across hundreds of FBRs based on local foods, which would not be possible to do manually. Furthermore, Optifood is a user-friendly software that allows users with no knowledge of linear programming to set up linear programming models and run them. Its systematic analysis allows all combinations of up to eight individual FBRs to be rapidly compared to identify the best set of FBRs. These automated processes using Optifood also reduces human error. Additionally, our study formulated FBRs taking into account local food patterns and availability, a strategy that is likely to enhance the FBRs' acceptability and long-term sustainability.<sup>15</sup>

Robust results from linear programming models are dependent on the accuracy of the model parameters. A weakness of the study, therefore, is that its model parameters were defined by dietary data collected from a small sample of infants living in the study area (n=60), so rarely consumed and nutrient dense food that could have been promoted in this population may have been missed. Additionally, serving sizes modelled may have been inaccurate when they were calculated from limited data. For example, over 75% of serving sizes modelled (n=34) were estimated using data from less than 10 infants.

Dietary data were collected in the winter months, so seasonality may also have affected the food list for the model parameters and the generalisability of the results to other seasons. For example, module 2's "best" diet selected seasonal foods such as guava and mustard leaves, so the "problem nutrients" might vary by season. However, alternative nutrient-rich foods are available year-round (i.e. not only in the winter) in the study setting. Furthermore, all five foods emphasised in s-FBRs were accessible year-round, and therefore not as likely to be affected by food availability and accessibility in different seasons.

Another weakness of this study is that the model results are highly dependent on food composition data and RNIs. The Indian FCT was the primary source of food composition values, which have not been updated for nearly two decades. The adjustments made for nutrient

losses from cooking were also made using American retention factors which might not have been appropriate for the Indian context. In particular, inaccurate food composition values for yogurt, wheat flour and red kidney beans might have affected the study results, since these foods were key to both s-FBRs and m-FBRs achieving  $\geq 65\%$  RNI for six nutrients. Additionally, most of the RNIs are based on Adequate Intakes (AIs), except for zinc and iron which are based on Recommended Dietary Allowances. AIs are based on observed or experimentally determined approximations of nutrient intakes by a group (or groups) of healthy people, and thus should be interpreted cautiously since they may overestimate actual nutrient needs.<sup>38</sup> We addressed this potential source of error by taking the more conservative approach of using 65% of the RNI instead of the previously used 70% of the RNI to compare define nutrient adequacy at the population level.

In conclusion, the study suggests that it is not possible to meet the RNIs for seven nutrients using local foods as consumed by 9-11 month old infants living in Faridabad district, Kheri Kalan PHC, Haryana state, signalling a need for an alternative intervention(s). Two sets of FBRs were formulated (m-FBRs and s-FBRs) that could be promoted to ensure dietary adequacy for six nutrients at the population level if successfully adopted. The m-FBRs had four messages, which represented the set of FBRs that ensure adequacy for the highest number of nutrients possible using the lowest number of messages. The s-FBRs represented a simple way to strengthen the national ICDS FBRs for ensuring dietary adequacy, which has implications for the programme's CF strategy in this setting if proven feasible in a community-based trial. These findings suggest that Optifood can be used to develop nutritionally optimal FBRs to improve CF by strengthening existing FBRs or formulating new ones based on the least number of messages. This process can be adapted to other contexts to ensure a selection of FBRs that are both nutritionally optimal and appropriate for testing for promotion in local contexts, and to assess whether an external strategy is required to ensure dietary adequacy for all nutrients.

## KEY MESSAGES

- Iron, zinc, folate, thiamine, niacin, and vitamins A and B6 are *absolute* “problem nutrients” in infant diets, signalling the need for a complementary intervention(s) to improve the nutritional status of infants in this setting.
- Food-based recommendations alone, using either four or seven messages will likely ensure dietary adequacy for at least six nutrients for most infants in this population.
- Optifood should be used in other contexts to develop FBRs or to identify the minimum number and types of modifications required to strengthen existing ones.

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## **CONFLICTS OF INTEREST**

We declare that we have no conflicts of interest

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## **CONTRIBUTORS**

ELF and NSS designed the study. ELF and ST advised on the data analysis plan. NB and ELF advised on dietary data collection and NSS and SM collected it. NSS analysed data with support from ELF and ST. NSS wrote drafts of the paper and ELF, NB, ST and SM commented on the drafts of the paper. All authors read and approved the final manuscript.

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## TABLES

**Table 1: Selected foods, consumers, median serving sizes, and upper constraints modelled for 9-11 month old infants**

	Serving size (grams/serving /meal) <sup>1</sup>	Upper constraints <sup>2</sup> (servings/week)	Cost/100g edible portion (INR)	Consumers, n(%) (n=60)
<b>Fruits (raw)</b>				
Apple <sup>3</sup>	12	5	8.2	3 (5.0)
Banana, ripe <sup>3</sup>	9	3	7.5	2 (3.3)
Green grapes <sup>3</sup>	18	5	5.2	1 (1.7)
Sapodilla <sup>3</sup>	12	4	4.7	4 (6.7)
Guava <sup>3</sup>	11	5	2.0	1 (1.7)
Orange <sup>3</sup>	9	3	4.6	1 (1.7)
Papaya, ripe <sup>3</sup>	10	2	3.1	1 (1.7)
<b>Added fats</b>				
Oil, sunflower	1	14	15.1	44 (73.3)
<b>Added sugars</b>				
Honey	1	4	46	3 (5.0)
Cane jaggery	2	28	3.4	1 (1.7)
White granulated sugar	3	28	3.4	49 (81.7)
<b>Grains</b>				
White rice, raw <sup>4</sup>	14	4	2.6	10 (16.7)
Wheat vermicelli, raw <sup>4</sup>	17	5	6.0	1 (1.7)
Wheat flour, whole, raw <sup>4</sup>	8	14	1.5	49 (81.7)
Semolina, dry, raw	6	5	2.1	3 (5.0)
<b>Dairy</b>				
Khoa (thickened buffalo milk)	9	2	28	2 (3.3)
Buffalo milk	39	28	3.7	42 (70.0)
Cow milk, 1.5% fat	12	14	3.0	4 (6.7)
Cow milk, whole	44	28	2.8	8 (13.3)
Buttermilk, buffalo	23	7	3.7	2 (3.3)
Yogurt, cow milk, plain	90	7	6.0	2 (3.3)
<b>Legumes</b>				
Red kidney beans, dried, raw	5	4	6.7	1 (1.7)
Chickpea, whole, dried, raw	5	4	6.7	2 (3.3)
Green gram, dried, raw	6	4	5.5	6 (10.0)
Groundnuts, roasted <sup>3</sup>	1	7	9.5	2 (3.3)
Almonds <sup>3</sup>	4	7	45.7	5 (8.3)
Chickpea, roasted <sup>3</sup>	1	5	23.8	1 (1.7)
<b>Animal-source food</b>				
Eggs, hen, raw	20	2	10.6	2 (3.3)

<b>Vegetables &amp; Roots (raw)</b>				
Cauliflower	5	5	2.5	3 (5.0)
Eggplant	22	5	1.2	3 (5.0)
Onion	2	5	1.4	16 (26.7)
Peas, green	2	5	1.6	7 (11.7)
Red tomatoes, ripe	2	3	1.3	21 (35.0)
Goosefoot leaves	5	4	2.1	1 (1.7)
Fenugreek leaves	5	4	2.7	4 (6.7)
Mustard leaves	5	4	1.0	3 (5.0)
Spinach	5	4	1.3	3 (5.0)
Carrot	4	3	1.7	5 (8.3)
Green cabbage	7	5	0.9	1 (1.7)
Green pepper	2	3	6.1	1 (1.7)
Potato	3	7	0.8	20 (33.3)
<b>Bakery</b>				
Wheat bread (white) <sup>3,4</sup>	15	3	3.4	3 (5.0)
Sweet biscuit <sup>3</sup>	9	14	5.9	26 (43.3)
Rusk <sup>3</sup>	8	7	8.5	17 (28.3)
<b>Breastmilk</b>	583	7	0.0	54 (90.0)

<sup>1</sup>Values are median serving sizes estimated from the observed intakes from consumers; <sup>2</sup>The lower constraints (servings/week) for all food items were 0, except human milk which was 6.9 serves/week and whole wheat flour which was 1 serving/week; <sup>3</sup>snacks; <sup>4</sup>staples

**Table 2: Lower and Upper constraints for food group (bold) and food sub-groups (*Italic*) in diets of 9-11 month old infants**

	Lower constraints (servings/week)	Upper constraints (servings/week)
<b>Added fats<sup>b</sup></b>	<b>0</b>	<b>14</b>
<b>Added sugars</b>	<b>2</b>	<b>28</b>
<i>Honey, syrup, nectar</i>	0	4
<i>Sugar</i>	0	28
<b>Bakery</b>	<b>0</b>	<b>14</b>
<i>Refined grain bread</i>	0	3
<i>Sweetened bakery products</i>	0	14
<b>Dairy</b>	<b>1</b>	<b>32</b>
<i>Cheese</i>	0	2
<i>Fluid or powdered milk</i>	0	28
<i>Other dairy excluding butter</i>	0	7
<i>Yogurt, solid and drinkable</i>	0	7
<b>Fruits</b>	<b>0</b>	<b>8</b>
<i>Vitamin C rich fruit</i>	0	7
<i>Other fruits</i>	0	7
<b>Grains &amp; grain products</b>	<b>3</b>	<b>21</b>
<i>Refined grains and products</i>	0	6
<i>Whole grains and products</i>	3	17
<b>Legumes, nuts &amp; seeds</b>	<b>0</b>	<b>9</b>
<i>Cooked beans, lentils, peas</i>	0	4
<i>Nuts, seeds &amp; unsweetened products</i>	0	7
<b>Meat, fish &amp; eggs<sup>a</sup></b>	<b>0</b>	<b>2</b>
<b>Vegetable</b>	<b>0</b>	<b>7</b>
<i>Other vegetables</i>	0	7
<i>Vitamin A source dark green leafy</i>	0	7
<i>Other Vitamin A source vegetables</i>	0	5
<i>Vitamin C-rich vegetables</i>	0	5
<b>Starchy roots<sup>b</sup></b>	<b>0</b>	<b>7</b>
<b>Human milk</b>	<b>6.9</b>	<b>7.1</b>
<b>Staples</b>	<b>3</b>	<b>15</b>
<b>Snack</b>	<b>2</b>	<b>20</b>

<sup>a</sup> Some food groups do not have food sub-groups since they only contain one food, i.e. “Added Fats” refers to vegetable oil; “Meat, fish & eggs” refers to eggs, and “Starchy roots” refers to potatoes.

**Table 3: Nutrient and cost implications of “best” diets and diets with % RNI minimised and maximised modelled in Optifood for 9-11 month old infants**

	% Recommended Nutrient Intake (RNI) <sup>1</sup>											Cost/day (Indian Rupees)
	Vitamin								Calcium	Iron	Zinc	
	C	B1 <sup>2</sup>	B2 <sup>3</sup>	B3 <sup>4</sup>	B6 <sup>5</sup>	B12	A <sup>6</sup>	Folate				
“Best” diet <sup>7</sup>	116.9	89.1	117.8	45.1	59.5	142.0	32.3	87.6	100.0	9.2	26.8	9.6
Diets with each nutrient maximised <sup>8</sup>	138.5	97.1	136.5	58.9	71.2	176.5	41.4	93.1	123.5	13.6	28.5	-
Diets with each nutrient minimised <sup>9</sup>	57.5	46	33.2	29.5	22.3	42.2	9.8	38.8	41.7	1.9	13.1	1.5
<b>Sensitivity analyses</b>												
<b>Testing conclusions with iZiNCG<sup>10</sup> recommendation instead of World Health Organisation (WHO) zinc recommendation</b>												
“Best” diet	100.1	89.5	119.4	45.2	58.7	141.8	33.1	86.8	100	9.2	45.1	9.6
Diets with each nutrient maximised	138.5	97.1	136.5	58.9	71.2	176.5	41.4	93.1	123.5	13.6	47.8	-
<b>Testing conclusions with WHO breastmilk composition values instead of Indian breastmilk composition values</b>												
“Best” diet	121.2	90.8	135.3	33.9	59	177.3	96.9	104.4	100	6.0	20.5	9.6
Diets with each nutrient maximised	157.2	98.1	145.1	54.7	77.4	195.3	100.8	116.8	123.6	13.0	23.7	-

<sup>1</sup>%RNIs ensuring nutrient adequacy ( $\geq 65\%$  AI) are displayed in bold; <sup>2-5</sup>B vitamins are defined as follows: (i) B1 = thiamine; (ii) B2 = riboflavin; and (iii) B3 = niacin.

<sup>6</sup>Values for shown for vitamin A Retinol Equivalents; <sup>7</sup>The “best” diet is the diet that came as close as possible to meeting the 2004 FAO/WHO RNIs for 11 nutrients;

<sup>8</sup>This row represents 11 distinct diets with the %RNI for each of the 11 nutrients maximised; <sup>9</sup>This row represents 11 distinct diets with the % RNI for each of the 11 nutrients minimised, and gives the cost of the cheapest diet; <sup>10</sup>iZiNCG is defined as International Zinc Nutrition Consultative Group.

**Table 4: Nutrient and cost implications of three sets of food-based recommendations on diets of 9-11 month old infants modelled in Optifood**

	% Recommended Nutrient Intake (RNI) <sup>1</sup>											Cost/day (Indian Rupees)	Number of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Calcium	Iron	Zinc		
	C	B1 <sup>2</sup>	B2 <sup>3</sup>	B3 <sup>4</sup>	B6 <sup>5</sup>	B12	A <sup>6</sup>	Folate					
<b>Existing ICDS FBRs vs. minimum number of FBRs<sup>7</sup> needed to improve infant diet quality (m-FBRs) vs. strengthened existing ICDS FBRs (s-FBRs)</b>													
Existing ICDS FBRs <sup>8</sup>	58.2	56.8	44.5	38.2	26.4	51.2	10	43.2	47.5	3.3	15.8	2.3	0
m-FBRs <sup>9</sup>	<b>90.9</b>	<b>75.2</b>	<b>70.3</b>	45.6	37	<b>89.2</b>	17.1	<b>66.7</b>	<b>70.3</b>	6.6	22.5	6.4	6
s-FBRs <sup>10</sup>	<b>82.9</b>	<b>90.7</b>	<b>99.7</b>	48.4	60.2	<b>111.5</b>	28.8	<b>80.5</b>	<b>113.0</b>	8.9	29.9	10.6	6
<b>Sensitivity analyses</b>													
<b>Testing conclusions with iZiNCG<sup>11</sup> recommendation instead of World Health Organisation (WHO) zinc recommendation</b>													
m-FBRs	<b>90.9</b>	<b>75.2</b>	<b>70.3</b>	45.6	37	<b>89.2</b>	17.1	<b>66.7</b>	<b>70.3</b>	6.6	37.9	6.4	6
s-FBRs	<b>82.9</b>	<b>90.7</b>	<b>99.7</b>	48.4	60.2	<b>111.5</b>	28.8	<b>80.5</b>	<b>113.0</b>	8.9	50.1	10.6	6
<b>Testing conclusions with WHO breastmilk composition values instead of Indian breastmilk composition values</b>													
m-FBRs	<b>110.1</b>	<b>76.8</b>	<b>91.5</b>	42.7	38.7	<b>127.7</b>	<b>79.1</b>	<b>93.3</b>	<b>70.3</b>	6.6	18.8	6.4	7
s-FBRs	<b>105.8</b>	<b>92.9</b>	<b>121.0</b>	45.3	62.7	<b>150.2</b>	<b>88.7</b>	<b>99.9</b>	<b>113.0</b>	9.0	27.6	10.6	7

<sup>1</sup>%RNIs ensuring nutrient adequacy (≥65% AI) are displayed in bold; <sup>2-5</sup>B vitamins are defined as follows: (i) B1 = thiamine; (ii) B2 = riboflavin; and (iii) B3 = niacin.

<sup>6</sup>Values for shown for vitamin A Retinol Equivalents; <sup>7</sup>FBRs are defined as food-based recommendations; <sup>8</sup>FBRs promoted in India's Integrated Child Development Service (ICDS) programme are the 7 food group-level FBRs described in Table 7; <sup>9</sup>m-FBRs are as follows: Yogurt - 1x/day; Vitamin-C rich fruit - 1x/day; Wheat flour - 2x/day; red kidney beans - 4x/week; <sup>10</sup>s-FBRs are described in Table 7; <sup>11</sup>iZiNCG is defined as International Zinc Nutrition Consultative Group.

**Table 5: Median and “best” diet food group patterns for 9-11 month old infants**

<b>Food Group (FG)</b>	<b>Median FG patterns (servings/week)</b>	<b>FG patterns in “best” diet (servings/week)</b>
Fruits	2	8 <sup>a</sup>
Added sugars	9	2 <sup>a</sup>
Vegetables	2	7 <sup>a</sup>
Dairy products	14	32 <sup>a</sup>
Added fats	7	7
Bakery & breakfast cereals	7	0 <sup>a</sup>
Starchy roots	2	7 <sup>a</sup>
Meat, fish & eggs	0	2 <sup>a</sup>
Grains & grain products	10	7 <sup>a</sup>
Legumes, nuts & seeds	2	4 <sup>a</sup>
Human milk	7	7
Staples	8	7 <sup>a</sup>
Snacks	11	8 <sup>a</sup>

<sup>a</sup> Values deviating from the observed median intake for 9-11 month old infants



**Table 6: Nutrient-rich food group, food sub-group and food sources in 9-11 month old infants' diet**

Food group source	Food sub-group source	Food source	# of nutrients the food provides >5% of nutrient source in optimised diets	Nutrients (all nutrients are absolute “problem nutrients”)
Dairy	Yogurt, solid or drinkable	Yogurt	7	Calcium, Thiamine, Riboflavin, Vitamin A, Vitamin B6, Folate, Zinc
	Fluid or powdered milk	Buffalo milk	7	Calcium, Thiamine, Riboflavin, Vitamin A, Vitamin B6, Folate, Zinc
Legumes	Cooked beans, lentils, peas	Red kidney beans	6	Thiamine, Niacin, Vitamin B6, Folate, Iron, Zinc
Grains	Whole grains and products	Wheat flour	5	Thiamine, Niacin, Folate, Iron, Zinc
Vegetables	Vitamin A source dark green leafy vegetables	Mustard leaves	3	Vitamin A, Folate, Iron
Meat, fish and eggs	Eggs	Eggs	2	Vitamin B6, Iron
Starchy roots	Other starchy plant foods	Potato	1	Vitamin B6
Fruit	Vitamin C-rich fruit	Guava	1	Vitamin C
		Orange	1	Vitamin A
	Other fruit	Sapodilla	1	Vitamin B6
Bakery	Sweetened bakery products	Rusk	1	Iron

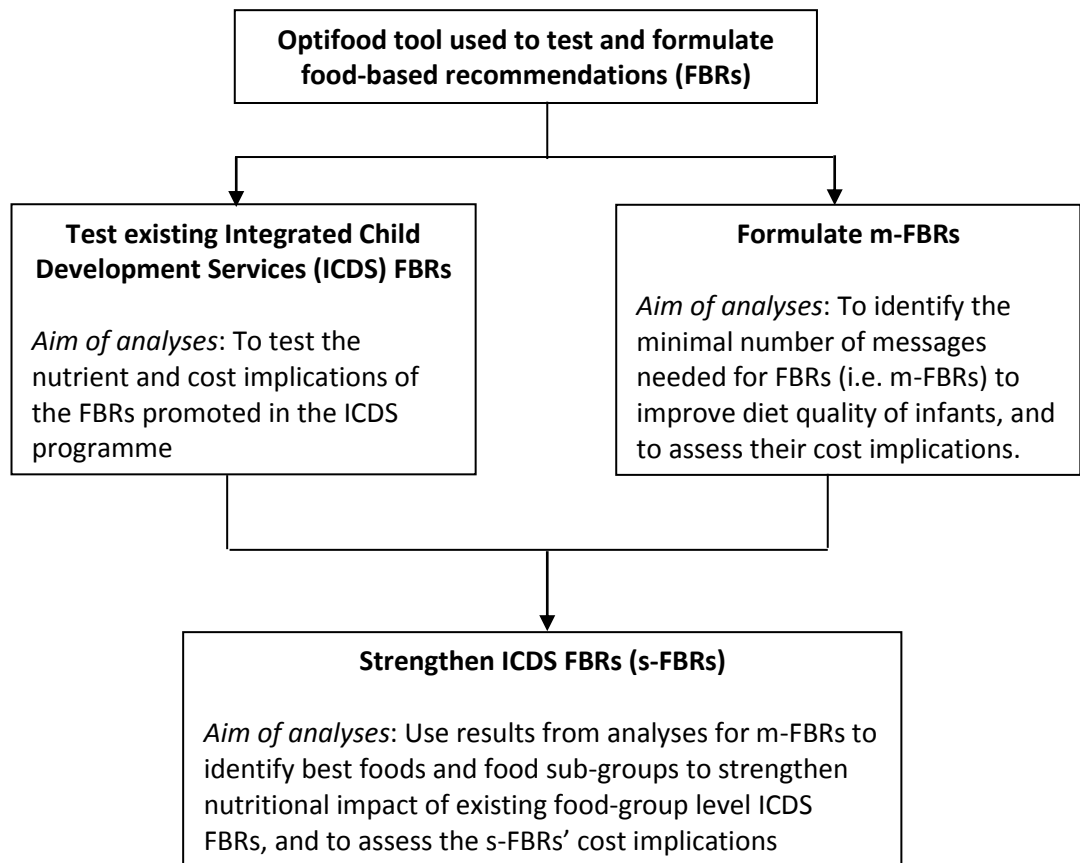
**Table 7: Finalised s-FBRs for testing with mothers of young infants in the study setting**

	<b>Food-Based Recommendations</b>	<b>Amount (g)</b>	<b>Weight in Household Measures</b>
1.	Breastfeed as often as the child wants	N/A	N/A
2.	Give fruits at least once per day, with preference to papaya or mango or guava or orange	10 <sup>a</sup>	Papaya – 5 small pieces or Guava – 2 small pieces or Orange – 1 to 2 slices Mango – 2 small pieces Sapodilla – ¼ piece Banana – 1/3 banana Grapes – 4 grapes Apple – 1 thin slice
3.	Give vegetables at least once per day	5	1 teaspoon
4.	Give dairy products (yogurt or undiluted buffalo milk or cow milk or packet milk or buttermilk) at least twice per day, with preference to buffalo milk or yogurt.	Milk- 40 Buttermilk- 25 Yogurt – 90	Undiluted milk – 8 teaspoons Buttermilk – 5 teaspoons Yogurt – 2/3 small bowl  - If the child is not breastfed, then give at least 2/3 small bowl of undiluted buffalo or cow or packet milk at least 6 times per day. Of these, undiluted buffalo milk is preferred for your child
5.	Give what is being made every day in the house (roti <sup>b</sup> or rice or vermicelli) at least twice per day, with preference to roti	Roti – 10 Rice – 15 Vermicelli – 20	Roti – ¼ piece or Rice – 1/3 small bowl or Vermicelli – 1 small bowl
6.	Give lentils and beans (lentils or chickpeas or kidney beans) at least four times per week, with preference to red kidney beans	Lentils – 5 Kidney beans – 10 Chickpeas – 5	Lentils – 5 teaspoons or Kidney beans – 1/3 small bowl or Chickpeas – 5 teaspoons
7.	Add ghee or oil to food at least once per day	1	½ teaspoon
<b><i>If non-vegetarian household:</i></b>			
8.	Give animal source foods twice per week	20	4 teaspoons

<sup>a</sup>All fruit amounts in household measures are equivalent to 10g; <sup>b</sup>Flatbread made with wheat flour and water

## FIGURE

Figure 1: Using the Optifood tool to test and formulate food-based recommendations for Indian infants aged 9-11 months



## ONLINE SUPPLEMENTAL MATERIAL

### Appendix A: Descriptions of Optifood module objective functions, constraints, and the modules in which each constraint is used

Optifood Module's objective functions					
Module 1	<ul style="list-style-type: none"> <li>- Minimises energy (n=1 objective function)<sup>1</sup></li> <li>- Maximises energy (n=1 objective function)<sup>1</sup></li> <li>- Minimises the deviations below the RNI for 12 nutrients (n=1 objective function)<sup>2</sup></li> <li>- Minimises the nutrient content for each of the 12 nutrients modelled (n=12 objective functions)</li> <li>- Maximises the nutrient content for protein (n=1 objective function)</li> <li>- Minimise cost (n= 1 objective function)</li> <li>- Maximises cost (n= 1 objective function)</li> </ul>				
Module 2	<ul style="list-style-type: none"> <li>- Minimises the deviations below the RNI for 12 nutrients (n=1 objective function)<sup>2</sup></li> <li>- Minimises the deviations below the RNI for 12 nutrients and deviations below and above food group patterns (n=1 objective functions)<sup>2</sup></li> </ul>				
Module 3	<ul style="list-style-type: none"> <li>- Minimises the nutrient content for each of the 12 nutrients modelled (n=12 objective functions)</li> <li>- Maximises the nutrient content for each of the 12 nutrients modelled (n=12 objective functions)</li> <li>- Minimises cost (n= 1 objective function)</li> <li>- Maximises cost (n= 1 objective function)</li> </ul>				
			Used in Module		
Constraints to ensure realistic diets:			1	2	3
Ensure food servings are $\geq 0$			√	√	√
Goal constraints to define deviation values in the equation $[(\text{goal} - \text{actual}) / \text{goal}] + \text{negative deviation} - \text{positive deviation} = 0^3$			√	√	√
Constraints to test FBRs:					
Ensure diet energy content = average energy requirement of target group			—	—	√
Ensure food group patterns (servings/week from food groups) $\leq$ maximum			—	—	√
Ensure food group patterns (servings/week from food groups (servings/week from food groups) $\geq$ minimum			—	—	√
Ensure food sub-group patterns (servings/week from food sub-groups) $\leq$ maximum			—	—	√
Ensure food sub-group patterns (servings/week from food sub-groups groups) $\geq$ minimum			—	—	√
Ensure food servings sizes $\leq$ maximum amounts (g)			—	—	√
Ensure food serving sizes $\geq$ minimum amounts (g); usually 0 g			—	—	√
Ensure servings/week per food, food sub-group, or food group $\geq$ FBR			—	—	√

<sup>1</sup>These models do not include the energy equality constraint; <sup>2</sup>If the objective function equals 0, then a second model is run, and its objective function is to minimise cost. Additional constraints are included in this second model, which is that the content of each nutrient modelled is  $\geq$  its RNI; <sup>3</sup>If the goal exceeds the diet's value, this constraint forces the negative deviation to equal 0 and the positive deviation to equal the standardized difference, i.e. difference/the goal value; if the goal and diet's value are equal this, constraint forces the negative and positive values to both equal 0; if the diet's value exceeds the goal then this constraint forces the negative deviation to equal the standardized difference and the positive deviation to equal 0.

**Appendix B: Nutrient, cost and nutrient adequacy implications of food-based recommendations based on nutrient-dense foods identified in Optifood's Module 2 to identify m-FBRs**

Food-based recommendations (FBRs)	% Recommended Nutrient Intake (RNI)											Cost/day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
"Best" diet	116.9	89.1	117.8	45.1	59.5	142	32.3	87.6	100	9.2	26.8	9.6	6
Diets with each nutrient minimised	57.5	46	33.2	29.5	22.3	42.2	9.8	38.8	41.7	1.9	13.1	1.5	0
Dairy - 2x/day	57.6	49.7	42.4	29.5	23.9	51.1	9.9	40.3	46.9	1.9	13.7	2	0
Legumes - 4x/week	57.5	46.1	33.2	29.6	22.7	42.2	9.8	39.3	41.7	2	13.4	1.5	0
Vitamin-C rich fruit - 1x/day	89	47.1	33.9	30.3	24.4	42.3	10.6	42.9	41.9	2	13.4	1.7	1
Green leafy veg - 1x/day	61.8	46.4	35.3	30.2	25.2	42.3	14.4	43.7	43	2.3	13.3	1.5	0
Egg - 2x/week	57.5	47.1	38.3	29.5	25.4	48.9	10.8	42.7	42.4	2.5	13.8	2	0
Wheat flour - 2x/day	57.5	65.1	37.9	42.7	22.7	42.2	10	42.5	43	5.4	15.7	1.6	1
Red kidney beans - 4x/week	57.9	51.3	34.4	30.8	25.7	42.2	9.8	52.6	42.2	2.9	13.8	1.6	0
Yogurt - 1x/day	59	52.3	63.4	30	30.4	89	16.1	44.9	68.1	1.9	18.5	6.2	2
Buffalo milk - 2x/day	60.1	52.7	50.1	29.7	35.9	56.9	11.4	41.6	81.6	2.4	17.4	3.4	1
Mustard leaves - 4x/week	60.2	46.2	34	30.1	24.1	42.2	12.6	45.1	42.8	4.4	13.2	1.5	0
Guava - 5x/week	113	46.6	33.6	30.3	24.9	42.3	9.8	43.3	41.8	2	13.3	1.6	1
Sapodilla - 4x/week	58.9	46.1	33.5	29.8	26.6	42.3	9.8	41	42.1	2.3	13.2	1.7	0
Orange - 3x/week	61.3	46.9	33.5	29.7	23	42.2	11.6	40.1	41.9	1.9	13.2	1.7	0
Rusk - 1x/day	57.5	46.5	33.3	31	22.5	42.2	10.1	39	41.7	2.3	13.4	1.8	0
Potato - 1x/day	58.5	46.5	33.2	30.2	25.4	42.2	9.9	38.9	41.7	2	13.2	1.5	0
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day	89	63.1	38.6	43.5	24.7	42.3	10.9	46.6	43.3	5.5	15.8	1.8	1
Vitamin C-rich fruit - x/day - Red kidney beans - 4x/week	89.4	52.3	35.1	31.6	27.8	42.3	10.6	56.7	42.4	3	14	1.7	1
Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day	90.5	53.3	64.2	30.8	32.5	89.2	16.9	49	68.4	2	18.6	6.4	3

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
Vitamin C-rich fruit - 1x/day - Buffalo milk - 2x/day	91.6	53.7	50.9	30.4	37.9	57	12.2	45.6	81.8	2.5	17.4	3.5	2
Vitamin C-rich fruit - 1x/day - Guava - 5x/week	115.6	47.1	33.9	30.5	25.3	42.3	10.6	44.2	41.9	2	13.4	1.7	1
Wheat flour - 2x/day - Red kidney beans - 4x/week	57.9	67.5	39.2	44	26.3	42.2	10	56.3	43.5	6.4	16.6	1.6	1
Wheat flour - 2x/day - Yogurt - 1x/day	59	68.6	68.3	43.4	31.3	89	16.3	48.6	69.5	5.5	21.5	6.2	4
Wheat flour - 2x/day - Buffalo milk - 2x/day	60.1	69.8	55.3	43.6	37	56.9	11.6	46.2	83.1	6	20.6	3.4	2
Wheat flour - 2x/day - Guava - 5x/week	113	62.7	38.4	43.5	25.3	42.3	10	46.9	43.1	5.5	15.8	1.7	1
Red kidney beans - 4x/week - Yogurt - 1x/day	59.4	57.8	64.8	31.3	34.1	89	16.1	58.7	68.6	2.9	19.4	6.3	2
Red kidney beans - 4x/week - Buffalo milk - 2x/day	60.5	58.5	51.6	31.2	39.5	56.9	11.4	55.5	82.1	3.4	18.3	3.5	1
Red kidney beans - 4x/week - Guava - 5x/week	113.4	51.9	34.9	31.6	28.4	42.3	9.8	57.1	42.3	3	14	1.7	1
Yogurt - 1x/day - Buffalo milk - 2x/day	61.6	61	81.6	31.3	45	104.3	17.6	49.3	108.7	2.6	23.6	8.4	3
Yogurt - 1x/day - Guava - 5x/week	114.5	53	63.9	30.8	33.1	89.1	16.1	49.4	68.3	2	18.6	6.3	3
Buffalo milk - 2x/day - Guava - 5x/week	115.6	53.3	50.6	30.5	38.5	57	11.4	46	81.7	2.5	17.5	3.5	2
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week	89.4	68.5	39.9	44.8	28.3	42.3	10.9	60.3	43.8	6.5	16.7	1.8	2
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Yogurt - 1x/day	90.5	69.5	69	44.1	33.3	89.2	17.1	52.7	69.7	5.6	21.6	6.4	5
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Buffalo milk - 2x/day	91.6	70.8	56	44.3	39	57.1	12.3	50.2	83.4	6.1	20.7	3.5	3

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Guava - 5x/week	115.6	63.1	38.6	43.7	25.6	42.3	10.9	47.8	43.3	5.5	15.9	1.8	1
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Yogurt - 1x/day	90.9	58.7	65.5	32.1	36.1	89.2	16.9	62.8	68.9	3	19.5	6.5	4
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Buffalo milk - 2x/day	92	59.4	52.2	31.9	41.5	57.1	12.2	59.5	82.4	3.5	18.4	3.7	2
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Guava - 5x/week	116	52.3	35.1	31.8	28.7	42.3	10.6	57.9	42.4	3	14.1	1.7	1
Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day - Buffalo milk - 2x/day	93.1	62	82.4	32	47	104.4	18.4	53.3	109	2.7	23.7	8.6	4
Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day - Guava - 5x/week	117.1	53.3	64.2	31	33.4	89.2	16.9	50.2	68.4	2	18.6	6.4	3
Vitamin C-rich fruit - 1x/day - Buffalo milk - 2x/day - Guava - 5x/week	118.2	53.7	50.9	30.6	38.8	57	12.2	46.9	81.8	2.5	17.5	3.5	2
Wheat flour - 2x/day - Red kidney beans - 4x/week - Yogurt - 1x/day	59.4	74.2	69.6	44.9	35	89.1	16.3	62.6	70.1	6.5	22.4	6.3	4
Wheat flour - 2x/day - Red kidney beans - 4x/week - Buffalo milk - 2x/day	60.5	75.6	56.9	45.1	40.7	57	11.6	60.2	83.8	7.1	21.6	3.5	2
Wheat flour - 2x/day - Red kidney beans - 4x/week - Guava - 5x/week	113.4	68.1	39.7	44.8	29	42.3	10.1	60.7	43.6	6.5	16.7	1.7	2
Wheat flour - 2x/day - Yogurt - 1x/day - Guava - 5x/week	114.5	69.2	68.8	44.1	34	89.1	16.3	53.1	69.6	5.5	21.6	6.3	5
Wheat flour - 2x/day - Buffalo milk - 2x/day - Guava - 5x/week	115.6	70.5	55.8	44.4	39.7	57.1	11.6	50.6	83.3	6.1	20.8	3.5	3

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
Red kidney beans - 4x/week - Yogurt - 1x/day - Buffalo milk - 2x/day	62	66.9	83.3	32.8	48.7	104.3	17.6	63.3	109.3	3.7	24.6	8.6	4
Red kidney beans - 4x/week - Yogurt - 1x/day - Guava - 5x/week	114.9	58.4	65.3	32.1	36.7	89.1	16.1	63.1	68.8	3	19.5	6.4	4
Red kidney beans - 4x/week - Buffalo milk - 2x/day - Guava - 5x/week	116	59.1	52	32	42.2	57	11.4	59.9	82.3	3.5	18.4	3.6	2
Yogurt - 1x/day - Buffalo milk - 2x/day - Guava - 5x/week	117.1	61.6	82.1	32.1	47.6	104.4	17.6	53.7	108.9	2.7	23.8	8.6	4
<b>Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week - Yogurt - 1x/day (i.e. m-FBRs)</b>	<b>90.9</b>	<b>75.2</b>	<b>70.3</b>	<b>45.6</b>	<b>37</b>	<b>89.2</b>	<b>17.1</b>	<b>66.7</b>	<b>70.3</b>	<b>6.6</b>	<b>22.5</b>	<b>6.4</b>	<b>6</b>
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week - Buffalo milk - 2x/day	92	76.6	57.5	45.8	42.7	57.1	12.3	64.3	84	7.2	21.7	3.7	3
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week - Guava - 5x/week	116	68.5	39.9	45	29.3	42.3	10.9	61.6	43.8	6.5	16.7	1.8	2
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Yogurt - 1x/day - Guava - 5x/week	117.1	69.5	69	44.3	34.3	89.2	17.1	54	69.7	5.6	21.7	6.4	5
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Buffalo milk - 2x/day - Guava - 5x/week	118.2	70.8	56	44.5	39.9	57.1	12.3	51.5	83.4	6.1	20.8	3.5	3
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Yogurt - 1x/day - Buffalo milk - 2x/day	93.5	68.2	84	33.6	50.7	104.5	18.4	67.4	109.7	3.9	24.7	8.8	6



Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Yogurt - 1x/day - Guava - 5x/week	117.5	58.7	65.5	32.3	37	89.2	16.9	64	68.9	3	19.5	6.5	4
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Buffalo milk - 2x/day - Guava - 5x/week	118.6	59.4	52.2	32.1	42.5	57.1	12.2	60.8	82.4	3.5	18.4	3.7	2
Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day - Buffalo milk - 2x/day - Guava - 5x/week	119.7	62	82.4	32.2	47.9	104.4	18.4	54.6	109	2.7	23.8	8.6	4
Wheat flour - 2x/day - Red kidney beans - 4x/week - Yogurt - 1x/day - Guava - 5x/week	114.9	74.8	70.1	45.6	37.7	89.2	16.3	67.1	70.2	6.6	22.6	6.5	6
Wheat flour - 2x/day - Red kidney beans - 4x/week - Buffalo milk - 2x/day - Guava - 5x/week	116	76.2	57.2	45.9	43.4	57.1	11.6	64.7	83.9	7.1	21.7	3.6	3
Red kidney beans - 4x/week - Yogurt - 1x/day - Buffalo milk - 2x/day - Guava - 5x/week	117.5	67.8	83.7	33.7	51.4	104.4	17.7	67.8	109.5	3.8	24.7	8.7	6
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week - Yogurt - 1x/day - Guava - 5x/week	117.5	75.2	70.3	45.8	37.9	89.2	17.1	68	70.3	6.6	22.6	6.5	6
Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week - Buffalo milk - 2x/day - Guava - 5x/week	118.6	76.6	57.5	46	43.6	57.1	12.3	65.6	84	7.2	21.7	3.7	4
Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week - Yogurt - 1x/day - Buffalo milk - 2x/day - Guava - 5x/week	120.1	68.2	84	33.8	51.6	104.5	18.4	68.7	109.7	3.9	24.8	8.8	6

**Appendix C: Nutrient, cost and nutrient adequacy implications of ICDS FBRs and food-based recommendations based on nutrient-dense foods identified in Optifood's Modules 2 and 3 to identify s-FBRs**

Food-based recommendations	% Recommended Nutrient Intake (RNI)											Cost/day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
"Worst" diets with each nutrient minimised	57.5	46	33.2	29.5	22.3	42.2	9.8	38.8	41.7	1.9	13.1	1.5	0
General ICDS FBRs	58.2	56.8	44.5	38.2	26.4	51.2	10	43.2	47.5	3.3	15.8	2.3	0
ICDS FBRs - Vitamin C-rich fruit-1x/day	89.3	57.4	44.6	39	27.7	51.2	10.8	47.1	47.6	3.3	15.8	2.3	1
ICDS FBRs - Wheat flour - 2x/day	58.2	66.8	48	43.1	26.4	51.2	10.1	44.9	48.6	5.7	16.7	2.3	1
ICDS FBRs - Green leafy veg - 1x/day	62.3	56.9	46.6	38.8	28.5	51.3	14.6	47.8	48.8	3.7	15.9	2.3	0
ICDS FBRs - Buffalo milk - 2x/day	60.7	61.7	53.2	39.5	39.1	57.1	11.4	46.2	82.7	4.1	20	3.7	1
ICDS FBRs - Yogurt - 1x/day	59.7	60.8	68.1	39.3	34.1	92.8	16.2	48.9	70.7	3.5	21.2	6.8	3
ICDS FBRs - Egg - 2x/week	58.2	58.2	49.7	38.2	29.7	58	11	47.1	48.3	3.9	16.7	2.7	0
ICDS FBRs - Red kidney beans - 4x/week	58.7	62.2	45.7	39.5	29.6	51.2	10	56.5	48	4.2	16.4	2.3	0
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day	89.3	67.4	48	43.8	27.7	51.2	10.9	48.8	48.6	5.7	16.7	2.3	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day	93.4	57.5	46.7	39.6	29.8	51.3	15.3	51.7	48.9	3.7	15.9	2.3	1
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Buffalo milk - 2x/day	91.7	61.9	53.2	40	40.3	57.1	12.2	49.9	82.7	4.1	20	3.7	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day	90.7	61.2	68.1	39.9	35.4	92.8	16.9	52.7	70.7	3.5	21.2	6.8	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Egg - 2x/week	89.3	58.7	49.8	39	31	58	11.8	51	48.4	3.9	16.7	2.7	1

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Red kidney beans - 4x/week	89.7	62.7	45.8	40.2	30.9	51.2	10.8	60.4	48	4.3	16.5	2.3	1
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day	62.3	66.8	50.1	43.6	28.5	51.3	14.7	49.5	49.8	6	16.8	2.4	1
ICDS FBRs - Wheat flour - 2x/day - Buffalo milk - 2x/day	60.7	71	56.2	43.9	39.1	57.1	11.6	47.3	83.5	6.3	21	3.7	2
ICDS FBRs - Wheat flour - 2x/day - Yogurt - 1x/day	59.7	70.3	71.3	43.8	34.1	92.8	16.3	50.2	71.5	5.7	22.1	6.8	4
ICDS FBRs - Wheat flour - 2x/day - Egg - 2x/week	58.2	68.1	53.2	43.1	29.7	58	11.1	48.8	49.3	6.3	17.6	2.8	1
ICDS FBRs - Wheat flour - 2x/day - Red kidney beans - 4x/week	58.7	72.1	49.2	44.3	29.6	51.2	10.1	58.2	49	6.6	17.4	2.4	1
ICDS FBRs - Green leafy veg - 1x/day - Buffalo milk - 2x/day	64.8	61.8	55.3	40.2	41.2	57.1	16	50.8	83.9	4.4	20.1	3.7	1
ICDS FBRs - Green leafy veg - 1x/day - Yogurt - 1x/day	63.8	60.8	70.1	39.8	36.2	92.8	20.7	53.6	72	3.8	21.3	6.8	3
ICDS FBRs - Green leafy veg - 1x/day - Egg - 2x/week	62.3	58.2	51.8	38.8	31.8	58	15.6	51.7	49.6	4.3	16.8	2.8	0
ICDS FBRs - Green leafy veg - 1x/day - Red kidney beans - 4x/week	62.8	62.3	47.8	40.1	31.7	51.3	14.6	61.1	49.3	4.6	16.5	2.3	0
ICDS FBRs - Buffalo milk - 2x/day - Egg - 2x/week	60.7	64.4	59.2	40.3	42.4	63.8	12.5	51.2	83.6	4.9	21	4.2	1
ICDS FBRs - Buffalo milk - 2x/day - Red kidney beans - 4x/week	61.1	67.7	55	41.3	42.3	57.1	11.5	60.3	83.2	5.1	20.7	3.8	2
ICDS FBRs - Yogurt - 1x/day - Egg - 2x/week	59.7	62.3	73.4	39.4	37.4	99.5	17.2	53.1	71.5	4.1	22.1	7.3	3

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Yogurt - 1x/day - Red kidney beans - 4x/week	60.1	66.2	69.4	40.6	37.3	92.8	16.2	62.5	71.2	4.4	21.9	6.9	4
ICDS FBRs - Egg - 2x/week - Red kidney beans - 4x/week	58.7	63.6	50.9	39.5	32.9	58	11	60.5	48.8	4.9	17.3	2.8	0
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day	93.4	67.4	50.1	44.4	29.8	51.3	15.5	53.4	49.9	6	16.8	2.4	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Buffalo milk - 2x/day	91.7	71.4	56.2	44.6	40.3	57.1	12.4	51.1	83.5	6.3	21	3.7	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Yogurt - 1x/day	90.7	70.8	71.3	44.5	35.4	92.8	17.1	53.9	71.6	5.7	22.2	6.8	5
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Egg - 2x/week	89.3	68.6	53.2	43.8	31	58	11.9	52.8	49.4	6.3	17.6	2.8	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Red kidney beans - 4x/week	89.7	72.6	49.2	45.1	30.9	51.2	10.9	62.1	49	6.6	17.4	2.4	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day	95.8	62	55.3	40.6	42.4	57.1	16.8	54.5	84	4.4	20.1	3.7	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Yogurt - 1x/day	94.8	61.3	70.2	40.5	37.5	92.8	21.5	57.3	72	3.8	21.3	6.8	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Egg - 2x/week	93.4	58.8	51.9	39.6	33.1	58	16.3	55.6	49.6	4.3	16.8	2.8	1

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Red kidney beans - 4x/week	93.8	62.8	47.9	40.8	33	51.3	15.3	65	49.3	4.6	16.6	2.3	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week	91.7	64.4	59.2	40.7	43.7	63.8	13.3	54.5	83.6	4.9	21	4.2	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	92.2	67.9	55	41.8	43.5	57.1	12.3	63.6	83.2	5.1	20.8	3.8	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day - Egg - 2x/week	90.7	62.7	73.4	40.1	38.7	99.5	17.9	56.9	71.6	4.1	22.2	7.3	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	91.1	66.7	69.4	41.3	38.6	92.8	16.9	66.2	71.2	4.4	21.9	6.9	6
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	89.7	64	51	40.2	34.2	58	11.8	64.3	48.8	4.9	17.4	2.8	1
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day	64.8	71	58.3	44.5	41.2	57.1	16.2	52	84.8	6.6	21.1	3.7	2
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day	63.8	70.4	73.3	44.4	36.2	92.8	20.9	54.8	72.8	6.1	22.3	6.8	4
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Egg - 2x/week	62.3	68.2	55.2	43.6	31.8	58	15.7	53.4	50.6	6.6	17.7	2.8	1
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Red kidney beans - 4x/week	62.8	72.2	51.3	44.9	31.7	51.3	14.7	62.8	50.3	6.9	17.5	2.4	1

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Wheat flour - 2x/day - Buffalo milk - 2x/day - Egg - 2x/week	60.7	72.5	61.6	44	42.4	63.8	12.6	51.5	84.4	6.9	21.9	4.2	2
ICDS FBRs - Wheat flour - 2x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	61.1	76.5	57.5	45.3	42.3	57.1	11.6	60.9	84	7.2	21.7	3.8	2
ICDS FBRs - Wheat flour - 2x/day - Yogurt - 1x/day - Egg - 2x/week	59.7	71.8	76.5	44	37.4	99.5	17.3	54.4	72.4	6.4	23.1	7.3	4
ICDS FBRs - Wheat flour - 2x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	60.1	75.8	72.5	45.2	37.3	92.8	16.3	63.7	72.1	6.7	22.9	6.9	4
ICDS FBRs - Wheat flour - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	58.7	73.4	54.4	44.3	32.9	58	11.1	62.2	49.8	7.2	18.2	2.8	1
ICDS FBRs - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week	64.8	64.7	61.3	40.9	44.6	63.9	17.1	56	84.9	5.3	21.1	4.3	1
ICDS FBRs - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	65.2	67.8	57.1	42	44.4	57.1	16.1	65.1	84.5	5.4	20.8	3.8	4
ICDS FBRs - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week	63.8	62.4	75.5	40	39.6	99.6	21.7	57.8	72.8	4.4	22.3	7.4	3
ICDS FBRs - Green leafy veg - 1x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	64.2	66.3	71.5	41.2	39.5	92.8	20.7	67.1	72.5	4.7	22	6.9	5
ICDS FBRs - Green leafy veg - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	62.8	63.6	53	40.1	35	58	15.6	65.1	50.1	5.2	17.4	2.8	1
ICDS FBRs - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	61.4	72.8	61.1	42.3	46	63.9	12.5	65.6	84.3	6.3	21.7	4.4	3

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	60.1	67.8	74.8	40.8	40.7	99.5	17.2	66.7	72	5	22.9	7.4	5
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day	95.8	71.5	58.3	45.2	42.4	57.1	17	55.7	84.8	6.6	21.1	3.7	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day	94.8	70.8	73.4	45.1	37.5	92.8	21.7	58.6	72.9	6.1	22.3	6.8	5
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Egg - 2x/week	93.4	68.7	55.3	44.4	33.1	58	16.5	57.4	50.6	6.6	17.7	2.8	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Red kidney beans - 4x/week	93.8	72.7	51.3	45.7	33	51.3	15.5	66.7	50.3	6.9	17.5	2.4	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Buffalo milk - 2x/day - Egg - 2x/week	91.7	73	61.6	44.7	43.7	63.9	13.4	55.3	84.4	6.9	22	4.2	3
ICDS FBRs - Vitamin C-rich fruit-1x/day - Wheat flour - 2x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	92.2	76.9	57.5	46	43.5	57.1	12.4	64.6	84.1	7.2	21.7	3.8	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Yogurt - 1x/day - Egg - 2x/week	90.7	72.3	76.5	44.6	38.7	99.5	18.1	58.1	72.4	6.4	23.1	7.3	5

Food-based recommendations	% RNI											Cost/day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	91.1	76.3	72.5	45.9	38.6	92.8	17.1	67.4	72.1	6.7	22.9	6.9	6
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	89.7	74	54.4	45.1	34.2	58	11.9	66.1	49.8	7.2	18.3	2.8	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week	95.8	64.7	61.3	41.3	45.8	63.9	17.9	59.3	84.9	5.3	21.1	4.3	2
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	96.3	68	57.1	42.4	45.7	57.2	16.8	68.4	84.5	5.4	20.9	3.8	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week	94.8	62.8	75.5	40.7	40.8	99.6	22.5	61.5	72.8	4.4	22.3	7.4	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	95.2	66.8	71.5	41.9	40.7	92.8	21.5	70.8	72.5	4.7	22.1	6.9	6
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	93.8	64.1	53.1	40.8	36.3	58	16.3	69	50.1	5.2	17.5	2.8	2



Food-based recommendations	% RNI											Cost/day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	92.2	72.8	61.1	42.7	46.9	63.9	13.3	68.7	84.3	6.3	21.7	4.4	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	91.1	68.2	74.8	41.4	41.9	99.5	17.9	70.4	72.1	5	22.9	7.4	6
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week	64.8	72.6	63.6	44.6	44.6	63.9	17.2	56.2	85.7	7.3	22	4.3	2
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	65.2	76.6	59.6	45.9	44.4	57.1	16.2	65.5	85.3	7.6	21.8	3.8	4
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week	63.8	71.9	78.6	44.5	39.6	99.6	21.9	59	73.7	6.7	23.2	7.4	4
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	64.2	75.9	74.6	45.8	39.5	92.8	20.9	68.3	73.3	7	23	6.9	5
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	62.8	73.5	56.5	44.9	35	58	15.7	66.8	51.1	7.5	18.4	2.9	2
ICDS FBRs - Wheat flour - 2x/day - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	73	78.9	63.5	45.8	46.5	63.9	13.9	67	85	7.9	22.7	4.5	4

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Wheat flour - 2x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	60.1	77.3	77.8	45.3	40.7	99.5	17.3	67.9	72.9	7.3	23.8	7.4	5
ICDS FBRs - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	65.8	73.2	63.2	43	48.3	63.9	17.1	70.6	85.6	6.8	21.8	4.4	4
ICDS FBRs - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	64.2	67.9	76.9	41.4	42.8	99.6	21.7	71.3	73.3	5.4	23	7.4	5
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week	95.8	73	63.7	45.3	45.8	63.9	18	59.9	85.7	7.3	22.1	4.3	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Red kidney beans - 4x/week	96.3	77	59.6	46.5	45.7	57.2	17	69.2	85.4	7.6	21.8	3.8	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week	94.8	72.4	78.6	45.2	40.8	99.6	22.7	62.7	73.7	6.7	23.3	7.4	5
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Red kidney beans - 4x/week	95.2	76.3	74.6	46.5	40.7	92.8	21.7	72.1	73.4	7	23	6.9	6

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	93.8	74	56.5	45.7	36.3	58	16.5	70.7	51.1	7.5	18.4	2.9	3
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	92.3	78.9	63.5	46.1	46.9	63.9	13.9	68.8	85	7.9	22.7	4.5	4
<b>ICDS FBRs - Vitamin C-rich fruit- 1x/day- Wheat flour - 2x/day - Yogurt - 1x/day - Buffalo milk-2x/day - Red kidney beans - 4x/week (i.e. s-FBRs)</b>	<b>82.9</b>	<b>90.7</b>	<b>99.7</b>	<b>48.4</b>	<b>60.2</b>	<b>111.5</b>	<b>28.8</b>	<b>80.5</b>	<b>113</b>	<b>8.9</b>	<b>29.9</b>	<b>10.6</b>	<b>6</b>
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	91.1	77.8	77.9	46	41.9	99.5	18.1	71.6	72.9	7.3	23.9	7.4	6
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	96.3	73.2	63.2	43.4	49.1	63.9	17.9	73.6	85.6	6.8	21.8	4.4	4
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	95.2	68.3	76.9	42	44.1	99.6	22.5	75	73.4	5.4	23	7.4	6
ICDS FBRs - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	64.2	77.4	79.9	45.9	42.8	99.6	21.9	72.5	74.2	7.6	23.9	7.4	5

Food-based recommendations	% RNI											Cost/ day (INR)	# of nutrients for which FBRs meet ≥65% RNI
	Vitamin								Ca	Fe	Zn		
	C	B-1	B-2	B-3	B-6	B-12	A RE	Folate					
ICDS FBRs-Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Yogurt - 1x/day - Egg - 2x/week - Red kidney beans - 4x/week	95.2	77.9	80	46.6	44.1	99.6	22.7	76.3	74.2	7.6	24	7.4	6
ICDS FBRs - Vitamin C-rich fruit - 1x/day - Wheat flour - 2x/day - Green leafy veg - 1x/day - Buffalo milk - 2x/day - Egg - 2x/week - Red kidney beans - 4x/week	95.9	79.1	66.8	46.7	49	63.8	23.2	76.9	86.3	9.9	22.8	4.6	5

## **4. CAN LOCAL FOOD-BASED RECOMMENDATIONS IMPROVE INFANT DIETARY INTAKE? FORMATIVE RESEARCH TO FINALISE MESSAGES FOR PROMOTION IN A MHEALTH INTERVENTION**

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### **PREFACE**

The article in the previous chapter presented findings from Optifood analyses showing that that 7 of the 11 micronutrients modelled were absolute “problem nutrients.” Module 2 and 3 analyses in Optifood identified s-FBRs, a set of FBRs based on strengthening existing FBRs by emphasizing: (i) vitamin-C rich fruits; (ii) yogurt; (iii) buffalo milk; (iv) wheat flour; and (v) kidney beans.

The research paper presented in this chapter presents findings from a formative research study assessing the feasibility and acceptability of s-FBRs in a week-long community-based study in the study setting. This study tested s-FBRs with mothers of young infants and identified barriers and facilitating factors for their future promotion in a community-based pilot mHealth intervention to improve infant CF practices.



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**3. For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper.**

I designed the study with the co-authors of this paper. I drafted the data collection instruments and revised them based on inputs from all co-authors. I collected the data for this paper along with Sarmila Mazumder and local research team members. I did all of the data analysis with advice from Elaine Ferguson, Sarmila Mazumder and Sunita Taneja. I wrote the first draft of the article. All co-authors provided comments on the draft article, many of which I incorporated during revisions to the article.

**NAME IN FULL** (Block Capitals): NEHA SONA SINGH

**STUDENT ID NO:** 237561

**CANDIDATE'S SIGNATURE**

**Date:** 4 June 2014

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**SUPERVISOR'S SIGNATURE**

## **MANUSCRIPT**

### **TITLE**

Can local food-based recommendations improve infant dietary intake? Formative research to finalise messages for promotion in an intervention to improve complementary feeding practices of 9-11 month old infants in rural Haryana State, India

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### **SOURCE OF SUPPORT**

UBS Optimus Foundation

### **LIST OF ABBREVIATIONS**

CF: complementary feeding  
FBR: Food-based recommendation  
ICDS: Integrated Child Development Services  
IQR: interquartile range  
NFHS: National Family Health Survey  
PHC: primary health centre  
TIPs: Trial of Improved Practices

### **CLINICAL TRIAL REGISTRY INFORMATION**

The study is registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) with the identifier number NCT01646710.

## **ABSTRACT AND KEY WORDS**

**Background:** India is home to the largest number of underweight and stunted children in the world. A key strategy to improve complementary feeding (CF) practices includes developing a set of specific and feasible food-based recommendations (FBRs) that focus on local foods and are developed to address barriers to mothers feeding nutrient-rich foods.

**Objectives:** (1) To assess mothers' and infants' adherence to a set of FBRs over a one week period; (2) to identify barriers and motivating messages to aid with promotion of these FBRs; and (3) to assess infants' energy and nutrient intakes and dietary diversity at baseline and on the last day of the one week trial period .

**Methods:** FBRs were tested over a 1-week period with 36 randomly selected mothers of infants aged 9-11 months in April 2012. 24-hour dietary recalls and structured open-ended questionnaires assessing adherence to FBRs and barriers to following them were collected at baseline. Structured open ended questionnaires were collected on days 1, 3 and 8 of the one week trial to assess the mother's experience. 24-hour dietary recalls were collected again on day 8 of the one week trial period.

**Results:** Results showed significant increases ( $p<0.05$ ) compared to baseline in the proportion of mothers feeding their infants legumes, vegetables and fruit at endline, but no significant increases in the proportion of mothers feeding their infants grains, dairy products, fats or egg. Mothers reported 19 barriers to following promoted FBRs, which were used to develop motivating statements for future promotion of the FBRs. These barriers related to CF quantities, variety, textures, digestibility, cost, availability, and accessibility, and traditional and religious beliefs. Study findings also showed significant increases ( $p<0.05$ ) in dietary intakes of energy and 13 nutrients, and in infant diet diversity before and after the study but no significant changes in dietary nutrient densities.

**Conclusion:** Most mothers were able to adhere to a set of FBRs promoting multiple food groups, which resulted in significant increases in their infants' intakes of energy and nutrient and diet diversity compared to baseline. Further research over a longer period of time is needed to assess maternal willingness and feasibility to implement FBRs in the long-term.

**Key Words:** complementary feeding, counselling, infant nutrition, formative research



## INTRODUCTION

One third<sup>1</sup> to one half<sup>2</sup> of deaths in children under the age of five can be attributed to undernutrition. Growth during infancy and childhood depends on birth weight, adequacy of infant feeding and absence of infection. Late introduction and inadequate quantity of complementary foods, coupled with an increase in morbidity, lead to increased rates of underweight and stunting after 6 months of age.<sup>1,3</sup> Early child undernutrition has long-term and irreversible effects on income, educational attainment, adult height, and birth weight of subsequent offspring.<sup>4</sup>

India is home to the largest number of underweight and stunted children in the world. The most recent data from the third National Family and Health Survey (NFHS) shows that despite national information, education and communication efforts on the need for timely introduction of complementary food, infants under the age of two years living with their mothers in India have poor complementary feeding (CF) practices.<sup>5</sup> Compared with existing national recommendations, only 21 percent of all children aged 6-23 months are fed according to the recommended appropriate feeding practices.<sup>5</sup> NFHS data show a steep increase in the prevalence of underweight from 15.4 % at less than 6 months to 52.6 % in the infants aged 12-23 months,<sup>5</sup> signalling the need for CF interventions within the first year of a child's life to improve nutritional status.

A core set of principles recently developed to improve programs and interventions that promote healthy child growth and development emphasise the importance of developing evidence-based, context-specific and feasible messages for promotion with target populations.<sup>6</sup> A key principle of CF program implementation includes developing a set of specific and feasible action-oriented food-based recommendations (FBRs) that focus on local foods, including animal source foods, and are developed to address barriers to mothers feeding nutrient-rich foods.<sup>6</sup> It is known that socio-environmental barriers such as poverty, education, mothers' workload and access to food influence mothers' abilities to adopt CF practices recommended by the World Health Organisation's Global Strategy for Infant and Young Child Feeding.<sup>7</sup> As a result, strategies to improve CF often address commonly known barriers to implementing FBRs such as food availability, affordability and accessibility. However, it has been shown that CF practices influenced by traditional beliefs or socio-environmental contexts can also be improved.<sup>8,9</sup> To date, there is no published literature identifying complex barriers to CF relating to traditional, religious or socio-cultural factors in India. Engle emphasises the importance of incorporating local beliefs and traditional practices

related to infant feeding into CF programming strategies, and identifies the need for formative research to identify regional and traditional beliefs to explain barriers to and variations in CF practices in India.<sup>10</sup>

We aimed to design and pilot test an mHealth counselling intervention to improve CF practices of 9-11 month old infants in Haryana State, India. Community-based formative research to finalise the study design and mobile phone components of the intervention are described elsewhere (Chapter 5). Initial content of FBRs to be tested with mothers were developed in a previous study using the novel Optifood tool, which takes into account the nutritional needs of 9-11 month old infants and local food patterns, cost and availability (Chapter 3). This study aimed to test the set of FBRs with mothers of young infants and to identify barriers and facilitating factors for their promotion in the intervention. Specific objectives were to: (1) assess mothers' and infants' adherence to FBRs during the trial; (2) identify barriers and motivating messages to aid with promotion of FBRs; and (3) assess infants' energy and nutrient intakes and dietary diversity before and after a week-long community-based trial.

## **MATERIALS AND METHODS**

### **Study Setting**

The study took place in the Kheri Kalan Primary Health Centre (PHC) in Haryana state, India. Kheri Kalan PHC consists of 6 subcenters, each with a population of about 5000. Literacy in the population is low – 15% of men and 50% of women have never attended school. Nearly 40% of under-five children in this area are underweight, and 46% are stunted.<sup>5</sup> The majority of households in Haryana (88.3 percent) practice Hinduism, whereas 6.4 percent of households are Muslim, and 5 percent of households are Sikh.<sup>5</sup> Women's autonomy in the household in Haryana is also low, with 38.4 percent of married women reporting usually participating in household decisions.<sup>5</sup>

### **Study Design and Participant Selection**

FBRs developed in a previous study (Chapter 3) were modified and tested over a 1-week period in April 2012 with 36 randomly selected mothers of infants aged 9-11 months. These FBRs were modified to test the feasibility and acceptability of promoting green leafy vegetables and egg, two rarely consumed nutrient-dense foods (Chapter 3), within its existing FG-level FBRs promoting vegetables and animal source foods, respectively. Appendix A describes the seven FBRs tested in this study.

The number of participants selected for this study was based on Trial of Improved Practices (TIPs) guidance and a similar study in Indonesia.<sup>11, 12</sup> Mother-infant dyads were randomly selected from the study site's (Figure 1) from a list of infants aged 9-11 months created from governmental birth registers and then physically verified at the household level for eligibility. Six infants were randomly selected from each of the 6 subcenters through a computer generated random number list in Stata 11 software (n=36). Infants were excluded if (i) they no longer lived in the study area; (ii) their mothers were planning on travelling during the pilot study period; (iii) their address was misclassified in the governmental birth register so they were not living in the study area (iv) they were hospitalised due to illness; or (v) they were not 9-11 months old because the date of birth was recorded inaccurately in the birth register.

Evaluation methodology was based on the ProPAN approach,<sup>13</sup> with one modification of using the TIPs<sup>14</sup> method of testing multiple instead of individual FBRs with each mother. In brief, the study team introduced FBRs to mothers in their respective homes with the help of pictorial cards (Appendix A), and gave them 7 days to implement them with their infants. Mothers' initial impressions of the FBRs and the feasibility of adopting them were assessed in an interview on the first visit (Day 1). The study team reinforced FBRs with mothers on Day 3 and Day 8 of the study, and assessed their impressions of the FBRs and feasibility of long-term practice via interviews. Mothers' impressions of FBRs in each home visit were recorded in interviewer-administered structured qualitative questionnaires, with the aim of identifying barriers and developing motivating statements to aid in the promotion of FBRs. The study team developed motivating statements for known barriers to infant feeding prior to the study, which they tested during the week-long trial. Motivating statements for overcoming new barriers identified during the study were developed by collaborating with local experts, and further tested with mothers during the study period. Infant dietary intakes were also assessed at baseline and at endline, i.e. Day 8 of the intervention, using an interactive 24-hour recall.

The primary outcomes of the study were to assess maternal willingness to follow FBRs and to identify barriers to their adoption and motivating statements for their promotion. Secondary outcomes of the study included changes in reported infant diet before and after the testing of the FBRs.

Ethics approval for the study was obtained from the London School of Hygiene and Tropical Medicine Research Ethics Committee and the Centre for Health Research and Development, Society for Applied Studies Ethics Review Committee in India. All participants gave written

informed consent if literate. Thumb impressions with signatures of impartial witnesses were obtained from illiterate participants prior to enrolling.

### **Data Collection Methods**

Each interview was conducted in a private setting in the mothers' homes and lasted about 45 minutes. Mothers' responses to the structured open-ended questionnaires were both recorded by interviewers in the questionnaire and recorded using a digital recorder. Trained study team members (n=6) who were fluent in local languages asked these structured questions on the reported adherence to, feasibility and acceptability of FBRs, barriers to their use and potential ways to change them.

Dietary data were collected on the same day of the week at both baseline and endline. Infant dietary intakes were assessed using an interactive two-pass 24-hour recall<sup>15</sup> (Appendix B) administered by trained study team members (n=6). In the first pass, interviewers asked mothers to recall all food and beverages consumed by their child in the past 24 hours starting from the first item the child consumed on the previous day. In the second pass, interviewers asked mothers to estimate the amount of each food or beverage consumed by showing the total volume, in water, of the item in the utensil used to feed the child and the volume leftover. The volume consumed by the child was recorded in the 24-hour recall form by subtracting the volume leftover from the total amount in the child's utensil. Foods that were not measured in volumes were recorded in the quantity consumed by the infant, e.g. half a banana.

The nutrient contents per 100g for each food were mainly obtained from the National Institute of Nutrition's Nutritive Value of Indian Foods FCT<sup>16</sup>, though missing foods or nutrient values from this source were obtained or imputed from the United States Department of Agriculture (USDA) National Nutrient Database for Standard Reference, Release 23<sup>17</sup>. Indian FCT values for raw foods were also adjusted for cooking losses, where appropriate, using USDA retention values<sup>18</sup>.

Sociodemographic data were also collected from mothers at baseline. At the end of the study, each infants' nude weight was measured in duplicate (Samso Suspension Weighing Scales; precision  $\pm 100\text{g}$ ).

## **Data Analysis**

### ***Data analysis of Questionnaire***

The lead author checked data from structured qualitative interview forms against audio files of the same interview for consistency. “Yes” or “No” responses related to each promoted FBR in the structured qualitative questionnaires administered on Day 3 and Day 8 of the study were reviewed to assess mothers’ reported adherence to and willingness to try FBRs on Day 1-3 and Days 4-7.

Qualitative data were used to identify the range of mothers’ attitudes toward the feasibility and acceptability of following each FBR promoted, and to identify perceived barriers and motivating factors for their adoption. Two study team members with extensive experience and knowledge of implementing FBRs with mothers in the study area independently listened to digital interview files and reviewed responses to the open-ended questionnaire to identify a list of barriers and develop motivating statements relating to the FBRs. The wording of motivating statements from both lists was integrated to reflect all strategies used to promote FBRs with mothers. This final list of barriers and motivating statements were used to promote FBRs in the mHealth study.

### ***Dietary Data Analysis***

In order to estimate total energy and nutrient intakes for each child, portion sizes for all foods consumed by each child were converted to grams using standard conversion factors for household measures based on national guidelines, which were developed for a previous study in the study setting.<sup>19,20</sup> To calculate nutrient densities at baseline and endline for each child, individual nutrient intake values from CF were divided by the total energy intake from CF and multiplied by 100. Nutrient densities were evaluated using the mean of Vossenaar’s reported desired nutrient densities for male and female infants aged 9-11 months of 50<sup>th</sup> percentile body weight.<sup>21</sup> We used Vossenaar’s values for desired nutrient densities instead of the WHO values since Indian diets have low iron and zinc bioavailability,<sup>22</sup> and Vossenaar takes low bioavailability into account for these nutrients, whereas WHO values for iron and zinc are based on moderate bioavailability.<sup>23</sup> Additionally, Vossenaar uses smaller infant body weight than the WHO to estimate average daily energy requirements used in calculations of desired nutrient densities. Indian infants living in Haryana State are similar to body weights used in the Vossenaar study.<sup>5,24</sup> Nutrient densities at baseline and endline were compared to Vossenaar’s average desired nutrient densities and classified into the following four categories: (i)  $\geq 100\%$ ; (ii)  $>80\%$ ; (iii) 50-80%; and (iv)  $<50\%$ . These categories were selected to distinguish nutrients

that were more likely to be problem nutrients, since a nutrient has a higher chance of being a problem nutrient in infant diets the further below it is from the desired nutrient density.

The WHO indicator for minimum dietary diversity was used to assess the proportion of infants who consumed foods from 4 or more food groups.<sup>25</sup> Infant dietary diversity was assessed according to whether a food was eaten once from the following food groups: (i) grains, roots and tubers; (ii) legumes and nuts; (iii) dairy products; (iv) flesh foods; (v) eggs; (vi) vitamin-A rich fruits and vegetables; and (vii) other fruits and vegetables. The percentage of infants meeting minimum dietary diversity at baseline and endline was calculated by dividing the number of infants who consumed foods from at least 4 food groups during the previous day by the total number of infants in the study times 100. WHO recommends using the cut-off of least 4 food groups because it is associated with better quality diets for both breastfed and non-breastfed infants.<sup>26</sup>

Weight-for-age (WAZ) Z-scores of infants at baseline were calculated in Stata 11 software (zscore06 module) using the 2006 WHO child growth standards<sup>27,28</sup> Infants were classified as underweight if their weight-for-age Z score was less than -2 SD.

### ***Statistical Analysis***

All quantitative data were double entered and data entry errors were identified using range and consistency checks. Data were transferred to Stata 11 software for analysis after being cleaned. The distributions of variables were checked for normality to determine whether parametric or non-parametric tests should be used in the analyses. Paired t-tests or Wilcoxon's signed rank sum test (for non-normally distributed variables) were used to evaluate differences in energy and nutrient intakes for protein, fat, calcium, thiamine, riboflavin, niacin, folate, vitamin B6, vitamin B12, vitamin C, vitamin A Retinol Equivalents (RE), iron and zinc. McNemar's test was used to evaluate differences in proportions of mothers reporting adherence to FBRs at baseline and endline. Differences were considered significant at  $p < 0.05$ .

## **RESULTS**

Of the 220 infants aged 9-11 months identified in the study site, 176 infants were eligible for enrolment in the pilot study after physical verification at the household level. Thirty-six mother/infant pairs were randomly selected to participate in the study and all but 1 mother/infant pair were available for follow up at the end of the week-long study period. Sociodemographic, anthropometric and household characteristics of participants are described

in Table 1. The majority of infants in the study were breastfed, and 1 in 5 infants were underweight ( $< -2$  WAZ). Over 60% of mothers could read ( $n=23$ ) and write ( $n=22$ ), and most of them (88.9%,  $n=32$ ) worked at home. Over 40% of fathers ( $n=15$ ) worked in private service, and less than 15% of them ( $n=5$ ) were farmers. Almost 70% of household ( $n=25$ ) used dung cakes as the main source of cooking fuel and loosely packed stone was the main materials of the majority of households (63.9%,  $n=23$ ).

At baseline, all mothers ( $n=36$ ) reported being willing to try the FBRs, with the exception of five or fewer mothers who reported they were unwilling to implement FBRs promoting vegetables, fruit or egg (Table 2). Over 90% of mothers reported implementing the FBRs during the week-long study period, with the exception of fewer than half of mothers (45.7%,  $n=16$ ) reporting feeding vegetables, and just over one third of mothers (37.1%,  $n=13$ ) reporting feeding egg to their infants. Compared to baseline, data from 24-hour dietary recalls at endline showed significant increases in the proportion of mothers who reported feeding legumes (17.1% vs. 45.7%,  $p<0.05$ ), vegetables (31.4% vs. 62.9%,  $p<0.05$ ) and fruit (5.7% vs. 40.0%,  $p<0.05$ ).

Qualitative data identified mothers' perceived barriers to implementing the promoted FBRs. These barriers related to traditional and religious beliefs as well as to CF quantities, types, textures, digestibility, cost, availability, and accessibility. These data were used to develop a list of 19 barriers and motivating statements to aid in future promotion of the FBRs, which are presented in Table 3. For example, mothers cited expense and sociocultural reasons such as religion, household restrictions on non-vegetarian food, and the belief that egg brings early onset menses if fed to female infants as barriers to feeding egg. Motivating statements for this barrier aimed to dispel the belief by explaining that eggs do not affect menstrual cycles, and that furthermore, they increase female infants' strength. Mothers reported lack of availability and higher cost in summer months (i.e. when the study took place) as barriers to feeding infants green leafy vegetables, but all mothers reported a willingness to feed green leafy vegetables when they are in season. One mother reported being unwilling to feed fruit to her infant due to its high cost. Mothers also reported that rice, bananas, yogurt and buttermilk could only be fed to infants in the summer since they are "cold" foods, and would cause illness if fed in the winter. Motivating statements for this barrier explained that foods do not cause illness, and that all foods are appropriate for infants to consume regardless of the season. Mothers also reported that legumes, undiluted milk and fats should not be fed to infants since they cannot be easily digested. Motivating statements for this barrier explained that these

foods provide energy to infants and satiate their hunger, and emphasised that infants are very active, and therefore able to digest all foods.

Compared to baseline, there were significant increases ( $p < 0.05$ ) in energy and 13 nutrient intakes at endline (Table 4), which were associated with significant increases ( $p < 0.05$ ) in median (IQR) energy intakes from legumes, sugars, vegetables, dairy and fruit. Dairy products, sugar and grains contributed the most to these energy increases, though the difference in energy contribution from grains is not significant ( $p > 0.05$ ) (Table 5). Grain products were the largest contributor to energy intake from CF at baseline (20.8%), and dairy products were the largest contributor to energy intake from CF at endline (23.9%).

Table 4 compares computed median nutrient densities at both baseline and endline to average desired nutrient densities for infants with an assumed body weight 50<sup>th</sup> percentiles defined by Vossenaar<sup>21</sup>. Eight out of 12 nutrients examined at baseline and endline were below 100% of the average desired nutrient densities, with the exception of vitamin B12, protein, calcium, and riboflavin. Values for vitamin C, vitamin A RE, vitamin B6, thiamine, niacin, iron and zinc were below 50% of desired average nutrient densities. With the exception of vitamin B6 and folate, differences in all nutrient densities were not significant when comparing baseline and endline nutrient densities.

Compared to baseline, there was a significant increase ( $p < 0.001$ ) in the minimum dietary diversity of breastfed infants in the study ( $n = 33$ ). Specifically, 6.1% of infants ( $n = 2$ ) at baseline reported consuming foods from at least 4 food groups in the previous day, whereas the proportion of infants achieving minimum dietary diversity increased to 57.6% at endline ( $n = 19$ ).

## **DISCUSSION**

Overall, the study showed significant increases ( $p < 0.05$ ) compared to baseline in the proportion of mothers feeding their infants legumes, vegetables and fruit in the 24-hour dietary recall day at endline, but no significant increases in the proportion of mothers feeding their infants grains, dairy, fats or egg. Mothers reported 19 barriers to following promoted FBRs, which were used to develop motivating statements for future promotion of FBRs. These barriers related to CF quantities, variety, textures, digestibility, cost, availability, and accessibility, and traditional and religious beliefs. Study findings also showed significant



increases ( $p < 0.05$ ) in dietary intakes of energy and 13 nutrients, and the diversity of diets before and after the study but there were no significant changes in dietary nutrient densities.

Study results suggest that mothers' willingness to try all FBRs at the start of the study led to significant increases in feeding legumes, vegetables and fruit to infants, but resulted in no significant increases in grains, dairy, added fats and egg. However, a limitation of the 24-hour dietary recall is that a one-day record may be insufficient to provide estimates of habitual dietary intake. It is plausible that the study may have underestimated mothers' adherence to feeding egg or legumes, since they are not daily recommendations. About three quarters of mothers reported feeding grains, dairy and added fats to infants at baseline, but less than one third of mothers were feeding legumes, vegetables and fruit before the study. The consumption of legumes, vegetables and fruit increased significantly once study team members promoted these FBRs with mothers using the motivating statements, and reinforced them in the Day 3 visit during the study. These increases in legume, vegetable and fruit consumption signal improvements in intakes of nutrient dense foods that were not being consumed by the majority of infants at baseline.

The discrepancy in the proportion of mothers reporting feeding vegetables in the 24-hour dietary recall on Day 8 at endline compared to during the weeklong study period (62.9% vs. 45.7%) is potentially explained by a miscommunication of the question asking mothers if they fed any vegetables to infants during the week. Since this FBR promotes all vegetables but emphasises green leafy vegetables in particular, it is possible that mothers only reported whether they fed green leafy vegetables during the week. This would explain why 24-hour recall data show that a higher proportion of mothers fed vegetables at endline compared to the proportion of mothers reporting feeding vegetables during Days 1 to 8, or throughout the study period.

Qualitative data from mothers identified well-documented barriers to promoting FBRs related to affordability, availability, accessibility, religious beliefs and "hot" and "cold" foods, which are consistent with barriers reported in other literature.<sup>10</sup> Mothers reported difficulty in buying green leafy vegetables in the summer months, when the study took place, since they were out of season and therefore difficult to obtain and more expensive to buy in the study site. However, mothers reported having no issues with feeding green leafy vegetables in winter months when they were in season. Mothers also reportedly favoured feeding lentils to infants instead of chickpeas or kidney beans, since these legumes cost more to buy in the market and

take more fuel to cook at home. Many mothers reported not being able to bring egg into their homes or to feed them to their infants since eggs are considered a non-vegetarian item and most households in the study were Hindu and observed vegetarian diets. Maternal beliefs related to “hot” and “cold” foods also played a role in the implementation of FBRs related to rice, bananas, yogurt and buttermilk. Mothers reported that these foods are “cold,” so can be fed in summer months but not in winter months without making infants ill. Although motivating statements aimed to dispel beliefs around “hot” or “cold” foods, these traditional beliefs underscore the important role that seasonality and traditional beliefs play in promoting FBRs in the study setting.

Other less well-documented barriers to adopting FBRs related to mothers’ sociocultural beliefs previously unreported in literature. Mothers reported that eggs should not be fed to female infants since it makes them menstruate early. This belief, coupled with religious restrictions may explain why only 86.1% of mothers reported being willing to feed eggs to infants during the study period. Study team members aimed to dispel these views by using motivating statements emphasising the nutritional benefits of eggs and promoting them as special items for infants to consume outside the house. Despite these strongly held traditional beliefs, 37.1% of mothers reported feeding egg to their infants during the study period. These findings suggest that some mothers can overcome religious and cultural restrictions with the help of the targeted motivating statements. Nonetheless, these findings also signal the need to promote alternative and more acceptable foods with similar nutritional value to eggs for mothers who retain their religious and cultural beliefs.

Additional perceived barriers to CF undocumented in previous literature relate to the digestibility, variety and quantity of foods. Some mothers reported that legumes, undiluted milk and fats cannot be fed to infants due to trouble with digestion, even though these are common foods in households in the study site. Motivating statements developed to address this barrier assured mothers that children gain energy from these foods, and that they are able to easily digest them when they are active and playing after eating. Significant increases at endline, compared to baseline, in legume consumption and nutrient density of folate in infant diets suggest that these motivating statements helped mothers to overcome their beliefs that infants cannot digest certain foods. These results signal a behaviour change strategy that may be useful in future CF programs and research to aid in overcoming similar maternal beliefs. Mothers’ reports that infants should also not be fed a wide variety or quantity of foods correspond with NHFS data from Haryana state reporting that for 9-11 month old breastfed

infants, only 18.1% of infants are fed from 3 or more food groups, 15.1% of infants are fed the minimum number of recommended times (i.e. 3 times/day), and 5.0% of infants are fed from 3 or more food groups and the minimum number of recommended times per day.<sup>5</sup> These beliefs may also explain low infant dietary intakes of legumes, vegetables, fruit and eggs at baseline. Motivating statements were successful in addressing mothers' traditional views on appropriate quantity and variety of foods for infants, since there were significant increases in minimum dietary diversity at endline compared to baseline. Moreover, FBRs promoted in the study may have a positive impact on infant growth, since previous research in India has shown that achieving minimum diet diversity for children 6-23 months of age is most strongly and significantly associated with HAZ, WAZ, stunting and underweight ( $p < 0.05$ ).<sup>29</sup>

Legumes, vegetables, dairy and fruit contributed to significant increases ( $p < 0.05$ ) in energy and nutrient intakes compared to baseline. However, except for folate, the nutrient densities of these diets did not significantly increase from baseline. At both baseline and endline, 8 out of 12 nutrients were below 100% of the average desired nutrient densities. The nutrient densities of only protein, calcium, riboflavin and vitamin B-12 were greater than 100% of the desired levels throughout the study.

The significant increases in energy intakes from CF reported at endline compared with baseline are a concern because the energy intake from CF at endline might have displaced breastmilk intake. The total median energy intake from CF at endline was assessed at 456 kcal/day, which is 149 kcal higher than the World Health Organisation's recommended average energy intake of 307 kcal/day from CF for 9-11 month old breastfed infants in lower- and middle-income countries.<sup>7</sup> Given that 40% of under-five children in this area are underweight, 46% are stunted, and 30% are wasted,<sup>5</sup> it is possible that some of the excess energy intake from CF in this study was used to support energy requirements for catch up growth. According to FAO, UNU and WHO guidelines, infants aged 9-11 months require an extra 58.3 kcal/day to allow for twice the normal growth rate.<sup>30</sup> Taking this excess energy for catch up into account, infants in the study still apparently consumed an excess of 90.7 kcal/day from CF at endline.

Study results suggest that undiluted milk contributed to the largest proportion of energy intake from CF at endline. Increase in undiluted milk may account for the increase in energy intake from sugar at endline (19.0 kcal vs. 32.2 kcal,  $p = 0.01$ ), since mothers in this area often sweeten milk with sugar. An alternative explanation for high energy intakes is reporting bias in 24-hour dietary recalls at endline. Mothers may have over-reported feeding certain foods to

their infants or overestimated portion sizes when interviewed by researchers. Based on these results, it is debatable whether undiluted milk should be promoted in this setting if it contributes to excess energy from CF. The rationale for continuing to promote undiluted milk is to reduce risk of contamination by the water mothers add to diluted milk in the study setting. Ten percent of children under 5 years of age reportedly had diarrhoea in the two weeks preceding the 2005-2006 National Family Health Survey survey, indicating that diarrhoea is common among young children in this study setting.<sup>5</sup>

Despite significant increases in energy and nutrient intakes compared to baseline, findings from this study signal the burden of nutrient deficits experienced by infants in the study. Nutrient densities for vitamin C, thiamine, niacin, vitamin B-6, vitamin A RE, iron and zinc met less than 50% of desired average nutrient densities in infant diets, suggesting that it might not be possible to meet recommended nutrient intakes for these nutrients with a local food-based strategy. It is unsurprising that nutrient densities for protein, calcium, riboflavin and vitamin B-12 met or exceeded the desired nutrient density values, since dairy products contributed the most energy to infant diets at endline. Despite increases in achieving minimum dietary diversity at endline, the study did not significantly increase nutrient densities of infant diets except for folate, which is expected due to significant increases in legume intakes at endline.

This study has several strengths. The week-long trial was based on established ProPAN methodology,<sup>31</sup> and used both qualitative and quantitative methods to assess the feasibility and acceptability of FBRs. Qualitative data allowed the study team to understand barriers to implementation of FBRs, and to develop motivating statements to aid in future promotion of the FBRs by increasing mothers' motivation, knowledge and capabilities related to CF. In addition, study participants were randomly selected, thus reducing selection bias and increasing generalisability of study findings to the study site.

Although most mothers reported implementing FBRs in the trial, the study period was only one week long so adherence to CF practices may diminish over a longer time period. Response bias also may have resulted in mothers over-reporting their willingness to try and adherence to FBRs. However, we expect response bias to be relatively low because interviewers in the study aimed to ask mothers for their insights into which FBRs were feasible and which ones were not, rather than promoting all FBRs despite maternal views. The small sample size of the study (n=36) also limits the power of the study to analyse changes compared to baseline. The set of FBRs were only tested in one season (i.e. summer), so it is unknown if mothers would have

encountered additional barriers to implementing them during other seasons. In addition, study findings cannot be generalised to other areas because these FBRs were developed for a specific population and only tested in one rural area of a district in a Northern Indian state.

Overall, study results suggest that it is possible to increase mothers' adherence to a set of FBRs promoting multiple food groups, and to significantly increase infants' energy and nutrient intakes compared to baseline. The study showed increases in minimum dietary diversity and the quantity of CF intake over one week, suggesting that it is possible for FBRs promoting local foods to have an impact on infant diets. The study also identified previously unreported barriers to feeding infants CF that aid in promoting FBRs in future CF interventions in similar settings. Further research over a longer period of time is needed to assess the feasibility of following these FBRs and maternal willingness to implement them in the long-term.

### **KEY MESSAGES**

1. It is possible for most mothers to adhere to a set of FBRs promoting multiple food groups, and to significantly increase infants' energy and nutrient intakes over a week-long period compared to baseline; however, with the exception of vitamin B6 and folate, no significant differences in nutrient densities were observed when comparing baseline and endline nutrient densities.
2. Increases in minimum dietary diversity and the quantity of CF intake over one week suggest that it is possible for FBRs promoting local foods to have an impact on infant diets.
3. Previously unidentified barriers to CF and corresponding motivating statements relating to CF digestibility, variety and quantity can aid in promoting FBRs in future CF interventions.

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### **CONFLICTS OF INTEREST**

The authors declare that they have no conflicts of interest.

## **CONTRIBUTIONS**

All authors designed the study. ELF and ST advised on the statistical analysis plan. NSS and SM conducted research with oversight from CF, NB, ST and ELF. NSS and SM analysed data with guidance from ELF and NB. NSS wrote drafts of the paper and ELF, SM, ST, NC and CF commented on the drafts of the paper. All authors read and approved the final manuscript.

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## TABLES

**Table 1: Sociodemographic, anthropometric and household characteristics**

n	n=36
Infant age (months), mean (SD)	10.3 (0.7)
Sex of infant – female, <i>n (%)</i>	15 (41.7)
Proportion of infants breastfed, <i>n (%)</i>	33 (91.7)
Infant weight in kilograms at endline (n=35), mean (SD)	8.0 (0.9)
WAZ at endline (n=35), mean (SD)	-1.1 (0.9)
Proportion of infants < -2 WAZ at endline (n=35), <i>n (%)</i>	7 (20.0)
Mother's age, mean (SD)	24.1 (3.2)
Mother's marital status, <i>n (%)</i>	
Married	36 (100.0)
Years of education completed, mean (SD)	6.5 (4.4)
Mothers who can read and write, <i>n (%)</i>	
Can read	23 (63.9)
Can write	22 (61.1)
Involved in income-generating activities, <i>n (%)</i>	4 (11.1)
Work away from or regularly leave the home at any time during the day, <i>n (%)</i>	4 (11.1)
Total number of household members, mean (SD)	8.4 (3.5)
Proportion of households with children <5 years of age, <i>n (%)</i>	
1-2 children <5 years of age	24 (66.7)
3-5 children <5 years of age	11 (30.6)
≥ 6 children <5 years of age	1 (2.8)
Father's age, mean (SD)	27.3 (4.5)
Occupation of father, <i>n (%)</i>	
Government service	2 (5.6)
Private service	15 (41.7)
Daily wage	4 (11.1)
Self-employed	6 (16.7)
Farming	5 (13.9)
Unemployed	2 (5.6)
Student	2 (5.6)
Years of education completed by father, mean (SD)	9.7 (3.7)

Annual household income in Indian Rupees, median (IQR)	120000 (56400-196000)
Household religion, <i>n (%)</i>	
Hindu	34 (94.4)
Muslim	2 (5.6)
Households with electricity, <i>n (%)</i>	35 (97.2)
Main source of cooking fuel for household	
Natural gas	10 (27.8)
Wood	1 (2.8)
Dung cakes	25 (69.4)
Main material of household's roof, <i>n (%)</i>	
Loosely packed stone	23 (63.9)
Reinforced cement concrete	7 (19.4)
Roofing shingles	1 (2.8)
Calamine/cement/concrete	5 (13.9)
Toilet facility mother uses, <i>n (%)</i>	
Flush or pour flush toilet	23 (63.9)
Pit latrine	2 (5.6)
No toilet; i.e. uses open space or field	11 (30.6)

**Table 2: Mothers' reported adherence to and willingness to try food-based recommendations**

Food Group	Food-Based Recommendations <sup>b</sup>	Willing to try during study period, n(%)	Reported trying during study period, n(%)	Reported feeding at baseline, n(%)	Reported feeding on Day 7, n(%)
Grains	Give what is being made every day in the house (e.g. roti or rice or wheat vermicelli) at least twice per day. Of these, roti is especially beneficial for your child.	36 (100.0)	35 (100.0)	27 (77.1)	32 (91.4)
Legumes	Give lentils and beans (lentils or kidney beans or chickpeas) at least four times per week. Of these, kidney beans or lentils are especially beneficial for your child.	36 (100.0)	34 (97.1)	6 (17.1)	16 (45.7) <sup>a</sup>
Dairy	Give dairy products (yogurt or undiluted buffalo or cow or packet milk <sup>1</sup> or buttermilk) at least twice per day (or 6x/day if not breastfed). Of these items, undiluted buffalo milk is especially beneficial for your child.	36 (100.0)	32 (91.4)	26 (74.3)	32 (91.4)
Vegetables	Give vegetables at least once per day. Green leafy vegetables such as spinach, <i>bathua</i> (white goosefoot), fenugreek leaves or mustard leaves are especially beneficial for your child.	35 (97.2)	16 (45.7)	11 (31.4)	22 (62.9) <sup>a</sup>
Fruit	Give fruits at least once per day. Papaya, mango, guava or orange are especially beneficial for your child.	35 (97.2)	32 (91.4)	2 (5.7)	14 (40.0) <sup>a</sup>
Added fats	Add ghee or oil to food at least once per day	36 (100.0)	33 (94.3)	26 (74.3)	31 (88.6)
Egg	Give egg at least twice per week	31 (86.1)	13 (37.1)	0	2 (5.71)

<sup>a</sup>Significant change in proportions ( $p < 0.05$ ) using McNemar's test; <sup>b</sup>See Appendix A for specific foods and quantities promoted in the FBRs

**Table 3: Barriers and motivating statements to aid promotion of FBRs**

	<b>Barrier</b>	<b>Motivating Statement</b>
1.	Mother has stopped breastfeeding	Try to breastfeed your child until 2 years of age. If you have stopped breastfeeding for a short while (2 to 3 weeks ago), then try to initiate breastfeeding again
2.	I am pregnant, so cannot breastfeed my infant	You can still breastfeed while pregnant. You only need to eat a little more food so that you, your unborn child, and your child get enough nutrition.
3.	My infant cannot eat so much food	We know that mothers in this area believe that in order for children to grow, they require very little amount of complementary food. Mothers in this area do not actively feed children (and if the child eats on his/her own, s/he consumes very small quantities of food). This is why mothers in your area often feel that the child's stomach is full and s/he does not require additional food. However, if children are fed properly (e.g. if mother actively feeds the child with her own hand and encourages the child to eat while feeding), then they are actually able to eat a greater quantity of food. Keep the following tips in mind: <ul style="list-style-type: none"> <li>- Increase amount of food fed to child daily by 1 big spoon</li> <li>- Feed child food from a separate dish, and ensure that s/he eats all the food in the dish</li> <li>- If the child does not eat the food at one sitting, then make sure to feed him/her a few times throughout the day</li> </ul>
4.	If you feed an infant too much food, then it is not digested	Growing children need increasing amounts of food, and they are easily able to digest it as well. Children get diarrhoea when we do not wash our hands before feeding them, or when we feed them stale or food that is kept in the open, or has not been stored properly. Anyway, children in this area often get diarrhoea. However, if you feed the child yourself properly, then the child will not become weak – s/he will have satiety, will not be irritable, will sleep well, and not bother you while you work.
5.	I don't need to feed my child so often - when my child becomes a little older, then s/he will start eating on her/his own	If you start adding complementary foods to your child's diet after 6 months of age, then the child is strong and healthy, does not repeatedly fall ill, and does well in school later on. You should try to feed your child with your own hand, and with love and affection.
6.	If you feed the child too often, then he develops bad habits and starts asking for food repeatedly	At this age, children are very active and grow quickly. This is why they become hungry quickly if they are not fed the required amount of food for their age. This is also why they ask for food repeatedly, when you think they are developing bad habits. If you feed your child the recommended amount of food, then his/her stomach will be full and s/he will easily play, sleep and not bother you.
7.	My child does not eat; he	– This is common when a child is eating a new food. The child

	spits food out	<p>will develop a taste for new foods and start liking them if s/he is fed it for a few days</p> <ul style="list-style-type: none"> <li>– Try to feed your child playfully and with encouragement</li> </ul>
8.	If I feed my child grains, then his/her stomach will stick out	This only happens when children do not get complementary foods at the correct age, or when they are not given a balanced diet once they start eating complementary foods. When this happens, then the child's arms and legs become thin, and the stomach looks very big in comparison.
9.	Chickpeas, kidney beans, green leafy vegetables and grapes can get stuck in the child's throat	<ul style="list-style-type: none"> <li>– Thoroughly cook and lightly mash chickpeas and kidney beans before feeding to the child</li> <li>– Finely chop, thoroughly cook and lightly mash green leafy vegetables before feeding to the child</li> <li>– Lightly mash grapes before feeding to the child</li> <li>– Be sure to be near the child and supervising him/her when feeding</li> </ul>
10.	Green leafy vegetables are less available in the summers locally, and are available in the bigger vegetable markets that are farther away from the house. They are also more expensive in the summers.	<ul style="list-style-type: none"> <li>– Try to feed green leafy vegetables to children whenever you manage to get them. They are extremely beneficial for children.</li> </ul>
11.	Chickpeas and kidney beans create gas in the child's stomach	<ul style="list-style-type: none"> <li>– If food is freshly prepared and fed, then gas is not created in the stomach</li> <li>– Children are very active. They start playing after eating, and easily digest food.</li> </ul>
12.	We cook lentils at home, not chickpeas or kidney beans	Definitely continue feeding lentils to your child. Feed your child chickpeas and kidney beans whenever they are cooked in the house – try to cook chickpeas or kidney beans at least once per week. Feeding the child chickpeas and kidney beans makes your child stronger, more active, and gives his/her body the strength to fight illnesses.
13.	Rice, bananas, yogurt and buttermilk are "cold," so make the child ill	No foods items are "hot" or "cold." Children often have illnesses such as fever and cough. It is food that gives children the strength to fight illnesses.
14.	Children cannot digest ghee (clarified butter) or oil	Ghee and oil give growing children strength. Ghee and oil also make the food tastier, so the child eats more.
15.	Adding ghee or oil to the child's food makes the child's bones greasy/ stunts height/ solidifies in the child's body	<ul style="list-style-type: none"> <li>– Ghee and oil give strength to the child. Children are very active – they run around and play after eating, and easily digest food.</li> <li>– Ghee and oil only sit in one's body when the body is not active. For example, oil solidifies in a sewing machine if it is not used, but if a sewing machine is greased with oil and</li> </ul>

		used, it works very well.
16.	A child cannot digest milk that has not been diluted with water	Diluting milk with water makes it less nutritious. Children can easily digest undiluted milk. Drinking undiluted milk does not cause constipation or diarrhoea in children. Children often get diarrhoea if water mixed into milk have germs that go into their body and cause illness. Giving diluted milk makes the child's stomach full, but reduces the amount of nutrients that the child needs to grow well. Instead of water, mash <i>roti</i> (a whole wheat flatbread), rice, or bread into milk and give it to the child.
17.	We do not cook eggs in the house	<ul style="list-style-type: none"> <li>– Try to explain to your family members that eggs provide a lot of strength, from which children can grow well.</li> <li>– You can keep a separate pot in the house to prepare eggs, or buy it already prepared from the market</li> </ul>
18.	Children cannot digest eggs	<ul style="list-style-type: none"> <li>– Children are very active. After eating, they play and are able to digest foods easily.</li> <li>– Diarrhoea is caused by poor hygiene and sanitation. A child will not get diarrhoea if hands are washed when preparing and feeding food to the child.</li> </ul>
19.	Eggs should not be fed to girls since it makes them menstruate earlier than usual	Menstrual cycles start for each girl – some start their periods early, and some start them late. Feeding egg to girls does not in any way affect when a girl's menstrual cycle starts. In fact, egg increases strength.

**Table 4: Energy and nutrient intakes from CF and nutrient densities before and after the study (n=34)**

	Median (IQR) intake/day <sup>a</sup>		Nutrient Density (ND) of infant diets				Average desired ND for 9-11 month old infants <sup>c</sup>
			Baseline		Endline		
	Baseline	Endline	Median (IQR) ND/100 kcal <sup>b</sup>	Compared to average desired NDs	Median (IQR) ND/100 kcal <sup>b</sup>	Compared to average desired NDs	
Energy (kcal)	227.2 (142.2, 411.7)	456.0 (301.9, 550.5)	-	-	-	-	-
Protein (g)	5.6 (3.1, 10.0)	13.7 (8.1, 16.4)	2.88 (2.16, 3.39)	≥100%	3.00 (2.49, 3.43)	≥100%	1.7
Fat (g)	6.5 (4.7, 17.9)	15.6 (8.3, 18.7)	3.26 (2.31, 4.49)	-	3.57 (2.76, 3.94)	-	-
Calcium (mg)	152.1 (37.2, 363.2)	353.7 (191.9, 498.8)	75.11 (20.29, 114.68)	≥100%	81.39 (49.06, 109.04)	≥100%	69.6
Vitamin C (mg)	2.1 (0.3, 5.9)	4.1 (2.4, 11.5)	0.65 (0.15, 1.46)	<50%	1.06 (0.55, 2.53)	<50%	2.4
Thiamin (mg)	0.1 (0.1, 0.2)	0.2 (0.1, 0.4)	0.05 (0.03, 0.08)	<50%	0.05 (0.04, 0.06)	<50%	0.1
Riboflavin (mg)	0.1 (0.1, 0.5)	0.3 (0.2, 0.5)	0.06 (0.03, 0.12)	≥100%	0.06 (0.05, 0.09)	≥100%	0.1
Niacin (mg)	0.7 (0.5, 1.4)	1.6 (0.9, 2.7)	0.38 (0.27, 0.69)	<50%	0.39 (0.24, 0.57)	<50%	0.9
Vitamin B-6 (mg)	0.1 (0.0, 0.2)	0.2 (0.1, 0.3)	0.03 (0.02, 0.05)*	<50%	0.04 (0.04, 0.06)*	<50%	0.1
Vitamin B-12 (mcg)	0.1 (0.0, 0.5)	0.3 (0.1, 0.7)	0.06 (0.02, 0.11)	≥100%	0.08 (0.03, 0.12)	≥100%	0.1
Folate (mcg)	12.0 (7.4, 26.4)	35.1 (19.1, 51.9)	6.02 (4.31, 7.87)*	50-80%	8.24 (6.19, 10.53)*	>80%	9.6
Vitamin A RE (mcg)	14.2 (4.8, 43.1)	22.3 (13.9, 144.6)	5.57 (3.10, 19.08)	<50%	5.69 (3.68, 29.87)	<50%	36.8
Iron (mg)	1.0 (0.6, 1.6)	2.3 (1.1, 3.3)	0.45 (0.27, 0.70)	<50%	0.51 (0.33, 0.79)	<50%	5.2
Zinc (mg)	1.0 (0.5, 1.5)	2.1 (1.4, 2.6)	0.42 (0.36, 0.54)	<50%	0.46 (0.37, 0.53)	<50%	2.2

<sup>a</sup> p < 0.05 for all values unless otherwise noted using Wilcoxon's signed rank test; <sup>b</sup>p>0.05 for all values unless otherwise noted with an asterisk (\*) using Wilcoxon's signed rank test; <sup>c</sup>Vossenaar's average desired NDs for infants in 50<sup>th</sup> percentile weight



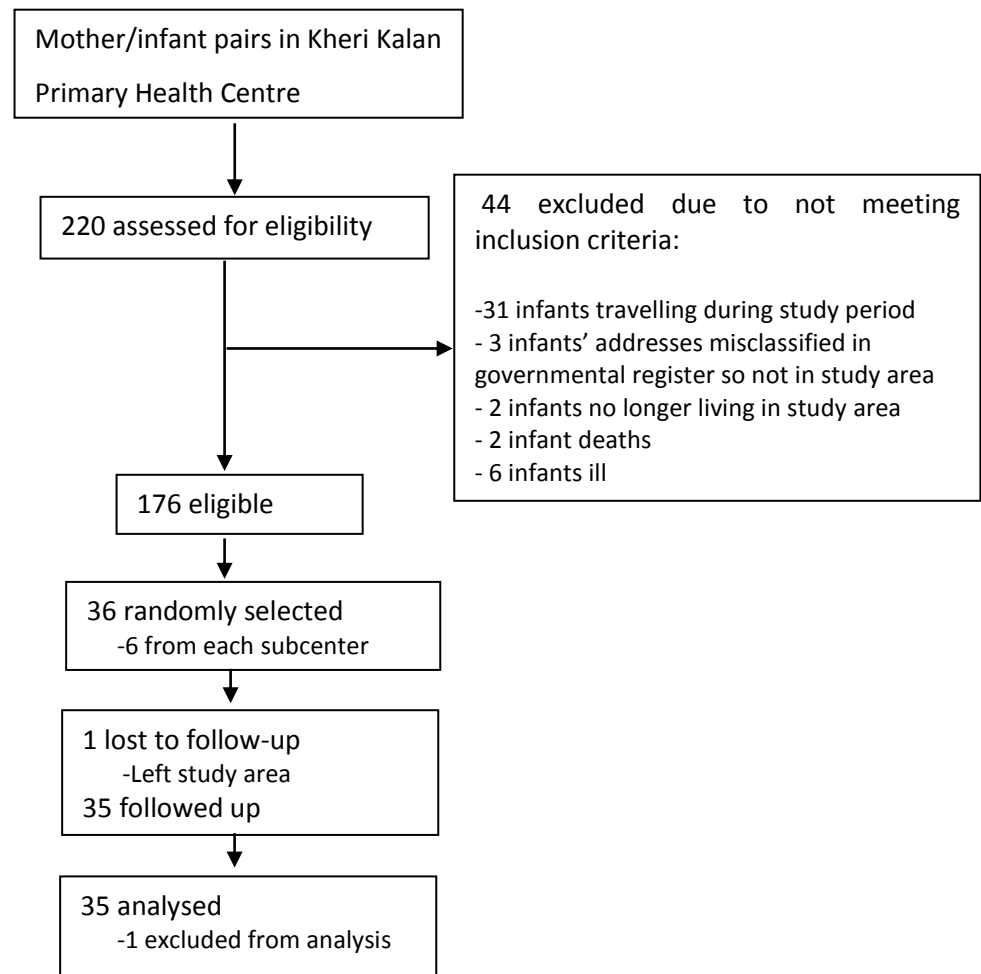
**Table 5: Food group contributions to total infant energy intake at baseline and  
endline**

Food Groups	Median (IQR) energy contribution (kcal) /day (n=34)		
	Baseline	Endline	p <sup>b</sup>
Grains	47.2 (15.7, 87.5)	76.2 (48.1, 118.8)	0.148
Legumes	0 (0,0)	0.9 (0, 56.5) <sup>a</sup>	0.001
Vegetables	0 (0, 2.4)	5.0 (0, 12.1) <sup>a</sup>	0.006
Fruit	0 (0,0)	0 (0, 14.6) <sup>a</sup>	0.002
Dairy	44.5 (0, 96.8)	109.0 (64.8, 219.1) <sup>a</sup>	0.018
Fats	15.3 (0.6, 43.9)	27.6 (4.2, 55.3)	
Eggs	0 (0,0)	0 (0,0)	0.268
Other	35.8 (7.2, 59.6)	51.3 (25.1, 105.4)	0.083
Other foods - Condiments	0 (0,0)	0 (0, 0.5)	0.137
Other foods - Bakery	0 (0,0)	0 (0,0)	0.083
Other foods - Sugars	19.0 (2.0, 56.6)	32.2 (24.4, 93.1) <sup>a</sup>	0.014
Other foods - Infant formula & cereals	0 (0,0)	0 (0,0)	0.706
Total daily energy intake	227.2 (142.2, 411.7)	456.0 (301.9, 550.5) <sup>a</sup>	0.001

<sup>a</sup> Differences considered significant at p<0.05; <sup>b</sup> Differences calculated using Wilcoxon's signed rank sum test

## FIGURE












Figure 1: Study profile



## ONLINE SUPPLEMENTAL MATERIAL

### Appendix A: Pictorial Card with Food-Based Recommendations

	<p>If child is breastfed, then breastfeed as often as the child wants</p>
	<p>Give what is being made every day in the house (e.g. roti or rice or sevian) at least twice per day. Of these, roti is especially beneficial for your child. Feed these items in at least the following amounts:</p> <p>Roti – ¼ piece or Rice – 1/3 small bowl or Sevian – 1 small bowl</p>
	<p>Give lentils and beans (dal or kidney beans or chickpeas) at least four times per week. Of these, kidney beans are especially beneficial for your child. Feed these items in at least the following amounts:</p> <p>Lentils – 5 teaspoons or Kidney beans – 1/3 small bowl or Chickpeas – 5 teaspoons</p>
	<p>Give at least 1 teaspoon of vegetables at least once per day. Green leafy vegetables such as spinach or bathua or methi or mustard leaves are especially beneficial for your child.</p>

		<p>Add at least ½ teaspoon of ghee or oil to food at least once per day</p>
		<p>Give dairy products (curd or undiluted buffalo or cow or packet milk<sup>1</sup> or buttermilk) at least twice per day. Of these items, undiluted buffalo milk is especially beneficial for your child. Give these items in at least the following amounts:</p>
		<p>Undiluted milk – 8 teaspoons Buttermilk – 5 teaspoons Yogurt – 2/3 small bowl</p>
		<p><sup>1</sup>If the child is not breastfed, then give at least 2/3 small bowl of undiluted buffalo or cow or packet milk at least 6 times per day. Of these, undiluted buffalo milk is especially beneficial for your child</p>
		<p>Give fruits at least once per day. Papaya, mango, guava or orange are especially beneficial for your child. Feed fruits in at least the following amounts:</p>
		<p>Papaya – 5 small pieces or Guava – 2 small pieces or Orange – 1 to 2 slices Mango – 2 small pieces Sapota – ¼ piece Banana – 1/3 banana Grapes – 4 grapes Apple – 1 thin slice</p>
		<p>Give at least ½ egg at least twice per week</p>

## **5. COMMUNITY-BASED PARTICIPATORY FORMATIVE RESEARCH TO DESIGN A MHEALTH INTERVENTION TO IMPROVE COMPLEMENTARY FEEDING PRACTICES**

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### **PREFACE**

The previous chapter presented findings from formative research to develop FBRs for promotion in a mHealth intervention to improve CF practices. The research paper presented in this chapter presents findings from community-based formative research to develop and design the mHealth intervention. This chapter describes how focus group discussions and an intervention development workshop with local stakeholders led the development of the mHealth intervention to be pilot tested in the study setting. Although the previous two chapters conclude that it is not possible to meet infants' nutrient requirements using only local foods as consumed, alternative dietary interventions were not included in the mHealth intervention since they were unfeasible and unacceptable to procure and promote within the ICDS programme in this setting.



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- 2.3. Stage of publication – **Not yet submitted** / Submitted / Undergoing revision from peer reviewers' comments / In press

**3. For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper.**

I designed the study with the co-authors of this paper. I drafted the data collection instruments and revised them based on inputs from all co-authors. I collected the data for this paper along with Sarmila Mazumder and local research team members. I did all of the data analysis with guidance from Caroline Free and Sarmila Mazumder. I wrote the first draft of the article. All co-authors provided comments on the draft article, many of which I incorporated during revisions to the article.

**NAME IN FULL** (Block Capitals): NEHA SONA SINGH

**STUDENT ID NO:** 237561

**CANDIDATE'S SIGNATURE**

**Date:** 4 June 2014

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**SUPERVISOR'S SIGNATURE**

## **MANUSCRIPT**

### **TITLE**

Community-based formative research to design a governmental mHealth counselling intervention to improve complementary feeding practices of 9-11 month old infants in Haryana State, India

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### **LIST OF ABBREVIATIONS**

AWC: Anganwadi centre

AWW: Anganwadi worker

CF: complementary feeding

ICDS: Integrated Child Development Services

IQR: interquartile range

NFHS: National Family Health Survey

PHC: primary health centre

## **CLINICAL TRIAL REGISTRY INFORMATION**

The trial is registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) with the identifier number NCT01645163.

## **ABSTRACT**

**Background:** Indian children bear the highest burden of morbidity and poor nutrition in the world. The spread of mobile phone technology in India provides new opportunities for delivering health interventions to vulnerable populations who are unable to access care. Mobile phones have not been used for complementary feeding (CF) counselling, signalling a need for formative research to inform intervention development in this area.

**Aim and Objectives:** To describe how formative research from February to April 2012 guided the development and design of a governmental mobile phone-delivered counselling intervention to improve CF practices of 9-11 month old infants in a rural district in Haryana State, India. Specific objectives are to: (1) conduct focus group discussions (FGDs) with mothers, mothers-in-law and governmental Anganwadi workers (AWWs) to explore their views regarding the feasibility, acceptability and best means of using mobile phones to facilitate the process of delivering CF counselling within the existing governmental programme in the study setting; and (2) use key FGD findings and stakeholder views from an intervention development workshop to finalise the design of the mobile phone-delivered intervention for pilot testing.

**Results:** FGD results show that although many mothers do not receive CF counselling from AWWs due to a number of factors relating to sociocultural issues, distance, and high work load, all mothers and AWWs reported a desire to receive and provide CF counselling, respectively, in order to improve infants' dietary intake. Participants were supportive of using mobile phones to reinforce CF messages promoted in face-to-face meetings; however, the provision of mobile phone handsets and mobile phone credit was key since cost was a barrier to using mobile phones for CF counselling. Most mothers, AWWs and mothers-in-law identified the importance of including mothers-in-law in a mHealth intervention to improve the feasibility and acceptability of AWWs providing CF counselling to mothers on mobile phones. Stakeholders in the intervention design workshop reported that mobile phones should not replace face-to-face contact with AWWs, and that call timings should be convenient to both AWWs and mothers. Additionally, ICDS staff reported wanting to avoid issues with



favouritism in the community due to provision of mobile phones or additional incentives to AWWs. Results from the FGDs and intervention design workshop were used to finalise the design of a mHealth intervention. This intervention would include an initial face-to-face group counselling meeting, followed by mobile phone calls to reinforce CF messages.

**Conclusions:** Results from this study show how participatory mixed method research including focus groups and an intervention design workshop with community members, health workers and other stakeholders influenced the design of a mobile phone-based intervention to improve CF practices. However, it is necessary to refine this intervention design in a pilot test, and to next test the intervention's impact in a randomised controlled trial to assess its effect on CF practices.

**Key words:** mobile phones, complementary feeding, child nutrition, formative research

## INTRODUCTION

Indian children bear the highest burden of morbidity and poor nutrition in the world.<sup>1-5</sup> At 22 percent, India's proportion of under-five deaths is also substantially higher than any other country.<sup>1</sup> Of the 25 million infants born in India each year, 1.7 million of them die within their first year of life.<sup>2,4</sup> Nearly half (45%) of under-five mortality in India can be attributed to pneumonia and diarrhoea,<sup>1,2,6</sup> and it is estimated that malnutrition also plays a role in 57% of these deaths.<sup>7</sup>

Data from the 2005-06 National Family Health Survey (NFHS) highlights India's poor complementary feeding (CF) practices and child nutritional status. Nearly 43% of under-five children are underweight (weight-for-age, WAZ, <-2 SD), 48% of under-five children in India are stunted (height-for age, HAZ, <-2 SD), and about 20% are wasted (weight-for-height, WHZ, <-2 SD).<sup>5,8</sup> NFHS data show that based on national recommendations, only about one in five Indian children age 6-23 months are fed with all the recommended appropriate feeding practices.<sup>8</sup>

Launched in 1975, the Integrated Child Development Services (ICDS) program is India's policy response to combat childhood undernutrition. Health, education and nutrition services are provided at an Anganwadi centre (AWC), often located in the village itself, by an Anganwadi worker (AWW). The AWW is charged with providing a population of 1000 with eight key services including (i) supplementary feeding; (ii) immunization; (iii) health check-ups; (iv) referrals; (v) health education to adult women; (vi) nutrition education to adult women; (vii) micronutrient supplementation for children aged 3-6 years; and (viii) preschool education for children aged 3-6 years. Nutrition education for women is based on the WHO Integrated Management of Childhood Illnesses (IMCI) guidelines.<sup>9</sup> In the past three decades, the ICDS program has also expanded to include additional interventions mainly delivered by AWWs, including adolescent girls' nutrition, income-generation schemes for women, and health awareness and skills development.<sup>10</sup>

World Bank and Indian governmental evaluations of ICDS show that AWCs have had little to no impact on the nutritional status of children, particularly in those under the age of 3 years.<sup>11,12</sup> AWWs spend nearly 40% of their time on food supplementation-related activities for children aged 3-6 years and 39% on preschool education, leaving little to no time for other tasks.<sup>13,14</sup> In particular, home visits to promote growth monitoring and to educate mothers on health and nutrition matters is the AWW's most neglected task.<sup>10,15</sup> Indian governmental and World Bank evaluations show that an AWW's job performance is also affected by demotivating factors,

since they are generally held in very low esteem in their communities and are paid highly irregularly.<sup>10, 14</sup>

India is witnessing a novel and exponential deployment of Information and Communication Technology. According to the Telecom Regulatory Authority of India, by January 2014 India's mobile teledensity, defined as mobile connections per 100 people, was 72.2% — there were nearly 773 million active mobile phone connections among the total wireless subscriber base of over 893 million.<sup>16</sup> The spread of mobile phone technology in India provides new opportunities for delivering health interventions to vulnerable populations who are unable to access care. However, mobile phones have never been used for CF counselling in this setting, signalling a need for formative research in this area.

Formative research can be used to identify a target population's beliefs, values, knowledge and behaviours related to a health problem, and aims to answer questions about the context that influences, and is influenced by, these individual factors.<sup>17</sup> Though the importance of using mixed method research to design context-specific interventions is widely recognised,<sup>17-21</sup> the methods, processes and their impact on the final intervention design are rarely reported.<sup>18</sup> There are no published examples of specific formative research methods to inform a CF counselling intervention or an intervention delivered using mobile phones to improve health (mHealth) by improving CF practices. As a result, this study aims to provide information on how community-based participatory methods were used to develop and design a mobile phone-based nutrition counselling intervention to improve CF practices of 9-11 month old infants in Haryana State, India. Specific objectives were to: (i) conduct focus group discussions (FGDs) with mothers, mothers-in-law and AWWs to explore their views regarding the feasibility, acceptability and best means of using mobile phones to facilitate the process of delivering CF counselling within the existing governmental programme in the study setting; and (ii) use key FGD findings and stakeholder views from an intervention development workshop to finalise the design of the mobile phone-delivered intervention for pilot testing. CF messages and barriers and motivating statements for promotion in the intervention were developed using the Optifood tool which takes into account the nutritional needs of 9-11 month old infants and local food patterns, cost and access,<sup>22</sup> and then tested with mothers in a community-based trial. These results are reported elsewhere (Chapter 4).

## **STUDY SETTING**

The study took place in Kheri Kalan Primary Health Centre (PHC) in Haryana state in Northern India. Haryana had a mobile phone subscriber base of nearly 20.7 million in January 2014, of which about 17.3 million wireless were active.<sup>16</sup> Kheri Kalan PHC is comprised of communities situated 3-5 km from the major highway. Literacy in the population is low – 15% of men and 50% of women have never attended school. Nearly 40% of under-five children in this area are underweight, and 46% are stunted.<sup>8</sup> ICDS services are mainly offered to children aged 3 years and above since unlike younger infants, these children can be left at AWCs on their own.<sup>23</sup>

## **MATERIALS AND METHODS**

### **Ethics and Consent**

Ethics approval was obtained from the London School of Hygiene and Tropical Medicine Research Ethics Committee and the Society for Applied Studies Ethics Review Committee in India. All participants gave written informed consent if literate. Thumb impressions with signatures of impartial witnesses were obtained from illiterate participants prior to enrolling.

### **Phase 1– Exploring Stakeholder Views**

The research team conducted a series of focus group discussions (FGDs) with AWWs, mothers and mothers-in-law of infants aged 9-24 months in February 2012 to explore their views regarding the feasibility, acceptability and how to use mobile phones to facilitate the process of delivering CF counselling within the existing ICDS program in the study site. A wide range of respondents was purposively selected to represent varying socioeconomic status, ages and education levels, with an additional criterion of years of work experience for AWWs. A set of qualitative research questions were developed (Table 1) to aid in defining the intervention to be used in the pilot study, and were tailored to each type of respondent.

The research team conducted 6 FGDs, 3 with AWWs (n=12 women) and 3 with mothers (n=16 women). FGDs results identified mothers-in-law as a strong influence on CF practices and mobile phone use by mothers in the study site, so 2 further FGDs were conducted with mothers-in-law (n=12 women) to assess the feasibility and acceptability of their daughter-in-laws (i.e. mothers) using mobile phones for CF counselling.

Each FGD included 3-7 participants and lasted about 1.5 hours. All FGDs took place in AWCs with privacy ensured in the study site, and were conducted until saturation, i.e. when no new themes emerged. A facilitator asked open-ended questions, followed by specific prompts related to the research question. Each FGD was recorded with the aid of a note taker and two digital recorders. Sociodemographic data were also collected from all FGD participants via interviewer-administered questionnaires.

FGDs were analysed as detailed below. Key findings from FGDs were summarized and used to draft parameters for the mHealth intervention, which were presented to stakeholders at the intervention design workshop in Phase 2 of the study.

### **Phase 2 – Intervention Design Workshop**

Next, the research team organised a day-long intervention design workshop with 12 local stakeholders and experts in the study site in April 2012. The aim of the workshop was to ensure the mHealth intervention design had local ownership, was in line with national policies and current evidence, and would likely be acceptable, feasible and sustainable to implement in Kheri Kalan PHC.

The research team invited 4 local public health experts, 2 ICDS officials, 2 AWWs, 2 mothers and 2 mothers-in-law (n=12) to the workshop to develop the mHealth intervention to be tested in a pilot study. The workshop facilitator was a lead researcher from the study team with extensive experience working in the study setting. The workshop commenced with the facilitator presenting the following: (i) a summary of food-based recommendations for promotion in the mHealth intervention, that were developed in a previous study (Chapters 3 and 4) (ii) key findings from FGDs with mothers, mothers-in-law and AWWs; and (iii) suggested parameters for the mHealth pilot study based on participant views in FGDs.

The facilitator used findings from earlier FGDs with mothers, mothers-in-law and AWWs as a starting point to initiate discussions with stakeholders on the intervention design. Next, the facilitator elicited each stakeholder's reaction to key issues presented, and asked them to suggest the best way forward to incorporate these findings into a mHealth intervention to improve CF practices. The facilitator asked all stakeholders for input on each intervention component identified, and an additional study team member took detailed notes during the discussion. The study team aimed to seek a consensus agreement, which was defined in the study as an agreement that all participants can accept or not oppose. The study team

facilitator systematically engaged each stakeholder present in the workshop with an aim to ensure equal participation and ownership of the intervention design, which was deemed finalised once a unanimous verbal agreement had been achieved among all participants. All stakeholders were asked to endorse the final recommendations for the mHealth intervention design at the end of the consensus building process. Outcomes from this workshop were used in the next phase to finalise the intervention design to be used in the implementation of the mHealth pilot study.

### **Data analysis**

All quantitative data from sociodemographic questionnaires were double-entered and data entry errors were identified using range and consistency checks. Data were imported to Stata 12 software after being cleaned, and subsequently analysed using univariate analyses to generate descriptive statistics.

Qualitative data analysis was iterative, thus evolving alongside data collection. FGD audio files were initially translated and transcribed into English by a team member, and then cross-checked by the lead author. NVivo 8 software was used to store and code all the FGD transcripts after they had been translated into English. Contents of FGD transcripts identified range of AWW, mothers and mothers-in-law' thoughts on using mobile phones for CF counselling. Two authors used a thematic approach to code FDGs, starting with initial free coding with an ultimate aim of grouping themes into categories. All qualitative data were coded allowing for emergence of new unanticipated themes, which influenced the pre-conceptualised parameters of the intervention.

## **RESULTS**

### **Phase 1– Exploring Stakeholder Views**

#### ***Participant characteristics***

Sociodemographic data for AWWs, mothers and mothers-in-law are described in Table 2 and Table 3. None of the mothers-in-law or mothers interviewed worked outside the home. In addition, no mothers-in-law reported owning or using mobile phones, but 31.3% (n=5) of mothers owned a mobile phone, of whom 80% (n=4) were able to keep the mobile phone with them at all times. All mothers owning a mobile phone reported using it to make personal calls, and 25% of mothers (n=4) reported using it for short message services (SMS) as well. The majority (91.7%) of AWWs reported owning a mobile phone and having ownership of it at all

times. Half of AWWs (n=6) reported using mobile phones for both ICDS-related work and personal use. One quarter of AWWs (n=3) reported using mobile phones for SMS.

Findings from the FGDs with all respondents are summarised below.

### ***Current state of CF counselling***

Mothers, mothers-in-law and AWWs reported conflicting views on the provision of CF counselling via AWCs or home visits. Most mothers reported that AWWs do not currently provide nutrition counselling, and that it is sometimes hard to reach the AWW. Some mothers-in-law reported that AWWs *“give nutrition advice at the AWC, and sometimes they even call us for group meetings”* (mother-in-law #3), whereas other mothers-in-law reported that AWWs only gave supplementary food to children at AWCs, and did not provide any CF counselling: *“My grandchildren go to the AWC to collect food. AWWs no longer give nutrition counselling to mothers or to us”* (mother-in-law #7). All mothers and mothers-in-law agreed that AWWs *“never visit our homes”* for CF counselling (mother #12).

In contrast, AWWs reported providing CF counselling at both AWCs and home visits when they were able to reach mothers. One AWW reported that mothers were more interested in listening to CF advice if her infant’s weight had not changed, stating that *“counselling means more to mothers when we use growth monitoring as an opportunity to talk to them. This [growth data] proves to them that the baby’s weight has not changed. This [data] also makes them trust our advice”* (AWW #3) However, most AWWs also reported that it was difficult to counsel all mothers in their community due to the mothers’ low literacy levels: *“Some mothers are illiterate – they don’t care or know about diet of the child and give them whatever is available at home. We have told them that we are providing healthy food at AWCs which they are not able to provide at home, but even then some mothers do not cooperate and do not come to the AWC”* (AWW #2). Some AWWs reported that some mother *“do not even come [to the AWC] for their child’s vaccinations because they are busy in their work and they also say their time will be wasted if they attend [CF counselling meetings]”* (AWW #9). Many AWWs reported having difficulties reaching *“those mothers who live a long distance from the AWC, and are unable to come to AWCs for food”* (AWW #5) or are unable to leave their homes due to sociocultural restrictions: *“Mothers who have had their first baby do not come [to the AWC] for counselling. Also, newlywed women – those married in the past two years – do not leave the house”* (AWW #10).

All AWWs and mothers reported a desire to provide and receive increased CF support. One AWW reported wanting increased contact with mothers since *“personal contact between AWWs and mothers creates good rapport. The more you meet, the easier it is to build trust, give advice and have it be understood easily”* (AWW #1).

### **Current Mobile Phone Usage**

All mothers, mothers-in-law and AWWs reported that mobile phones are a very common technology in their communities: *“Everyone in villages have them [mobile phones]. First there were landlines, now even grandmothers and grandfathers have mobile phones”* (mother #14). However, most participants agreed that mainly men or senior family members in a household own mobile phones: *“I have five daughters-in-law and only one has a mobile phone. All my sons have a mobile phone”* (mother-in-law #11).

Most mothers, mothers-in-law and AWWs reported using mobile phones to mainly stay in touch with their relatives, and to access emergency medical care: *“If anyone is sick in the family, then we can call the AWC or hospital immediately for advice or an ambulance”* (mother-in-law #2). Some mothers and AWWs also reported allowing their children to listen to music and play games on mobile phones.

Many AWWs also reported using mobile phones to stay in touch with their ICDS supervisors and for referrals: *“If my work is in the field today, then I inform my supervisor on the phone. We inform the ICDS centre or supervisor that we are sending this mother to centre, and ask if we can send her”* (AWW #6). Some AWWs reported using mobile phones to answer mothers' queries related to ICDS-related activities: *“We have distributed our [mobile phone] numbers to mothers and they ask questions like, ‘When do we get vaccinations?’ ‘When do we need to visit the hospital?’ We tell them these things on the phone”* (AWW #10). However, none of the AWWs reported using mobile phones for CF counselling.

### **Attitudes to Mobile Phones**

Overall, all mothers, mothers-in-law and AWWs agreed that mobile phones are a popular and convenient technology. One AWW reported feeling that *“mobile phones are very advantageous for mothers who have mothers-in-law who don't let them leave the house or who don't feel comfortable talking in front of their mothers-in-law”* (AWW #7). One mother also reported that *“women don't have to go with men to a phone booth”* (mother #1) if they can make mobile phone calls from the privacy of their home.



However, a few mothers and mothers-in-law reported feeling that mobile phones harm health. One mother held the view that *“vibrations from mobile phones cause side effects and are not good for the heart or ear drum”* (mother #4) whereas one mother-in-law had *“heard that keeping mobile phones in the front pocket causes some heart and chest diseases”* (mother-in-law #3).

In addition, many mothers and AWWs reported that mobile phone calls from unknown numbers creates tension and mistrust with their husbands and family members. One mother explained how calls from strangers led to her losing ownership of her mobile phone: *“My husband gave me a phone and told me ‘Whenever there is any emergency, call me on my phone.’ But after some time there were some missed calls and wrong numbers and my husband started asking me about them. Now he has told me ‘Whenever you need to call your sister or parents, I will dial the number,’ and keeps the mobile phone with him”* (mother #8).

Most mothers-in-law also reported feeling that *“mobile phones can be bad when they are used in love affairs by boys and girls”* (mother-in-law #1). One mother-in-law also reported that women should not be allowed to have mobile phones, since *“if a woman has a mobile phone, then her number can be misused by men easily”* (mother-in-law #7).

### ***Attitudes to using mobile phones for CF counselling***

#### ***Mobile phones are convenient and increase contact with mothers***

All mothers and AWWs reported that using mobile phones for CF counselling would save time due to their overwhelming workloads: *“We have to leave our work at home to come to the AWC. If advice will be available on phone, then we will not have to go anywhere and could get it while sitting at home”* (mother #15). Most mothers-in-law reportedly agreed that their *“daughters-in-law are very busy in their housework, so counselling on mobile phones will be good for them”* (mother-in-law #5). Most AWWs reported that using mobile phones for CF counselling would increase contact with mothers: *“With mobile phones, mothers won’t need to wait for 2-3 days to contact us – they could talk to us any time. We visit two families at home daily, but with mobile phones we could contact 10 or more families daily. We could reach more mothers”* (AWW #12).

### **Mobile phones cannot replace face-to-face contact**

However, most mothers, mothers-in-law and AWWs reported that mobile phones should only be used to reinforce CF messages and for medical emergencies, since it cannot replace face-to-face CF counselling. In particular, some AWWs reported that CF counselling delivered exclusively via mobile phones would not allow them to fully explain dietary advice to mothers that they currently promote via face-to-face contact: *“In face-to-face counselling, we can be there in person to show mothers if child is not eating well. We can then do demonstrations in person and show her how to feed children”* (AWW #9).

### **Logistics and timing of calls**

All AWWs already owning a mobile phone reported that they preferred to have ICDS provide phone credit for their existing mobile phone, rather than be provided with a separate mobile phone for counselling mothers. In addition, most AWWs reported that they would not want to make or receive calls from mothers for CF advice outside their normal work hours.

### **Barriers to using mobile phones for CF counselling**

#### **Cost**

Money was the main reported barrier to using mobile phones for CF counselling: *“There is a financial problem – neither mothers nor we can afford to waste our money. The main issue is expenses. If we will call mothers, they will listen to us but they themselves will never call us”* (AWW #3). All mothers, mothers-in-law and AWWs reported that they could not afford to buy mobile phone handsets or credit to deliver or receive counselling: *“We will not have any money to recharge it [mobile phones] with phone credit. Our husbands do not earn any money”* (mother #16).

#### **Mothers-in-law**

Although all mothers-in-law reported being supportive of their daughters-in-law receiving CF counselling on mobile phones, most AWWs and mothers reported that mothers-in-law would be a barrier to mothers using mobile phones to talk to AWWs: *“My mother-in-law will fight with me if I get counselling on the mobile phone. She prefers that I meet with the AWW face-to-face”* (mother #4). One AWW explained that *“mothers-in-law might think that they raised their children without mobile phones, so why do mothers now need to be reached on mobile phones?”* (AWW #4).

### **Unwanted calls**

A few AWWs also reported not wanting to provide CF counselling to mothers via mobile phone to avoid receiving unwanted calls from men: *“We cannot distribute our numbers to everyone in villages, even to mothers. Alcohol abuse is a problem in villages- husbands or men in the household may misbehave with us on phone so we do not give our mobile phone numbers to anyone”* (AWW #6).

### **Mistrust**

Overall, most mothers and mothers-in-law reported a lack of faith in AWWs for compliance with mobile phone counselling: *“AWWs don’t even do their current work properly, so how will they use mobile phones for counselling?”* (mother-in-law #10). One mother-in-law reported that *“AWWs currently fill buckets of [supplementary AWC-provided] food rations and take it for themselves”* (mother-in-law #9), so she did not trust that they would reach mothers on mobile phones. A few mothers and mothers-in-law also reported that if asked to deliver CF counselling via mobile phones, *“AWWs will not provide [CF] advice on the phone. They will lie to everyone and say ‘We have called every mother,’ but will not call anyone. They are careless”* (mother #7).

Most AWWs reported not trusting that mothers would be more interested in personal conversations than CF counselling if provided with a mobile phone: *“10% of mothers will use mobile phones for nutrition advice and most of them will misuse it for personal calls”* (AWW #12). One AWW reported feeling that *“If mothers don’t want to listen to us, they will say ‘wrong number’ and then hang up”* (AWW #1).

### ***Desire to including other family members in mobile-phone delivered CF counselling***

Most mothers and AWWs reported that caregivers such as mothers-in-law should be reached with CF messages, whereas a few mothers and AWWs reported that fathers should also be included since they made decisions on spending resources: *“The father should get [CF] advice, since he will get the groceries. Relatives like the grandmother and grandfather should also know because they are the ones who feed my child when I am busy”* (mother #10). One AWW reported that *“during [home] visits, elders are satisfied if we talk to them – they then allow mothers to listen us happily. When we talk to mothers-in-law and elders first, they do not perceive our visits negatively”* (AWW #2).

Mothers-in-law reported contrasting views on which family members to include in a mobile phone-delivered CF counselling intervention. Some mothers-in-laws reported feeling that *“everyone [in the household] should listen [to mobile phone-delivered CF advice] in the family...If anyone forgets any point regarding the diet, then others can help and together we can remember all the [CF] advice given”* (mother-in-law #7). One mother-in-law reported feeling that *“mothers and grandmothers are enough to get counselling on mobile phones. I can always ask my son for groceries since he does the shopping. Sometimes I do shopping for the home too”* (mother-in-law #1).

## **Phase 2 – Intervention Design Workshop**

Next, the study team presented findings from the earlier focus groups to stakeholders in an intervention design workshop, with the aim of designing the intervention to be implemented in the mHealth pilot study. Key issues presented at the workshop are outlined in Table 4. Stakeholders proposed and discussed elements to include in the intervention design based on feedback from the focus group participants. Mobile phone possession was a main point of discussion among the stakeholders. Both mothers initially opposed having to return mobile phones to the study team at the end of the intervention, but both ICDS officials, one AWW and one mother-in-law recommended returning all mobile phones to the study team at the end of the pilot study in order to avoid being accused of favouritism from community members not enrolled in the study. All participants reached consensus toward the end of the workshop on components of the mHealth intervention design to be pilot tested. These are described as follows:

### ***Mobile phone possession***

Mobile phones should be given to all study participants, and distributed with study team staff present so ICDS is not accused of favouring participants chosen to take part in the pilot study. Additionally, mobile phones should be taken back at the end of the study to eliminate any concerns in the community relating to favouritism. It should be emphasized that mobile phones should be kept with mothers since husbands often take the phone with them to work.

### ***Frequency of contact***

An initial face-to-face group counselling session should be followed by a mobile phone call to mothers to reinforce messages within 72 hours. AWWs should also call mothers once every 2

weeks during the 6-week pilot intervention to reinforce messages and clarify mothers' queries, i.e. call at week 2, 4 and 6 during the intervention.

### ***CF message content***

Messages finalized in the Optifood study household trials (Chapter 4) are feasible and acceptable to stakeholders, and should be promoted in the face-to-face group counselling session at the start of the mHealth pilot study. During mobile phone calls, AWWs should start by asking mothers about CF practices, and then repeat CF messages and reinforce/problem solve issues as needed.

### ***Call timings***

AWWs should reach mothers between 12 and 2pm. Mothers should be encouraged to call AWWs for CF queries, but the time should be limited to between 9am and 5pm. They can also call AWWs outside the specified hours if there is an emergency.

### ***Incentives***

Incentives should not be given to AWWs since CF counselling is part of their duties.

Table 5 summarises the implications of findings from both formative research phases for intervention design, and Table 6 summarises the final mHealth intervention design.

## **DISCUSSION**

### **Key Findings**

This study describes how FGDs with mothers, mother-in-law and AWWs, and an intervention development workshop with key stakeholders were used to design a mHealth intervention to improve CF practices of 9-11 month old infants in Northern India. FGD results show that although many mothers do not receive CF counselling from AWWs due to a number of factors relating to sociocultural issues, distance, and high work load, all mothers and AWWs reported a desire to receive and provide CF counselling, respectively, in order to improve infant diets. Participants were supportive of using mobile phones to reinforce CF messages promoted in face-to-face meetings; however, the provision of mobile phone handsets and mobile phone credit were key components since cost was a barrier to using mobile phones for CF counselling. Most mothers, AWWs and mothers-in-law identified the importance of including

mothers-in-law in a mHealth intervention to improve the feasibility and acceptability of AWWs providing CF counselling to mothers on mobile phones. Stakeholders in the intervention design workshop reported that mobile phones should not replace face-to-face contact with AWWs, and that call timings should be convenient to both AWWs and mothers. Additionally, ICDS staff reported wanting to avoid issues with favouritism in the community due to provision of mobile phones or additional incentives to AWWs. Results from the FGDs and intervention design workshop were used to finalise the design of a mHealth intervention with an initial face-to-face group counselling meeting, followed by mobile phone calls to reinforce CF messages.

### **Strengths of the Study**

This study has several strengths. It is the first study describing the use of formative research methods to design a community-based CF counselling intervention. Furthermore, it investigates ways in which mobile phones can be used to support CF counselling, a delivery mechanism that has not been used to date to improve CF practices in young infants. The study also took a participatory approach to designing the intervention, aiming to ensure that its components were selected and approved by governmental and local stakeholders, thus increasing its potential to be supported in the study setting and scaled up in the future if proven effective in a randomised controlled trial.

### **Limitations of the Study**

Since research to inform an intervention is conducted prior to its implementation, this preparatory research can be constrained by resources and time.<sup>24</sup> In addition, limitations related to various qualitative research methods may add to concerns of the validity and generalisability of the findings to the study setting. However, these issues are partially addressed by triangulation of data from all FGDs and views expressed in the stakeholder workshop. It should be noted that the number of FGDs conducted (n=3,3,2) are small, so it is unknown if data saturation were reached despite no novel themes emerging in the final FGD of each sub-group. It is likely that findings from this study are generalisable to Kheri Kalan PHC since participants were purposively selected to represent varying socioeconomic status, ages, education levels, and years of work experience. It is unknown if results from this study are applicable to other settings.

Although AWWs, mothers-in-law and mothers were included in the FGDs, it is possible that it would have also been beneficial to conduct formative research with ICDS officials, local stakeholders and experts. However, the study team elicited their input in the stakeholder workshop, with an aim of ensuring all ICDS staff and public health experts present had contributed to and supported the finalised design of the mHealth intervention.

It is possible that feedback from the limited number of stakeholders (n=12) in the intervention design workshop was less comprehensive than if a greater number of participants were invited. However, the study team sought to collaborate with a purposively selected group of stakeholders with a deep understanding of local policies, nutrition programs and sociocultural issues, in order to gain in-depth views and inputs on a locally feasible mHealth intervention design.

Additionally, findings from FGDs with mothers should be interpreted with caution due to the maternal literacy rate, which at 81% is much higher compared to data from the 2005-2006 National Family Health Survey reporting that 40.2% of females in Haryana have received no education.<sup>8</sup>

### **Strengths and limitations in relation to other studies**

Results from this study emphasise the importance of including caregivers of infants other than mothers in a CF counselling intervention. These results are similar to a study in Iran that found it beneficial to include household and community members in a nutrition education intervention to improve child growth.<sup>25</sup> Mothers-in-law were encouraged to take part in the intervention after formative research showed that they are the de facto head of the household in the study site while men are away working, and have great influence over CF decisions. These findings were similar to other research supporting the role of grandmothers as culturally designated advisors and caregivers with substantial influence on child feeding practices.<sup>26, 27</sup>

This study's methods were based on other studies' recommendations for successful mHealth interventions and North-South collaborations to implement projects. A recent systematic review of mHealth projects in Africa found that implementation successes can be attributed to effective adaptation to local contexts, strong stakeholder collaboration, and government involvement.<sup>28</sup> Other studies documenting enabling factors in North-South collaborations to design and implement interventions emphasise the importance of building relationships and shared ownership,<sup>29, 30</sup> developing acceptable and meaningful ways to ensure that contributions from all parties are valued,<sup>31</sup> and designing research collaboratively among

those with local knowledge, those with methodological expertise, and those in positions to implement findings.<sup>31</sup> Our study took into account these enabling factors for successful interventions through ongoing collaboration with key stakeholders in the study setting including mothers, mothers-in-law, AWWs, ICDS supervisors and other officials, and local public health experts, whose views were critical to designing and implementing the mHealth intervention.

### **Summary and implications for future research and interventions**

Results from this study show how participatory mixed method research including focus groups and an intervention design workshop with community members, health workers and other key stakeholders influenced the design of a mobile phone-based intervention to improve CF practices. Although current ICDS strategies for CF counselling only includes AWWs and mothers, research findings show the importance of also including mothers-in-law in CF counselling in this study setting due to their important influence on infant feeding practices. However, it is necessary to refine this intervention design in a pilot test, and to next test the intervention's impact in a randomised controlled trial to assess its effect on CF practices. Regardless, formative research including focus groups and stakeholder consultation provides a basis for the development of a locally feasible and acceptable intervention, and this process can be replicated in other settings to strengthen interventions to improve infant feeding practices.

### **KEY MESSAGES**

- It is feasible to design a community-based mobile phone-based intervention to improve CF practices by addressing perceived barriers identified by rigorous participatory formative research with community members, health workers and other stakeholders.
- Including mothers-in-law in the intervention design addressed potential hindrances to the intervention raised by AWWs, mothers and mothers-in-law.
- Mobile phones are more acceptable for reinforcing CF messages rather than replacing face-to-face contact.

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## **CONFLICTS OF INTEREST**

The authors declare that they have no conflicts of interest.

## **CONTRIBUTIONS**

All authors designed formative research to inform the mHealth intervention. NSS and SM conducted research with oversight from CF, NB, ST and ELF. NSS and SM analysed qualitative data with guidance from CF. NSS wrote drafts of the paper and CF, SM, ELF, NB and ST commented on the drafts of the paper. All authors read and approved the final manuscript.

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## TABLES

**Table 1: Topic Guide for Focus Group Discussions with Anganwadi Workers, Mothers and Mothers-in-law**

What is the current state of AWW-delivered nutrition counselling in the study area?

### *Mobile phones – Role*

- How are mobile phones used in this community?
- How are mobile phones used for health promotion?

### *Mobile phones – Acceptability*

- What would AWWs, mothers and mothers-in-law think of using mobile phones for nutrition counselling?
- What would friends, family, and community members think of AWWs and mothers using mobile phones for nutrition counselling?
- How could mobile phones be used for supervisor-AWW supervision?

### *Mobile phones – Feasibility*

- Would it be feasible for AWWs and mothers to have a mobile phone if it was not provided?
- What would make it easier or more difficult to use phones to support CF activities?
- What potential issues would mothers and AWWs face if provided with mobile phones to receive CF advice?
- What potential issues would arise if using phones for supervisor-AWW supervision?

### *Mobile phones – Usage*

- What are the best ways that mobile phones can be used within the ICDS program to support CF activities?
- What are the most acceptable means of using mobile phones for nutrition counselling, e.g. automated messages, SMS, direct phone calls, etc.?

### *Mobile phones – Other Issues*

- Who else should be targeted in the household to facilitate uptake of CF messages via mobile phones?

**Table 2: Sociodemographic Characteristics of Mothers, Mothers-in-law and their Households**

	<b>Mothers (n=16)</b>	<b>Mothers-in-law (n=12)</b>
Infant age (months), mean (SD)	15.9 (2.4)	21.4 (24.6)
Sex of infant – female, <i>n (%)</i>	9 (56.3)	6 (50.0)
Age, mean (SD)	22.7 (2.4)	52.7 (12.4)
Marital status, <i>n (%)</i>		
Married	15 (93.8)	11 (91.7)
Widowed	1 (6.3)	1 (8.33)
Years of education completed, mean (SD)	9.4 (3.4)	2.9 (4.0)
Can read and write, <i>n (%)</i>	13 (81.3)	4 (33.3)
Involved in income-generating activities, <i>n (%)</i>	1 (6.3)	2 (16.7)
Total number of household members, mean (SD)	7.9 (3.4)	10.1 (4.5)
Number of children <5 years of age in households, <i>n (%)</i>		
1-2 children <5 years of age	11 (68.8)	8 (66.7)
3-5 children <5 years of age	5 (31.3)	4 (33.3)
Annual household income in Indian Rupees, median (IQR)	240000 (66000, 360000)	150000 (84000, 300000)

**Table 3: Sociodemographic Characteristics of Anganwadi Workers in Focus Group Discussions**

	n=12
Age, <i>n (%)</i>	
≤ 25 years	4 (33.3)
26-45 years	5 (41.7)
> 45 years	1 (8.3)
Do not know age	2 (16.7)
Years of education, mean (SD)	13.8 (2.4)
Years of AWW work experience, <i>n (%)</i>	
≤ 1 year	5 (41.7)
2-10 years	3 (25.0)
11-20 years	2 (16.7)
> 20 years	2 (16.7)
AWWs with ICDS training, <i>n (%)</i>	10 (83.3)
AWWs with refresher ICDS training, <i>n (%)</i>	6 (50.0)
Participated in refresher training:	
More than 1 year ago	6 (50.0)
Never received a refresher training	6 (50.0)
Frequency of seeing ICDS supervisor, <i>n (%)</i>	
Once per month	1 (8.3)
2-3 times per month	11 (91.7)
Duration of average work day in hours, mean (SD)	5 (0.4)

**Table 4: Key Issues Presented to Stakeholders in Intervention Design Workshop**

**Food-based recommendations (FBRs) to promote in the mHealth intervention<sup>a</sup>**

- FBRs drafted based on infant dietary and cost data from study setting
- FBRs promote the following food groups with emphasis on specific nutrient-rich foods:
  - (i) Grains – twice per day; (ii) Legumes – 4 times per week; (iii) Dairy - twice per day;
  - (iv) Vegetables – once per day; (v) Fruit - once per day; (vi) Added fats - once per day;
  - (vii) Eggs - twice per week

**Summary of findings from focus group discussions to inform mHealth intervention design**

- Mothers do not have much interaction with AWWs and want dietary recommendations for their infants
- Money is the main barrier to using mobile phones for nutrition counselling
- Mothers-in-law in joint families need to be involved in an mHealth intervention to improve feasibility and acceptability of AWWs providing nutrition counselling to mothers on mobile phones
- Mobile phones need to be provided to those mothers and AWWs who do not have one
- Mobile phones should not replace individual or group face-to-face counselling, and should be used for:
  - Following up face-to-face counselling with short and/or reinforcing messages
  - Emergency feeding-related queries
- Mothers and/or other family members should be discouraged from calling AWWs after working hours, i.e. 2pm.

**Suggested parameters for mHealth pilot study**

- Setting: Kheri Kalan PHC
- Participants:
  - 12 AWWs - 2 sampled randomly from each of the 6 subcentres
  - 60 mothers of 9-11 month old infants - 5 mothers randomly sampled from each of 6 subcentres
- Timing: 6-week pilot study with initial group face-to-face counselling session followed by mobile phone calls to reinforce FBRs

<sup>a</sup> Earlier research to develop and test FBRs for promotion in the mHealth intervention are described elsewhere (Chapters 3 and 4).



**Table 5: Implications of Key Formative Research Findings for Intervention Design**

Formative research component	Key findings	Implications for intervention design
Focus group discussions with Anganwadi workers (AWWs), mothers and mothers-in-law	<ul style="list-style-type: none"> <li>Mothers desire increased complementary feeding (CF) support from AWWs</li> </ul>	<ul style="list-style-type: none"> <li>A mobile phone-delivered intervention is an opportunity for AWWs to contact mothers for CF counselling</li> </ul>
	<ul style="list-style-type: none"> <li>AWWs have difficulties reaching all mothers for CF counselling via home visits</li> </ul>	<ul style="list-style-type: none"> <li>AWWs may be able to reach more mothers via mobile phones than in home visits</li> </ul>
	<ul style="list-style-type: none"> <li>AWWs and mothers report that mobile phones are a popular technology that could increase contact with each other.</li> </ul>	<ul style="list-style-type: none"> <li>The intervention design included mobile phone calls to increase contact between mothers and AWWs.</li> </ul>
	<ul style="list-style-type: none"> <li>Some AWWs do not trust mothers to use mobile phones for CF counselling, and some mothers and mothers-in-law do not trust AWWs to provide CF counselling via mobile phones.</li> </ul>	<ul style="list-style-type: none"> <li>The mobile-phone delivered intervention will first be pilot tested to assess its feasibility.</li> </ul>
	<ul style="list-style-type: none"> <li>AWWs, mothers and mothers-in-law are concerned with the cost of mobile phone calls</li> </ul>	<ul style="list-style-type: none"> <li>The pilot test of the intervention will provide mobile phone credit to participants</li> </ul>
	<ul style="list-style-type: none"> <li>AWWs and mothers report feeling that mothers-in-law in joint families need to be involved in a mHealth intervention to improve the feasibility and acceptability of using mobile phones for CF counselling.</li> </ul>	<ul style="list-style-type: none"> <li>The intervention will encourage participation from mothers-in-law in the group counselling session and subsequent mobile phone calls.</li> </ul>
	<ul style="list-style-type: none"> <li>Some mothers and AWWs do not have their own mobile phone.</li> </ul>	<ul style="list-style-type: none"> <li>All participants in the pilot test of the intervention will be provided with a mobile phone</li> </ul>
	<ul style="list-style-type: none"> <li>Mothers and AWWs value face-to-face contact.</li> </ul>	<ul style="list-style-type: none"> <li>The intervention will use mobile phone contact for:                             <ul style="list-style-type: none"> <li>- Following up face-to-face counselling with short and/or reinforcing messages</li> <li>- Emergency feeding queries</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>AWWs do not want to start receiving unwanted calls from men on mobile phones.</li> <li>AWWs do not want to be reached on mobile phones after working hours.</li> </ul>	<ul style="list-style-type: none"> <li>The intervention will only share AWW mobile phone numbers with mothers in the study.</li> <li>Mother will be instructed to reach AWWs during working hours unless they have an emergency feeding query.</li> </ul>
Intervention design workshop with stakeholders	<ul style="list-style-type: none"> <li>ICDS officials and AWWs reported that providing mobile phones to study participants may create issues of favouritism in the community</li> </ul>	<ul style="list-style-type: none"> <li>Study team staff will be present when AWWs give mobile phones to mothers, so that ICDS is not accused of favouring participants chosen to take part in the pilot</li> </ul>

	<ul style="list-style-type: none"> <li>Mothers and AWWs reported that mobile phones could be used to reinforce messages after a face-to-face counselling session.</li> <li>All stakeholders agreed that CF messages developed with the Optifood tool are acceptable for promotion with mothers</li> <li>Mothers did not want to be reached on mobile phones when they would be busy with housework.</li> <li>AWWs did not want to be reached on mobile phones after working hours.</li> <li>ICDS supervisors and officials did not want AWWs to receive any incentives for making mobile phone calls, since CF counselling is part of their job responsibilities. Additionally, they reported that providing AWWs enrolled in the study with incentives would create issues of favouritism with non-participating AWWs.</li> </ul>	<p>study.</p> <ul style="list-style-type: none"> <li>Participants will return mobile phones to the study team at the end of the pilot test to eliminate any concerns in the community relating to favouritism</li> <li>AWWs will call mothers within 72 hours of the group counselling session to reinforce messages, and subsequently call them once every 2 weeks during the pilot study.</li> <li>AWWs will promote these CF messages with mothers in the mHealth intervention.</li> <li>AWWs will call mothers between 12 and 2pm</li> <li>Mothers will be instructed to call AWWs between 9 and 5pm unless they have an emergency query.</li> <li>The intervention will not provide any incentives to AWWs.</li> </ul>
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**Table 6: Final mHealth Intervention Design**

<b>Who</b>	<ul style="list-style-type: none"> <li>• Anganwadi Workers (AWWs) (n=12)</li> <li>• Mothers (n=60)</li> </ul>
<b>What</b>	<ul style="list-style-type: none"> <li>• Initial face-to-face group nutrition counselling meeting at the Anganwadi centre (AWC)</li> <li>• Mobile phone calls between AWWs and mothers (and mothers-in-law if they are interested) for reinforcing complementary feeding (CF) recommendations and nutrition advice</li> <li>• Materials used: <ul style="list-style-type: none"> <li>- Mobile phones</li> <li>- Pictorial card with CF recommendations</li> <li>- Bowls and spoons</li> <li>- Barriers and motivating statements for AWWs</li> <li>- Diaries for AWWs to track incoming and outgoing calls</li> </ul> </li> </ul>
<b>When</b>	<ul style="list-style-type: none"> <li>• <i>Day 1</i>: Face-to-face contact between AWWs and mothers/mothers-in-law</li> <li>• <i>Day 3 or 4</i>: Reinforcing call from AWW to mothers/mothers-in-law</li> <li>• <i>Every 2 weeks</i>: Reinforcing call from AWW to mothers/mothers-in-law</li> <li>• Mothers and mothers-in-law encouraged to call AWWs</li> </ul>
<b>Where</b>	AWCs and homes in Kheri Kalan Primary Health Centre, Haryana State, India
<b>How</b>	<ul style="list-style-type: none"> <li>• Face-to-face group counselling meeting at the AWC</li> <li>• Use mobile phones for all other contact between AWWs and mothers (and mothers-in-law if they are interested)</li> <li>• Specific strategies include: <ul style="list-style-type: none"> <li>- AWWs use barriers and motivating statements to counsel mothers (and mothers-in-law if they are interested) on CF recommendations in a face-to-face group counselling meeting lasting about 1 to 1.5 hours</li> <li>- AWWs share their phone number with mothers and mothers-in-law, inform them about the calling schedule, and encourage them to call for any feeding queries and/or CF advice</li> <li>- AWWs call mothers on Day 3 or 4 and every 2 weeks subsequently. AWWs also speak to mothers-in-law on mobile phones if they are interested.</li> <li>- Mothers call AWWs anytime if they have any feeding queries</li> <li>- AWWs record incoming and outgoing phone calls in a diary</li> </ul> </li> </ul>

## **6. FEASIBILITY OF STRENGTHENING ICDS-DELIVERED COUNSELLING TO IMPROVE COMPLEMENTARY FEEDING PRACTICES OF 9-11 MONTHS OLD INFANTS THROUGH A COMMUNITY-BASED PILOT MHEALTH INTERVENTION**

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### **PREFACE**

The article in the previous chapter presented findings from formative research to design the mHealth intervention. The finalised intervention design included an initial face-to-face group counselling meeting with mothers, followed by mobile phone calls to reinforce CF messages developed in Chapter 4.

The article in this chapter presents quantitative findings from the pilot test of the mHealth intervention to improve CF practices. This is the first study to test the feasibility of using mobile phones for CF counselling in a low-income setting.



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I designed the study with the co-authors of this paper. I drafted the data collection instruments and revised them based on inputs from all co-authors. I collected the data for this paper along with Sarmila Mazumder and local research team members. I did all of the data analysis with advice from Elaine Ferguson and Sunita Taneja. I wrote the first draft of the article. All co-authors provided comments on the draft article, many of which I incorporated during revisions to the article.

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**CANDIDATE'S SIGNATURE**

**Date:** 4 June 2014

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**SUPERVISOR'S SIGNATURE**

## **MANUSCRIPT**

### **TITLE**

Feasibility of strengthening ICDS-delivered counselling to improve complementary feeding practices of 9-11 months old infants through a community-based pilot mHealth intervention in Haryana, India

### **SHORT RUNNING TITLE**

mHealth intervention to improve infant diets

### **KEY WORDS**

mHealth, mobile phones, nutrition counselling, complementary feeding, community-based health workers

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### **FINANCIAL SUPPORT**

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### **CONFLICTS OF INTEREST**

None

## **AUTHORSHIP**

All authors designed the mHealth pilot study. ST advised on the statistical analysis plan. ELF advised on data collection required for dietary analyses. NSS and SM conducted research with oversight from CF, ELF and ST. NSS and ST analysed data. NSS wrote drafts of the paper and CF, ELF, ST and SM commented on the drafts of the paper. All authors read and approved the final manuscript.

## **CLINICAL TRIAL REGISTRY INFORMATION**

The trial is registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) with the identifier number NCT01645163.

## **ETHICS**

Ethics approval was obtained from the London School of Hygiene and Tropical Medicine Research Ethics Committee and the Society for Applied Studies Ethics Review Committee in India. Written informed consents were obtained from all participants.

## **ABSTRACT**

**Objectives:** To determine the: (1) proportion of mothers receiving group and mobile phone (MP)-delivered complementary feeding (CF) counselling from governmental community-based nutrition workers called Anganwadi workers (AWWs); and (2) effect of the mHealth intervention on self-reported infant diet practices, and maternal CF knowledge.

**Design:** A 6-week pilot test from May to July 2012 with before and after comparison assessed via study team-administered questionnaires.

**Setting:** Homes and Anganwadi centres in a rural district in Northern India.

**Subjects:** Randomly selected 12 AWWs and 60 mothers of 9-11 month old infants.

**Results:** All mothers received CF counselling in the initial group counselling session, and 98.3% (n=59) of mothers received reinforcing CF messages via MPs. Compared to baseline, there were significant increases in median number of servings per week of grains ( $p=0.016$ ), legumes ( $p < 0.001$ ), fruit ( $p < 0.001$ ), and fats ( $p=0.008$ ). There were no significant changes in median number of servings per week for dairy products (21 vs. 24,  $p=0.226$ ) or vegetables (1 vs. 2,  $p=0.109$ ). Compared to baseline, there were significant increases in the proportion of mothers feeding green leafy vegetables (1.7% vs. 20.3%,  $p=0.001$ ), undiluted milk (27.1% vs. 49.2%,  $p=0.012$ ), and eggs (3.4% vs. 39.0%,  $p < 0.001$ ). Compared to baseline, there was a significant increase in maternal knowledge regarding food consistency ( $p < 0.05$ ).

**Conclusions:** It is feasible to use MPs for CF counselling with mothers and AWWs, and the interventions shows promise in improving maternal CF practices and knowledge. However, a randomised controlled trial is needed to reliably establish the effects of the intervention.



## INTRODUCTION

Nutrition is a key determinant of child morbidity and mortality worldwide. It is estimated that undernutrition contributes to 61% of all diarrheal deaths and 53% of pneumonia deaths.<sup>1,2</sup> Moreover, studies estimate that undernutrition is responsible for 33<sup>3</sup> to 50%<sup>4</sup> of all under-five child deaths. The most recent study estimates that in 2011, 45% or 3.1 million of global deaths in under-five children could be attributed to combined nutritional conditions.<sup>5</sup>

India bears the largest burden of ill child health and poor nutrition in the world.<sup>1,6-9</sup> At 22%, India's proportion of under-five deaths is also substantially higher than any other country in the world.<sup>1</sup> Of the 25 million infants born in India each year, 1.7 million of them die within their first year of life.<sup>6,8</sup> Nearly half (45%) of under-five mortality in India is due to pneumonia and diarrhoea in children aged 1-59 months.<sup>1,2,6</sup> Recent data from the 2005-06 National Family Health Survey (NFHS) further highlights India's grave child undernourishment problem. Nearly 43% of under-five children are underweight (weight-for-age, WAZ, <-2 SD), 48% of under-five children in India are stunted (height-for age, HAZ, <-2 SD), and about 20% are wasted (weight-for-height, WHZ, <-2 SD).<sup>9,10</sup>

Studies have shown that infants should be exclusively breastfed from 0-6 months of age to protect them from morbidity and malnutrition.<sup>11</sup> However, even exclusively breastfed children will have increased morbidity, stunting and low weight if they are not fed an adequate amount and quality of complementary foods after 6 months of age.<sup>3,9</sup> NFHS data highlight poor complementary feeding (CF) practices in infants under the age of two years living with their mothers in India. Compared with existing national recommendations, only 21 percent of all children age 6-23 months are fed according to the recommended feeding practices<sup>10</sup>

Launched in 1975, the Integrated Child Development Services (ICDS) program is India's policy response to combat early childhood malnutrition. Services are provided in an Anganwadi centre (AWC), which is often located in the village itself, by an Anganwadi worker (AWW). One of the current strategies to reduce malnutrition in India is for AWWs to provide nutrition counselling and follow-up visits to mothers of malnourished infants.<sup>12</sup> However, Indian governmental and World Bank evaluations indicate that due to their large workload, AWWs often do not have time for home visits to provide follow-up counselling to help reduce malnutrition.<sup>13,14</sup> Two evaluations conducted by the Indian government indicate that AWWs spend nearly 40% of their time on food supplementation-related activities for children aged 3-6 years and 39% of their time on preschool education, leaving little to no time for other

tasks.<sup>15, 16</sup> It is therefore unsurprising that AWCs have had little to no impact on the nutritional status of young children, particularly in those under the age of 3 years.<sup>13</sup>

Interventions to improve infant and maternal nutrition are urgently needed to improve health. The spread of mobile phone technology in India provides new opportunities for delivering health interventions to vulnerable populations via a novel channel that can reduce the AWW workload of home visits. Mobile phones are an increasingly popular way of delivering support with minimal resources for diet modification in developed countries.<sup>17, 18</sup> Recent literature in developed countries suggests that telephone support can be used to reinforce health messages, prevent relapse of unhealthy behaviours, and provide clinical advice, especially for people with limited access to medical services.<sup>17-20</sup> Given the high penetration rates of mobile phones in populations of lower socioeconomic position, telephone counselling via mobile phones could present an innovative delivery channel for nutrition interventions in rural India.<sup>21</sup>

Previous research using mobile phones to improve nutritional status has mainly focused on using text messaging and internet-based phone applications to reduce overnutrition in developed countries.<sup>17, 18, 21-23</sup> However, low literacy rates and internet connectivity are barriers to using text messaging and smart phones in lower socioeconomic and remote or rural settings.

To our knowledge, mobile phone-delivered CF counselling has never been studied in any setting, so there is a gap in exploring this intervention's potential to reduce child undernutrition. Mobile phones have potential to be a promising delivery channel to reinforce CF messages and to increase contact between mothers of young infants and AWWs, given their large workload. However, since the use of mobile phones for this purpose has never been evaluated, concerns were raised about the feasibility of using this technology to reinforce CF messages in this setting, including: (i) mothers and AWWs may not retain mobile phone ownership; i.e. husbands or other family members may take the mobile phone; (ii) mobile phones may increase AWW workload because of the need to make or respond to calls; (iii) using mobile phones to reinforce messages may not be acceptable to AWWs, mothers or their family members; (iv) participants may prefer to use mobile phone credit for personal calls; or (v) mobile phones may get lost, stolen or sold for money; (vi) intermittent access to electricity may be a barrier to charging mobile phones; and/or (vii) mobile phone contact with AWWs may have no impact on maternal CF knowledge and practices.

Hence, a mHealth pilot study was conducted to test the feasibility of an mHealth intervention to strengthen CF components of the ICDS program based on earlier participatory formative research with ICDS personnel and community members. (Chapter 5) Quantitative results from the study are presented here, and qualitative results on the feasibility and acceptability of the intervention are presented elsewhere (Chapter 7). The specific objectives of the quantitative study were to determine: (1) the proportion of mothers receiving nutrition counselling from AWWs via group counselling and mobile phones to reinforce CF messages; and (2) changes in reported infant diet and maternal knowledge and attitudes toward CF.

## **EXPERIMENTAL METHODS**

### **Study setting**

The study was conducted in the Kheri Kalan Primary Health Centre (PHC) in Haryana state, Northern India. Kheri Kalan PHC consists of 6 subcentres, each with a population of about 5000. Literacy in the population is low – 15% of men and 50% of women have never attended school. Nearly 40% of under-five children in this area are underweight, and 46% are stunted.<sup>10</sup> ICDS services are mainly offered to children aged 3 years and above since unlike younger infants, these children can be left at AWCs on their own.<sup>24</sup>

### **Study design and Participant Selection**

The mHealth study was a 6-week pilot with before and after comparison, testing initial face-to-face and subsequent mobile phone-delivered nutrition counselling by AWWs to mothers to improve CF practices of their 9-11 month old infants in Kheri Kalan PHC area. Twelve AWWs and 60 mothers of 9-11 month old infants were randomly selected from the study site (**Figure 1**). Of the 68 AWWs working in the 6 subcentres, 2 were randomly selected from each subcentre through a computer generated random number list. Each AWW provided nutritional counselling using mobile phones with 5 mothers of 9-11 month old infants who were randomly selected from a list compiled from data in AWW birth registers. AWWs were eligible for inclusion if they were currently working in Kheri Kalan PHC. Mothers were eligible for inclusion if they had an eligible infant aged 9-11 months and lived in an AWW area in the study site. Infants were excluded if (i) they no longer lived in the study area; (ii) their mothers were planning to travel during the pilot study period; (iii) their address was misclassified in the AWW register so they were not living in the study area (iv) were hospitalised due to illness; (v) were not 9-11 months old because the date of birth was recorded inaccurately in the birth register; or (vi) had been included in the previous formative research to develop CF recommendations. Stata 11 software was used for randomly sampling all participants.

The primary outcome of the intervention was the proportion of mothers receiving nutrition counselling from AWWs via group counselling and mobile phones to reinforce CF messages. Secondary outcomes of the intervention included changes in reported infant diet, maternal knowledge and attitudes toward CF.

### **Ethics**

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the London School of Hygiene and Tropical Medicine Research Ethics Committee and the Centre for Health Research and Development, Society for Applied Studies Ethics Review Committee in India. All participants gave written informed consent if literate. Thumb impressions with signatures of impartial witnesses were obtained from illiterate participants prior to enrolling.

### **Intervention Procedures**

The pilot study started with face-to-face group nutrition counselling meetings in the AWC where each of the 12 AWWs promoted CF recommendations (**Table 3**) with their 5 assigned mothers/infant pairs for 1-1.5 hours. Mothers-in-law of the recruited mothers were also asked to join the intervention's group counselling meeting if they lived in the same household, and were interested and available. AWWs used this meeting to explain all CF messages, emphasize benefits of healthy CF practices and problem-solve with participants, answer their queries, address any barriers and use motivating statements to encourage mothers. CF messages based on local dietary patterns, food availability, access and cost were developed in an earlier formative research study, and were pilot tested with AWWs, mothers and mothers-in-law in the study area (Chapter 5). Barriers and motivating statements were also developed in the formative research phase to address sociocultural norms and beliefs around CF practices in the community and promote healthy CF practices in the study (Chapter 5). All participants were given double-sided laminated cards with written and pictorial depictions of CF messages (Online supplemental material), in addition to bowls and spoons to aid in feeding their infants according to specified portion sizes in the CF messages.

All AWWs and mothers were provided with basic pre-paid mobile phones with phone credit equivalent to about 17 USD for the 6-week study duration. AWWs were to contact mothers on their phones on Day 3 or 4 after initial face to face meeting, in addition to fortnightly phone calls at Weeks 2, 4, and 6 of the pilot study to reinforce CF messages and problem-solving as required. Mothers were encouraged to call AWWs for CF queries anytime during the study period. All participants were given reminder cards with their own mobile phone numbers and

corresponding mothers' or AWW's mobile phone number. Phones were given to AWWs and mothers as a tool with which contact could increase regarding feeding advice and queries after an initial face-to-face meeting.

### **Data Collection Tools**

AWWs recorded details of each outgoing and incoming call with mothers during the pilot study in a diary given to them at the start of the study. Information recorded included whether the call was dialled or received, duration of the call, and whether the mother and/or other family members were present on the call. Mothers were not given diaries to record calls due to high illiteracy rates. At endline, mothers and AWWs also provided information via interviewer-administered phone use assessment forms on adverse events such as lost, damaged or stolen phones, as well as qualitative data on frequency and duration of mobile phone contact for CF reinforcement during the study.

Infant diet was measured pre – and post-intervention by interviewer-administered food frequency questionnaires (FFQs). The FFQ had previously been used in an Indian study,<sup>24</sup> and was modified by adding foods promoted in the CF recommendations in the pilot study. Mothers were asked by interviewers about the number of times per week and the number of times per day each food was consumed by their infant in the past 7 days. Maternal knowledge and attitudes toward infant feeding practices were also measured pre – and post-intervention via interviewer-administered questionnaires, in which mothers were asked questions about feeding practices promoted in the pilot study.

At baseline, sociodemographic data including mobile phone ownership and usage prior to the study were collected from both AWWs and mothers. At the end of the study, two trained field workers used hanging Salter scales to measure infant weights. Mothers and AWWs were also interviewed qualitatively at the end of the pilot study to collect data on feasibility, acceptability, comprehensibility, barriers and motivating factors, as well as ways to improve the intervention. These results are reported elsewhere (Chapter 7).

### **Statistical analysis**

All quantitative data were double-entered and data entry errors were identified using range and consistency checks. Data were transferred to Stata 11 software for analysis after being cleaned. They were checked for normality to determine whether parametric or non-parametric tests should be used in the analyses. For normally distributed variables, in mean baseline and endline data, significant differences in means were identified by using paired t-tests. For non-

normally distributed variables, significant differences in medians were identified by using Wilcoxon's signed rank sum test. McNemar's test was used to identify significant differences in proportions. Differences were considered significant at  $p < 0.05$ .

## RESULTS

Twelve AWWs and 60 mother/infant pairs were randomly selected to take part in the pilot study with a 100% response rate. All AWWs identified met the inclusion criteria to enrol in the study. Of the 286 infants aged 9-11 months identified in the study site, 227 infants were eligible for enrollment in the pilot study after physical verification at the household level. All participants except for 1 mother/infant pair were available for follow up at the end of the 6-week study period (**Figure 1**).

AWWs had a mean (SD) of 11.7 (2.3) years of education, and 50% (n=6) were between 26-45 years of age (**Table 1**). Mothers' mean (SD) age was 24 (3) years (**Table 2**), and the majority of participating mothers (93.3%, n=56) were the child's primary caretaker and did not work away from home. Of the 4 mothers who worked away from home, 5% (n=3) took their infants with them and 1.7% (n=1) left her infant at home with a family member > 18 years of age. At baseline, infants had a mean age of 10 months, 90% were breastfeeding (n=54), and 35% were female (n=21) (**Table 2**). Infants were fed on an average 2.9 (1.1) main meals/day, and 2.2 (1.2) snacks/day not including breastmilk and/or formula milk. 68.3% of mothers (n=41) said they did not feed their child meat, fish, poultry or eggs due to religious reasons and/or according to the norm of the community and or family culture.

At baseline, all participants reported being comfortable with using a mobile phone, but only 26.7% of mothers (n=16) and 41.7% of AWWs (n=5) reported owning one. A large proportion of mothers (63.3%, n=38) and AWWs (41.7%, n=5) reported using their husbands' mobile phone. Mobile phones were mainly used by participants for phone calls, only 10% of mothers (n=6) and 33.3% of AWWs (n=4) reported using mobile phones for SMS, 30% of mothers (n=18) and 33.3% of AWWs (n=4) made calls at baseline on mobile phones more than once per day, and 25% of mothers (n=15) and 50% of AWWs (n=6) reported receiving calls more than once per day. The majority of AWWs (75%, n=9) reported using mobile phones for both personal and work use at baseline. Most mothers (73.3%, n=44) reported using mobile phones for personal use, and nearly a third of them (32.3%, n=14) reported only using it for emergencies. Nearly half of mothers (46.7%, n=28) reported spending Rs. 100 or less on mobile phone credit per month at baseline, whereas 50% of AWWs (n=6) reported spending between Rs.100-200 on mobile phone credit per month.

At the end of the pilot study, all mothers reported receiving CF counselling at the initial face-to-face group counselling session, and 98.3% (n=59) of mothers received reinforcement of CF messages from AWWs via mobile phones during the 6-week study period. One mother (1.67%) was unreachable on her mobile phone during the study period because she left the study setting. AWWs reported making and receiving a median (IQR) of 31 (23, 35) mobile phone calls with a mean (SD) duration of 4 (3.51) minutes, spending an average of 124 minutes on the phone during the 6-week study period. AWWs made more calls to mothers than they received from them [(median, (IQR) of 21 (20, 26) vs. 7.5 (4, 14)]. Mothers-in-law and other family members of enrolled mothers participated in 4.17% and 5.21% of all mobile phone calls, respectively (**Tables 3 and 4**).

For the dietary assessment, compared to baseline there was an increase in the median number of servings per week of grains ( $p=0.016$ ), legumes ( $p < 0.001$ ), fruit ( $p < 0.001$ ), and fats ( $p=0.008$ ) (Table 3). Compared to low levels at baseline, there was also a significant increase in the proportion of infants meeting the promoted CF recommendations for legumes (31.7% vs. 72.9%,  $p < 0.001$ ) and fruits (25.0% vs. 54.2%,  $p < 0.001$ ) (Table 3). In contrast, there were no significant changes in the median number of servings per week for dairy products (21 vs. 24,  $p=0.23$ ) or vegetables (1 vs. 2,  $p=0.11$ ), or in the proportion of infants meeting the promoted CF recommendations for dairy products (75.0% vs. 76.3%,  $p=1.00$ ) or vegetables (10.2% vs. 6.8%,  $p=0.75$ ) (**Table 5**). The median number of servings per week of green leafy vegetables, undiluted milk and eggs were 0 at both baseline and endline. However, to further investigate change in CF practices relating to these three foods, a secondary analysis was undertaken to assess the proportion of mothers reporting feeding these foods before and after the study. Compared to baseline, there were significant increases in the proportion of mothers (n=59) feeding green leafy vegetables (1.7%, n=1 vs. 20.3%, n=12,  $p < 0.001$ ), undiluted milk (27.1%, n=16 vs. 49.2%, n=29,  $p=0.01$ ), and eggs (3.4% n=2 vs. 39.0%, n=23,  $p < 0.001$ ). Compared to baseline, there was also a significant increase in maternal knowledge regarding food consistency (38.3% vs. 64.4%,  $p < 0.05$  for medium foods, 10.0% vs. 54.2% for undiluted buffalo milk,  $p < 0.05$  and 22.0% vs. 44.1% for undiluted cow's milk,  $p < 0.05$ ) (**Table 6**).

## **DISCUSSION**

### **Key findings**

This pilot study suggests that mobile phones are a feasible delivery mechanism for AWWs to reinforce CF messages to almost all mothers to improve infant diet and maternal knowledge. All AWWs reported making a median of 21 mobile phone calls to mothers during the study

period, thus adhering to planned contact of 20 mobile phone calls to mothers during the 6-week pilot testing period. Concerns raised prior to the study about the feasibility of using mobile phone technology in this study setting to reinforce CF messages were not realised. During the study, there were no field reports of adverse events e.g. lost, stolen or sold mobile phones, not being able to charge mobile phones, or participants' husbands or other family members appropriating mobile phones for personal use. According to mothers' self-report, the following increased after the intervention when compared to baseline: (i) infants' median servings per week of grains, legumes, fruit, and added fats; (ii) the proportion of mothers reporting feeding eggs, undiluted milk and green leafy vegetables; (iii) the proportion of infants meeting promoted CF recommendations for all these foods except dairy; and (iv) maternal knowledge regarding food consistency.

### **Strengths of the study**

This study has several strengths. To our knowledge, this is the first study to evaluate mobile phone-delivered nutrition counselling to improve CF practices. In addition, the intervention promoted population-specific CF recommendations that took into account nutritional requirements and local dietary patterns of 9-11 month old infants, local food availability, access and cost, as well as views of AWWs, mothers and local stakeholders. Barriers and motivating statements were tailored to local beliefs and sociocultural norms and aided in explaining CF messages to mothers. These messages promoted in person were reinforced using mobile phones, an increasingly popular technology in India. AWWs spent 17 minutes on average in multiple mobile phone calls to each mother to reinforce CF messages during the study period. This is considerably less time consuming than providing in-person CF support to mothers. This pilot study provides a basis for future rigorous research to test the effectiveness of using mobile phones to reinforce nutrition messages to improve CF practices.

### **Limitations of the study**

Although the pilot study shows improvements in infant dietary intake and maternal knowledge, results should be interpreted cautiously due to these data being self-reported and not objectively measured. In addition, the lack of a control group in this study makes it difficult to attribute observed changes to the intervention.<sup>25</sup> Results of uncontrolled before and after studies can overestimate the effects of interventions.<sup>26</sup> The intervention is also confounded by the Hawthorne effect, i.e. the non-specific beneficial effect on performance of taking part in research,<sup>27</sup> which could also lead to an overestimate of the effectiveness of an intervention. Mobile phones and phone credit were provided to all participants, regardless of whether they already owned a mobile phone, which can be viewed as an incentive. The intervention's



effects on maternal knowledge and CF practices if tested for a longer period of time than the 6-weeks pilot study duration are unknown.

In addition, young infants eat a greater variety of food more frequently as they grow older, so without a control group, it is not possible to know if the increases in dietary intake and proportion of infants meeting CF recommendations at the end of the pilot study can be attributed to the intervention. Given that the norm in the study setting is to feed infants of all ages buffalo milk diluted with water, increases in the proportion of mothers reporting feeding undiluted buffalo milk is unlikely to be due to infants growing older.

The study is small and was conducted in only one catchment area in Haryana State, so its findings are limited in generalisability to other populations including those in other areas of India. It is also unclear which elements of the intervention, e.g. group counselling sessions, mobile phone-delivered reinforcement, behaviour change techniques including motivating statements, or incentives such as mobile phones and phone credit, were most important in improving dietary intake and maternal knowledge and attitudes toward CF practices.

### **Strengths and limitations in relation to other studies**

To our knowledge, this is the first mHealth intervention using mobile phone-delivered counselling to improve CF practices. The mHealth study was multi-faceted and promoted evidence-based and context-specific messages, strategies that have had success in improving CF practices and the nutritional status of young children in the Information, Education and Communication components of other interventions<sup>24, 28-39</sup>. The pilot study also included behaviour change strategies, i.e. barriers and motivating statements, and other family members, including mothers-in-law, when developing the intervention and implementing group counselling meetings at the beginning of the study. This strategy is similar to one used in a study in Iran that included influential community and family members, along with mothers, and had a significant impact on children's physical growth Z-scores in addition to attained weight and length.<sup>35</sup> However, this pilot study differed from all previous nutrition counselling studies aiming to improve CF practices by utilising a low-cost and widely available technology, mobile phones, to deliver and reinforce messages.

### **Meaning of the study – possible mechanisms of action and implications**

Results from this study show that mobile phones are a feasible way for AWWs and mothers to deliver and receive CF messages, which was previously not possible for many participants due to heavy workloads and sociocultural beliefs. Self-reported increases in infant diet and

maternal CF knowledge suggest the intervention may be effective in improving CF practices. However, effects of this pilot study are likely overestimated due to the lack of a control group, and therefore cannot be compared to other rigorously evaluated trials.

Seasonality must be considered when interpreting dietary results from the pilot study, since it has potential to bias findings. The pilot study period spanned the end of spring and beginning of summer, which is the season in which green leafy vegetables are less available and more expensive. This may explain why the median servings per week of Vitamin-A rich green leafy vegetables remained unchanged at 0, although there was a significant increase at endline in the proportion of mother reporting feeding this item. It is possible that this CF recommendation would have been more widely adopted in the winter, when green leafy vegetables are in season and more affordable. Eggs were considered a “hot” item, thus being unsuitable for consumption in the summer since it was thought their consumption would unduly heat the body. This belief may have contributed to lower adoption of the CF message than if it had been promoted in the winter. Seasonality also likely contributed to the significant increase in median servings per week of mango at endline (0 vs. 3,  $p < 0.001$ ), since mango is more commonly available in the summer than in the spring.

Sociocultural norms and religious beliefs are additional considerations when interpreting study results pertaining to egg intake. Female infants were prohibited from eating egg in some households due to the belief that they would start the girls’ menstrual cycles early. In addition, many households were vegetarian due to religious reasons, making it difficult for mothers to feed eggs to their children. Though sociocultural beliefs relating to eggs were addressed in the promoted barriers and motivating statements, these beliefs were likely deep-rooted in the community since this CF recommendation was not as widely adopted as others in the intervention, despite significant increases in the proportion of mothers reporting feeding egg to their infants compared to baseline.

### **Unanswered questions and future research**

A randomised controlled trial is needed to reliably establish the effects of this intervention showing promising results in delivering context-specific CF messages via mobile phones to improve maternal CF practices and knowledge. If confirmed by a randomised controlled trial, results from this pilot study may have policy, design and implementation implications for future CF research and ICDS programming strategies. Given the recent substantial increases in mobile phone usage in developing countries, if proven effective, this intervention also has potential to be easily adapted to other contexts to improve CF practices.

## **ACKNOWLEDGEMENTS**

### **Contributors**

All authors designed the mHealth pilot study. ST advised on the statistical analysis plan. NB and ELF advised on data collection required for dietary analyses. NSS and SM conducted research with oversight from NB, CF, ELF and ST. NSS and ST analysed data. NSS wrote drafts of the paper and CF, ELF, NB, ST and SM commented on the drafts of the paper. All authors read and approved the final manuscript.

### **Conflicts of interest**

We declare that we have no conflicts of interest.

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## TABLES

**Table 1: Sociodemographic Characteristics of Anganwadi Workers (AWWs)**

	n=12
Age, n (%)	
≤ 25 years	4 (33.3)
26-45 years	6 (50.0)
> 45 years	2 (16.7)
Years of education, mean ±SD	11.7± 2.3
Years of AWW work experience, n (%)	
≤ 1 year	5 (41.7)
2-4 years	0 (0.0)
5-11 years	2 (16.7)
12-20 years	0 (0.0)
> 20 years	5 (41.7)
AWWs with formal nutrition training, n (%)	6 (50.0)
AWWs with ICDS training, n (%)	12 (100.0)
AWWs with refresher ICDS training, n (%)	8 (66.7)
Participated in refresher training in:	
Past 1-6 months	1 (8.3)
7-12 months	1 (8.3)
More than 1 year	6 (50.0)
No refresher training	4 (33.3)
Frequency of seeing ICDS supervisor, n (%)	
Once/month	5 (41.7)
2-3 times/month	7 (58.3)
Average duration of work/ day in hours, mean ±SD	4.8 ±1.3

**Table 2: Sociodemographic Characteristics of Mothers and Household**

	n=60
Infant age (months), mean $\pm$ SD	10.4 $\pm$ 0.8
Sex of infant – female, <i>n (%)</i>	21 (35.0)
Proportion of infants breastfed, <i>n (%)</i>	54 (90.0)
WAZ at endline, mean $\pm$ SD	-1.7 $\pm$ 1.1
Proportion of infants < -2 WAZ Z-score at endline, <i>n (%)</i>	23 (39.0)
Mother's age, mean $\pm$ SD	24.0 $\pm$ 3.0
Mother's marital status, <i>n (%)</i>	
Married	60 (100.0)
Years of education completed, mean $\pm$ SD	6.4 $\pm$ 4.7
Mothers who can read and write, <i>n (%)</i>	
Can read	41 (68.3)
Can write	23 (38.3)
Involved in income-generating activities, <i>n (%)</i>	5 (8.3)
Work away from or regularly leave the home at any time during the day, <i>n (%)</i>	4 (6.7)
Total number of household members, mean $\pm$ SD	7.6 $\pm$ 3.1
Number of children <5 years of age in each household, mean $\pm$ SD	2.4 $\pm$ 1.5
Occupation of father, <i>n (%)</i>	
Government service	1 (1.7)
Private service	24 (40.0)
Daily wage	10 (16.7)
Self-employed	12 (20.0)
Farming	9 (15.0)
Does not work	2 (3.3)
Student	2 (3.3)
Annual household income in Indian Rupees, median (IQR)	96000 (60000- 178000)
Household religion, <i>n (%)</i>	
Hindu	58 (96.7)
Muslim	2 (3.3)
Households with electricity, <i>n (%)</i>	60 (100.0)
Main source of drinking water for household, <i>n (%)</i>	
Tube well, bore hole or hand pump	34 (56.7)
Piper water into the house	14 (23.3)
Public tap or stand pipe	9 (15.0)
Bottled water	3 (5.0)
Main material of household's roof, <i>n (%)</i>	
Loosely packed stone	51 (85.0)
Reinforced cement concrete	6 (10.0)
Asbestos sheets	2 (3.3)
Calamine/cement/concrete	1 (1.7)
Toilet facility mother uses, <i>n (%)</i>	
Flush or pour flush toilet	40 (66.7)
Pit latrine	2 (3.3)
No toilet; i.e. uses open space or field	18 (30.0)



**Table 3: Incoming phone calls during 6-week study period reported in Anganwadi Workers' Diaries**

<b>AWW ID</b>	<b>Number of calls received</b>	<b>Duration of calls in minutes (Mean ± SD)</b>	<b>Total number of times mother-in-law on call</b>	<b>Total number of times other family members on call</b>
1	4	4.78 ± 2.75	-	-
2	2	2.50 ± 0.71	-	-
3	12	2.50 ± 1.88	3	5
4	15	2.67 ± 2.72	2	-
5	41	2.59 ± 1.82	1	-
6	4	10.00 ± 1.41	-	-
7	8	8.00 ± 6.12	2	-
8	13	3.08 ± 2.47	-	-
9	17	2.41 ± 1.42	-	-
10	0	-	-	-
11	3	2.00 ± 2.00	-	1
12	7	3.57 ± 2.23	-	-
<b>Total</b>	Median (IQR): 7.5 (4, 14)	3.30±3.01	8 (6.35% of calls received)	6 (4.76%) of calls received)

**Table 4: Outgoing phone calls during 6-week study period reported in Anganwadi Workers' Diaries**

<b>AWW ID</b>	<b>Number of calls dialled</b>	<b>Duration of calls in minutes (Mean ± SD)</b>	<b>Number of times mother-in-law on call</b>	<b>Number of times other family members on call</b>
1	24	2.88 ± 2.40	-	-
2	22	2.91 ± 2.99	-	2
3	22	3.23 ± 2.84	1	6
4	21	1.62 ± 1.40	6	-
5	29	2.62 ± 2.66	1	2
6	11	5.45 ± 5.28	-	-
7	35	5.94 ± 5.64	-	1
8	21	4.14 ± 2.57	-	1
9	18	4.17 ± 1.69	-	-
10	20	8.15 ± 3.91	-	-
11	14	2.86 ± 3.01	-	-
12	21	1.86 ± 1.74	-	2
<b>Total</b>	median (IQR): 21 (20, 26)	3.82 ± 3.72	8 (3.10% of calls dialled)	14 (5.43% of calls dialled)

**Table 5: Infants' median weekly intake relating to complementary feeding (CF) recommendations**

Food Group	Specific recommendation	Median Number of Servings per week (IQR)			Proportion of infants meeting CF recommendations, n (%)		
		Baseline (n=60)	Endline (n=59)	p <sup>1</sup>	Baseline (n=60)	Endline (n=59)	p <sup>2</sup>
Grains	Give what is being made every day in the house (e.g. roti or rice or wheat vermicelli) at least twice per day. Of these, roti is especially beneficial for your child. Feed these items in at least the following amounts:	24 (16,28)	26 (22,35)	0.016	51 (85.0)	56 (94.9)	0.125
	– Roti <sup>3</sup> (wheat flatbread) – ¼ piece <sup>4</sup> or	14 (14,21)	21 (14,21)	0.282	-	-	-
	– Rice – 1/3 small bowl <sup>5</sup> or	3 (2,6)	5 (2,8)	0.009			
	– Wheat vermicelli – 1 small bowl	0 (0,0)	0 (0,1)	<0.001			
Legumes	Give lentils and beans (lentils or kidney beans or chickpeas) at least four times per week. Of these, kidney beans or lentil are especially beneficial for your child. Feed these items in at least the following amounts:	2 (0,4)	6 (3,9)	<0.001	19 (31.7)	43 (72.9)	<0.001
	– Lentils – 5 teaspoons <sup>6</sup> or	2 (0,4)	4 (2,5)	0.002	-	-	-
	– Kidney beans – 1/3 small bowl or	0 (0,0)	0 (0,2)	<0.001			
	– Chickpeas – 5 teaspoons	0 (0,0)	1 (0,2)	<0.001			
Dairy	Give dairy products (yogurt or undiluted buffalo or cow or packet milk or buttermilk) at least twice per day (or 6x/day if not breastfed). Of these items, undiluted buffalo milk is especially beneficial for your child. Give these items in at least the following amounts:	21 (11,30)	24 (14,35)	0.226	45 (75.0)	45 (76.3)	1.000
	– Undiluted milk – 8 teaspoons	0 (0,7)	0 (0,21)	<0.001	-	-	-
	➤ Undiluted buffalo milk	0 (0,0)	0 (0,14)	0.018			
	– Buttermilk – 5 teaspoons	0 (0,2)	1 (0,7)	0.013			
	– Yogurt – 2/3 small bowl	1 (0,7)	4 (0,7)	0.005			
Vegetables	Give at least 1 teaspoon of vegetables at least once per day. Green leafy vegetables such as spinach, <i>bathua</i> (white goosefoot), fenugreek leaves or mustard leaves are especially beneficial for your child.	1 (0,2)	2 (1,4)	0.109	6 (10.2)	4 (6.8)	0.754
	– Green leafy vegetables	0 (0,0)	0 (0,0)	0.001	-	-	-
	– Other vegetables	1 (0,2)	2 (0,4)	0.404			
Fruit	Give fruits at least once per day. Papaya, mango, guava or orange are especially beneficial for your child. Feed fruits in at	3 (1,7)	8 (3,15)	<0.001	15 (25.0)	32 (54.2)	0.002

	least the following amounts <sup>7</sup> :						
	– Papaya – 5 small pieces or	0 (0,0)	0 (0,2)	0.002			
	– Guava – 2 small pieces or	0 (0,0)	0 (0,0)	0.180			
	– Orange – 1 to 2 slices	0 (0,0)	0 (0,0)	0.686			
	– Mango – 2 small pieces	0 (0,1)	3 (1,6)	<0.001	-	-	-
	– Sapota – ¼ piece	0 (0,0)	0 (0,0)	0.064			
	– Banana – 1/3 banana	1 (0,4)	2 (0,6)	0.036			
	– Grapes – 4 grapes	0 (0,0)	0 (0,0)	0.324			
	– Apple – 1 thin slice	0 (0,0)	0 (0,0)	0.716			
Added fats	Add at least ½ teaspoon of ghee or oil to food at least once per day	4 (0,21)	10 (5,21)	0.008	27 (45.0)	42 (71.2)	0.004
	– Ghee (clarified butter)	0 (0,14)	7 (0,14)	0.155	-	-	-
	– Oil	0 (0,3)	4 (0,14)	<0.001			
Egg	Give at least ½ egg <sup>8</sup> at least twice per week	0	0 (0,2)	<0.001	0 (0.0)	16 (27.1)	<0.001

<sup>1</sup>Differences tested using Wilcoxon's signed rank test for n=59 since one infant unavailable at endline; <sup>2</sup>Differences tested using McNemar's test for n=59 since one infant unavailable at endline; <sup>3</sup>Values not calculated for individual foods recommendations since CF recommendations gave mothers a choice between various food items; <sup>4</sup>One piece of roti = 40g; <sup>5</sup>One small bowl = 150ml; <sup>6</sup>One teaspoon = 5ml; <sup>7</sup>All fruit amounts are equivalent to 10g; <sup>8</sup>One egg = 53g

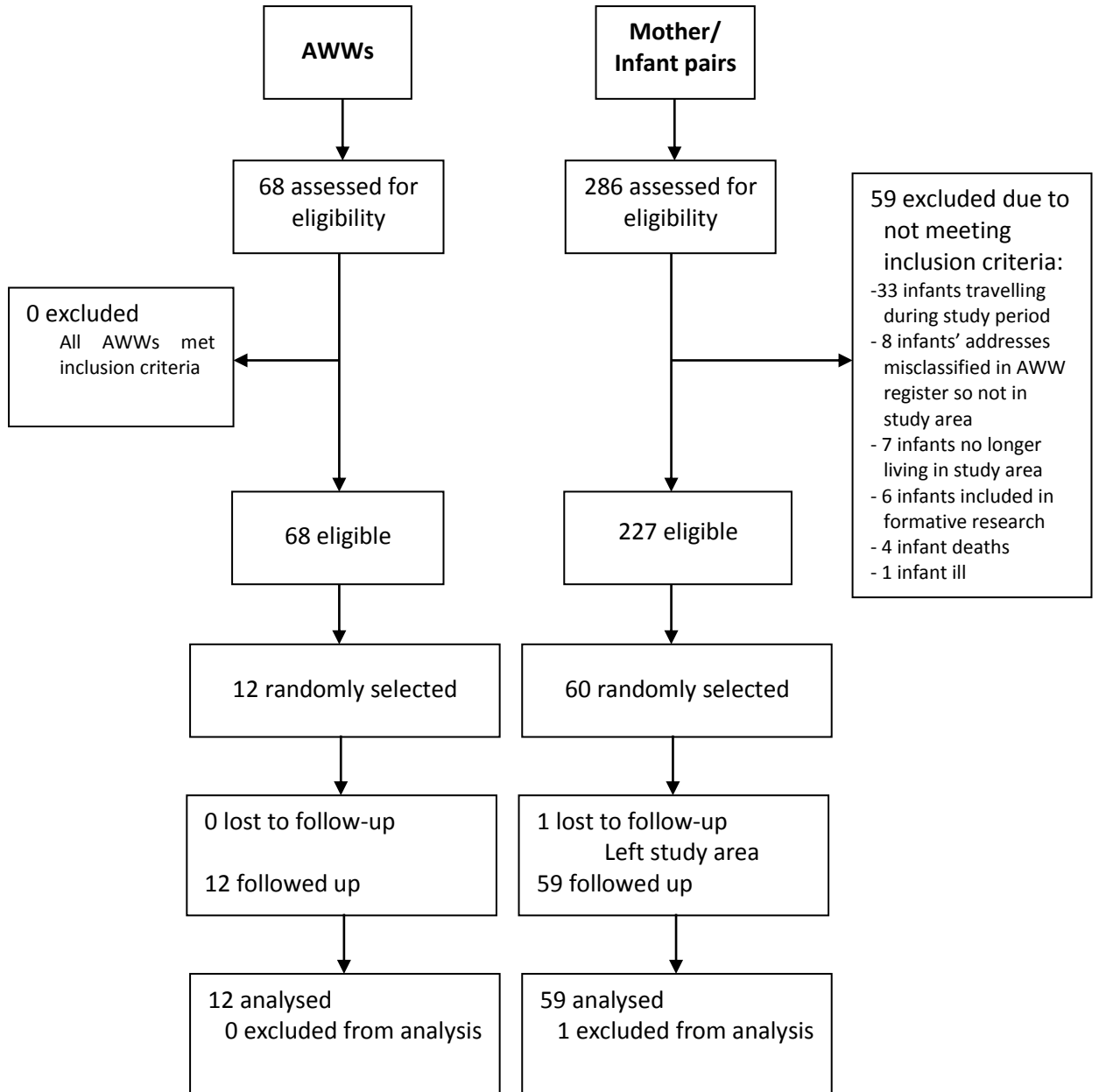
**Table 6: Maternal knowledge and attitudes relating to complementary feeding practices at baseline and endline**

	<b>Baseline (n=60)</b>	<b>Endline (n=59)</b>	<b>p**</b>
Age (in months) until a child should be exclusively breastfed, mean $\pm$ SD	9.5 $\pm$ 6.1	10.5 $\pm$ 7.9	0.435
Age (in months), mean $\pm$ SD when following liquids/foods should be added to child's diet, and proportion of mothers [n (%)] reporting it should never be fed:			
Milk, mean $\pm$ SD	6.0 $\pm$ 1.3)	5.3 $\pm$ 2.5	0.090
Mothers reporting it should never be fed to infants, n (%)	8 (13.3)	5 (8.5)	0.549
Semisolid food , mean $\pm$ SD	6.4 $\pm$ 1.4	6.5 $\pm$ 1.4	0.887
Mothers reporting it should never be fed to infants, n (%)	1 (1.7)	0 (0.0)	1.000
Solid food , mean $\pm$ SD	7.2 $\pm$ 1.7	7.2 $\pm$ 1.5	0.897
Mothers reporting it should never be fed to infants, n (%)	0 (0.0)	2 (3.4)	0.500
Ways to encourage to eat more, n (%)			
Motivate the child with gestures, games, words	26 (43.3)	37 (62.7)	0.013*
No need to motivate	33 (55.0)	22 (37.3)	0.013*
Best way to feed a child, n (%)			
From own plate and utensils	29 (48.3)	30 (50.9)	1.000
From the infant's own bowl, plate and/or utensils	27 (45.0)	29 (49.2)	0.839
Does not know because does not feed child CF	3 (5.0)	0 (0.0)	0.250
Best consistency of food for 9-11 month old infants, n (%)			
Diluted	22 (36.7)	8 (13.6)	0.007*
Medium	23 (38.3)	38 (64.4)	0.004*
Thick	14 (23.3)	13 (22.0)	1.000
Type of milk that 9-11 month old infants should consume, n (%)			
Undiluted buffalo milk	6 (10.0)	32 (54.2)	<0.001*
Undiluted cow's milk	13 (21.7)	26 (44.1)	0.011*
Undiluted packet milk	0 (0.0)	3 (5.1)	0.250
Diluted buffalo milk	42 (70.0)	14 (23.7)	<0.001*
Diluted cow's milk	29 (48.3)	5 (8.5)	<0.001*
Diluted packet milk	1 (1.7)	4 (6.8)	0.250

\*Results considered significant because  $p < 0.05$ ; \*\*Differences in means calculated using t-tests, and differences in proportions calculated using McNemar's test with  $n=59$  since one infant was unavailable at endline

**FIGURE**

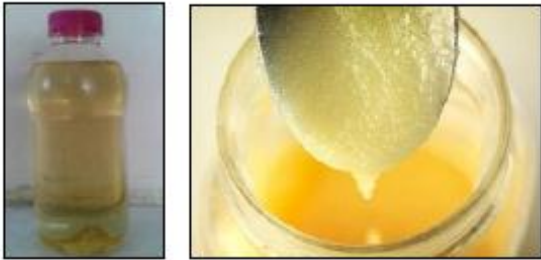



**Figure 1: mHealth pilot study profile of participants selected from Kheri Kalan Primary Health Centre**



**ONLINE SUPPLEMENTAL MATERIAL**

**Appendix A – Pictorial card with complementary feeding recommendations promoted in mHealth study**

	<p>If child is breastfed, then breastfeed as often as the child wants</p>
	<p>Give what is being made every day in the house (e.g. roti or rice or sevian) at least twice per day. Of these, roti is especially beneficial for your child. Feed these items in at least the following amounts:</p> <p>Roti – ¼ piece or Rice – 1/3 small bowl or Sevian – 1 small bowl</p>
	<p>Give lentils and beans (dal or kidney beans or chickpeas) at least four times per week. Of these, kidney beans are especially beneficial for your child. Feed these items in at least the following amounts:</p> <p>Lentils – 5 teaspoons or Kidney beans – 1/3 small bowl or Chickpeas – 5 teaspoons</p>
	<p>Give at least 1 teaspoon of vegetables at least once per day. Green leafy vegetables such as spinach or bathua or methi or mustard leaves are especially beneficial for your child.</p>

	<p>Add at least ½ teaspoon of ghee or oil to food at least once per day</p>
	<p>Give dairy products (curd or undiluted buffalo or cow or packet milk<sup>1</sup> or buttermilk) at least twice per day. Of these items, undiluted buffalo milk is especially beneficial for your child. Give these items in at least the following amounts:</p> <p>Undiluted milk – 8 teaspoons  Buttermilk – 5 teaspoons  Yogurt – 2/3 small bowl</p> <p><sup>1</sup> If the child is not breastfed, then give at least 2/3 small bowl of undiluted buffalo or cow or packet milk at least 6 times per day. Of these, undiluted buffalo milk is especially beneficial for your child</p>
	<p>Give fruits at least once per day. Papaya, mango, guava or orange are especially beneficial for your child. Feed fruits in at least the following amounts:</p> <p>Papaya – 5 small pieces or  Guava – 2 small pieces or  Orange – 1 to 2 slices  Mango – 2 small pieces  Sapota – ¼ piece  Banana – 1/3 banana  Grapes – 4 grapes  Apple – 1 thin slice</p>
	<p>Give at least ½ egg at least twice per week</p>



## **7. ARE MOBILE PHONES A SOLUTION? PARTICIPANT VIEWS ON A PILOT MOBILE PHONE-DELIVERED COUNSELING INTERVENTION TO IMPROVE COMPLEMENTARY FEEDING PRACTICES**

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### **PREFACE**

The paper in the previous chapter presented quantitative findings from the pilot test of the mHealth intervention. The paper in this chapter presents qualitative findings from the pilot test of the mHealth intervention. Participants were interviewed at the end of the pilot study to assess their views, experiences and perceived impact of the counselling intervention designed to use the telephone call function of mobile phones to improve CF practices of 9-11 month old infants in a rural catchment area in Haryana State, India. The implications of these findings for future CF research and programming strategies is discussed.



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**DECLARATION OF SUBMISSION FOR PUBLICATION**

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**1. For a 'research paper' already published – NOT APPLICABLE**

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- 1.2. When was the work published?.....
  - 1.2.1. If the work was published prior to registration for your research degree, give a brief rationale for its inclusion .....
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- 2.1. Where is the work intended to be published? Public Health Nutrition
- 2.2. Please list the paper's authors in the intended authorship order:  
Neha S. Singh, Sarmila Mazumder, Elaine L. Ferguson, Sunita Taneja, Caroline Free
- 2.3. Stage of publication – Not yet submitted/ Submitted / Undergoing revision from peer reviewers' comments / In press

**3. For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper.**

I designed the study with the co-authors of this paper. I drafted the data collection instruments and revised them based on inputs from all co-authors. I collected the data for this paper along with Sarmila Mazumder and local research team members. I did all of the data analysis with advice from Sarmila Mazumder and Caroline Free. I wrote the first draft of the article. All co-authors provided comments on the draft article, many of which I incorporated during revisions to the article.

**NAME IN FULL** (Block Capitals): NEHA SONA SINGH

**STUDENT ID NO:** 237561

**CANDIDATE'S SIGNATURE**

**Date:** 4 June 2014

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**SUPERVISOR'S SIGNATURE**

## **MANUSCRIPT**

### **TITLE**

Are mobile phones a solution? Participant views on a pilot mobile phone-delivered counselling intervention to improve complementary feeding practices in Haryana, India

### **SHORT RUNNING TITLE**

Mobile phone use to improve infant feeding

### **KEY WORDS**

Mobile phones, mHealth, complementary feeding, nutrition counselling, community health workers

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## **CONFLICTS OF INTEREST**

None

## **AUTHORSHIP**

All authors designed the mHealth intervention. SM and CF advised on the data analysis plan. NSS and SM conducted research with oversight from CF, ST and ELF. NSS, CF and SM analysed qualitative data. NSS wrote drafts of the paper and CF, SM, ELF and ST commented on the drafts of the paper. All authors read and approved the final manuscript.

## **CLINICAL TRIAL REGISTRY INFORMATION**

The trial is registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) with the identifier number NCT01645163.

## **ETHICS**

Ethics approval was obtained from the London School of Hygiene and Tropical Medicine Research Ethics Committee and the Society for Applied Studies Ethics Review Committee in India. Written informed consents were obtained from all participants.

## **ABSTRACT**

**Objectives:** To describe governmental Anganwadi workers (AWWs) and mothers' views, experiences and perceived impact of a counselling intervention using the telephone call function of mobile phones (MPs) to improve complementary feeding (CF) practices of 9-11 month old infants in a rural area in Haryana State, India

**Design:** In-depth interviews with mothers and AWWs at the end of a 6-week long mHealth pilot study that took place from May to July 2012.

**Setting:** Anganwadi centres in a rural Northern Indian district.

**Subjects:** Twelve AWWs and 24 mothers of 9-11 month old infants.

**Results:** AWWs reported reaching all mothers in the initial group counselling session, and all but one mother via MPs for the duration of the study. Mothers and AWWs reported enjoying using MPs to contact each other and to receive and deliver CF messages. CF messages developed for the intervention were reportedly feasible to implement and acceptable to all AWWs. Mothers and AWWs reported increases in infant diet diversity and quantity, and a reduction in diluting milk with water before feeding it to infants. Although the intervention was developed taking into account issues related to cost, access, and traditional cultural beliefs, some mothers reported these barriers hindered them from feeding green leafy vegetables, fruit and eggs to their infants.

**Conclusions:** From AWW and mothers' perspectives, using MPs to support AWW-delivered CF counselling in a similar Indian setting is convenient, feasible and acceptable, and shows promise in improving infant diets. If proven effective in a randomised controlled trial, the intervention has implications for future CF programming and research strategies.

## INTRODUCTION

Over 45% of global deaths in under-five children can be attributed to the effects of poor nutrition.<sup>1</sup> India has the highest proportion of malnourished children in the world.<sup>2-6</sup> The most recent Indian National Family Health Survey (NHFS) in 2005-2006 shows that nearly half (43%) of children under the age of five years are underweight, and 22% of them do not live past the age of five years.<sup>3</sup> Although there have been modest reductions in stunting (NHFS-3:2005–06, 45%; NHFS-2:1998–99, 51%), there are no signs of significant improvement in wasting over time. The prevalence of wasting has increased slightly from previous NHFS surveys (23–20%).<sup>7</sup>

Founded in 1975, India's Integrated Child Development Services (ICDS) program aims to reduce early childhood malnutrition by providing maternal and child health services at the village via Anganwadi Workers (AWWs) at Anganwadi Centres (AWCs). AWWs are governmental community-based nutrition workers charged with eight key tasks, including providing nutrition counselling and follow-up visits at the household level to mothers of young children.<sup>8</sup> However, two World Bank evaluations indicate that due to their large workload, AWWs often do not have time for home visits to provide follow-up counselling — home visits to promote growth monitoring and to advise mothers on health and nutrition matters is reported to be the AWW's most neglected task.<sup>9,10</sup> In addition, three recent studies estimating the association between having an AWC in a village and the likelihood that a child is underweight found little or no significant association between the presence of an AWC and child nutritional status.<sup>9,11,12</sup> Results from a national consultation with the Ministry of Women and Child Development, Government of India and the World Bank on how to strengthen the ICDS program to reduce child malnutrition showed that AWCs have had no significant impact on the nutritional status of children under the age of 3 years.<sup>13</sup>

Widespread mobile phone use in India provides new opportunities for reaching its vulnerable populations with health interventions. In 2000, India had a population of more than 1 billion and 28.5 million telephones, mostly landlines.<sup>14</sup> According to the Telecom Regulatory Authority of India, by February 2013 India's mobile teledensity, defined as mobile connections per 100 people, was 70.57% — there were about 708 million active mobile phone connections among the total wireless subscriber base of 862.62 million.<sup>14,15</sup> Of these mobile phone connections, the urban to rural subscriber ratio was about 61.31% to 38.69%, with the rural market expanding by 2.14 million mobile subscribers per month.<sup>15</sup> According to India's most recent census in 2011, more Indians have used a mobile phone than a toilet.<sup>16</sup>

Recent randomized controlled trials show that mobile phones can be used to reinforce health messages, improve health behaviour, and provide clinical advice, especially for people with limited access to medical services.<sup>17, 18</sup> Given the high penetration rates of mobile phones in populations of low socioeconomic position and those with poor health, telephone counselling via mobile phones could present an innovative delivery channel for nutrition interventions in rural India.<sup>19</sup>

There are no published mHealth interventions designed to improve complementary feeding practices in lower and middle income countries. Previous research using mobile phones to improve nutritional status has mainly focused on using text messaging and smart-phone based applications to reduce overnutrition in developed countries.<sup>19-23</sup> Recent systematic reviews have not identified any mobile phone-delivered nutrition counselling interventions to improve complementary feeding (CF) practices.<sup>24</sup> A literature search in PubMed and Medline (OvidSP) databases using combinations of MeSH terms “mobile phone,” “cell phone,” “infant,” “child,” “diet,” “complementary feeding,” and “feeding practices” yielded no published literature on using mobile phones to improve infant feeding practices.

We designed and implemented a participatory mHealth study designed to improve CF practices by strengthening CF counselling components of an ICDS program in Northern India. Intervention components were developed based on : (i) existing evidence; (ii) views of community members, relevant ICDS personnel and local stakeholders; (iii) CF messages developed using the Optifood tool which takes into account the nutritional needs of infants and food cost, availability and food patterns (Chapter 3). This paper aims to describe AWW and mothers’ views, experiences and perceived impact of a counselling intervention which was designed to use the telephone call function of mobile phones to improve CF practices of 9-11 month old infants in a rural catchment area in Haryana State, India. Results of participatory and community-based formative research conducted to design the intervention and quantitative results of the pilot study are reported elsewhere (Chapters 5 and 6).

## **EXPERIMENTAL METHODS**

### **Study setting**

The mHealth pilot study took place in Kheri Kalan Primary Health Centre (PHC) in Haryana state in Northern India in May and June 2012. As of January 2013, Haryana had 75.8% total teledensity, of which 97.2% (19.3 million) connections were wireless.<sup>15</sup> Kheri Kalan PHC consists of 6 subcentres, each with a population of about 5000. Women in this area mainly stay at home and engage in house or farm work, and common occupations for men include

agriculture and factory work. Undernutrition in young children is common —nearly 40% of under-five children in this area are underweight, and 46% are stunted.<sup>7</sup> ICDS services largely ignore children under the age of 3 in this area, since unlike older children, they cannot be left alone at AWCs.<sup>25</sup>

## **Ethics**

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the London School of Hygiene and Tropical Medicine Research Ethics Committee and the Centre for Health Research and Development, Society for Applied Studies Ethics Review Committee in India. All participants gave written informed consent if literate. Thumb impressions with signatures of impartial witnesses were obtained from illiterate participants prior to enrolling.

## **The Intervention**

The mHealth pilot study took place over 6 weeks with 12 AWWs and 60 mothers of 9-11 month old infants randomly selected from the study site. Each AWW tested the intervention with 5 mothers, whose mothers-in-law were also encouraged to take part in counselling if interested. The intervention was developed based on: (i) the Optifood tool which takes into account the nutritional requirements of 9-11 month old infants in addition to local food costs, availability and food patterns <sup>26</sup>; (ii) local stakeholder, AWW and other ICDS personnel's knowledge of local CF practices and beliefs and the socioenvironmental context; and (iii) views of mothers-in-law and mothers of young infants on the best ways to implement an mHealth intervention to improve CF practices in the study setting. A detailed description of formative research to inform the intervention, and the intervention design are available elsewhere (Chapter 5).

The intervention was delivered via an initial face-to-face group counselling meeting, followed by mobile phone calls for reinforcement and/or problem-solving. All participants were given a Samsung E1200 mobile phone handset with 1000 Indian Rupees (~15 USD) credit for the 6-week study period. Participants were also given a pictorial card illustrating foods promoted in CF messages for additional reinforcement. Food quantities promoted in CF messages were expressed in household measures, i.e. a small bowl and teaspoon, so each participant was also provided with a bowl and spoon to aid in feeding her infant.

CF messages promoted in the intervention were developed in an earlier community-based study (Chapters 3 and 4), and can be summarized as follows: in addition to breastmilk, feed (i)



grain products at least twice per day; (ii) legumes (e.g. lentils, beans) at least 4 times per week; (iii) undiluted dairy products at least twice per day (at least 6 times per day if child is not breastfed); (iv) vegetables at least once per day; (v) fruits at least once per day; (vi) fats (e.g. butter, oil) at least once per day; and (vii) eggs at least twice per week. AWWs explained these CF messages, i.e. feeding behaviours, to mothers using key messages to address barriers and increase motivation (see Appendix A for barriers and motivating statements).

From a behaviour change perspective based on Michie's behaviour change wheel, the mHealth intervention components targeted mothers' capabilities, motivation, and opportunity to potentially influence their CF behaviours to improve infant diet.<sup>27</sup> CF messages and barriers and motivating statements promoted in the intervention also utilised 20 behaviour change techniques identified to help people change dietary behaviours.<sup>28</sup> Full details of the intervention are reported elsewhere (Chapter 5).

### **Data Collection**

Qualitative data were collected via in-depth interviews (IDIs) at the end of the study from all 12 AWWs and 24 mothers randomly selected through a computer-generated random number list of mothers. These data were collected with the aim of describing participant views, experiences and the perceived impact of the intervention. Interviewers (n=4) with fluency in local languages interviewed mothers and AWWs in private settings in AWCs, where they were asked open-ended research questions about the usability, feasibility and acceptability of mobile phones and CF recommendations promoted in the study. All interviews were digitally recorded and lasted about 1 hour. Sociodemographic data were also collected from all AWWs and mothers at baseline via interviewer-administered questionnaires.

### **Data Analysis**

All quantitative data were double-entered and data entry errors were identified using range and consistency checks. Data were transferred to Stata 11 software after being cleaned and were subsequently analysed.

Qualitative data analysis was iterative, thus evolving alongside data collection. IDI audio files were initially translated and transcribed into English by a team member, then cross checked by the lead author (NSS). NVivo 10 software was used to store and code all transcripts after they had been translated into English. Contents of IDI transcripts identified the range of AWW and mothers' views on CF messages and using mobile phones for nutrition counselling during the 6-week testing period. To reduce researcher bias during data analysis and interpretation, three

authors (NSS, SM and CF) reviewed and analysed qualitative data individually, then met and discussed the results until they reached consensus. Data were analysed using a thematic approach to code IDIs, starting with initial free coding with an ultimate aim of categorising themes into categories. All qualitative data were coded to allow for the emergence of new unanticipated themes.

## **RESULTS**

Sociodemographic characteristics for mothers and AWWs interviewed are presented in Table 1 and Table 2. The median (inter quartile range) age of mothers was 24 (23-25) years, and most of them (n=18; 75%) were literate. Only 1 (4.2%) mother was involved in income-generating activities, and none of them worked outside their home. On average, mothers were caring for 2 preschool children at home. The median (inter quartile range) age of AWWs was 38.5 (24.5-43) years, and a third of them (n=4) were young (<25 years old). Half of the AWWs (n=6) had worked in the role for more than 10 years, while 42% of AWWs (n=5) had been in the role for less than 1 year. The mean (SD) years of education completed by AWWs was 11.7 (2.3) years, and on average, they worked just under 5 hours per day.

Key themes identified are described in four sections covering: (i) the feasibility of using mobile phones for CF counselling; (ii) acceptability of the intervention; (iii) impact of the intervention; and (iv) participant recommendations to improve the intervention.

### **Feasibility of Using Mobile Phones for CF Counselling**

#### ***Mobile phones increase contact between mothers and AWWs***

All participants reported making or receiving calls regarding CF messages during the study period. All mothers except for one reported being reached multiple times via mobile phones by AWWs during the study period. One mother was unreachable as she unexpectedly had to leave the study area for another rural area with no mobile phone network. In addition, all but two mothers reported calling AWWs during the study. One mother did not call her AWW since she lived near the AWC and preferred to visit the AWW in person, and the other had no problem following dietary advice, *“but if it was needed then I would have called”* (mother #56).

Overall, mothers and AWWs reported that they enjoyed using mobile phones to stay in touch with each other, especially with mothers who were not allowed to leave the house by their family members: *“Usually in our village, we are not allowed to go anybody’s home. But there were no restrictions on talking over the phone. So we have talked a lot for our children [to*

improve their diet]" (mother #4). Mothers also reported enjoying the increased attention they received from AWWs during the study, since they "*do not [usually] get that much attention*" (mother #22) from them.

AWWs also noted that mobile phones had increased their contact with mothers who were inaccessible due to distance, and subsequently thought mobile phones were a good substitute for home visits with them. One AWW reported that the mobile phone allowed more frequent contact with mothers, so she was no longer reliant on only seeing them during home visits. All AWWs reported feeling happy when mothers were interested in staying in touch over the phone: "*I felt good that they [mothers] called. They spoke to [me] about their problem to get the solution*" (AWW #3).

In addition to using mobile phones to promote and receive CF messages, participants used mobile phones to inquire about medical advice for infants, availability of supplementary food rations at AWCs, and immunisation program schedules. A few AWWs reported mothers asking them to speak to mothers-in-law about more culturally sensitive dietary advice, such as feeding eggs to infants. A few AWWs also reported using their mobile phones for other ICDS work purposes, such as scheduling work-related activities and contacting their ICDS supervisor or Anganwadi helper. Mothers reported using mobile phones for personal calls, though AWWs reportedly only made personal mobile phone calls in emergency situations.

In contrast to the general positive experiences reported by participants, one AWW reported she had to call mothers multiple times to reach them, and even had to visit one mother in person to remind her to answer her mobile phone.

### ***Access to mobile phones***

Mothers reported retaining access to mobile phones. Two mothers' husbands preferred to answer the mobile phone when they were at home, although they were supportive of their wives talking to AWWs. Other husbands and mothers-in-law reportedly only answered the mother's mobile phone when they were unavailable or not near the phone. All AWWs interviewed reported being in possession of their mobile phones at all times, and no mothers reported having problems reaching AWWs via mobile phones.

### ***Logistical issues using mobile phones***

None of the participants reported any problems with comprehension related to tone or volume while speaking on the mobile phone. Electricity cuts are common in the study area, but

most participants had inverters at home so reported having no issues with charging their mobile phone batteries. A few participants reported experiencing network problems that led to temporary connectivity issues during the study period – however, these mainly affected women when they travelled outside the study site.

None of the participants reported having issues with the amount of phone credit provided for the study period of 6 weeks (1000 INR; about 15 USD); most of them did not spend the entire amount by the end of the study.

## **Acceptability of the Intervention**

### ***Acceptability of Learning CF messages via Mobile Phones***

Mothers reported that they appreciated learning about what to feed their children via mobile phones: *“From the phone, I came to know about what things should be given to the child. If we can’t come to the AWC, then we can ask the AWW over phone for advice”* (mother #34).

Mothers also reported that mobile phones were a convenient way to remember CF messages promoted in the initial face-to-face group counselling meeting: *“Face to face counselling is not enough... because if I forget something later on, then if I have a phone, I can call her [the AWW] and say that I have forgotten about what to give and what not to give. She will then tell us and we will give the child food accordingly”* (mother #60). Mothers also reported that *“with the mobile phone, the AWW keeps calling to remind us [of CF messages], so then we have it in our mind that we have to give the right foods to the child”* (mother # 48).

AWWs also held the view that mobile phones had an advantage when compared to group counselling visits, since mothers listen more carefully and benefitted from individual attention. One AWW admitted that phone counselling can require more time than a group session, but reported that it was worth it since it benefits infant health: *“More energy is required to make phone calls, but in a meeting, some mothers understand, whereas some don’t but when we explain to each mother individually then they understand more... More time and energy is required [to talk on the phone], but a child’s health is also important”* (AWW #6).

While a few AWWs reported it was boring to repeat similar messages on the phone to different mothers, other AWWs reported liking the repetition, since it helped them memorize the messages. Repetition of CF messages also reportedly increased mothers’ knowledge; one AWW noted *“if we repeat anything, then they [mothers] will understand and remember”* (AWW #11).

A few AWWs reported that they preferred face-to-face counselling, since they disliked not being able to see the mother's expression or to give physical demonstrations over the phone: *"Face to face, things can be explained in a much better way. Like, on the phone, she [a mother] says that she is feeding banana to her child but how can I know whether she is really feeding that or not? But face-to-face, we can verify whether she is feeding that or not... over phone we can't see, but only listen to what she is saying"* (AWW #1).

### **Acceptability of CF Message Content**

Mothers reported willingness to practice most CF recommendations developed for the intervention. Recommendations relating to grains, legumes, fruit, fats and dairy were very popular and widely accepted. However, traditional beliefs were a barrier to some mothers following specific CF recommendations. For example, some foods were seen as aggravating or causing illnesses — one mother reported that her family thought *"the child will get cold and cough or can get pneumonia"* (mother #34) if fed yogurt. Additionally, a few mothers refused to give undiluted milk to their children, due to the belief that it is too thick to be digested and causes diarrhoea. Another mother stopped adding fats to foods when her child was ill, since her mother told her it would increase the child's cold and cough. Though mothers reported feeding egg to their infants, a few mothers retained the view that *"egg is a very hot item and therefore, should be given less during summers"* (mother #17) lest they cause ill health. In addition, a few mothers thought it was unacceptable to feed egg to their infants or even bring the item in their house due to religious or sociocultural taboos.

Mothers also reported difficulty in accessing green leafy vegetables since they were either expensive or difficult to find for sale in summer months. For example, one mother reported only being able to afford feeding her children green leafy vegetables by thinning them with water and grinding them to form a paste. Due to seasonality, mothers reported having more confidence they could feed green leafy vegetables to their infants in the winter when the vegetables are more readily available.

Additionally, a few mothers mentioned cost as a barrier to buying fruit and eggs. One mother reported that fruit was a luxury she could only afford to buy once or twice a month. Another mother reported not buying eggs since she could buy vegetables for her whole family with the same amount of money: *"One egg cost Rs. 5 and two eggs are Rs. 10. What would I do if my older daughter also asked for egg? Also, I can make more vegetables with Rs.10"* (mother #53).

AWWs reportedly tried to overcome barriers to implementing CF messages by counselling mothers to feed their infants ghee, undiluted milk, eggs, and fruits by emphasising the foods' beneficial properties to their infants' growth and immune system. When mothers complained about the expense of legumes, one AWW tried to convince mothers that feeding the child well was an investment in their health, and would save them money in doctor's fees in the long-term: *"They [mothers] said that rajma [red kidney beans] and chana [chickpeas] are so expensive, that how can we feed this to the child? I tell them if your child gets sick, then you will spend about Rs.1000 for the doctor. But if you feed good things at home, then the child will not fall sick and you won't have to spend money"* (AWW #8).

AWWs reported that the CF recommendations were acceptable and feasible for promotion with mothers. However, some AWWs recognised that mothers could not follow CF recommendations promoting foods that were unavailable in the villages; going to the market was a barrier to procuring some foods. One AWW noted the value of promoting foods that are available close to households and can be prepared at home: *"The advice which we gave mothers regarding food, all of these are absolutely correct. They [mothers] say that they are very poor and can't give so much food to the child. But we tell them that whatever you prepare on regular basis be it rice, bread, milk recipes or whatever is available at home and affordable can be given to the child. Feed the child while watching television or playing with him/her"* (AWW #9).

### ***Family, Community member and ICDS attitudes to the Intervention***

Mothers reported experiencing positive attitudes from their husband, family and neighbours toward the intervention, though a few mothers reported having family members question whether mobile phones would distract from their household work. AWWs described they sometimes had to speak to gatekeepers such as mothers-in-law and husbands on the mobile phones before speaking to mothers, but once they had this conversation, the family was supportive of the intervention.

All AWWs reported having full support for the study from their family, ICDS supervisors and colleagues. One AWW even reported her supervisor was pleased to be able to contact both her and mothers in the study setting if needed on the mobile phone: *"She [supervisor] said that it is very good that you have got the phone. Now the weather is so hot, so it's good you don't have to walk down to their [mothers'] homes. You can talk to them over the phone and we can also talk to you and the mothers when we have some work"* (AWW #12).

A few participants reported experiencing envious reactions from community members over not being included in the study or given a mobile phone.

## **Impact of the Intervention**

### ***Impact on Infant Diet***

Mothers reported greater confidence in introducing new foods to their infant's diet, and increases in their infant's diet diversity and quantity of food intake after receiving the intervention. Mothers also reported feeling that their child started to develop good eating habits as a result of the study, which would lead to improved health: *"This [intervention] is good. The child stays healthy. I have another elder son. At that time [when he was young], there was no such [nutrition] advice given. So we didn't give him milk, yogurt, buttermilk. Now he has grown up but he still doesn't take milk, yogurt and buttermilk. So if I start giving this child from now on, then it will be good for him"* (mother #5). AWWs reported that mothers had improved their infants' diets by including foods promoted in the study. Moreover, AWWs reported that mothers not only increased diversity of the diet, but also the quantity and quality of food fed to infants. They reported that most mothers were no longer diluting milk with water, and were feeding it to their infants in greater quantities.

### ***Impact on Infant Well-being***

Mothers reported that infants were less *"irritated"* (mother #4) than before and ill less frequently compared to children who did not receive the intervention: *"My neighbour's child gets sicker.... and the health of my child remained very good. Now he also gets irritated less. Earlier, he used to remain very agitated. So I tried to give him different foods. And now he has discovered different tastes, his mood has changed and his health has also improved. Now he is always smiling. If a child remains hungry, then he will always cry"* (mother #4). Some mothers also reported improved weight gain for their infants.

### ***Impact on Maternal and AWW Resources for Childcare***

Mothers reported that the intervention helped them value their infants' health and focus more attention on them by more effective time management and balancing other household responsibilities: *"From this programme, I learned that we all have household work, but that we should also take care of our child and give proper food to the child"* (mother #25).

None of the participants reported negative effects of the intervention.

## **Participant Recommendations to Improve the Intervention**

All mothers and AWWs reported they liked the intervention and wanted it to continue. They suggested a number of modifications to improve the intervention.

### ***Provide Financial Incentives***

Given that cost was a reported barrier to using mobile phones, both AWWs and mothers reported wanting ICDS to continue implementing the intervention and allocating money for mobile phone credit: *“If the government gives money then we will [deliver the intervention via mobile phones], otherwise what can we do with our own money?”* (AWW #3).

A few AWWs also reported that monetary incentives for mobile phone calls would motivate them to work harder and make them feel appreciated. One AWW even suggested giving additional money to mothers for food, even if it meant allocating less money toward mobile phone credit in the intervention.

### ***Expand Intervention Reach and Content***

A few mothers and AWWs suggested expanding the intervention’s reach and content to target vulnerable mothers and children, in addition to including more mothers of children of varied age groups: *“We will feel good if we will be able to talk to the mothers. Our time would be saved. Otherwise we have to call them repeatedly to visit the centre and sometimes they are busy and are not able to come. But with this phone, our time would be saved as well as our message would also reach them”* (AWW #11).

Mothers and AWWs also suggested that intervention messages should be expanded to include dietary recommendations for younger and older children, since CF messages promoted in the intervention were specific to 9-11 month old infants. One mother also asked for individual dietary plans for ill infants who require personal attention: *“There are many women who say that their child is weak and their child is not growing, some messages should be developed for such special categories so that their children can gain energy, grow faster and become healthy”* (mother #20).

One mother also suggested training AWWs to improve their communication with illiterate mothers by using local dialects, and by giving them bowls with markings up to half or 1/3 to help explain measurements of food quantities to be fed to infants.



In addition, a few AWWs reported that it would be beneficial to include physical demonstrations of CF messages promoted in the intervention, including recipe preparation and showing mothers the appropriate quantities of food to be fed to infants. A few AWWs also expressed interest in expanding counselling messages to include other health messages, e.g. immunization and neonatal health.

All mothers and AWWs approved of including mothers-in-law, but some also suggested including other household members who care for infants, such as sisters-in-law or cousins. Overall, mothers were positive about including their husbands in the intervention. AWWs were divided in their opinion on whether to include husbands – a few AWWs thought it would be useful since husbands often buy groceries and have a strong influence on the household, whereas other AWWs reported it was unnecessary since husbands are usually not at home or involved in feeding infants.

### ***Expand Intervention Dose***

Both AWWs and mothers reported that the intervention should be implemented beyond the 6-week pilot testing period. They also reported that both face-to-face group counselling meetings and mobile phone calls should continue after the initial group counselling session has taken place. AWWs and mothers suggested a minimum of weekly mobile phone calls, and having group counselling meetings every 2-4 weeks.

### ***Ensure Access to Mobile Phones***

AWWs expressed frustration with not being able to reach mothers when they called, or of husbands taking ownership of mobile phones. One AWW recommended that going forward, steps should be taken to ensure the *“phone should be with the mother only and nobody else”* (AWW #1) by emphasising the principle with MILs, husbands, and other senior family members.

## **DISCUSSION**

### **Key findings**

Findings from this study suggest that with mobile phones, AWWs were now able to reach almost all mothers with CF messages, and mothers were now able to reach AWWs when they had any CF queries. From the AWWs and mothers’ perspectives, our mHealth intervention to improve CF practices was convenient, feasible and acceptable. The intervention helped to

tackle problems AWWs and mothers had previously experienced in delivering and receiving CF counselling due to heavy workloads, distance and sociocultural beliefs. Concerns raised prior to the study about participants not being able to charge mobile phone batteries, and mobile phones being lost, stolen or appropriated by family members were not experienced. CF messages developed for the intervention were reportedly feasible and acceptable to all AWWs. Mothers and AWWs reported increases in infant diet diversity and quantity, and a reduction in diluting milk with water before feeding it to infants. Although the intervention was developed taking into account issues related to cost, access, and traditional cultural beliefs, these barriers hindered a few mothers from feeding green leafy vegetables, fruit and eggs to their infants.

### **Strengths of the study**

This study has several strengths. There are no evaluations to date on using mobile phones with mothers to improve infant diet, so this is the first intervention examining how an increasingly common technology in lower and middle income countries – mobile phones– could be used to improve CF practices. The mHealth intervention was designed to take into account the study setting’s network connectivity, socioeconomic constraints and literacy levels by using the most basic mobile phone function – telephone calls – rather than other mobile phone functions that are more expensive and rely on participant literacy and stronger mobile phone and data networks.

The mHealth intervention was designed to strengthen components of an existing governmental nutrition program, rather than as a separate program that would compete with health resources and infrastructures already in place. The intervention was tailored to the study setting’s sociocultural context by encouraging mothers-in-law to participate after formative research in the study site showed that they are the de facto head of the household while men are away working, and have great influence over CF decisions (Chapter 5). CF messages for the intervention were also developed using the Optifood tool, which takes into account the nutritional requirements of infants, in addition to local food cost, availability and consumption patterns.<sup>26</sup>

CF messages including barriers and motivating statements were developed with inputs from local stakeholders, service providers, ICDS supervisors, AWWs, mothers and mothers-in-law (Chapters 4 and 5). Barriers and motivating statements utilised 20 behaviour change techniques related to Michie’s behaviour change wheel, aiming to target sociocultural beliefs

relating to CF in the study setting.<sup>29</sup> These behaviour change techniques aimed to change maternal CF behaviour in the intervention by focusing on providing information, goal setting, action planning, problem solving, planning social support, stimulating anticipation of future rewards and prompting reviews, feedback and rewards related to behaviour change.<sup>30</sup>

### **Limitations of the study**

Although mothers and AWWs' reports of the pilot study were very positive, it is possible that this could be due to all participants being given a mobile phone and the relatively short 6-week duration of the intervention. Participants may have been less enthusiastic of the intervention if they had been asked to use their own mobile phones and mobile phone credit. It is unknown if mothers would have fed their infants greater or lesser diversity and quantity of foods promoted in CF recommendations if the study had been tested over a longer period of time. The novelty of mobile phones may have worn off over time if they had been asked to deliver or follow CF messages for more than 6 weeks. Alternatively, a longer intervention with more reinforcing CF messages may have increased the intervention's impact. In addition, this study did not have a control group, and uncontrolled studies tend to overestimate effects.

AWWs in this study were only asked to reinforce CF messages via mobile phones with five mothers. It is possible that AWWs may have different views on the intervention's effect on their workload if they had been asked to test mobile phones with all mothers of young infants in their respective villages.

### **Strengths and limitations in relation to other studies**

To our knowledge, this is the first intervention to use mobile phones for counselling to improve CF practices. However, results from this study suggesting that mothers gained CF knowledge and fed their infants greater diversity and quantity of foods are consistent with outcomes of other multi-faceted interventions targeting mothers with evidence-based, context-specific messages through group and individual contact, resulting in improved CF practices.<sup>25, 31-42</sup> This intervention confirms results from other studies that mobile phones can be a powerful and effective tool for health communication interventions.<sup>19-21, 43</sup>

Results from this study confirm the importance of including family members in child nutrition interventions, and are consistent with other studies demonstrating that in non-Western societies, child health practices and attitudes are strongly influenced by members of the extended family and by age, experience and gender-specific roles of household members<sup>44, 45</sup>. Our findings contrast with other study findings that despite being "heads of the household,"

husbands do not have great influence or interest in household nutrition-related matters.<sup>45-48</sup> Husbands of mothers in our study were interested in the intervention, though it is unclear if they were more interested in mobile phone technology or CF messages.

Findings from interviews with mothers also confirm ICDS program evaluation results stating that home visits are often neglected by AWWs<sup>9,10</sup>. Results from this study suggest that in most cases, if mothers could not visit AWCs, then they did not have any contact with AWWs. Reports of AWWs asking for financial incentives to counsel using mobile phones is expected given an evaluation's finding that AWWs do not have a stable income, and are provided with a small monthly stipend whose payment is often delayed.<sup>9</sup> It is unclear if mobile phone credit alone would be a sufficient incentive for AWWs to provide CF reinforcement via mobile phones.

### **Meaning of the study – possible mechanisms of action**

It is not possible for qualitative studies to robustly elucidate mechanisms of action in an intervention. However, qualitative studies can describe participants' perspectives on how they thought the intervention worked. A key result from this study suggests that using mobile phones decreased the AWWs' workload and allowed nutrition education to fit into the mother's heavy daily workload. Mobile phones were reportedly a convenient and time-saving way for mothers to contact AWWs for CF and other queries without compromising their duties at home, and for AWWs to reinforce CF messages with mothers, especially with those who would otherwise have little to no contact with AWWs. Moreover, results suggest that mothers desire increased knowledge and support from AWWs to improve infant feeding practices, and that mobile phone use in this intervention addressed, and potentially even generated demand for CF counselling.

Though barriers and motivating statements had been developed to address beliefs toward specific foods (Chapter 4), it is unsurprising that some mothers retained traditional beliefs toward feeding egg to infants. Since the pilot study took place over the summer, perhaps mothers retaining the view that eggs are "hot" would have fed this food to their infants in the winter. Seasonality was a barrier to feeding green leafy vegetables, since they are less available and more expensive in summer months.

Reports that AWWs "felt good" when contacted by mothers via mobile phones suggest the possibility that mobile phones may have added prestige, job satisfaction and recognition for the AWW, potentially enhancing their motivation to provide CF support to mothers.

Evaluations of ICDS have shown that AWWs have a very high workload and that their job performance is affected by demotivating factors— for example, AWWs are generally held in very low regard in their communities, and are paid highly irregularly.<sup>10, 49</sup>

Although most mothers reported having husbands who were supportive of the interventions, it is possible that some husbands unintentionally hampered CF message delivery by answering phone calls.

Both mothers and AWWs also suggested the intervention should increase the frequency of face-to-face and mobile phone contact. These recommendations are likely a result of perceived benefits experienced by infants, and of mothers and AWWs enjoying being in touch with each other after reportedly having little to no contact before the study.

### **Implications for future interventions**

Study findings suggest that mobile phones allowed mothers to receive CF advice, and AWWs to provide it more easily than previously. Currently, AWWs mainly reach older children and their mothers with ICDS services,<sup>9</sup> so study findings also show that mobile phones may potentially be a way for them to reach more mothers of young infants.

Some health benefits of the intervention reported by mothers seem implausible over such a short time period. However, it is possible that feeding infants milk not diluted with water could have resulted in fewer cases of diarrhoea, and hence improved infant health in the short-term. Motivating statements used by AWWs in the intervention to aid the promotion of CF messages addressed the common practice in the study setting of feeding infants small quantities and varieties of foods. It is possible that mothers feeding infants greater quantities and variety of foods during the intervention led to infants feeling more satiated and crying less frequently.

Mothers-in-law were generally supportive of the intervention, suggesting it would be beneficial to include them in the development and implementation of future CF interventions. It is possible that future CF interventions would also benefit from including husbands. Given that cost was a reported barrier to using mobile phones, it is unsurprising that participants reportedly wanted ICDS to continue implementing the intervention and allocate money for mobile phone credit.

Participant views on some CF messages also suggest a potential need to customise CF messages based on food seasonality and availability.

### **Summary and implications for future research**

Our intervention shows promise in improving CF practices of young infants. Results suggest that using mobile phones allowed mothers to receive reinforcing CF messages in a convenient and time saving way from AWWs. Mobile phones also allowed AWWs to reach mothers who previously had trouble going to the AWC, and increase contact with those they already saw in person. The majority of participants reported having support of community and family members for the intervention, though some AWWs reported husbands as a barrier to reaching some mothers on mobile phones. Nearly all participants retained ownership of mobile phones over the 6-week period, and none of them were lost or stolen. These findings lay the groundwork for testing the intervention in a randomised controlled trial. If proven effective, the intervention has implications for future ICDS and CF programming and research strategies. Given the spread of mobile phone technology worldwide, the intervention may also have potential to be tested and implemented in other settings.

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## TABLES

**Table 1: Sociodemographic characteristics of mothers and their household**

	<i>n</i> =24
Infant age (months), mean $\pm$ SD	9.9 $\pm$ 1.1
Sex of infant – female, <i>n</i> (%)	6 (25.0)
Proportion of infants breastfed, <i>n</i> (%)	23 (95.8)
Mother's age, mean $\pm$ SD	24.4 $\pm$ 3.2
Mother's marital status, <i>n</i> (%)	
Married	24 (100.0)
Years of education completed, mean (SD)	6.6 (4.4)
Mothers who can read and write, <i>n</i> (%)	18 (75.0)
Total number of household members, mean (SD)	7.3 (3.0)
Number of children <5 years of age in households, mean $\pm$ SD	2.0 $\pm$ 0.8
Occupation of father, <i>n</i> (%)	
Private service	7 (29.2)
Daily wage	6 (25.0)
Self-employed	5 (20.8)
Farming	5 (20.8)
Does not work	1 (4.2)
Annual household income in Indian Rupees, mean $\pm$ SD	115608.3 $\pm$ 190033
Household religion, <i>n</i> (%)	
Hindu	24 (100.0)
Households with electricity, <i>n</i> (%)	24 (100.0)
Main source of drinking water for household, <i>n</i> (%)	
Tube well, bore hole or hand pump	14 (58.3)
Piped water into the house	5 (20.8)
Public tap or stand pipe	3 (12.5)
Bottled water	2 (8.3)
Main material of household's roof, <i>n</i> (%)	
Loosely packed stone	22 (91.7)
Reinforced cement concrete	2 (8.3)
Toilet facility mother uses, <i>n</i> (%)	
Flush or pour flush toilet	16 (66.7)
No toilet; i.e. uses open space or field	8 (33.3)

**Table 2: Sociodemographic characteristics of Anganwadi Workers**

	<i>n</i> =12
Age, <i>n</i> (%)	
≤ 25 years	4 (33.3)
26-45 years	6 (50.0)
> 45 years	2 (16.7)
Years of education, mean ± SD	11.7 ± 2.3
Years of AWW work experience, <i>n</i> (%)	
≤ 1 year	5 (41.7)
2-10 years	1 (8.3)
11-20 years	1 (8.3)
> 20 years	5 (41.7)
AWWs with formal nutrition training, <i>n</i> (%)	6 (50.0)
AWWs with ICDS training, <i>n</i> (%)	12 (100.0)
AWWs with refresher ICDS training, <i>n</i> (%)	8 (66.7)
Participated in refresher training in:	
Past 1-6 months	1 (8.3)
7-12 months	1 (8.3)
More than 1 year	6 (50.0)
No refresher training	4 (33.3)
Frequency of seeing ICDS supervisor, <i>n</i> (%)	
Once/month	5 (41.7)
2-3 times/month	7 (58.3)
Duration of average work day in hours, mean ± SD	4.8 ± 1.3

## ONLINE SUPPLEMENTAL MATERIAL

### Appendix 1: Barriers and Motivating Statements to Aid Promotion of Dietary Recommendations in mHealth Study

	Barrier	Motivating Statement
1.	Mother has stopped breastfeeding	Try to breastfeed your child until 2 years of age. If you have stopped breastfeeding for a short while (2 to 3 weeks ago), then try to initiate breastfeeding again
2.	I am pregnant, so cannot breastfeed my infant	You can still breastfeed while pregnant. You only need to eat a little more food so that you, your unborn child, and your child get enough nutrition.
3.	My infant cannot eat so much food	<p>We know that mothers in this area believe that in order for children to grow, they require very little amount of complementary food. Mothers in this area do not actively feed children (and if the child eats on his/her own, s/he consumes very small quantities of food). This is why mothers feel that the child's stomach is full and s/he does not require additional food. If children are fed properly (e.g. if mother actively feeds the child with her own hand and encourages the child to eat while feeding), then they are able to eat a greater quantity of food.</p> <ul style="list-style-type: none"> <li>- Increase amount of food fed to child daily by 1 big spoon</li> <li>- Feed child food from a separate dish, and ensure that s/he eats all the food in the dish</li> <li>- If the child does not eat the food at one sitting, then make sure to feed him/her a few times throughout the day</li> </ul>
4.	If you feed an infant too much food, then it is not digested	Growing children need increasing amounts of food, and they are easily able to digest it as well. Children get diarrhoea when we do not wash our hands before feeding them, or when we feed them stale or food that is kept in the open, or has not been stored properly. Anyway, children in this area often get diarrhoea. However, if you feed the child yourself properly, then the child will not become weak – s/he will have satiety, will not be irritable, will sleep well, and not bother you while you work.
5.	When my child becomes a little older, then s/he will	If you start adding complementary foods to your child's diet after 6 months of age, then the child is strong and healthy, does

	start eating on her/his own	not repeatedly fall ill, and does well in school later on. You should try to feed your child with your own hand, and with love and affection.
6.	If you feed the child too often, then he develops bad habits and starts asking for food repeatedly	At this age, children are very active and grow quickly. This is why they become hungry quickly if they are not fed the required amount of food for their age. This is also why they ask for food repeatedly, when you think they are developing bad habits. If you feed your child the recommended amount of food, then his/her stomach will be full and s/he will easily play, sleep and not bother you.
7.	My child does not eat; he spits food out	<ul style="list-style-type: none"> <li>– This is common when a child is eating a new food. The child will develop a taste for new foods and start liking them if s/he is fed it for a few days</li> <li>– Try to feed your child playfully and with encouragement</li> </ul>
8.	If I feed my child grains, then his/her stomach will stick out	This only happens when children do not get complementary foods at the correct age, or when they are not given a balanced diet once they start eating complementary foods. When this happens, then the child's arms and legs become thin, and the stomach looks very big in comparison.
9.	Chickpeas, kidney beans, green leafy vegetables and grapes can get stuck in the child's throat	<ul style="list-style-type: none"> <li>– Thoroughly cook and lightly mash chickpeas and kidney beans before feeding to the child</li> <li>– Finely chop, thoroughly cook and lightly mash green leafy vegetables before feeding to the child</li> <li>– Lightly mash grapes before feeding to the child</li> <li>– Be sure to be near the child and supervising him/her when feeding</li> </ul>
10.	Green leafy vegetables are less available in the summers locally, and are available in the bigger vegetable markets that are farther away from the house. They are also more expensive in the summers.	<ul style="list-style-type: none"> <li>– Try to feed green leafy vegetables to children whenever you manage to get them. They are extremely beneficial for children.</li> </ul>

11.	Chickpeas and kidney beans create gas in the child's stomach	<ul style="list-style-type: none"> <li>– If food is freshly prepared and fed, then gas is not created in the stomach</li> <li>– Children are very active. They start playing after eating, and easily digest food.</li> </ul>
12.	We cook lentils at home, not chickpeas or kidney beans	Definitely continue feeding lentils to your child. Feed your child chickpeas and kidney beans whenever they are cooked in the house – try to cook chickpeas or kidney beans at least once per week. Feeding the child chickpeas and kidney beans makes your child stronger, more active, and gives his/her body the strength to fight illnesses.
13.	Rice, bananas, yogurt and buttermilk are “cold,” so make the child ill	No foods items are “hot” or “cold.” Children often have illnesses such as fever and cough. It is food that gives children the strength to fight illnesses.
14.	Children cannot digest ghee (clarified butter) or oil	Ghee and oil give growing children strength. Ghee and oil also make the food tastier, so the child eats more.
15.	Adding ghee or oil to the child's food makes the child's bones greasy/ stunts height/ solidifies in the child's body	<ul style="list-style-type: none"> <li>– Ghee and oil give strength to the child. Children are very active – they run around and play after eating, and easily digest food.</li> <li>– Ghee and oil only sit in one's body when the body is not active. For example, oil solidifies in a sewing machine if it is not used, but if a sewing machine is greased with oil and used, it works very well.</li> </ul>
16.	A child cannot digest milk that has not been diluted with water	Diluting milk with water makes it less nutritious. Children can easily digest undiluted milk. Drinking undiluted milk does not cause constipation or diarrhoea in children. Children often get diarrhoea if water mixed into milk have germs that go into their body and cause illness. Giving diluted milk makes the child's stomach full, but reduces the amount of nutrients that the child needs to grow well. Instead of water, mash <i>roti</i> (a whole wheat flatbread), rice, or bread into milk and give it to the child.
17.	We do not cook eggs in the house	<ul style="list-style-type: none"> <li>– Try to explain to your family members that eggs provide a lot of strength, from which children can grow well.</li> <li>– You can keep a separate pot in the house to prepare eggs, or</li> </ul>

		buy it already prepared from the market
18.	Children cannot digest eggs	<ul style="list-style-type: none"> <li>– Children are very active. After eating, they play and are able to digest foods easily.</li> <li>– Diarrheal is caused by poor hygiene and sanitation. A child will not get diarrhoea if hands are washed when preparing and feeding food to the child.</li> </ul>
19.	Eggs should not be fed to girls	Menstrual cycles start for each girl – some start their periods early, and some start them late. Feeding egg to girls does not in any way affect when a girl’s menstrual cycle starts. In fact, egg increases strength.



## 8. SUMMARY & CONCLUSIONS

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### **PREFACE**

Findings of each research component of this thesis have been discussed comprehensively in each of the five papers in Chapters 3-7. The structure of each papers' discussion section is based on guidance from the British Medical Journal,<sup>1</sup> and presents each research sub-study's principal findings, strength and weaknesses of the study, strengths and weaknesses in relation to other studies, possible mechanisms of action and implications for researchers and policymakers, and unanswered questions and future research recommendations.

This final chapter synthesises findings across study objectives, explores implications of study findings for improving CF practices in Indian infants and presents the overall strengths and limitations of the thesis. Finally, recommendations for further research are made.

## SYNTHESIS OF PRINCIPAL FINDINGS

The main findings of the research presented in this thesis aiming to improve CF practices for 9-11 month old infants in a rural area in Haryana State, India are summarised in Figure 8.1 below. **Chapter 3** presents findings from the study's first objective – to use Optifood to create and enhance existing FBRs to improve infant CF practices. Linear programming analyses in Optifood showed that local food-based approaches could not meet recommended nutrient intakes for seven “problem nutrients” (i.e. iron, zinc, folate, thiamine, niacin and vitamins A and B6). Two sets of FBRs – one with four messages (i.e. m-FBRs) and one with seven messages (i.e. s-FBRs) could ensure adequacy (i.e.  $\leq 65\%$  RNI) using the fixed cutoff point approach for six nutrients in infant diets (i.e. calcium, thiamine, niacin, folate and vitamins B12 and C). s-FBRs were formulated to fit within existing governmental FBRs, and were subsequently selected for further testing with mothers of young infants in the study before being promoted in a mHealth intervention. Results of the study's second objective, presented in **Chapter 4**, show that although infant diet diversity and dietary intakes of energy and 13 nutrients significantly increased over the week-long testing period ( $p < 0.05$ ), nutrient densities of infant diets for vitamin C and all the “problem nutrients” identified in Objective 1 remained below the average desired values at both baseline and endline.

The development and testing of s-FBRs in this setting show that although local food-based strategies can improve infant diet diversity and diet quality to a certain extent, dietary intakes of iron, zinc, folate, thiamine, niacin and vitamins A, B6 and C remain well below the recommended values. These findings are consistent with Indian data reporting Vitamin A and iron deficiencies in infants in Haryana State,<sup>2</sup> and Indonesian and Cambodian studies using linear programming analyses to report that iron, zinc, folate, thiamine, and niacin were “problem nutrients” in infant diets.<sup>3,4</sup> Although Optifood analyses did not identify vitamin C as a “problem nutrient,” infants' median intakes of this nutrient at the end of the s-FBRs testing period remained well below the value recommended by WHO/FAO (4.1 mg/day vs. 30 mg/day).<sup>5</sup> Despite significant increases in mothers reporting feeding fruit to infants at endline compared to baseline (40.0% vs. 5.7%,  $n=35$ ), additional analyses show that only 22.9% of mothers ( $n=8$ ) reported feeding vitamin C-rich fruit at endline. These data could possibly explain low vitamin C intakes since Optifood analyses showed that vitamin C-rich fruit were critical in ensuring adequacy for this nutrient in infant diets.

**Chapter 4** also presents findings from the study's second objective identifying barriers and facilitating factors to promoting s-FBRs, which AWWs subsequently used with mothers in the

mHealth pilot study. Mothers reported a number of barriers relating to CF quantities, variety, textures, digestibility, cost, availability, accessibility, and traditional and religious beliefs, which were used to develop motivating statements to aid the promotion of s-FBRs. It is possible that these motivating statements influenced the increase in dietary diversity over the mHealth pilot testing period. However, findings from the mHealth pilot test (**Chapters 6 and 7**) report that some mothers were unable to feed their infants fruit, green leafy vegetables, and egg at baseline, and linear programming analyses presented in **Chapter 3** identified vitamin C-rich fruit as a key nutrient-dense FSG in infant diets. Together, these findings signal the need for further strategies to promote nutritionally advantageous foods in this setting.

The study's third objective presented results from FGDs and an intervention development workshop that were used to inform the design of a mHealth intervention with an initial face-to-face group counselling meeting, followed by mobile phone calls to reinforce CF messages (**Chapter 5**). FGD findings showed that although many mothers did not receive CF counselling from AWWs due to a number of factors relating to sociocultural issues, distance, and high work load, all mothers and AWWs reported a desire to receive and provide CF counselling, respectively, in order to improve infants' dietary intake. Participants were supportive of using mobile phones to reinforce CF messages promoted in face-to-face meetings; however, the provision of mobile phone handsets and credit to participants was key since money was a barrier to the use of mobile phones for CF counselling.

Findings that mobile phones should only be used for reinforcement of CF messages or emergency feeding queries indicate the value that participants place on face-to-face contact with AWWs (**Chapter 5**). However, given that most mothers and mothers-in-law reported lack of CF support from AWWs, compared to face-to-face counselling in home visits, mobile phones are possibly a more convenient way to reach mothers with CF messages to improve their infants' dietary intake. Moreover, the use of mobile phones as an additional channel to deliver CF messages to mothers has potential to have an impact on CF knowledge and feeding practices. These findings are consistent with another study in the same study setting that showed that contacting mothers at multiple opportunities resulted in improved CF practices.<sup>6</sup>

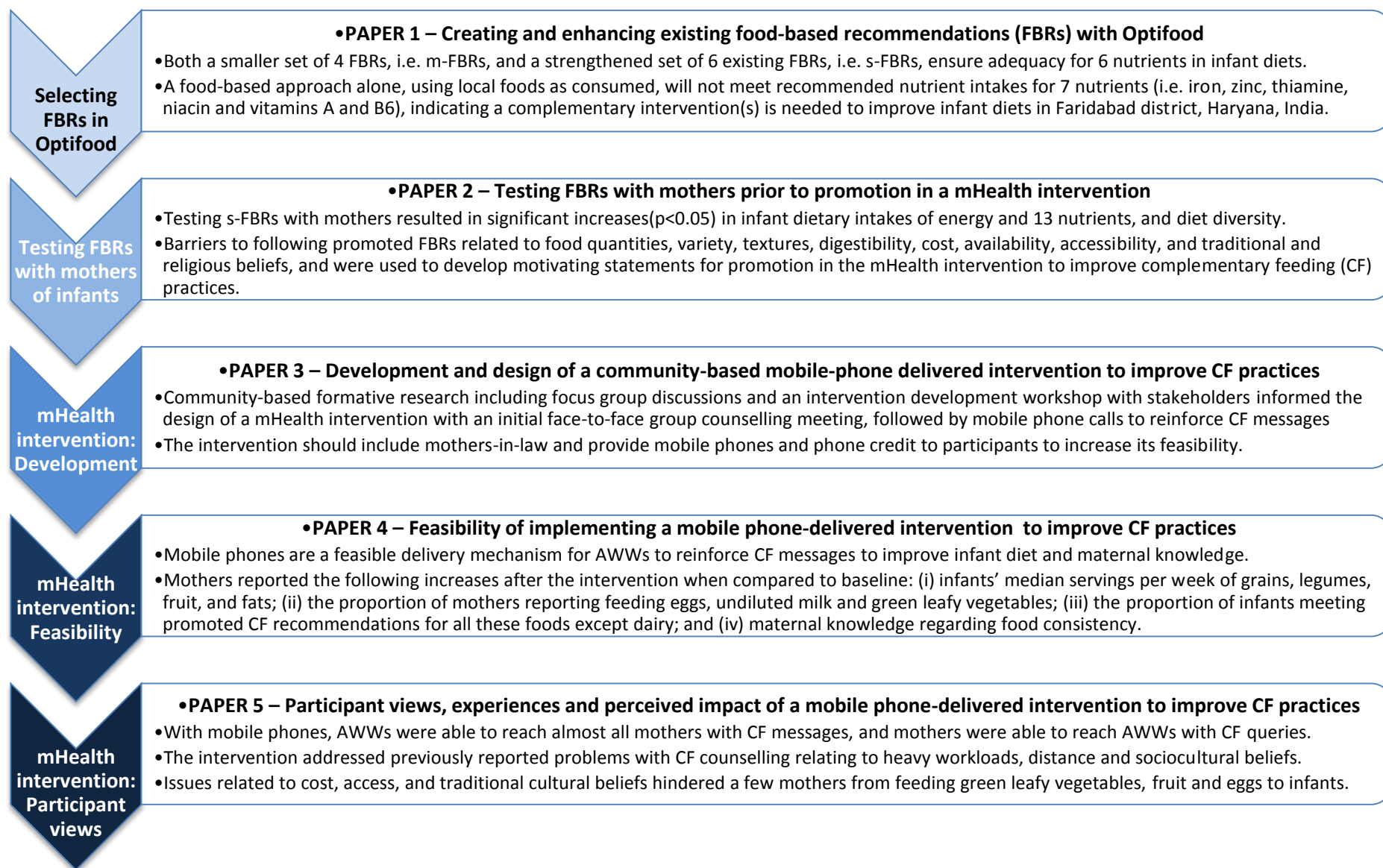
Taking into account AWW and mothers' positive attitudes toward the potential use of mobile phones for CF counselling (**Chapter 5**), it is unsurprising that key findings from the study's fourth objective to assess the feasibility of the mHealth intervention in a pilot test suggest that mobile phones are a feasible delivery mechanism for AWWs to reinforce CF messages to

almost all mothers in order to improve infant diet and maternal knowledge (**Chapter 6**). Results from the study's fifth, and final objective describing participant views, experiences and perceived impact of the mHealth intervention suggest that with mobile phones, AWWs were now able to reach almost all mothers with CF messages, and mothers were now able to reach AWWs when they had any CF queries. From the AWWs and mothers' perspectives, the mobile phone-delivered intervention to improve CF practices was convenient, feasible and acceptable. The intervention helped to tackle problems AWWs and mothers had previously experienced in delivering and receiving CF counselling due to heavy workloads, distance and sociocultural beliefs (**Chapter 7**).

Additionally, both qualitative and quantitative data from the mHealth pilot study suggest that the mHealth intervention shows promise in improving infant diets (**Chapters 6 and 7**). CF messages developed for the intervention were reportedly feasible and acceptable to all AWWs. Mothers and AWWs reported increases in infant diet diversity and quantity, and a reduction in diluting milk with water before feeding it to infants. According to mothers' self-report, the following increased after the intervention when compared to baseline: (i) infants' median servings per week of grains, legumes, fruit, and added fats; (ii) the proportion of mothers reporting feeding eggs, undiluted milk and green leafy vegetables; (iii) the proportion of infants meeting promoted CF recommendations for all these foods except dairy; and (iv) maternal knowledge regarding food consistency. Although the intervention was developed taking into account issues related to cost, access, and traditional cultural beliefs, these barriers hindered a few mothers from feeding green leafy vegetables, fruit and eggs to their infants.

Concerns raised prior to the pilot study about the feasibility of using mobile phone technology in this study setting to reinforce CF messages were not experienced. Mothers and AWW's mutual lack of faith in each other for compliance with mobile phone counselling reported in **Chapter 5** were largely unrealised. With the exception of one AWW who had to remind a mother to answer her phone and call another mother multiple times to reach her, all other participants reported no problems in reaching each other via mobile phones. During the pilot study, there were no reports of adverse events such as lost, stolen or sold mobile phones, not being able to charge mobile phones, or participants' husbands or other family members appropriating mobile phones for personal use (**Chapters 6 and 7**).

**Figure 8.1: Summary of the main findings**



## **STRENGTHS AND LIMITATIONS**

Most strengths and limitations of the Optifood and mHealth sub-studies have already been discussed in the results chapters of the thesis (**Chapters 3-7**). The overall considerations are presented below.

### **Overall strengths**

Research findings presented in this thesis make an important contribution to the dearth in evidence on the use of linear programming and mHealth approaches to strengthen governmental nutrition messages and CF counselling strategies. The mHealth intervention is the first reported research study to evaluate the feasibility of governmental health workers using mobile phone calls to reinforce CF messages with mothers of young infants. The intervention was designed to strengthen counselling within the existing governmental ICDS framework, instead of creating a competing programme. Rather than creating a new set of FBRs, the study team used Optifood to enhance existing FBRs promoted in the study setting by emphasising specific foods; doing so built on AWWs' and mothers' knowledge of existing FBRs and was in line with the ICDS programme's nutrition education strategy.

Recent evidence suggests successful CF behaviour change interventions in developing countries use formative research to identify cultural barriers and enablers to optimal feeding practices to shape the intervention strategy and to formulate appropriate messages and mediums for delivery.<sup>7</sup> Both the design and piloting of the mHealth intervention and the FBRs it promoted were based on Optifood analyses and extensive formative research with key community members, ICDS staff and other stakeholders. AWWs and mothers of young infants in the study setting provided key insights to implementation of the mHealth intervention and promotion of s-FBRs in this setting. The intervention design was based on a community-based participatory approach to formative research engaging mothers, mothers-in-law, AWWs, their supervisors and other key ICDS and local governmental stakeholders in the study setting.

This thesis uses mixed methods to triangulate data and investigate the feasibility of promoting a set of FBRs in an intervention using mobile phones to reinforce CF messages. The study aimed to answer the research objectives from a number of perspectives by using varied qualitative and quantitative data collection methods. Dietary data collection tools enabled the quantitative assessment of s-FBRs' and the mHealth intervention's impact on infant diets. Additionally, qualitative findings in both the Optifood and mHealth sub-studies of this thesis

enabled a nuanced understanding to the promotion of s-FBRs and implementation and perceived impact of the mHealth intervention in this setting.

Another strength of this thesis lies in its use of behaviour change strategies to influence infant CF practices. It is widely recognised that changing dietary behaviour is complex, and that personal, sociocultural and environmental expectations and experiences can often have a greater influence on dietary choices than health motivations alone.<sup>8,9</sup> Barriers and motivating statements developed to promote s-FBRs in this study utilised 20 behaviour change techniques from Michie's behaviour change wheel. The aim was to target sociocultural beliefs relating to CF and change maternal CF behaviour by focusing on providing information, goal setting, action planning, problem solving, planning social support, stimulating anticipation of future rewards and prompting reviews, feedback and rewards related to behaviour change.<sup>10</sup>

### **Overall limitations**

This thesis has a number of limitations. The lack of a control group in the mHealth pilot study makes it difficult to attribute observed changes to the intervention.<sup>11</sup> Moreover, results of uncontrolled before and after studies can overestimate the effects of interventions.<sup>12</sup>

Although most mothers reported implementing FBRs in the week-long trial to test s-FBRs and the 6-week mHealth pilot study, adherence to CF practices may diminish over a longer time period. Response bias also may have resulted in mothers over-reporting their willingness to try and adhere to s-FBRs. The small sample size of the week-long trial to test s-FBRs (n=36) and the 6-week mHealth pilot study (n=60) also limits the power of the study to analyse changes compared to baseline. In addition, study findings cannot be generalized to other areas because these FBRs and the mHealth intervention were only tested in one rural area of a district in a Northern Indian state.

Seasonality also plays a role in this study's limitations. Infant dietary data to define Optifood model parameters were collected in the winter months, and FBRs based on these data were promoted in mHealth intervention in the summer months. Seasonality explains, in part, why green leafy vegetables identified as a nutrient-rich FSG in the winter might be difficult to promote with some mothers in the summer. However, given the low diet diversity of infants in Haryana – fewer than 1 in 5 breastfed infants aged 9-11 months are fed from 3 or more food groups<sup>2</sup> – it is unlikely that the food frequency questionnaire did not capture foods commonly consumed by infants in the study setting. s-FBRs were only tested in one season (i.e. summer),

so it is unknown if mothers would have encountered additional barriers to implementing them during other seasons.

Another limitation of this thesis is its reliance on self-reported mobile phone use data. Although the study planned on giving participants post-paid mobile phone connections which would have allowed the mobile phone company to keep a record of all phone usage, the majority of mothers and AWWs in the study setting did not have identity cards required to obtain a post-paid mobile phone connection. Participants used mobile phones with pre-paid connections, which Indian mobile phone companies cannot monitor. As a result, the study captured data on all calls made and received, as well as their durations though qualitative questionnaires and phone usage records kept by AWWs.

Provision of mobile phones and mobile phone credit to participants in the mHealth pilot study limits the intervention's scope for long-term sustainability. Although a large proportion of mothers and AWWs reported having access to their husband's mobile phone (63.3%, n=38 and 41.7%, n=5, respectively), only 26.7% of mothers (n=16) and 41.7% of AWWs (n=5) reported owning one. It was necessary to provide mobile phones and mobile phone credit to all participants in the pilot study to test the feasibility and acceptability of the mHealth intervention in this setting. However, it would not be possible for the ICDS programme to provide all AWWs and mothers of young infants with mobile phones for CF counselling, suggesting the need for alternative strategies to increase AWWs' and mothers' access to this technology. The intervention could potentially be scaled up by only providing AWWs with mobile phones and credit to reach mothers on a mobile phone they can easily access, e.g. a shared household mobile phone or their husbands' mobile phone. However, this strategy would need to be explored in either a programmatic or research setting, since there are no published studies of national programmes providing frontline health workers with mobile phones to counsel mothers of young infants to improve CF practices.

Another limitation of this thesis is that its scope did not allow the mHealth pilot study to comprehensively address two key findings relating to diet affordability and inadequacy of local foods to meet nutrient needs of infants as consumed. Cost of certain foods such as green leafy vegetables in the summer and egg were highlighted by mothers throughout the sub-studies presented in the thesis. Although motivating statements were developed to address cost, they did not succeed in influencing all mothers in the study to feed their infants more expensive foods. Additionally, due to local governmental restrictions, alternative dietary interventions



could not be incorporated into the mHealth intervention for promotion in the ICDS programme in the study setting. However, given that both Optifood analyses and the TIPs trial show that local foods, as consumed, do not meet infants' nutrient requirements in this setting, it is clear that a longer-term intervention would need to promote alternative dietary strategies in addition to FBRs based on local foods to improve infant dietary intake. Figure 8.1 reflects a linear process to develop and test the pilot intervention presented in this thesis; however, it is recognised that prior to scaling up the intervention for implementation, each sub-study's findings in Figure 8.1 will have to be linked to each other to address barriers identified to improving infant feeding practices in this setting.

It is also possible that the pilot study's small sample size played a role in AWWs reported positive views of the mHealth intervention. AWWs in the pilot study were only asked to reinforce CF messages via mobile phones with five mothers, so AWWs may have had different views on the intervention's effect on their workload if they had been asked to test mobile phones with all mothers of young infants in their respective villages.

The exclusive focus in this thesis on promoting FBRs in counselling messages may be another limitation because this uni-dimensional perspective ignores other dimensions contributing to child nutritional status (e.g. water, sanitation and hygiene practices). However, it was beyond the scope of this thesis to include alternative strategies to improve child nutritional status in the pilot test of the mHealth intervention.

## **CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK**

### **Improve Indian infants' poor diets**

ICDS policies and CF programming strategies should address ways to reach mothers of young infants with effective CF messages and nutrient-rich foods or supplements. This thesis shows that it is possible for most mothers to adhere to a set of FBRs promoting multiple food groups, and to significantly increase infants' energy and nutrient intakes over a week-long period. Increases in minimum dietary diversity and the quantity of CF intake over one week also suggest that it is possible for FBRs promoting local foods to have an impact on infant diets. However, Optifood analyses showed that a local food-based approach alone will not achieve the 2004 WHO/FAO RNIs for seven nutrients in infant diets, but, it likely can be used to ensure nutrient adequacy for six nutrients. These findings are consistent with the dietary data collected at the end of the one-week trial showing significant increases in intakes of energy and nutrients as well as dietary diversity through a food based approach. However, overall

these findings provide an advocacy message, of the critical need for a complementary intervention(s) to improve infant diets in this setting.

### **Support India's frontline workers**

Although it is well recognised that frontline workers in low resource setting are crucial bridges between communities and health services, qualitative findings presented in this thesis are consistent with other evaluations recognising the high workload of AWWs that prevent their ability to effectively reach most mothers and young children.<sup>13-16</sup> Though mobile phones have the potential to alleviate part of AWWs' workload, this technology is not a "golden bullet" to increase community-based nutrition service delivery within the ICDS programme.

It is recommended that policymakers and implementers find additional ways to support AWWs in delivering health services to vulnerable populations.

### **Conduct and report formative research to improve design of interventions**

This thesis confirms the importance of rigorous formative research to design and develop context-specific interventions.<sup>17-21</sup> Testing FBRs with mothers in the study setting prior to their implementation in the mHealth intervention uncovered previously unidentified barriers to CF and corresponding motivating statements relating to CF digestibility, variety and quantity. Findings from FGDs and an intervention design workshop with community members, ICDS staff and other stakeholders led the development of the intervention, and identified a number of design considerations that would have otherwise not been incorporated into the mHealth intervention. Examples include the inclusion of mothers-in-law and use of only the voice component of mobile phones to deliver messages.

It is recommended that researchers and programme implementers spend sufficient time and resources on in-depth formative research strategies to inform CF interventions. Doing so has the potential to increase an intervention's feasibility, acceptability, and long-term impact on its beneficiaries. Additionally, it is recommended that researchers and programme implementers publish the methods and processes of formative research and its impact on the final intervention design, since they are rarely reported.<sup>17</sup>

### **Mobile phones have potential to improve the delivery of CF interventions**

With an increasing number of mHealth partnerships being developed between governments, academia, non-governmental organisations, technologists, and various industries, there is

great potential to harness the evidence, resources and commitment required to use this increasingly popular technology to improve the delivery of nutrition services to vulnerable populations. The mHealth sub-study presented in this thesis is the first of its kind to pilot test the feasibility of using mobile phone-delivered CF counselling. Both quantitative and qualitative results show that this intervention is convenient, feasible and acceptable and shows promise in improving infant diets.

Results from this pilot study provide evidence that an investment in mHealth approaches in the ICDS programme may result in improved infant feeding practices. However, it is well recognised that mHealth approaches need to engage frontline workers, communities, governments and other relevant stakeholders in order to scale up from pilot studies to national programmes.<sup>22</sup> The first step in scaling up this intervention in this setting is the development and testing of special infant foods that will ensure dietary adequacy, since research findings presented in this thesis show that local food-based approaches alone will not meet 100% of the WHO/FAO RNIs<sup>5</sup> for seven nutrients in infant diets in Faridabad District, Haryana state, India. Similar to a study in Cambodia, this type of investigation would require market research, product development and a subsequent RCT to assess infant growth outcomes.<sup>4</sup> In addition to development of special infant foods, existing fortified foods or products such as fortified wheat flour or micronutrient powder could also be tested in this setting to assess their feasibility, acceptability and impact on infant growth outcomes. It is key to identify a feasible, acceptable, affordable and effective alternative dietary intervention(s) along with local food-based FBRs in this setting, and to develop effective behaviour change strategies (including revising motivating statements developed in this thesis) to aid their promotion for an intervention to have promise in improving nutrient adequacy of infant diets in this setting.

Once the dietary intervention and its accompanying behaviour change promotion strategies have been identified and tested in a RCT to assess infant growth outcomes, the next step would be to conduct a RCT assessing the impact and scale up of these components in a mHealth intervention. This step is especially important given that the mHealth pilot study provided mobile phones and credit to all participants, and each AWW only counselled five mothers. If this RCT shows impact on infant growth or dietary outcomes, then the final step would be to conduct implementation research to strengthen the mHealth intervention's scale up within the ICDS programme.

If revised as outlined above, and subsequently proven to significantly improve infant CF practices and growth, the mHealth intervention presented in this thesis has implications for future CF programming and research strategies, both within India's ICDS programme and in other governmental nutrition programmes in similar settings.

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## 9. APPENDICES

### APPENDIX 1: SUPPLEMENTAL MATERIAL REFERENCED IN STUDY BACKGROUND

#### Appendix 1.1: Food-based recommendations promoted in the Integrated Child Development Services Programme





**COUNSEL THE MOTHER**

➤ **Feeding Recommendations During Sickness and Health**

ASSESS FEEDING IN ALL CHILDREN BELOW 2 YEARS AND ALSO IN CHILDREN WITH VERY LOW WEIGHT FOR AGE (Malnutrition grade 2, 3 or 4) OR ANAEMIA.

ASSESS FEEDING:

**Do you breast feed the child?**  
**How many times in a day?**  
**Do you breast feed the child at night?**  
**Does the child take any other foods or fluids?**  
**What foods or fluids?**  
**How many times per day?**  
**How large are the servings (katori, teaspoon)?**  
**Does the child receive separate serving?**  
**Who feeds the child and how?**  
**Ask if the child's feeding has changed during this illness?**  
**If yes how?**

Up to 6 Months	6 Months up to 12 Months	12 Months up to 2 Years	2 Years and Older
			
<ul style="list-style-type: none"> <li>• Breastfeed as often as the child wants, day and night, at least 8 times in 24 hours.</li> <li>• Do not give any other foods or fluids not even water</li> </ul> <p><u>Remember:</u></p> <ul style="list-style-type: none"> <li>• Continue breastfeeding if the child is sick</li> </ul>	<ul style="list-style-type: none"> <li>• Breastfeed as often as the child wants.</li> <li>• Give <u>one katori serving*</u> at a time of :               <ul style="list-style-type: none"> <li>- Mashed roti/ rice /bread/biscuit mixed in sweetened undiluted milk OR</li> <li>- Mashed roti/rice/bread mixed in thick dal with added ghee/oil or khichri with added oil/ghee. Add cooked vegetables also in the servings OR</li> <li>- Sevian/dalia/halwa/kheer prepared in milk or any cereal porridge cooked in milk OR</li> <li>- Mashed boiled/fried potatoes or give one banana/ cheeko/ mango.</li> </ul> </li> </ul> <p>*3 times per day if breastfed; 5 times per day if not breastfed.</p> <p><u>Remember:</u></p> <ul style="list-style-type: none"> <li>• Keep the child in your lap and feed with your own hands</li> <li>• Wash your own and child's hands with soap and water every time before feeding</li> </ul>	<ul style="list-style-type: none"> <li>• Breastfeed as often as the child wants.</li> <li>• Offer food from the family pot</li> <li>• Give <u>1 1/2 katori serving*</u> at a time of :               <ul style="list-style-type: none"> <li>- Mashed roti/rice/bread mixed in thick dal with added ghee/oil or khichri with added oil/ghee. Add cooked vegetables also in the servings OR</li> <li>- Mashed roti/ rice /bread/biscuit mixed in sweetened undiluted milk OR</li> <li>- Sevian/dalia/halwa/kheer prepared in milk or any cereal porridge cooked in milk OR</li> <li>- Mashed boiled/fried potatoes or give at least one banana/ cheeko/ mango.</li> </ul> </li> </ul> <p>* 5 times per day.</p> <p><u>Remember:</u></p> <ul style="list-style-type: none"> <li>• Sit by the side of child and help him to finish the serving</li> <li>• Wash your child's hands with soap and water every time before feeding</li> </ul>	<ul style="list-style-type: none"> <li>• Give family foods at 3 meals each day.</li> <li>• Also, twice daily, give nutritious food between meals, such as: banana/biscuit/ cheeko/ mango/ papaya/ egg as snacks</li> </ul> <p><u>Remember:</u></p> <ul style="list-style-type: none"> <li>• Ensure that the child finishes the serving</li> <li>• Teach your child wash his hands with soap and water every time before feeding</li> </ul>

\* A good daily diet should be adequate in quantity and include an energy-rich food (for example, thick cereal porridge with added oil); meat, fish, eggs, or pulses; and fruits and vegetables. Egg is a good snack where culturally acceptable.

## Original Article

## Designing appropriate complementary feeding recommendations: tools for programmatic action

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### Abstract

Suboptimal complementary feeding practices contribute to a rapid increase in the prevalence of stunting in young children from age 6 months. The design of effective programmes to improve infant and young child feeding requires a sound understanding of the local situation and a systematic process for prioritizing interventions, integrating them into existing delivery platforms and monitoring their implementation and impact. The identification of adequate food-based feeding recommendations that respect locally available foods and address gaps in nutrient availability is particularly challenging. We describe two tools that are now available to strengthen infant and young child-feeding programming at national and subnational levels. *ProPAN* is a set of research tools that guide users through a step-by-step process for identifying problems related to young child nutrition; defining the context in which these problems occur; formulating, testing, and selecting behaviour-change recommendations and nutritional recipes; developing the interventions to promote them; and designing a monitoring and evaluation system to measure progress towards intervention goals. *Optifood* is a computer-based platform based on linear programming analysis to develop nutrient-adequate feeding recommendations at lowest cost, based on locally available foods with the addition of fortified products or supplements when needed, or best recommendations when the latter are not available. The tools complement each other and a case study from Peru illustrates how they have been used. The readiness of both instruments will enable partners to invest in capacity development for their use in countries and strengthen programmes to address infant and young child feeding and prevent malnutrition.

**Keywords:** infant and young child feeding, complementary feeding, *ProPAN*, *Optifood*, infant and young child nutrition.

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### Introduction

Programmes to promote breastfeeding and complementary feeding are among the most effective interventions to promote healthy growth and development in infants and young children (Jones *et al.* 2003). The

World Health Organization (WHO)/United Nations Children's Fund (UNICEF) Global Strategy for Infant and Young Child Feeding (WHO/UNICEF 2003) provides the overall framework for actions needed to protect, promote and support appropriate feeding practices in early childhood. It



recommends early initiation of breastfeeding, exclusive breastfeeding for 6 months, and the introduction of adequate complementary foods at 6 months with continued breastfeeding for 2 years or beyond.

The time of complementary feeding, typically between 6 and 23 months of age, is nutritionally the most vulnerable and in developing countries coincides with a rapid acceleration in the incidence of stunting, especially among children 6–12 months (Victora *et al.* 2010). Complementary foods may be dilute, lacking diversity, not given frequently enough, given in too little amounts, or prepared and given with insufficient attention to hygiene and food safety. The Pan American Health Organization/WHO Guiding Principles for Complementary Feeding of the Breastfed Child propose 10 guiding principles for complementary feeding (PAHO/WHO 2003). Similar guiding principles are available for feeding of non-breastfed children (WHO 2005). Recognizing the challenge to provide a nutritionally adequate diet for young children in resource-poor settings (Dewey & Brown 2003), national strategies should maximize the utilization of locally produced foods in any given setting, and consider the promotion of additional products only if they can fill a critical gap in nutrients in an acceptable, feasible, affordable, sustainable and safe way (WHO 2008a). Where locally available foods alone will not satisfy nutritional requirements, various types of products offer promise; they may include centrally produced fortified foods, micronutrient powders or lipid-based nutrient supplements (WHO 2008a).

An excellent qualitative tool, *Designing by Dialogue*, is available to support the design, implementation and evaluation of infant and young

child-feeding programmes (Dickin *et al.* 1997). However, tools that include a systematic, quantitative assessment of diet including one based on linear programming to identify nutrient gaps and food-based feeding recommendations, and relying primarily on locally available foods to remedy these gaps, have not been available. The need for a more detailed framework and user-friendly tools to guide assessment, prioritization, planning and evaluation of interventions for children 6–23 months has been apparent for some time (WHO 2008a). In this paper, we describe two tools to guide the development of appropriate infant and young child-feeding recommendations and programmes. *Process for the Promotion of Child Feeding (ProPAN)* by its Spanish acronym) provides qualitative and quantitative methods to assess the local situation with respect to breastfeeding and complementary feeding practices and develop locally appropriate and acceptable feeding recommendations (Pan American Health Organization & UNICEF 2013). *Optifood* provides an electronic interface which uses linear programming analyses to identify 'problem nutrients' (i.e. nutrients whose requirements cannot be met using foods as eaten), and guides the selection of food-based recommendations, for any age group, based on locally available foods, with the addition of fortified products or supplements when needed (World Health Organization, London School of Hygiene and Tropical Medicine, USAID 2013). Linear programming analysis is a mathematical optimization process, which in *Optifood* is used to model realistic diets for the target population. The food patterns and nutrient adequacy of these modelled diets inform decisions.

#### Key messages

- Design of adequate food-based feeding recommendations that maximize the use of locally available foods and fill nutrient gaps can be a challenge, especially in resource-limited settings.
- *ProPAN* and *Optifood* tools are now available to enhance the assessment, planning, monitoring and evaluation of infant and young child-feeding programmes.
- When used alone or in synergy, these tools provide guidance for development of feeding recommendations, prioritization of interventions, design of key messages and communication strategy, policy and advocacy, monitoring and evaluation.

The objectives of this paper are to describe the basic principles and methods of each tool and provide an example of how the tools can be used jointly to design interventions.

## ProPAN

*ProPAN*, which was first published in 2004 and recently updated, is a tool designed for ministries of health, non-governmental organizations, and bilateral and international organizations working to improve the diets and feeding practices of children under 24 months of age to prevent early childhood malnutrition (Pan American Health Organization & UNICEF 2013). It guides users through a step-by-step process for identifying problems related to young child nutrition, breastfeeding and complementary feeding, within a specific target population; defining the context in which these problems occur, including barriers to and facilitators of improved or 'ideal' practices (Table 1); formulating, testing, and selecting behaviour-change recommendations and nutritional recipes; developing the interventions to promote them; and designing a monitoring and evaluation system to measure progress towards intervention goals. *ProPAN* materials include a multi-module field

**Table 1.** *ProPAN* ideal practices

1. All infants breastfed for first time within 1 h of birth
2. All infants not fed anything other than breast milk during first 3 days of life
3. All infants fed colostrum
4. All infants and young children breastfed on demand, day and night
5. All infants less than 6.0 months exclusively breastfed
6. All children breastfed through the age of 2 years old or older
7. All infants fed semi-solid complementary foods at the age of 6 months (180 days)
8. All infants and young children aged 6.0–23.9 months meet recommended daily energy and nutrient requirements
9. All infants and young children aged 6.0–23.9 months fed nutrient- and energy-dense foods
10. All infants and young children 6.0–23.9 months fed recommended number of meals daily
11. All infants and young children 6.0–23.9 months fed by caregiver responsive to child
12. All infants and young children 6.0–23.9 months fed as recommended during and after illness

manual with detailed instructions on how to collect, analyse, and integrate the quantitative and qualitative data required to design and evaluate interventions, an Epi Info™-based software program developed specifically for quantitative analysis of household demographic and socio-economic characteristics and infant and young child diets and as an analytical tool for identifying locally available foods that provide the greatest amount of energy and nutrients at the lowest cost, and a software user's guide.

## *ProPAN* field manual

The *ProPAN* field manual comprises four modules: Assessment (Module I); Testing recommendations and recipes (Module II); Developing the intervention plan (Module III); and Designing a monitoring and evaluation system (Module IV). Each module has two components: (1) an overview of the module's purpose, products, and steps, and the concepts and techniques that will be applied in the research, and (2) an annex containing custom-designed data-gathering tools and instructions on how to apply them. *ProPAN* methodologies can be used to develop interventions to improve both breastfeeding and complementary feeding but places a relative emphasis on complementary feeding because less is known about how to most effectively improve these practices.

The development of *ProPAN* benefited from earlier manuals on aspects of infant and young child feeding. In particular, 'Designing by Dialogue' (Dickin *et al.* 1997) and 'Tools to Measure Performance of Nutrition Programs' (Levinson *et al.* 2000) contributed towards many of the concepts used in Modules II and IV, respectively. In addition, many ideas, such as the Food Attributes Exercise and the methodologies used in the semi-structured interviews and focus groups, were borrowed from 'Culture, Environment, and Food to Prevent Vitamin A Deficiency' (Kuhnlein & Pelto 1997).

As shown in Fig. 1, the main methods and products (outcomes) of *ProPAN*, by module, are as follows: Module I guides users in applying quantitative and qualitative research methods to identify diet and feeding problems based on a set of 'ideal' practices (Table 1), the practices that lead to them and the

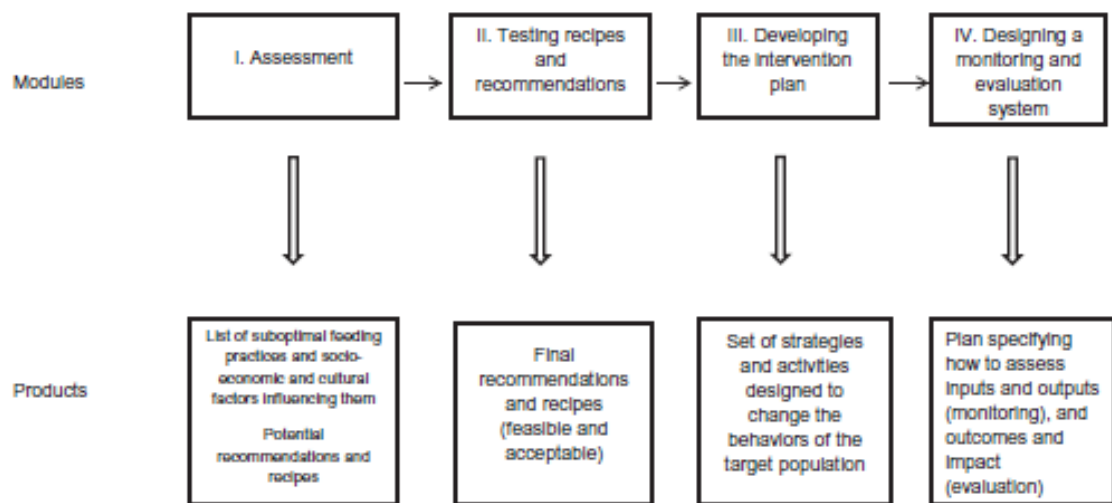


Fig. 1. Structure and products of the ProPAN modules.

context in which they occur. This module provides an assessment algorithm for evaluating responsive feeding, based on research conducted in Peru (Creed-Kanashiro *et al.* 2010) as well as questions on infant feeding within the context of human immunodeficiency virus infection/acquired immunodeficiency syndrome. The main product is the identification of problematic diet and feeding practices and the generation of a list of recommendations that could be promoted to improve them. Module II helps users test the acceptability and feasibility of the potential recommendations identified in Module I, using behaviour and recipe testing based on trials of improved practices methodology developed by the Manoff Group (Dickin *et al.* 1997). The main products of Module II are final recommendations based on practicality, feasibility and acceptability by the community – that is, practices that caregivers, family members, health workers or other gatekeepers can and are willing to adopt, and foods and recipes that family members are willing to prepare and feed to young children. Module III helps users devise an intervention plan based on the final recommendations selected and tested in Module II. The main product of this module is the selection of optimal strategies, activities, materials and messages for promoting the desired changes in diet and feeding practices. Lastly, Module IV helps users (1) design

appropriate indicators to monitor the intervention-implementation process and impact, and (2) select an appropriate evaluation design. The main product of this module is the design of a system for monitoring and evaluating the intervention.

In addition to the content described above, ProPAN includes a logistics section explaining the resources required to carry out the various components and the estimated budget, staffing and time frame required.

### ProPAN software

Epi Info™ is a public domain software package designed and developed for public health practitioners and researchers worldwide by the US Centers for Disease Control and Prevention (2008). The ProPAN software program is compatible with Epi Info™ version 3.5.4 and has been updated for use in Windows. It allows for creation and modification of survey questionnaires and database construction, data entry, data analysis and standardized outputs. The data analysis tools can help identify key nutrient gaps, and determine the relative nutritional importance and cost of local foods available to fill them. They can also be used to analyse the anthropometric data collected in Module I (described below), and the energy and nutrient profile of recipes created in



Module II (described below), and to determine the frequency of consumption of foods, average food serving sizes and the number of servings of foods provided from selected food groups and food sub-groups – outputs that are required inputs for Optifood (World Health Organization, London School of Hygiene and Tropical Medicine, USAID 2013). A *ProPAN* Software User's Guide is available to facilitate use of the software (Pan American Health Organization & UNICEF 2013).

*ProPAN* criteria for the quantitative analysis of diet and feeding practices are based on international guidelines and indicators (Dewey & Brown 2003; PAHO/WHO 2003; WHO 2005, 2008b). Assessment of weight-for-age, length-for-age and weight-for-length Z-scores is based on the WHO Child Growth Standards (WHO 2006) and mid-upper arm circumference is based on the WHO/UNICEF recommendation (WHO/UNICEF 2009).

### **ProPAN uses**

*ProPAN* is designed for use as one comprehensive unit – from the assessment of the general nutrition situation through monitoring and evaluation of the intervention. However, it can also be applied 'cafeteria style'. That is, where users select and apply only the modules or parts of modules needed to complement existing information on infant and young child feeding and to meet programming needs as was done in Bolivia and Ecuador (Pachón & Reynoso 2002; Lutter *et al.* 2008), among other countries. For those wishing to design a new programme on infant and young child feeding, use of all of the modules is recommended. *ProPAN* can be used to build on existing programmes [e.g. to conduct formative research for programme planning (Haider *et al.* 2010), develop key programme messages (Arabi *et al.* 2009), identify optimal recipes for community demonstrations, assess the quality of the diet (Arabi *et al.* 2005), or determine facilitators of and/or barriers to the adoption of improved practices (Rasheed *et al.* 2011)]. Users seeking to adapt, expand or improve an existing programme may only want to apply selected modules or components relevant to a specific purpose (e.g. Module II, for testing the feasibility and acceptability

of new recommended practices or recipes, or Module IV, for designing a monitoring and evaluation system). Although *ProPAN* is primarily designed for developing interventions directed at caregivers, it can also be used for alternate applications, such as incorporating infant feeding counselling into health providers' routine care or training nutrition researchers in quantitative and qualitative methods.

While *ProPAN* materials focus mainly on undernutrition, they can also be applied to address problems of overweight. For example, the 24-hour Dietary Recall and Anthropometry questionnaire can be used to identify populations where energy intake is above recommendations and the percentage is high of the population with weight-for-height Z-score above two standard deviations of the WHO Child Growth Standard. Other tools in *ProPAN* can be used to explore the reasons for these problems and to identify and test potential recommendations to correct them.

*ProPAN* is comprehensive and adaptable and thus can be used in a variety of settings. To date, *ProPAN* has been used in over 15 countries in Africa, Asia and Latin America. Lessons learned from these experiences have been incorporated into the current, updated version of *ProPAN*, including a global food composition table found in the *ProPAN* software package, which can be updated with new foods as needed (described below).

### **Optifood**

Optifood is a tool designed for use by nutritionists working in academic institutions, government or non-government organizations to inform nutrition programme planning and government policy decisions regarding nutrition interventions for any age group. It is a computerized tool based on linear programming analysis, a mathematical optimization process that selects the best diet from among all possible alternative diets given model parameters (Briend *et al.* 2003). Its strength lies in mathematical optimization, which simultaneously takes into account the target population's dietary patterns and their estimated requirements for energy and 13 nutrients – a process which is too complex to do by hand (Ferguson *et al.* 2006). It is also very fast, which allows rapid comparisons across

**Table 2.** Optifood modules, purpose, outputs and questions answered

Module	Purpose	Outputs	Questions answered
I – Check Diets	To check model parameters (i.e. dietary data constraints entered prior to starting analyses) to ensure Optifood is generating realistic diets	21 diets, including two diets to define the possible energy range to help user check model parameters	<ol style="list-style-type: none"> <li>1. Is the model generating realistic diets?</li> <li>2. Do changes need to be made to model parameters to make diets realistic?</li> </ol>
II – Identify Draft Recommendations	To identify the two best diets for the target population given the dietary constraints— one diet follows average food patterns and the other deviates from them. Both diets come as close as possible to meeting recommended nutrient intakes	<ul style="list-style-type: none"> <li>- Create food-based recommendations</li> <li>- Problem nutrients i.e. nutrients whose requirements are difficult to achieve using local foods</li> </ul>	<ol style="list-style-type: none"> <li>1. Can a nutritionally adequate diet be promoted given local foods &amp; food patterns?</li> <li>2. What are the best food sources of nutrients for this target population?</li> <li>3. What are the nutritional and cost implications of selecting recommendations that deviate from the population's average food patterns?</li> <li>4. What alternative food-based recommendations should be tested in Module III?</li> </ol>
III– Test Food Based Recommendations	Test and compare alternative sets of food-based recommendations	Comparison of the lowest nutrient content and cost of diets that adhere to tested food-based recommendations	<ol style="list-style-type: none"> <li>1. Which set of recommendations is best for the target population, taking nutrients and cost (if modelled) into consideration?</li> <li>2. Are food-based recommendations likely to ensure that nutrient needs are met?</li> </ol>
IV – Cost Analysis (optional module)	To generate the lowest cost nutritionally adequate diet	<ul style="list-style-type: none"> <li>- Lowest cost diet</li> <li>- Percentage of diet cost contributed by each food in the lowest cost diet</li> </ul>	<ol style="list-style-type: none"> <li>1. What is the lowest cost nutritionally 'best' diet for this target population?</li> <li>2. What foods are most expensive in the lowest cost nutritionally 'best' diet for this target population?</li> <li>3. What nutrient requirements are the most expensive to achieve?</li> </ol>

many alternative sets of food-based recommendations, providing evidence to transparently justify the selection of a set of food-based recommendations from among alternatives (Santika *et al.* 2009).

Optifood's models were previously created in MS Excel using the solver function (Ferguson *et al.* 2006). This process was complex and error prone, which made it extremely difficult to master. With the creation of the Optifood interface, which guides the user through the modelling process, this problem has been overcome. Optifood users do not require any expertise in linear programming analysis. Through its interface they can set up and run robust linear programming models without having to make decisions about model structures. The only expertise required to use Optifood is knowledge of the target population's typical dietary practices, some background in

nutrition and experience with menu-driven computer applications. Most users can master the tool within a week.

Optifood has two sets of internal reference data: a food composition table (FCT) and a set of recommended nutrient intakes (RNIs). It has two data entry areas. In one optional data entry area (Reference data area), food composition data and RNI values are entered to supplement or use in place of the existing reference data in Optifood. In the other mandatory data entry area (Target group area), target group-specific data are entered to set up the model parameters for linear programming analyses.

The linear programming analyses are done in four analytical modules, each of which generates a series of optimized diets that answer the questions outlined in Table 2. These modelled diets show the number of

servings per week from individual foods over a 7-day period, i.e. weekly diets. The specific foods in these modelled diets, however, are not prescriptive; instead their food patterns inform decisions.

### Optifood reference data

The validity of an Optifood analysis depends on the FCT and RNI reference data. The FCT is used to estimate the nutrient content of each modelled diet. The RNIs are used to evaluate and compare alternative sets of food-based recommendations and, with data on food prices, identify the lowest cost nutritionally best diet. Although Optifood has an inbuilt FCT and set of RNIs, it provides flexibility for users to import and use analysis-specific reference data. In cases where user-defined reference data are employed, they must include a complete set of data for energy and all nutrients modelled; namely protein, fat; carbohydrate and water (FCT only); calcium, iron, zinc; vitamins A (expressed as retinol equivalents and retinol activity equivalents), C, B<sub>6</sub>, B<sub>12</sub>, folate, thiamine, riboflavin and niacin.

The inbuilt core reference data for RNIs are drawn from the WHO/FAO (Food and Agriculture Organization of the United Nations) vitamin and mineral requirements (WHO/FAO 2004), with the exception of iron for pregnant women (IOM 2001), the WHO/FAO/United Nations University (UNU) protein requirements (WHO/FAO/UNU 2007) and the FAO/WHO/UNU energy requirements (FAO/WHO/UNU 2004). The RNIs cover 13 nutrients and 27 demographic groups ranging from infants to the elderly. For fat, the desired level is expressed as a percentage of the energy intake, which is set as 30% for all target groups (FAO/WHO 2008). The algorithms for calculating protein and energy requirements require data on the target population's average body weight; and the estimated average physical activity levels for adult energy requirements. For flexibility, the user can also overwrite the calculated energy requirements with a number the user can enter.

Optifood and *ProPAN* use the same FCT. It was developed based on the version included in the first release of *ProPAN* (PAHO *et al.* 2004). The inbuilt core food composition database in Optifood has

nearly 2000 foods. The primary source of these data is the United States Department of Agriculture National Nutrient Database for Standard Reference, Release 23 (USDA 2010). Secondary sources are from Tanzania (Lukhmanji *et al.* 2008), Zambia (National Food and Nutrition Commission 2007), Mali (Barikmo *et al.* 2009), West Africa (Stadlmayr *et al.* 2010), Southeast Asia (Puwastien *et al.* 2000), the English-speaking Caribbean (Caribbean Food and Nutrition Institute 2000) and Central America (Menchú & Méndez 2007), as well as McCance and Widdowson's *Composition of Foods* (Food Standards Agency 2002).

### Data entry and analysis in Optifood

Data are entered into the reference data or target group data entry areas either by hand or by importing csv files to save time and avoid data entry errors (Fig. 2). In the target group data entry area, five data entry sheets guide users through the process of setting up the models, using dietary data, the target populations mean body weight, and market survey data (see footnote in Fig. 2). The market survey data are optional, depending on whether or not the user will model diet cost. Error trapping messages alert users to data entry errors, with guidance provided for their resolution.

Once the data are entered into Optifood, the analyses are done in four analytical modules. The purpose and outputs from each analytical module are outlined in Table 2. The first and only mandatory analytical module (Module I) is used to first verify that entered target group data create realistic modelled weekly diets before running the main analyses in Modules II, III and IV. It is an iterative process where target group data are modified until the user is satisfied the models are robust. At this point, the model parameters are locked and the user elects whether to run analytical modules II and III to formulate and test food-based recommendations or analytical module IV to undertake a detailed cost analysis.

Module II generates the two nutritionally best diets for the target population; one conforms to the target population's average food patterns, whereas the other can deviate from the average food patterns while



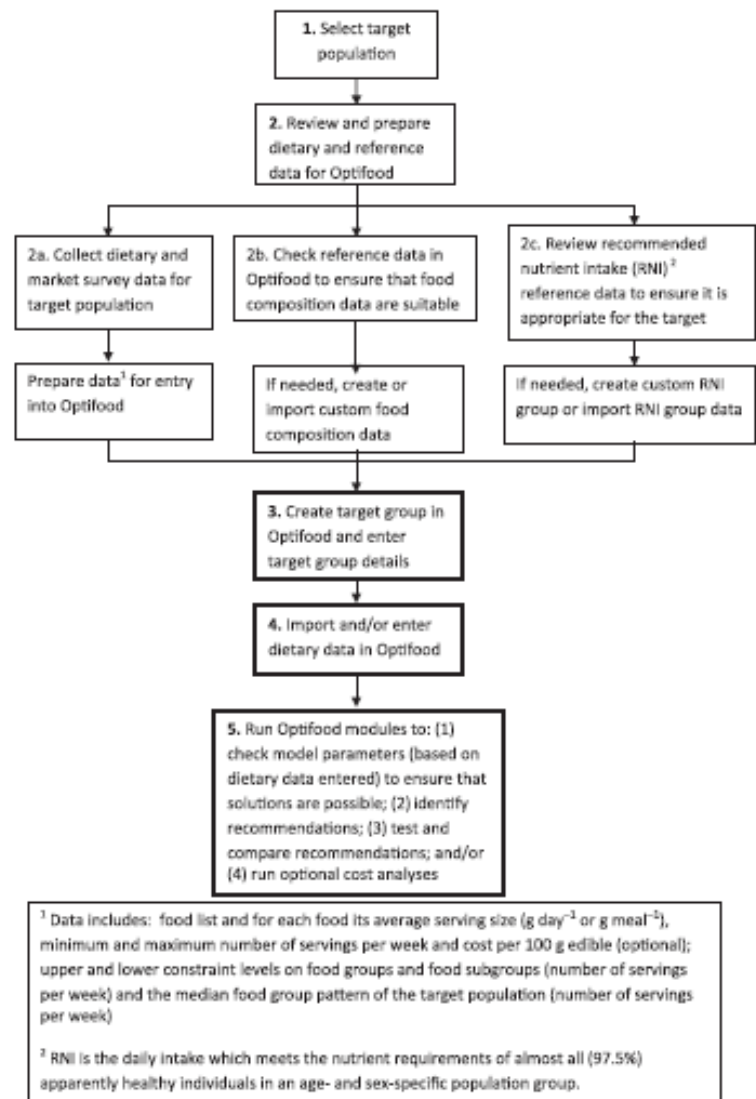


Fig. 2. Overview of the Optifood process.

remaining within the observed food pattern ranges. These diets indicate whether realistic combinations of local foods can achieve desired nutrient intake levels (WHO/FAO 2004). Where gaps remain, the 'problem nutrients' are identified, thus providing evidence to advocate for solutions that go beyond the use of locally available food sources. Further, because they represent the nutritionally best diets, their food patterns are used to help formulate alternative sets of food-based recommendations for evaluation in Module III. Any number of individual food-based

recommendations, which are expressed as the number of servings per week from individual food groups, food subgroups or foods, can be selected. They are first screened in Module III to select three to six individual recommendations that are then combined into alternative sets of multiple food-based recommendations for further testing.

In Model III, alternative sets of food-based recommendations are compared on the basis of cost (optional) and their ability to ensure a nutritionally adequate diet. These recommendations can be either

those formulated from Module II or external food-based recommendations already in use in the country. From these comparative results, the best set of food-based recommendations from among alternatives is selected. An interface between *ProPAN* and *Optifood* corresponds to the testing of the food-based recommendations in community-based trials to assess their feasibility and acceptability for long-term use by the target population prior to dissemination. This methodology is described in *ProPAN*'s Module II.

The final type of analysis in *Optifood* is done in Module IV to select the lowest cost nutritionally best diet, showing the percentage cost contribution of each food in the diet. Outputs from this module inform decisions regarding the minimum price of a nutritional diet. It is independent of Modules II and III.

### Older versions based on linear programming analyses

Two other diet modelling tools are available using linear programming analyses, namely *Nutrisurvey* and the *Cost of Diet* tool (Frega *et al.* 2012). They differ from *Optifood* in their scope (i.e. in the number and types of linear programming models run) and in the nature of the modelled diets. *Optifood* is based on 188 different linear programming models, including two goal programming models, whereas the other two tools are based on one or two different linear programming models. Further, *Optifood* unlike the other two tools aims to select a realistic modelled diets (i.e. diets that are consumed by the target population) when a nutritionally adequate diet is unfeasible. These intertool differences mean the data requirements and modelling processes are slightly more complex in *Optifood* than in the other two tools. However, its interface is designed to mask its complexity. All three tools can be used to identify the lowest cost diet and 'problem nutrients', and to compare the costs of alternative dietary interventions. Only the *Cost of Diet* tool is designed to analyse diets at both the individual and household level. Only the *Optifood* tool is designed to test alternative sets of food-based recommendations, select the nutritionally best diets when a nutritionally adequate diet is not

feasible or identify the level at which individual nutrients have an impact on diet cost.

### Uses of *Optifood*

*Optifood* has been tested or is currently being used in 10 countries in Asia, Africa and Latin America to generate food-based recommendations for young children and women of reproductive age, to inform agriculture-nutrition programmes and food value-chain interventions and to help formulate a regional strategy to address maternal and child micronutrient malnutrition in south-east Asia.

*Optifood* models are best set-up using high-quality dietary data, for example, using dietary data collected in *ProPAN* Module I, which has been designed to interface with *Optifood* dietary data input requirements – a distinct advantage in terms of dietary data preparation time. *Optifood*'s use is not restricted to the availability of high quality dietary data. Expert opinion or published data can also be used to set up target group model parameters. However, it will influence the quality of *Optifood* outputs and confidence in the results.

### Discussion

#### Role and place of *ProPAN* and *Optifood* in the programme cycle

The programming and implementation cycle for improved infant and young child feeding includes (1) baseline situation assessment, (2) development of a national infant and young child feeding policy with clear recommendations for adequate infant and young child-feeding practices, (3) development of a comprehensive infant and young child-feeding strategy with prioritized interventions, (4) integration of the interventions in commonly used delivery platforms such as maternal and child health services, (5) development of subnational action plans and implementation, and (6) monitoring and evaluation (UNICEF, Cornell University 2011). *ProPAN* and *Optifood* tools support several steps of this cycle and Panel 1 provides a concrete example of how both tools have been used in Peru.



*ProPAN* guides the baseline assessment, development of feeding recommendations, identification of interventions to promote these recommendations, and their integration in other programmes. It focuses on infant and young child-feeding practices. It provides input data on existing feeding practices, available foods, feeding frequency and servings and prices that are necessary to run the *Optifood* tool. *ProPAN* can be used alone but it gains strength when combined with *Optifood* for the identification of the lowest-cost food-based feeding recommendations and the need to include a non-food-based strategy (e.g. micronutrient powders) to ensure dietary adequacy, as illustrated in the example from Peru. *ProPAN* is particularly helpful for making evidence-based decisions on how to promote the identified feeding recommendations. It guides the design of key messages and the development of a communication strategy. It provides information that can be used to support policy changes that may be necessary for implementing the recommended feeding practices. Finally, *ProPAN* is designed to help guide the user towards the design of a monitoring and evaluation plan.

*Optifood* is complementary to *ProPAN*, and can be used for older age groups as well. It can be used to help identify the best set of food-based recommendations to promote in a given nutrition programme. Its results provide evidence about whether a behaviour-change strategy alone could be used to improve micronutrient status or whether micronutrient malnutrition relates to a lack of accessible or affordable micronutrient-rich foods, as is shown in the Peruvian example (Panel 1). The latter justifies public-private sector partnerships to increase the availability and affordability of micronutrient-rich foods through the Ministry of Health, food industry and/or agricultural-based food value chains. Further, *Optifood* can be used to predict the impact of a food-based intervention on dietary micronutrient adequacy or to investigate the nutritional basis for an observed lack of programme impact on micronutrient status. Finally, results from *Optifood* can support nutrition advocacy by providing mathematical evidence that local food supplies will or will not ensure all individuals in a target populations achieve their nutrient needs.

There are obviously also some limitations with regards to the use of both tools. *ProPAN* is resource-intensive when used in its totality, and requires a multidisciplinary team which may be hard to assemble in a low-resource country. The food composition has few foods from Asia, and hence there is a need to manually update the FCT in those settings which is prone to error. *ProPAN* software modifications require a skilled Epi Info™ user. Similar to all mathematical modelling techniques, the validity of conclusions drawn from an *Optifood* analysis will depend on the accuracy of model parameters (i.e. dietary and food composition data) and the assumptions made about nutrient requirements. The process of quickly testing hundreds of alternative sets of food-based recommendations requires careful planning to avoid exceeding the computer's memory capacity with unnecessary tests. The use of both tools therefore requires that there is expertise in nutrition and dietary data analyses. Further, the results alone are insufficient to lead the larger system changes that are often necessary to facilitate desired behaviour changes. Nevertheless, experiences of using *ProPAN* and/or *Optifood* in countries in Africa, America and Asia have shown that tools fill a critical gap and that relevant local expertise can be mobilized to facilitate their use. Moreover, both tools are 'living' documents and they will be revised and updated as information and feedback from their application in the field is obtained.

### Looking towards the future

There is a clear global demand, expressed by many countries, for guidance on infant and young child-feeding programming, especially for improved strategic planning on complementary feeding. In 2012–2013, UNICEF supported several intercountry workshops to strengthen national strategic planning for stunting reduction involving a broad range of partners. Hosted by the governments of Malawi (for Malawi, Lesotho, and Zambia), Namibia (for Botswana, Namibia, South Africa, Tanzania), Ghana (for Ghana, Liberia, Sierra Leone) and Pakistan, these workshops generated significant interest in *ProPAN*

and participants pointed out its importance for improvement of national planning and programming process. Optifood was still under development at the time and not specifically discussed. Tanzania has since then implemented *ProPAN* and results are being analysed. The workshops emphasized the importance of a good orientation about the tools in order for national policymakers and programme managers to appreciate its role. This will generate demand but is also a first building block towards national capacity for effective use of the tools. Experience with field application of Optifood in 10 countries confirms these findings. It is worth noting that in Guatemala, Optifood was also used to develop food-based recommendations for pregnant and lactating women. There is a clear interest to use Optifood for maternal nutrition.

In order to respond to the need and demand generated to date, WHO and UNICEF, together with a host of other partners, will build capacity by (1) using different nutrition fora for providing relevant briefing and orientation on *ProPAN* and Optifood tools, (2) developing capacity of a core team of facilitators in each region to support countries to use the available tools, and (3) supporting the implementation of the tools in countries with a high burden of malnutrition. By doing so, we hope to make a significant contribution towards evidence-based planning for infant and child nutrition programmes and ensuring that all children enjoy healthy growth.

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### Conflicts of interest

Helena Pachón works at the Flour Fortification Initiative (FFI) which receives in-kind contributions from vitamin and mineral pre-mix companies to host meals and breaks at FFI co-sponsored workshops held worldwide. All other authors declare that they have no conflict of interest.

### Contributions

AB and EF conceptualized the Optifood tool. AB and BD provided oversight to the development of the Optifood tool and CKL, HP, EC, NM and RM provided oversight to the development of the *ProPAN* tool. EF wrote the linear programming models and technically guided the design of the electronic platform and its field testing. MW led the development of and updates to the Optifood reference data files and gave technical advice throughout the process. HP co-ordinated the harmonization of *ProPAN* and Optifood, HCK participated in the development of *ProPAN*. HCK, RP and NS field tested Optifood. BD, CKL, HP, EF, NS, HCK, RP and NM drafted sections



of the manuscript. All authors read, edited and approved the final manuscript.

## Disclaimer

BD is a staff member of the Pan American Health Organization and CKL is a staff member of the World Health Organization. The authors alone are responsible for the views expressed in this publication and they do not necessarily represent the decisions, policy or views of the Pan American Health Organization or of the World Health Organization.

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## Panel I The Peru experiences

### ProPAN

*ProPAN* has been applied in Peru to assist in the development of infant and young child-feeding interventions in different populations. In a peri-urban population of Lima, all the steps of *ProPAN* were applied with local adaptation, resulting in the



selection, recipe development, household testing and promotion of locally appropriate complementary feeding recommendations. The application of *ProPAN* facilitated the selection of key recommendations: (1) giving food of an appropriate consistency at each meal instead of the commonly given dilute soups, (2) adding available, accessible and acceptable animal source foods (chicken liver, egg, or fish) and suggested preparations using these foods to improve the quality of the diet and increase the intakes of the deficient nutrients, and (3) a responsive feeding message to address concerns of the mother. These recommendations have subsequently been promoted widely by the Ministry of Health and other institutions.

The following components of the *ProPAN* guide were found particularly useful in the Peru setting and have subsequently been applied for interventions in other parts of the country to complement information already known or to focus on specific aspects. (1) The calculation of the Best Buy, the cost-nutrient benefit of locally available foods in the market which facilitated the selection of low-cost nutrient-rich foods accessible to the target population. (2) The exploration of perceptions towards specific foods in the food attributes exercise as a first step towards learning of their acceptability. (3) The household trials and the behaviour analysis which were extremely valuable in selecting the behaviours with most potential for nutritional benefit and most acceptable and feasible to put into practice by the target population. (4) The analysis and integration of the quantitative and qualitative data using the user-friendly matrixes to determine the barriers and opportunities for behaviour change of the different practices, thus facilitating the selection of the foods and practices. (5) Alternatives for intervention channels at both the health service and community levels. (6) The responsive feeding component. These parts have been used, according to need (separately or in sequence), and adapted to the local context in the development of several infant-feeding interventions in different populations and geographical areas in Peru. In particular, the application of the household trials and behaviour analysis to test responsive feeding recommendations in a rain forest area of Peru (Ucayali) facilitated the selection

of four responsive feeding messages, subsequently promoted by local organizations (Creed-Kanashiro *et al.* 2010).

### Optifood

The Optifood tool was used in an impoverished peri-urban population in Lima, Peru to identify food-based recommendations for infants 9 to 11 months of age. Analysis of the food patterns reported for this group found deficiencies in several nutrients, especially iron, zinc and calcium. The Optifood programme was used to calculate how nutrient intakes could be increased with local food, with the finding that it was impossible to meet the recommended intakes of the deficient nutrients using only available food in acceptable quantities and frequency. Therefore, the following three food-based recommendations were developed and subsequently tested in household trials with 32 mothers using pictorial education materials as promotional aids: (1) the addition of chicken liver to the infant's diet three times a week, (2) adding milk (3 tablespoonfuls) daily to the child's pudding, stew or purée, and (3) mixing multiple micronutrient powder into the child's food every other day (home fortification consistent with Ministry of Health recommendations).

The household trials were conducted for a period of 2 weeks during which mothers were visited at home on four occasions to explore acceptability and encourage adoption of the recommended practices. A 24-hour recall of the infant's intake was conducted before and after the intervention to explore changes in food and nutrient intakes.

All the recommendations tested were well received by mothers, with almost 90% of them putting the recommendations into practice from the beginning. According to the pre-intervention 24-h recall, children consumed less than 60% of the recommended nutrient intakes (RNIs) of zinc and iron, and mean calcium intake was near to the RNIs; at the end of the intervention, mean intakes of iron and calcium surpassed, and zinc approached 100% of RNI, showing that the recommendations tested had a positive impact on the infant's nutrient intake as well as being well accepted by the mothers.

### Complementarity of *ProPAN* and *Optifood*

In the Peru experience, several aspects of *ProPAN* facilitated the application of *Optifood* and vice versa. *Optifood* was used to determine the nutrient deficiencies from dietary intake data collected using a recall methodology similar to *ProPAN*. Based on this data, the exploration for potential food-based strategies, alternatives, amounts and frequency of consumption to arrive at specific recommendations to improve nutrient intakes was easily done using *Optifood*.

The cost section of *Optifood* provided important information for determining the food-based recommendations (FBRs); the information on the local foods available and their prices required for this was obtained using the market survey of *ProPAN*.

The household trials to test the FBRs arrived at using *Optifood* were conducted using the Test of

Recommendation module of *ProPAN*. Specifically, the 24-hour dietary recall conducted before and after the introduction of the FBRs to caregivers was based on the *ProPAN* format and the calculation of adequacy of nutrient intakes using *Optifood*. The guides for the exploration of the acceptability and feasibility of mothers in implementing the FBRs were taken from the *ProPAN* module.

The analysis of the results of these trials was done using *ProPAN*'s matrixes which facilitated defining the barriers and opportunities from the mothers' experiences of implementing the recommendations. The two tools were complementary in providing the information required to develop adequate and acceptable FBRs to improve the infants' nutrition.

**APPENDIX 2: ETHICAL APPROVALS**

**Appendix 2.1: Ethical approvals for the Optifood sub-study from the London School of Hygiene and Tropical Medicine, United Kingdom**

**LONDON SCHOOL OF HYGIENE  
& TROPICAL MEDICINE**

**ETHICS COMMITTEE**



**APPROVAL FORM**

**Application number: 6000**

**Name of Principal Investigator Neha S Singh**

**Faculty Epidemiology and Population Health**

**Head of Faculty Professor Laura Rodrigues**

**Title: Optifood – An Approach to Improve Nutrition**

This application is approved by the Committee.

**Chair of the Ethics Committee**



**Date .....22 July 2011 .....**

**Approval is dependent on local ethical approval having been received.**

**Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form.**



**OBSERVATIONAL/INTERVENTIONS RESEARCH ETHICS COMMITTEE**

27 April

Neha S Singh

Dear Neha

**Study Title:** Optifood – An Approach to Improve Nutrition  
**LSHTM ethics ref:** 6000  
**LSHTM amend no:** A328  
**Department:** Epidemiology and Population Health

Thank you for your application of 26 April for the amendment above to the existing ethically approved study and submitting revised documentation.

The amendment application has been considered by the Committee.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above amendment to research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval for the amendment having been received, where relevant.

**Approved documents**

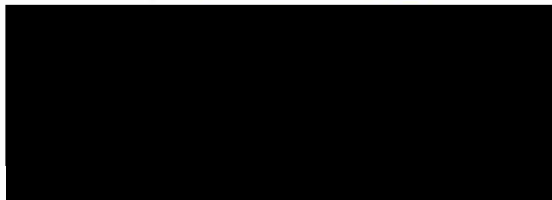
The final list of documents reviewed and approved by the Committee is as follows:

<i>Document</i>	<i>Version</i>	<i>Date</i>	
LSHTM amendment application	n/a		
Protocol	V2.0	26/04/12	
Information Sheet	V2.0	26/04/12	
Consent form	V2.0	26/04/12	

**After ethical review**

Any further changes to the application must be submitted to the Committee via an E2 amendment form.

Yours sincerely,



Professor Nrewa  
Chair



Appendix 2.2: Ethical approvals for the Optifood sub-study from the Centre for Health Research and Development, Society for Applied Studies, India

LETTER OF APPROVAL OF RESEARCH PROPOSAL BY SAS ERC

**Ethics Review Committee\***  
**Society for Applied Studies**  
45, Kalu Sarai, New Delhi-110016, India

Ref No: SAS ERC/22/2011

Date: October 14, 2011

Dear Dr. Sarmila Mazumder,  
Principal Investigator  
Society for Applied Studies,  
45, Kalu Sarai,  
New Delhi - 110016

The Ethics Review Committee reviewed and discussed your application to conduct the trial entitled "Optifood – An Approach to Improve Nutrition" on October 14, 2011.

Level of risk	Minimal	<input checked="" type="checkbox"/>	More than minimal risk	<input type="checkbox"/>
Type of review	Expedited	<input type="checkbox"/>	Full committee	<input checked="" type="checkbox"/>

The following members of the Ethics Review Committee were present at the meeting held on October 14, 2011, 4.00 pm at 45, Kalu Sarai, New Delhi - 110016.

1. Dr. Anju Virmani, Chairperson
2. Dr. Sarmila Mazumder, Member Secretary
3. Dr. B.L.Jaikhani, Member, Basic Scientist
4. Dr JV Meenakshi, Basic Scientist
5. Dr. Sanghmitra S Acharya, Member, Social Scientist
6. Dr. Rajib Dasgupta, Member, Social Scientist
7. Ms. Enatoli K. Sema, Member, Legal Expert
8. Colonel Gian Sagar, Member, Legal Expert
9. Mrs. Girija Sapra, Member, Community Representative
10. Mrs. Kiran Kanda, Member, Community Representative
11. Dr. Anjul Chaturvedi, Member, Clinician

The reasons for non- approval were clarified by Dr Nita Bhandari, the co-investigator:

- The program is not intended for use in the community. It is meant for use by authorities formulating the recommendations, therefore the concern about feasibility was not relevant.
- Earlier studies have shown that a sample size of 30 mothers is sufficient. Moreover, since the study was to assess the software, not the recommendations emerging from its use, the socio-economic and cultural differences were not relevant.
- The ICF for mothers has been modified (version 1.1, dated 14 October, 2011).

Therefore we approve the trial to be conducted in its presented form.

**Approval date:** October 14, 2011

**Approval expiration date:** October 13, 2012

The SAS ERC expects to be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information / informed consent and asks to be provided a copy of the final report.

The SAS ERC is constituted and conforming with the requirements of ICMR ethical guidelines, ICH-GCP (Section 3), Declaration of Helsinki. The OHRP Federal Wide Assurance number for SAS ERC is FWA00001757.

A status report must be submitted to, reviewed and approved by the SAS ERC before the current approval expires.

The SAS ERC must be informed within 7 working days of the principal investigator learning of (a) any unexpected, serious, study related adverse event (b) expected adverse event occurring at a greater than expected frequency (c) unanticipated problems with the study which may pose a risk to the participants or effect the integrity of the data and minor deviations (non compliance) at the time of the study report. For deaths, the SAS ERC must be informed within 24 hours of confirmation of the event by the Principal Investigator.

Changes or modifications to this research activity must be submitted to and approved by the SAS ERC before they are implemented. Unapproved changes will be considered as protocol deviations and will require reporting to regulatory authorities.

Regulatory documents (including signed study consent forms) must be maintained by the principal investigator and available for audit for 3 years after the study is closed with the SAS ERC.

It is the responsibility of the principal investigator and all research staff to comply with the applicable regulatory, legal and ethical guidelines governing human subject research.

Yours sincerely,

[Redacted Name]

\_\_\_\_\_  
Name of Chairperson

[Redacted Signature]

\_\_\_\_\_  
Signature of Chairperson

14/10/2011

\_\_\_\_\_  
Date

*\*[The Office for Human Research Protections, Department of Health and Human Services, USA approved Federal Wide Assurance Identifier: FWA 00001757, IRB 00007526]*

LETTER OF APPROVAL OF AMENDMENT OF RESEARCH PROPOSAL  
BY SAS ERC

**Ethics Review Committee\***  
**Society for Applied Studies**  
45, Kalu Sarai, New Delhi-110016, India

Ref. No. SAS ERC/30/2012

Date: April 27, 2012

Dear Dr. Sarmila Mazumder,  
Principal Investigator  
Society for Applied Studies,  
45, Kalu Sarai,  
New Delhi - 110016

The Ethics Review Committee reviewed the amendment in the previously approved the trial entitled "Optifood – An Approach to Improve Nutrition" which was last approved on October 14, 2011.

The following documents were reviewed:

1. Optifood Study Protocol
2. Information sheet and Informed Consent for Mothers in English, Version 1.2, Dated April 20, 2012
3. Information sheet and Informed Consent for Mothers in Hindi, Version 1.2, Dated April 23, 2012
4. Back translation of Information sheet and Informed Consent for Mothers, Version 1.2, Dated April 23, 2012
5. Translation and back translation certificates

Level of risk	Minimal	<input checked="" type="checkbox"/>	More than minimal risk	<input type="checkbox"/>
Type of review	Expedited	<input checked="" type="checkbox"/>	Full committee	<input type="checkbox"/>

The following amendment was reviewed and the ERC approves the proposed research.

**Amendment:** Infants in the study will be weighed.

**Approval date:** October 14, 2011

**Approval expiration date:** October 13, 2012

The Ethics Review Committee expects to be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information / informed consent and asks to be provided a copy of the final report.

The SAS ERC is constituted and conforming with the requirements of ICMR ethical guidelines, ICH-GCP (Section 3), Declaration of Helsinki. The OHRP Federal Wide Assurance number for SAS ERC is FWA00001757.

A status report must be submitted to, reviewed and approved by the SAS ERC before the current approval expires.

The SAS ERC must be informed within 7 working days of the principal investigator learning of (a) any unexpected, serious, study related adverse event (b) expected adverse event occurring at a greater than expected frequency (c) unanticipated problems with the study which may pose a risk to the participants or effect the integrity of the data and minor deviations (non compliance) at the time of the study report. For deaths, the SAS ERC must be informed within 24 hours of confirmation of the event by the Principal Investigator.

Changes or modifications to this research activity must be submitted to and approved by the SAS ERC before they are implemented. Unapproved changes will be considered as protocol deviations and will require reporting to regulatory authorities.

Regulatory documents (including signed study consent forms) must be maintained by the principal investigator and available for audit for 3 years after the study is closed with the SAS ERC.

It is the responsibility of the principal investigator and all research staff to comply with the applicable regulatory, legal and ethical guidelines governing human subject research.

Yours sincerely,



Name of Chairperson



Signature of Chairperson

27 April 2012

Date

*\*[The Office for Human Research Protections, Department of Health and Human Services, USA approved Federal Wide Assurance Identifier: FWA 00001757, IRB 00007526]*

**Appendix 2.3: Ethical approvals for the mHealth sub-study from the London School of Hygiene and Tropical Medicine, United Kingdom**

**LONDON SCHOOL OF HYGIENE  
& TROPICAL MEDICINE**

**ETHICS COMMITTEE**



**APPROVAL FORM**

**Application number: 6011**

**Name of Principal Investigator Neha S Singh**

**Faculty Epidemiology and Population Health**

**Head of Faculty Professor Laura Rodrigues**

**Title: A Novel Approach to Improve Child Nutrition in India**

This application is approved by the Committee.

**Chair of the Ethics Committee**



**Date .....18 August 2011 .....**

**Approval is dependent on local ethical approval having been received.**

**Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form.**



**OBSERVATIONAL/INTERVENTIONS RESEARCH ETHICS COMMITTEE**

16 January

Neha S Singh

Dear Neha

**Study Title:** mHealth – A Novel Approach to Improve Child Nutrition in India  
**LSHTM ethics ref:** A299  
**LSHTM amend no:** 6011  
**Department:** Epidemiology and Population Health

Thank you for your application of 21 December for the amendment above to the existing ethically approved study and submitting revised documentation.

The amendment application has been considered by the Committee.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above amendment to research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval for the amendment having been received, where relevant.

**Approved documents**

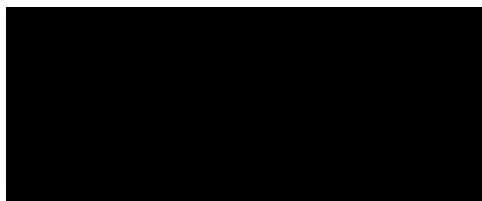
The final list of documents reviewed and approved by the Committee is as follows:

<i>Document</i>	<i>Version</i>	<i>Date</i>	
LSHTM amendment application	n/a		
Protocol	V1.0	11/01/12	
Information Sheet	V1.0	11/01/12	
Consent form	V1.0	11/01/12	

**After ethical review**

Any further changes to the application must be submitted to the Committee via an E2 amendment form.

Yours sincerely,



**Professor Andrew J Hall**  
Chair

**Appendix 2.4: Ethical approvals for the mHealth sub-study from the Centre for Health Research and Development, Society for Applied Studies, India**

**LETTER OF APPROVAL OF RESEARCH PROPOSAL BY SAS ERC**

**Ethics Review Committee\***  
**Society for Applied Studies**  
45, Kalu Sarai, New Delhi-110016, India

Ref No: SAS ERC/18/2011

Date: September 21, 2011

Dear Dr. Sarmila Mazumder,  
Principal Investigator  
Society for Applied Studies,  
45, Kalu Sarai,  
New Delhi - 110016

The Ethics Review Committee reviewed and discussed your application to conduct the trial entitled "mHealth – A Novel Approach to Improve Child Nutrition in India" on September 9, 2011.

The following documents were reviewed:

1. mHealth Study Protocol
2. Full review form
3. Information sheet and Informed Consent for FGD in English, Version 1.0, Dated August 17, 2011
4. Information sheet and Informed Consent for FGD in Hind, Version 1.0, Dated August 17, 2011
5. Back translation of Information sheet and Informed Consent for FGD, Version 1.0, Dated August 17, 2011
6. Translation and back translation certificates
7. LSHTM mHealth study approval\_FORM B
8. Undertaking by the Investigator
9. Curriculum vitae of the investigators

Level of risk	Minimal	<input checked="" type="checkbox"/>	More than minimal risk	<input type="checkbox"/>
Type of review	Expedited	<input type="checkbox"/>	Full committee	<input checked="" type="checkbox"/>

The following members of the Ethics Review Committee were present at the meeting held on September 9, 2011, 4.00 pm at 45, Kalu Sarai, New Delhi - 110016.

1. Dr. Anju Virmani, Chairperson
2. Dr. Sarmila Mazumder, Member Secretary
3. Dr. B.L.Jailkhani, Member, Basic Scientist
4. Dr. Sanghmitra S Acharya, Member, Social Scientist
5. Dr. Rajib Dasgupta, Member, Social Scientist
6. Ms. Enatoli K. Sema, Member, Legal Expert
7. Colonel Gian Sagar, Member, Legal Expert
8. Mrs. Girija Sapra, Member, Community Representative
9. Mrs. Kiran Kanda, Member, Community Representative
10. Dr. Anjul Chaturvedi, Member, Clinician
11. Dr. Vidya Gupta, Member, Clinician

We approve the trial to be conducted in its presented form.

**Approval date:** September 9, 2011

**Approval expiration date:** September 8, 2012

The SAS ERC expects to be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information / informed consent and asks to be provided a copy of the final report.

The SAS ERC is constituted and conforming with the requirements of ICMR ethical guidelines, ICH-GCP (Section 3), Declaration of Helsinki. The OHRP Federal Wide Assurance number for SAS ERC is FWA00001757.

A status report must be submitted to, reviewed and approved by the SAS ERC before the current approval expires.

The SAS ERC must be informed within 7 working days of the principal investigator learning of (a) any unexpected, serious, study related adverse event (b) expected adverse event occurring at a greater than expected frequency (c) unanticipated problems with the study which may pose a risk to the participants or effect the integrity of the data and minor deviations (non compliance) at the time of the study report. For deaths, the SAS ERC must be informed within 24 hours of confirmation of the event by the Principal Investigator.

Changes or modifications to this research activity must be submitted to and approved by the SAS ERC before they are implemented. Unapproved changes will be considered as protocol deviations and will require reporting to regulatory authorities.

Regulatory documents (including signed study consent forms) must be maintained by the principal investigator and available for audit for 3 years after the study is closed with the SAS ERC.

It is the responsibility of the principal investigator and all research staff to comply with the applicable regulatory, legal and ethical guidelines governing human subject research.

Yours sincerely,



\_\_\_\_\_  
Name of Chairperson



\_\_\_\_\_  
Signature of Chairperson

\_\_\_\_\_  
Date 21/9/11

*\*[The Office for Human Research Protections, Department of Health and Human Services, USA approved Federal Wide Assurance Identifier: FWA 00001757, IRB 00007526]*



LETTER OF APPROVAL OF RESEARCH PROPOSAL BY SAS ERC  
FOLLOWING AMENDMENTS

**Ethics Review Committee\***

**Society for Applied Studies**

45, Kalu Sarai, New Delhi-110016, India

Ref No: SAS ERC/25/2011

Date: December 24, 2011

Dear Dr. Sarmila Mazumder,  
Principal Investigator  
Society for Applied Studies,  
45, Kalu Sarai,  
New Delhi - 110016

The Ethics Review Committee reviewed your application for amendment in the clinical trial entitled "mHealth – A Novel Approach to Improve Child Nutrition in India" which was approved initially on September 9, 2011.

The following documents were reviewed:

1. mHealth Study Protocol Dated December 21, 2011
2. Information sheet and Informed Consent for FGD in English, Version 1.1, Dated December 21, 2011
3. Information sheet and Informed Consent for FGD in Hind, Version 1.1, Dated December 21, 2011

Level of risk	Minimal	<input checked="" type="checkbox"/>	More than minimal risk	<input type="checkbox"/>
Type of review	Expedited	<input checked="" type="checkbox"/>	Full committee	<input type="checkbox"/>

The following amendment was reviewed and the ERC approves the amended protocol.

**Amendment:** Conducting Focus Group Discussions (FGDs) with caregivers to obtain additional information to design intervention. In the initial approval, the ERC had approved FGDs with mothers and Anganwadi Workers.

**Approval date:** September 9, 2011

**Approval expiration date:** September 8, 2012

The SAS ERC expects to be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information / informed consent and asks to be provided a copy of the final report.

The SAS ERC is constituted and conforming with the requirements of ICMR ethical guidelines, ICH-GCP (Section 3), Declaration of Helsinki. The OHRP Federal Wide Assurance number for SAS ERC is FWA00001757.

A status report must be submitted to, reviewed and approved by the SAS ERC before the current approval expires.

The SAS ERC must be informed within 7 working days of the principal investigator learning of (a) any unexpected, serious, study related adverse event (b) expected adverse event occurring at a greater than expected frequency (c) unanticipated problems with the study which may pose a risk to the participants or effect the integrity of the data and minor deviations (non compliance) at the time of the study report. For deaths, the SAS ERC must be informed within 24 hours of confirmation of the event by the Principal Investigator.

Changes or modifications to this research activity must be submitted to and approved by the SAS ERC before they are implemented. Unapproved changes will be considered as protocol deviations and will require reporting to regulatory authorities.

Regulatory documents (including signed study consent forms) must be maintained by the principal investigator and available for audit for 3 years after the study is closed with the SAS ERC.

It is the responsibility of the principal investigator and all research staff to comply with the applicable regulatory, legal and ethical guidelines governing human subject research.

Yours sincerely,

\_\_\_\_\_

Name of Chairperson

\_\_\_\_\_

Signature of Chairperson

14 Dec 2011

Date

*[The Office for Human Research Protections, Department of Health and Human Services, USA  
approved Federal Wide Assurance Identifier: FWA 00001757, IRB 00007526]*

## **APPENDIX 3: OPTIFOOD SUB-STUDY INFORMED CONSENT FORMS AND QUESTIONNAIRES**

### **Appendix 3.1: Information sheet and informed consent form for mothers providing infant dietary data**

#### **Informed Consent Form for Mothers**

[Name of PI (specific to country)]: Dr. Sarmila Mazumder

[Name of Organization depending on country]: Society for Applied Studies

Funder: UBS Optimus Foundation

Project: Optifood – An Approach to Improve Nutrition

**This Informed Consent Form has two parts:**

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

**You will be given a copy of the full Informed Consent Form**

#### **Part I: Information Sheet**

##### **Introduction**

I am [name], working for the Society for Applied Studies. I am doing research on the possibility of using Optifood. Optifood is a new nutrition tool that creates nutrition tips and key advocacy messages to improve health of mothers and children. I am going to give you information and invite you to be part of this research.

You can talk to anyone you feel comfortable with about the research before you decide if you want to take part in it.

This form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me or of another researcher at any time.

##### **Purpose of the research**

We would like to find ways to make long-term improvements in nutrition. So, we recently developed Optifood, a new tool to create advocacy messages and computer generated nutrition recommendations. However, we need to do research to see how this new tool can improve the nutrition of populations.

We are asking you to join this study to share what you feed usually your child. We want to know what mothers in your area feed infants so we can use this information to create nutrition recommendations in Optifood for your community.

##### **Type of Research Intervention**

This study will involve your participation in a questionnaire on what you fed your child in the past day and week. You will also be asked to answer a few questions about yourself and your family.

##### **Participant Selection**

You are being invited to take part in this research because you are a mother of a young infant, and we feel that your knowledge of infant feeding can contribute much to our understanding and knowledge of how Optifood can be used to create food-based recommendations for your community.

### **Voluntary Participation**

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. You may change your mind later and stop participating even if you agreed earlier.

### **Procedures**

We will ask you to share what you fed your child in the past day and the past week. One additional survey with questions about yourself and your family will take place. You will be asked to answer some questions about yourself, your family and community. You may ask to move on to the next question if you don't want to answer a specific question. The information you will give is confidential. Your name will not be on the forms, only a number will identify you. Also, no one but the project coordinator and person asking you questions will have access to the information you provide.

The discussion will take place at your home and no one but you and my colleague asking you questions will be there. The information recorded is confidential. This means that no one else except but the project coordinator and person asking you questions during the talk will have access to the files.

### **Duration**

The meeting will be held once and will last 1-2 hours.

### **Risks**

You will not be at physical or psychological risk if you take part in this study. Also, you should not experience any discomfort resulting from the questions we will ask you. There is a risk that you may share some personal or confidential information by chance. There is also a risk that you may feel uncomfortable talking about some topics. However, we do not want this to happen. You do not have to answer any question or take part in the talk if you feel the questions are too personal. Also, you can leave the study at any point if talking about certain issues makes you uncomfortable.

### **Benefits**

You will not directly benefit from this study. However, you taking the time to answer our questions will help us find out if and how we can make Optifood available.

### **Reimbursements**

You will not have to pay anything to join this study. Also, you will not be paid to participate in the study.

### **Confidentiality**

This study may draw attention from the community. Community members might also ask you questions if you join the study. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key and on a password-secured computer. It will not be shared with or given to anyone except the research sponsors and study investigators.

### **Sharing the Results**

Nothing that you tell us today will be shared with anybody outside the study. Also, nothing will be

linked to your name. Everything we learn will be shared with you and your community before we share it with everyone else. Each participant will receive a summary of the results.

**Right to Refuse or Withdraw**

You do not have to take part in this study if you do not want to. Your decision will not affect your job or any evaluations in any way. You may stop participating in the group talk and answering any questions at any time that you wish. Doing so will not affect your job.

**Who to Contact**

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following: Dr.Sarmila Mazumder: 9811681530, Dr.Sunita Taneja: 9811206456.

This proposal has been reviewed and approved by the Ethics Review Committee Society for Applied Studies, which is a committee whose task it is to make sure that study participants are protected from harm. If you wish to find about more about the ERC, contact on 9582595320.

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

**Part II: Certificate of Consent**

**I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to:**

- be a participant in this study**
- be recorded while participating in interviews**
- my quotes being used for reports and/or publications**

Print Name of Participant \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

Signature of Participant \_\_\_\_\_

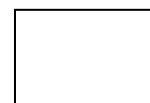
**If illiterate**

**I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely to:**

- be a participant in this study**
- be recorded while participating in interviews**
- his/her quotes being used for reports and/or publications**

Print name of witness \_\_\_\_\_

Thumb print of participant



Signature of witness \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

**Statement by the researcher/person taking consent**

**I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the research study. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.**

Print Name of Researcher/person taking the consent \_\_\_\_\_

Signature of Researcher /person taking the consent \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

## **Appendix 3.2: Information sheet and informed consent form for mothers testing food-based recommendations**

### **Informed Consent Form for Mothers**

**[Name of PI (specific to country)]: Dr. Sarmila Mazumder**

**[Name of Organization depending on country]: Society for Applied Studies**

**Funder: UBS Optimus Foundation**

**Project: Optifood – An Approach to Improve Nutrition**

**This Informed Consent Form has two parts:**

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

**You will be given a copy of the full Informed Consent Form**

### **Part I: Information Sheet**

#### **Introduction**

I am [name], working for the Society for Applied Studies. I am doing research on the possibility of using Optifood. Optifood is a new nutrition tool that creates nutrition tips and key advocacy messages to improve health of mothers and children. I am going to give you information and invite you to be part of this research.

You can talk to anyone you feel comfortable with about the research before you decide if you want to take part in it.

This form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me or of another researcher at any time.

#### **Purpose of the research**

We would like to find ways to make long-term improvements in nutrition. So, we recently developed Optifood, a new tool to create advocacy messages and computer generated nutrition recommendations. However, we need to do research to see how this new tool can improve the nutrition of populations. We would also like to find out how Optifood can be used by Indian organisations for nutrition programmes and advocacy.

We are asking you to join this study to share your opinions of the nutrition recommendations developed by Optifood. We want to learn whether it is easy to follow these recommendations so we can work toward making them available to other communities.

#### **Type of Research Intervention**

This study will involve your participation in 3 interviews and 2 questionnaires on what you fed your child. All 3 interviews will be written down and will last about one hour. We may tape the last interview. You will also be asked to answer a few questions about yourself and your family during the first interview. We will measure your infant's weight after the last meeting.

#### **Participant Selection**

You are being invited to take part in this research because we feel that your experience as a mother of a young child can contribute much to our understanding and knowledge of perceptions of Optifood's food-based recommendations and their potential use in nutrition program planning and advocacy.

### **Voluntary Participation**

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. You may change your mind later and stop participating even if you agreed earlier.

### **Procedures**

We are asking you to help us learn more about the possibility of using food-based recommendations produced by the Optifood tool. You will be asked to take part in a discussion with an interviewer three times over the course of 8 days. We will also ask you questions on what you fed your child twice – once before the first interview, and once after the last interview at the end of the 8 days. One additional survey with questions about yourself and your family will take place once during the first interview. Your infant's weight will also be measured after the last meeting.

The interview will start with my colleague who will make sure you are comfortable. He will also answer any questions you might have. Next, he will ask you questions about the food-based recommendations and give you time to share your knowledge. The questions will be about your perceptions of the recommendations. He will make sure to give you time to share your opinions. He will not ask you to share personal beliefs. Also, you will not have to share anything that you are not comfortable with. He will also ask you to provide information on what you fed your child during the first and last interview.

The discussion will take place in the community/at home and no one but you and my colleague asking you questions will be there. The entire talk will be tape-recorded with a digital recorder, but you will not be identified by name on any records. The file will be kept on a secure computer. The information recorded is confidential. This means that no one else except but the project coordinator and person asking you questions during the talk will have access to the files. The tapes will be kept for 5 years.

During the first interview, you will be asked to answer some questions about yourself, your family and community. You may ask to move on to the next question if you don't want to answer a specific question. The information you will give is confidential. Your name will not be on the forms, only a number will identify you. Also, no one but the project coordinator and person asking you questions will have access to the information you provide.

### **Duration**

The meetings will be held three times over the course of 8 days.

### **Risks**

You will not be at physical or psychological risk if you take part in this study. Also, you should not experience any discomfort resulting from the questions we will ask you. There is a risk that you may share some personal or confidential information by chance. There is also a risk that you may feel uncomfortable talking about some topics. However, we do not want this to happen. You do not have to answer any question or take part in the talk if you feel the questions are too personal. Also, you can leave the study at any point if talking about certain issues makes you uncomfortable.



**Benefits**

You will not directly benefit from this study. However, you taking the time to answer our questions will help us find out if and how we can make Optifood available.

**Reimbursements**

You will not have to pay anything to join this study. Also, you will not be paid to participate in the study.

**Confidentiality**

This study may draw attention from the community. Community members might also ask you questions if you join the study. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key and on a password-secured computer. It will not be shared with or given to anyone except the research sponsors and study investigators.

We will ask you and others in the group not to talk to other people about what was said in the group talk. We will, in other words, ask each of you to keep what was said in the group confidential. You should know, however, that we cannot stop or prevent participants who were in the group from sharing things that should be confidential.

**Sharing the Results**

Nothing that you tell us today will be shared with anybody outside the study. Also, nothing will be linked to your name. Everything we learn will be shared with you and your community before we share it with everyone else. Each participant will receive a summary of the results.

**Right to Refuse or Withdraw**

You do not have to take part in this study if you do not want to. Your decision will not affect your job or any evaluations in any way. You may stop participating in the group talk and answering any questions at any time that you wish. Doing so will not affect your job. I will give you an opportunity at the end of the group talk to review what you said. You can ask to change or remove portions of what you said if you do not agree with my notes or if I did not understand you correctly.

**Who to Contact**

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following: Dr.Sarmila Mazumder: 9811681530, Dr.Sunita Taneja: 9811206456.

This proposal has been reviewed and approved by the Ethics Review Committee Society for Applied Studies, which is a committee whose task it is to make sure that study participants are protected from harm. If you wish to find about more about the ERC, contact on 9582595320.

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

**Part II: Certificate of Consent**

**I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to:**

- be a participant in this study**
- be recorded while participating in interviews**
- my quotes being used for reports and/or publications**

Print Name of Participant \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

Signature of Participant \_\_\_\_\_

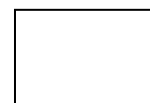
**If illiterate**

**I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely to:**

- be a participant in this study**
- be recorded while participating in interviews**
- his/her quotes being used for reports and/or publications**

Print name of witness \_\_\_\_\_

Thumb print of participant



Signature of witness \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

**Statement by the researcher/person taking consent**

**I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the research study. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.**

Print Name of Researcher/person taking the consent \_\_\_\_\_

Signature of Researcher /person taking the consent \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year



**3. INTERACTIVE 24-HOUR RECALL (page 1 of 3)**

Time Eaten	Place Eaten	Who Fed this Food to your Infant?	Food or Drink	Description / Brand / Ingredients / Additions (RECIPE)	Amount Served	Amount Left Over	Mode of Feeding	Normal Frequency Consumed in Past Week
								(days x times/day)

3. INTERACTIVE 24-HOUR RECALL (page 2 of 3)

Time Eaten	Place Eaten	Who Fed this Food to your Infant?	Food or Drink	Description / Brand / Ingredients / Additions (RECIPE)	Amount Served	Amount Left Over	Mode of Feeding	Normal Frequency Consumed in Past Week
								(days x times/day)

3. INTERACTIVE 24-HOUR RECALL (page 3 of 3)

Time Eaten	Place Eaten	Who Fed this Food to your Infant?	Food or Drink	Description / Brand / Ingredients / Additions (RECIPE)	Amount Served	Amount Left Over	Mode of Feeding	Normal Frequency Consumed in Past Week
								(days x times/day)

## SUMMARY OF RECALL AND CONCLUDING QUESTIONS

*Summarize the 24-hour recall including the items listed below:*

- ✓ *Meals*
- ✓ *Snacks*
- ✓ *Breastmilk or breastmilk substitute*

4.1 Is this a good reflection of what your infant had to eat and drink yesterday? {NutSummary}

[1] Yes

[0] No

*(If no, please summarize again and ask the caregiver to provide information about the foods or beverages eaten, which were not included in the recall.)*

**FOOD FREQUENCY**

Please specify how often the child consumed the following foods and liquids in the last 7 days and number of times each day

Days x Times/day

Buffalo milk (undiluted) .....

x

Buffalo milk (diluted) .....

x

Cow milk (undiluted) .....

x

Cow milk (diluted) .....

x

Packet milk (undiluted) .....

x

Packet milk (diluted) .....

x

Formula milk .....

x

Kheer .....

x

Curd .....

x

Lassi/chachh .....

x

Egg .....

x

Meat/fish/chicken .....

x

Rajma .....

x

Chana .....

x

Other whole pulses (lobia, soyabean) .....

x

Sabut dals (sabut moong, sabut black urad dal) .....

x

Split dals .....

x

Dal water .....

x

Bajra .....

x



Dalia.....	<input type="checkbox"/> x <input type="checkbox"/>
Roti.....	<input type="checkbox"/> x <input type="checkbox"/>
Parantha.....	<input type="checkbox"/> x <input type="checkbox"/>
Bread.....	<input type="checkbox"/> x <input type="checkbox"/>
Biscuit.....	<input type="checkbox"/> x <input type="checkbox"/>
Rusk.....	<input type="checkbox"/> x <input type="checkbox"/>
Fan.....	<input type="checkbox"/> x <input type="checkbox"/>
Sevian.....	<input type="checkbox"/> x <input type="checkbox"/>
Halwa.....	<input type="checkbox"/> x <input type="checkbox"/>
Khichri (enquire about dal used).....	<input type="checkbox"/> x <input type="checkbox"/>
Potato.....	<input type="checkbox"/> x <input type="checkbox"/>
Rice.....	<input type="checkbox"/> x <input type="checkbox"/>
Rice water.....	<input type="checkbox"/> x <input type="checkbox"/>
Spinach.....	<input type="checkbox"/> x <input type="checkbox"/>
Methi.....	<input type="checkbox"/> x <input type="checkbox"/>
Bathua.....	<input type="checkbox"/> x <input type="checkbox"/>
Sarson.....	<input type="checkbox"/> x <input type="checkbox"/>
Chaulai.....	<input type="checkbox"/> x <input type="checkbox"/>
Pudina.....	<input type="checkbox"/> x <input type="checkbox"/>
Red-yellow coloured vegetables (carrot, pumpkin).....	<input type="checkbox"/> x <input type="checkbox"/>

Other vegetables .....	<input type="checkbox"/> x <input type="checkbox"/>
Papaya .....	<input type="checkbox"/> x <input type="checkbox"/>
Guava.....	<input type="checkbox"/> x <input type="checkbox"/>
Mango .....	<input type="checkbox"/> x <input type="checkbox"/>
Orange .....	<input type="checkbox"/> x <input type="checkbox"/>
Banana .....	<input type="checkbox"/> x <input type="checkbox"/>
Apple.....	<input type="checkbox"/> x <input type="checkbox"/>
Grapes.....	<input type="checkbox"/> x <input type="checkbox"/>
Cheeku .....	<input type="checkbox"/> x <input type="checkbox"/>
Other fruits .....	<input type="checkbox"/> x <input type="checkbox"/>
Juices .....	<input type="checkbox"/> x <input type="checkbox"/>
Ghee .....	<input type="checkbox"/> x <input type="checkbox"/>
Oil .....	<input type="checkbox"/> x <input type="checkbox"/>
Butter .....	<input type="checkbox"/> x <input type="checkbox"/>
Sugar .....	<input type="checkbox"/> x <input type="checkbox"/>
Honey .....	<input type="checkbox"/> x <input type="checkbox"/>
Sago .....	<input type="checkbox"/> x <input type="checkbox"/>
Ice cream (milk/without milk) .....	<input type="checkbox"/> x <input type="checkbox"/>
Namkeen .....	<input type="checkbox"/> x <input type="checkbox"/>
Cerelac .....	<input type="checkbox"/> x <input type="checkbox"/>
Mithai .....	<input type="checkbox"/> x <input type="checkbox"/>
Dry Fruits.....	<input type="checkbox"/> x <input type="checkbox"/>

**THANK YOU! 😊**

**Introducing Food-Based Recommendations on First Visit - DAY 1**

Date (dd/mm/yyyy):

Worker ID:

Subcentre:

(1=Baroli, 2=Nacholi, 3=Jasana, 4=Kheri Kalan, 5=Bhaskola, 6=Faridpur)

Mother ID:

Child ID:

Household contact phone number: \_\_\_\_\_

Date for second household visit (dd/mm/yyyy):

**\*Introduce food-based recommendations with pictorial card, and fill the forms on the following pages**

1. Recommendation #1

1.1 What do you understand that we are recommending you to do?

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---

1.2 Do you think that you could put this recommendation into practice? If answer is no, why not?

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---

1.3 How could you put it into practice?

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---

1.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food)

---

---

1.5 Have you heard something similar before? where?

---

---

1.6 Have you done something similar before? What did you do?

---

---

1.7 Do you have any doubt or question about this recommendation?

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---

1.8 What could you do during the next days? (commitment)

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---

1.9 Observations:

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2. Recommendation #2

2.1 What do you understand that we are recommending you to do?

---

---

2.2 Do you think that you could put this recommendation into practice? If answer is no, why not?

---

---

2.3 How could you put it into practice?

---

---

2.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food)

---

---

2.5 Have you heard something similar before? where?

---

---

2.6 Have you done something similar before? What did you do?

---

---

2.7 Do you have any doubt or question about this recommendation?

---

---

2.8 What could you do during the next days? (commitment)

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2.9 Observations:

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## 3. Recommendation #3

3.1 What do you understand that we are recommending you to do?

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3.2 Do you think that you could put this recommendation into practice? If answer is no, why not?

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3.3 How could you put it into practice?

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---

3.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food)

---

---

3.5 Have you heard something similar before? where?

---

---

3.6 Have you done something similar before? What did you do?

---

---

3.7 Do you have any doubt or question about this recommendation?

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---

3.8 What could you do during the next days? (commitment)

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3.9 Observations:

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4. Recommendation #4
4.1 What do you understand that we are recommending you to do? _____ _____
4.2 Do you think that you could put this recommendation into practice? If answer is no, why not? _____ _____
4.3 How could you put it into practice? _____ _____
4.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food) _____ _____
4.5 Have you heard something similar before? where? _____ _____
4.6 Have you done something similar before? What did you do? _____ _____
4.7 Do you have any doubt or question about this recommendation? _____ _____
4.8 What could you do during the next days? (commitment) _____ _____
4.9 Observations: _____ _____

5. Recommendation #5
5.1 What do you understand that we are recommending you to do? _____ _____
5.2 Do you think that you could put this recommendation into practice? If answer is no, why not? _____ _____
5.3 How could you put it into practice? _____ _____
5.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food) _____ _____
5.5 Have you heard something similar before? where? _____ _____
5.6 Have you done something similar before? What did you do? _____ _____
5.7 Do you have any doubt or question about this recommendation? _____ _____
5.8 What could you do during the next days? (commitment) _____ _____
5.9 Observations: _____ _____



6. Recommendation #6

6.1 What do you understand that we are recommending you to do?

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6.2 Do you think that you could put this recommendation into practice? If answer is no, why not?

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6.3 How could you put it into practice?

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---

6.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food)

---

---

6.5 Have you heard something similar before? where?

---

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6.6 Have you done something similar before? What did you do?

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6.7 Do you have any doubt or question about this recommendation?

---

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6.8 What could you do during the next days? (commitment)

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6.9 Observations:

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7. Recommendation #7
7.1 What do you understand that we are recommending you to do? _____ _____
7.2 Do you think that you could put this recommendation into practice? If answer is no, why not? _____ _____
7.3 How could you put it into practice? _____ _____
7.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food) _____ _____
7.5 Have you heard something similar before? where? _____ _____
7.6 Have you done something similar before? What did you do? _____ _____
7.7 Do you have any doubt or question about this recommendation? _____ _____
7.8 What could you do during the next days? (commitment) _____ _____
7.9 Observations: _____ _____

8. Recommendation #8

8.1 What do you understand that we are recommending you to do?

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8.2 Do you think that you could put this recommendation into practice? If answer is no, why not?

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8.3 How could you put it into practice?

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8.4 Would you like to change it in any way? how? (type of preparation, frequency, type of food)

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8.5 Have you heard something similar before? where?

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8.6 Have you done something similar before? What did you do?

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8.7 Do you have any doubt or question about this recommendation?

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8.8 What could you do during the next days? (commitment)

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8.9 Observations:

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**Appendix 3.5: Day 3 Visit - Structured Open-ended Questionnaire**

**Following up Food-Based Recommendations - DAY 3**

Date (dd/mm/yyyy):

Worker ID:

Subcentre:

(1=Baroli, 2=Nacholi, 3=Jasana, 4=Kheri Kalan, 5=Bhaskola, 6=Faridpur)

Mother ID:

Child ID:

Household contact phone number: \_\_\_\_\_

Date for final household visit (dd/mm/yyyy):

I. Do you remember any of the recommendations we talked to you about 2 days ago? (1=yes, 2=no) <input type="checkbox"/>
II. What recommendations do you remember? (List in the order in which mother remembers the recommendations)
<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

**\*In the following pages, evaluate the recommendations that mothers remembered in the order that they remembered them (specified above). After doing so, reinforce and evaluate the recommendations that they may have forgotten.**

**1. First recommendation to be evaluated :**

1.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

1.2 Have you had the opportunity to put the recommendation into practice?

1.2.1 If answer to a 1.2 is no, why?

1.2.2 If answer to a 1.2 is yes, what did you do?

1.3 How did you feel putting the recommendation into practice?

1.4 How many times were you able to put the recommendation into practice since my last visit?

1.5 What did you like about the recommendation and putting it into practice?

1.6 Is there anything you did not like about this recommendation?

1.7 Do you think that your child likes this recommendation? Why or why not?

1.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

1.9 Review the commitment with the mother and Observations:

2. Second recommendation to be evaluated :

2.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

2.2 Have you had the opportunity to put the recommendation into practice?

2.2.1 If answer to a 2.2 is no, why?

2.2.2 If answer to a 2.2 is yes, what did you do?

2.3 How did you feel putting the recommendation into practice?

2.4 How many times were you able to put the recommendation into practice since my last visit?

2.5 What did you like about the recommendation and putting it into practice?

2.6 Is there anything you did not like about this recommendation?

2.7 Do you think that your child likes this recommendation? Why or why not?

2.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

2.9 Review the commitment with the mother and Observations:

3. Third recommendation to be evaluated :

3.1 Did mother remember this recommendation or is she being reminded of it?   
(1=mother remembered, 2=mother had to be reminded)

3.2 Have you had the opportunity to put the recommendation into practice?

3.2.1 If answer to a 3.2 is no, why?

3.2.2 If answer to a 3.2 is yes, what did you do?

3.3 How did you feel putting the recommendation into practice?

3.4 How many times were you able to put the recommendation into practice since my last visit?

3.5 What did you like about the recommendation and putting it into practice?

3.6 Is there anything you did not like about this recommendation?

3.7 Do you think that your child likes this recommendation? Why or why not?

3.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

3.9 Review the commitment with the mother and Observations:

4. Fourth recommendation to be evaluated :

4.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

4.2 Have you had the opportunity to put the recommendation into practice?

4.2.1 If answer to a 4.2 is no, why?

4.2.2 If answer to a 4.2 is yes, what did you do?

4.3 How did you feel putting the recommendation into practice?

4.4 How many times were you able to put the recommendation into practice since my last visit?

4.5 What did you like about the recommendation and putting it into practice?

4.6 Is there anything you did not like about this recommendation?

4.7 Do you think that your child likes this recommendation? Why or why not?

4.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

4.9 Review the commitment with the mother and Observations:



5. Fifth recommendation to be evaluated :

5.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

5.2 Have you had the opportunity to put the recommendation into practice?

5.2.1 If answer to a 5.2 is no, why?

5.2.2 If answer to a 5.2 is yes, what did you do?

5.3 How did you feel putting the recommendation into practice?

5.4 How many times were you able to put the recommendation into practice since my last visit?

5.5 What did you like about the recommendation and putting it into practice?

5.6 Is there anything you did not like about this recommendation?

5.7 Do you think that your child likes this recommendation? Why or why not?

5.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

5.9 Review the commitment with the mother and Observations:

6. Sixth recommendation to be evaluated :

6.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

6.2 Have you had the opportunity to put the recommendation into practice?

6.2.1 If answer to a 6.2 is no, why?

6.2.2 If answer to a 6.2 is yes, what did you do?

6.3 How did you feel putting the recommendation into practice?

6.4 How many times were you able to put the recommendation into practice since my last visit?

6.5 What did you like about the recommendation and putting it into practice?

6.6 Is there anything you did not like about this recommendation?

6.7 Do you think that your child likes this recommendation? Why or why not?

6.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

6.9 Review the commitment with the mother and Observations:

7. Seventh recommendation to be evaluated :

7.1 Did mother remember this recommendation or is she being reminded of it?   
(1=mother remembered, 2=mother had to be reminded)

7.2 Have you had the opportunity to put the recommendation into practice?

7.2.1 If answer to a 7.2 is no, why?

7.2.2 If answer to a 7.2 is yes, what did you do?

7.3 How did you feel putting the recommendation into practice?

7.4 How many times were you able to put the recommendation into practice since my last visit?

7.5 What did you like about the recommendation and putting it into practice?

7.6 Is there anything you did not like about this recommendation?

7.7 Do you think that your child likes this recommendation? Why or why not?

7.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

7.9 Review the commitment with the mother and Observations:

**8. Eighth recommendation to be evaluated :**

8.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

8.2 Have you had the opportunity to put the recommendation into practice?

8.2.1 If answer to a 8.2 is no, why?

8.2.2 If answer to a 8.2 is yes, what did you do?

8.3 How did you feel putting the recommendation into practice?

8.4 How many times were you able to put the recommendation into practice since my last visit?

8.5 What did you like about the recommendation and putting it into practice?

8.6 Is there anything you did not like about this recommendation?

8.7 Do you think that your child likes this recommendation? Why or why not?

8.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

8.9 Review the commitment with the mother and Observations:

### Appendix 3.6: Day 8 Visit - Structured Open-ended Questionnaire

#### Assessing Food-Based Recommendations - DAY 8

Page 1 of 17

Date (dd/mm/yyyy):

Worker ID:

Subcentre:

(1=Baroli, 2=Nacholi, 3=Jasana, 4=Kheri Kalan, 5=Bhaskola, 6=Faridpur)

Mother ID:

Child ID:

Household contact number: \_\_\_\_\_

I. Do you remember any of the recommendations we talked to you about 4 days ago? (1=yes, 2=no)

II. What recommendations do you remember?

(List in the order in which mother remembers the recommendations)

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**\*In the following pages, evaluate the recommendations that mothers remembered in the order that they remembered them (specified above). After doing so, reinforce and evaluate the recommendations that they may have forgotten.**

**1. First recommendation to be evaluated :**

1.1 Did mother remember this recommendation or is she being reminded of it?   
(1=mother remembered, 2=mother had to be reminded)

1.2 Have you had the opportunity to put the recommendation into practice?

1.2.1 If answer to a 1.2 is no, why?

1.2.2 If answer to a 1.2 is yes, what did you do?

1.3 How did you feel putting the recommendation into practice?

1.4 How many times were you able to put the recommendation into practice since my last visit?

1.5 What did you like about the recommendation and putting it into practice?

1.6 Is there anything you did not like about this recommendation?

1.7 Do you think that your child likes this recommendation? Why or why not?

1.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

1.9 Review the commitment with the mother and Observations:

1.10 Did you ever change the recommendation at the moment that you put it into practice?  
What did you change? Why did you change it?

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---

1.11 Are you willing to continue practicing this recommendation? Why? Why not?

---

---

1.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

---

---

1.13 What would you say to somebody that say that you should not do it?

---

---

1.14 Observations:

---

---

**2. Second recommendation to be evaluated :**

2.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

2.2 Have you had the opportunity to put the recommendation into practice?

---

---

2.2.1 If answer to a 2.2 is no, why?

---

---

2.2.2 If answer to a 2.2 is yes, what did you do?

---

---

2.3 How did you feel putting the recommendation into practice?

---

---

2.4 How many times were you able to put the recommendation into practice since my last visit?

---

---

2.5 What did you like about the recommendation and putting it into practice?

---

---

2.6 Is there anything you did not like about this recommendation?

---

---

2.7 Do you think that your child likes this recommendation? Why or why not?

---

---

2.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

---

---

2.9 Review the commitment with the mother and Observations:

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---



2.10 Did you ever change the recommendation at the moment that you put it into practice?  
What did you change? Why did you change it?

---

---

2.11 Are you willing to continue practicing this recommendation? Why? Why not?

---

---

2.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

---

---

2.13 What would you say to somebody that say that you should not do it?

---

---

2.14 Observations:

---

---

**3. Third recommendation to be evaluated :**

3.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

3.2 Have you had the opportunity to put the recommendation into practice?

3.2.1 If answer to a 3.2 is no, why?

3.2.2 If answer to a 3.2 is yes, what did you do?

3.3 How did you feel putting the recommendation into practice?

3.4 How many times were you able to put the recommendation into practice since my last visit?

3.5 What did you like about the recommendation and putting it into practice?

3.6 Is there anything you did not like about this recommendation?

3.7 Do you think that your child likes this recommendation? Why or why not?

3.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

3.9 Review the commitment with the mother and Observations:

3.10 Did you ever change the recommendation at the moment that you put it into practice?

What did you change? Why did you change it?

---

---

3.11 Are you willing to continue practicing this recommendation? Why? Why not?

---

---

3.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

---

---

3.13 What would you say to somebody that say that you should not do it?

---

---

3.14 Observations:

---

---

4. Fourth recommendation to be evaluated :

4.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

4.2 Have you had the opportunity to put the recommendation into practice?

---

4.2.1 If answer to a 4.2 is no, why?

---

---

4.2.2 If answer to a 4.2 is yes, what did you do?

---

---

4.3 How did you feel putting the recommendation into practice?

---

---

4.4 How many times were you able to put the recommendation into practice since my last visit?

---

---

4.5 What did you like about the recommendation and putting it into practice?

---

---

4.6 Is there anything you did not like about this recommendation?

---

---

4.7 Do you think that your child likes this recommendation? Why or why not?

---

---

4.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

---

---

4.9 Review the commitment with the mother and Observations:

---

---

4.10 Did you ever change the recommendation at the moment that you put it into practice?

What did you change? Why did you change it?

---

---

4.11 Are you willing to continue practicing this recommendation? Why? Why not?

---

---

4.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

---

---

4.13 What would you say to somebody that say that you should not do it?

---

---

4.14 Observations:

---

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**5. Fifth recommendation to be evaluated :**

5.1 Did mother remember this recommendation or is she being reminded of it?   
(1=mother remembered, 2=mother had to be reminded)

5.2 Have you had the opportunity to put the recommendation into practice?

5.2.1 If answer to a 5.2 is no, why?

5.2.2 If answer to a 5.2 is yes, what did you do?

5.3 How did you feel putting the recommendation into practice?

5.4 How many times were you able to put the recommendation into practice since my last visit?

5.5 What did you like about the recommendation and putting it into practice?

5.6 Is there anything you did not like about this recommendation?

5.7 Do you think that your child likes this recommendation? Why or why not?

5.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

5.9 Review the commitment with the mother and Observations:

<p>5.10 Did you ever change the recommendation at the moment that you put it into practice? What did you change? Why did you change it?</p> <hr/> <hr/>
<p>5.11 Are you willing to continue practicing this recommendation? Why? Why not?</p> <hr/> <hr/>
<p>5.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?</p> <hr/> <hr/>
<p>5.13 What would you say to somebody that say that you should not do it?</p> <hr/> <hr/>
<p>5.14 Observations:</p> <hr/> <hr/>

**6. Sixth recommendation to be evaluated :**

6.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

6.2 Have you had the opportunity to put the recommendation into practice?

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6.2.1 If answer to a 6.2 is no, why?

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6.2.2 If answer to a 6.2 is yes, what did you do?

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6.3 How did you feel putting the recommendation into practice?

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6.4 How many times were you able to put the recommendation into practice since my last visit?

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6.5 What did you like about the recommendation and putting it into practice?

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6.6 Is there anything you did not like about this recommendation?

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6.7 Do you think that your child likes this recommendation? Why or why not?

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6.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

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6.9 Review the commitment with the mother and Observations:

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6.10 Did you ever change the recommendation at the moment that you put it into practice?

What did you change? Why did you change it?

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6.11 Are you willing to continue practicing this recommendation? Why? Why not?

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6.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

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6.13 What would you say to somebody that say that you should not do it?

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6.14 Observations:

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7.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

7.2 Have you had the opportunity to put the recommendation into practice?

7.2.1 If answer to a 7.2 is no, why?

7.2.2 If answer to a 7.2 is yes, what did you do?

7.3 How did you feel putting the recommendation into practice?

7.4 How many times were you able to put the recommendation into practice since my last visit?

7.5 What did you like about the recommendation and putting it into practice?

7.6 Is there anything you did not like about this recommendation?

7.7 Do you think that your child likes this recommendation? Why or why not?

7.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

7.9 Review the commitment with the mother and Observations:

7.10 Did you ever change the recommendation at the moment that you put it into practice?

What did you change? Why did you change it?

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7.11 Are you willing to continue practicing this recommendation? Why? Why not?

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7.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

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7.13 What would you say to somebody that say that you should not do it?

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7.14 Observations:

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**8. Eighth recommendation to be evaluated :**

8.1 Did mother remember this recommendation or is she being reminded of it?  
(1=mother remembered, 2=mother had to be reminded)

8.2 Have you had the opportunity to put the recommendation into practice?

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8.2.1 If answer to a 8.2 is no, why?

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8.2.2 If answer to a 8.2 is yes, what did you do?

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8.3 How did you feel putting the recommendation into practice?

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8.4 How many times were you able to put the recommendation into practice since my last visit?

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8.5 What did you like about the recommendation and putting it into practice?

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8.6 Is there anything you did not like about this recommendation?

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8.7 Do you think that your child likes this recommendation? Why or why not?

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8.8 Did somebody tell you anything about this recommendation? Is yes, then who? What did they say?

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8.9 Review the commitment with the mother and Observations:

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8.10 Did you ever change the recommendation at the moment that you put it into practice?  
What did you change? Why did you change it?

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8.11 Are you willing to continue practicing this recommendation? Why? Why not?

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8.12 What would you tell to your neighbor or relative to encourage her to put into practice this recommendation with her child?

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8.13 What would you say to somebody that say that you should not do it?

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8.14 Observations:

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**Appendix 3.7: Infant Weight Form**

<b>Child ID</b>	<b>Date (dd/mm/yyyy)</b>	<b>Infant Weight (grams) measurement #1</b>	<b>Infant Weight (grams) measurement #2</b>
001			
002			
003			
004			
005			
006			
007			
008			
009			
010			
011			
012			
013			
014			
015			
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## Appendix 3.8: Sociodemographic Questionnaire

### Optifood study in Kheri Kalan PHC, Haryana, India

#### QUESTIONNAIRE FOR MOTHERS IN HOUSEHOLD TRIALS TO TEST OPTIFOOD-GENERATED FOOD-BASED RECOMMENDATIONS

[Code:1=Yes, 2=No, 9= Not applicable, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/>
2	Worker Code	2	<input type="text"/>
3	Woman ID	3	<input type="text"/>
4	Child ID	4	<input type="text"/>
5	Child sex (3=male, 4=female)	5	<input type="text"/>
6	Child birth date (dd/mm/yyyy)	6	<input type="text"/>
7	Source of birth date data (3= Immunization record, 4= Birth certificate, 5= Mother's recall with events calendar, 6= Mother's recall with confidence, 7= Mother's recall without confidence, 10= Other source, 9=NA)	7	<input type="text"/>
8	If source of child's birth date data is "other source", specify	8	_____
9	Age of child in months	9	<input type="text"/>
10	Address (Subcentre codes: 3=Baroli, 4=Nacholi, 5=Jasana, 6=Kheri Kalan, 7=Bhaskola, 10=Faridpur)	10	Subcentre: <input type="text"/> Village: _____
<b>FAMILY CHARACTERISTICS</b>			
11	How many people are currently living in the home, including elderly and young children?	11	<input type="text"/>
12	How many of these people in the household are less than 5 years old?	12	<input type="text"/>
13	Can you please tell me a little more about people currently living in your home (including you but excluding your 9-11 month old child)	13	

13a	<b>Person 1: Name initial</b>	13a	_____
13a.i	Person 1: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13a.i	<input type="checkbox"/> <input type="checkbox"/>
13a.ii	If relation to child "other relation", specify	13a.ii	_____
13a.iii	Person 1: Sex (3=male, 4=female)	13a.iii	<input type="checkbox"/>
13a.iv	Person 1: Age	13a.iv	<input type="checkbox"/> <input type="checkbox"/>
13a.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13a.v	<input type="checkbox"/>
13a.vi	Person 1: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13a.vi	<input type="checkbox"/> <input type="checkbox"/>
13a.vii	Person 1: Years of education completed	13a.vii	<input type="checkbox"/> <input type="checkbox"/>
13a.viii	Person 1: Eats at home	13a.viii	<input type="checkbox"/>
13a.ix	Person 1: Sleeps at home	13a.ix	<input type="checkbox"/>
13b	<b>Person 2: Name initial</b>	13b	_____
13b.i	Person 2: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13b.i	<input type="checkbox"/> <input type="checkbox"/>
13b.ii	If relation to child "other relation", specify	13b.ii	_____
13b.iii	Person 2: Sex (3=male, 4=female)	13b.iii	<input type="checkbox"/>
13b.iv	Person 2: Age	13b.iv	<input type="checkbox"/> <input type="checkbox"/>
13b.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13b.v	<input type="checkbox"/>
13b.vi	Person 2: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13b.vi	<input type="checkbox"/> <input type="checkbox"/>
13b.vii	Person 2: Years of education completed	13b.vii	<input type="checkbox"/> <input type="checkbox"/>



13b.viii	Person 2: Eats at home	13b.viii	<input type="checkbox"/>
13b.ix	Person 2: Sleeps at home	13b.ix	<input type="checkbox"/>
13c	Person 3: Name initial	13c	_____
13c.i	Person 3: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13c.i	<input type="checkbox"/> <input type="checkbox"/>
13c.ii	If relation to child "other relation", specify	13c.ii	_____
13c.iii	Person 3: Sex (3=male, 4=female)	13c.iii	<input type="checkbox"/>
13c.iv	Person 3: Age	13c.iv	<input type="checkbox"/> <input type="checkbox"/>
13c.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13c.v	<input type="checkbox"/>
13c.vi	Person 3: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13c.vi	<input type="checkbox"/> <input type="checkbox"/>
13c.vii	Person 3: Years of education completed	13c.vii	<input type="checkbox"/> <input type="checkbox"/>
13c.viii	Person 3: Eats at home	13c.viii	<input type="checkbox"/>
13c.ix	Person 3: Sleeps at home	13c.ix	<input type="checkbox"/>
13d	Person 4: Name initial	13d	_____
13d.i	Person 4: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13d.i	<input type="checkbox"/> <input type="checkbox"/>
13d.ii	If relation to child "other relation", specify	13d.ii	_____
13d.iii	Person 4: Sex (3=male, 4=female)	13d.iii	<input type="checkbox"/>
13d.iv	Person 4: Age	13d.iv	<input type="checkbox"/> <input type="checkbox"/>
13d.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13d.v	<input type="checkbox"/>
13d.vi	Person 4: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13d.vi	<input type="checkbox"/> <input type="checkbox"/>

13d.vii	Person 4: Years of education completed	13d.vii	<input type="text"/> <input type="text"/>
13d.viii	Person 4: Eats at home	13d.viii	<input type="checkbox"/>
13d.ix	Person 4: Sleeps at home	13d.ix	<input type="checkbox"/>
13e	Person 5: Name initial	13e	_____
13e.i	Person 5: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13e.i	<input type="text"/> <input type="text"/>
13e.ii	If relation to child "other relation", specify	13e.ii	_____
13e.iii	Person 5: Sex (3=male, 4=female)	13e.iii	<input type="checkbox"/>
13e.iv	Person 5: Age	13e.iv	<input type="text"/> <input type="text"/>
13e.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13e.v	<input type="checkbox"/>
13e.vi	Person 5: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13e.vi	<input type="text"/> <input type="text"/>
13e.vii	Person 5: Years of education completed	13e.vii	<input type="text"/> <input type="text"/>
13e.viii	Person 5: Eats at home	13e.viii	<input type="checkbox"/>
13e.ix	Person 5: Sleeps at home	13e.ix	<input type="checkbox"/>
13f	Person 6: Name initial	13f	_____
13f.i	Person 6: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13f.i	<input type="text"/> <input type="text"/>
13f.ii	If relation to child "other relation", specify	13f.ii	_____
13f.iii	Person 6: Sex (3=male, 4=female)	13f.iii	<input type="checkbox"/>
13f.iv	Person 6: Age	13f.iv	<input type="text"/> <input type="text"/>
13f.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13f.v	<input type="checkbox"/>

13f.vi	Person 6: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13f.vi	<input type="checkbox"/> <input type="checkbox"/>
13f.vii	Person 6: Years of education completed	13f.vii	<input type="checkbox"/> <input type="checkbox"/>
13f.viii	Person 6: Eats at home	13f.viii	<input type="checkbox"/>
13f.ix	Person 6: Sleeps at home	13f.ix	<input type="checkbox"/>
13g	Person 7: Name initial	13g	_____
13g.i	Person 7: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13g.i	<input type="checkbox"/> <input type="checkbox"/>
13g.ii	If relation to child "other relation", specify	13g.ii	_____
13g.iii	Person 7: Sex (3=male, 4=female)	13g.iii	<input type="checkbox"/>
13g.iv	Person 7: Age	13g.iv	<input type="checkbox"/> <input type="checkbox"/>
13g.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13g.v	<input type="checkbox"/>
13g.vi	Person 7: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13g.vi	<input type="checkbox"/> <input type="checkbox"/>
13g.vii	Person 7: Years of education completed	13g.vii	<input type="checkbox"/> <input type="checkbox"/>
13g.viii	Person 7: Eats at home	13g.viii	<input type="checkbox"/>
13g.ix	Person 7: Sleeps at home	13g.ix	<input type="checkbox"/>
13h	Person 8: Name initial	13h	_____
13h.i	Person 8: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13h.i	<input type="checkbox"/> <input type="checkbox"/>
13h.ii	If relation to child "other relation", specify	13h.ii	_____
13h.iii	Person 8: Sex (3=male, 4=female)	13h.iii	<input type="checkbox"/>

13h.iv	Person 8: Age	13h.iv	<input type="text"/> <input type="text"/>
13h.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13h.v	<input type="text"/>
13h.vi	Person 8: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13h.vi	<input type="text"/> <input type="text"/>
13h.vii	Person 8: Years of education completed	13h.vii	<input type="text"/> <input type="text"/>
13h.viii	Person 8: Eats at home	13h.viii	<input type="text"/>
13h.ix	Person 8: Sleeps at home	13h.ix	<input type="text"/>
13i	Person 9: Name initial	13i	_____
13i.i	Person 9: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13i.i	<input type="text"/> <input type="text"/>
13i.ii	If relation to child "other relation", specify	13i.ii	_____
13i.iii	Person 9: Sex (3=male, 4=female)	13i.iii	<input type="text"/>
13i.iv	Person 9: Age	13i.iv	<input type="text"/> <input type="text"/>
13i.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13i.v	<input type="text"/>
13i.vi	Person 9: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13i.vi	<input type="text"/> <input type="text"/>
13i.vii	Person 9: Years of education completed	13i.vii	<input type="text"/> <input type="text"/>
13i.viii	Person 9: Eats at home	13i.viii	<input type="text"/>
13i.ix	Person 9: Sleeps at home	13i.ix	<input type="text"/>
13j	Person 10: Name initial	13j	_____
13j.i	Person 10: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13j.i	<input type="text"/> <input type="text"/>

13j.ii	If relation to child "other relation", specify	13j.ii	_____
13j.iii	Person 10: Sex (3=male, 4=female)	13j.iii	<input type="checkbox"/>
13j.iv	Person 10: Age	13j.iv	<input type="checkbox"/> <input type="checkbox"/>
13j.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13j.v	<input type="checkbox"/>
13j.vi	Person 10: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13j.vi	<input type="checkbox"/> <input type="checkbox"/>
13j.vii	Person 10: Years of education completed	13j.vii	<input type="checkbox"/> <input type="checkbox"/>
13j.viii	Person 10: Eats at home	13j.viii	<input type="checkbox"/>
13j.ix	Person 10: Sleeps at home	13j.ix	<input type="checkbox"/>
13k	Person 11: Name initial	13k	_____
13k.i	Person 11: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13k.i	<input type="checkbox"/> <input type="checkbox"/>
13k.ii	If relation to child "other relation", specify	13k.ii	_____
13k.iii	Person 11: Sex (3=male, 4=female)	13k.iii	<input type="checkbox"/>
13k.iv	Person 11: Age	13k.iv	<input type="checkbox"/> <input type="checkbox"/>
13k.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13k.v	<input type="checkbox"/>
13k.vi	Person 11: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13k.vi	<input type="checkbox"/> <input type="checkbox"/>
13k.vii	Person 11: Years of education completed	13k.vii	<input type="checkbox"/> <input type="checkbox"/>
13k.viii	Person 11: Eats at home	13k.viii	<input type="checkbox"/>
13k.ix	Person 11: Sleeps at home	13k.ix	<input type="checkbox"/>

13l	Person 12: Name initial	13l	_____
13l.i	Person 12: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13l.i	<input type="checkbox"/> <input type="checkbox"/>
13l.ii	If relation to child "other relation", specify	13l.ii	_____
13l.iii	Person 12: Sex (3=male, 4=female)	13l.iii	<input type="checkbox"/>
13l.iv	Person 12: Age	13l.iv	<input type="checkbox"/> <input type="checkbox"/>
13l.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13l.v	<input type="checkbox"/>
13l.vi	Person 12: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13l.vi	<input type="checkbox"/> <input type="checkbox"/>
13l.vii	Person 12: Years of education completed	13l.vii	<input type="checkbox"/> <input type="checkbox"/>
13l.viii	Person 12: Eats at home	13l.viii	<input type="checkbox"/>
13l.ix	Person 12: Sleeps at home	13l.ix	<input type="checkbox"/>
14	What Is your (the mother's) marital status? (3= married/has a partner, 4= single*, 5= separated/ divorced/widowed*, 8= does not answer*)  * If response is code 4, 5 or 8, skip to question 16	14	<input type="checkbox"/>
15	Do you live with your husband/partner?	15	<input type="checkbox"/>
16	Would you (the mother) mind reading what's on this piece of paper for me? (hand mother piece of paper with line in Hindi written on it)  Can the mother read?	16	<input type="checkbox"/>
17	Would you (the mother) mind writing your address for me? (Give her this piece of paper and pen and ask to write her address)  Can the mother write?	17	<input type="checkbox"/>  _____
18	Are you (the mother) involved in any income-generating activities?	18	<input type="checkbox"/>

19	What is your annual household income?	19	<input type="text"/>
20	Do you (the mother) currently work away from home or regularly leave home at any time during the day?  <b>*If response is code 2 (no), skip question 21 and go to question 22</b>	20	<input type="checkbox"/>
21	When you (the mother) are working or away from home, who takes care of _____ (child's name)?  (3= Mother takes child with her, 4= Family member more than 18 years old, 5= Family member less than 18 years old, 6=friend/neighbour, 7= child stays alone, no one takes care of child, 10= Other, 11= Does not work away from home, 88= Does not know/answer)	21	<input type="text"/>
22	How many times per month do you or any other family member buy food?	22	<input type="text"/>
23	How much money do you spend on the following foods for the household per week		
23a	Vegetables	23a	<input type="text"/>
23b	Cereals	23b	<input type="text"/>
23c	Snacks	23c	<input type="text"/>
23d	Animal products (including milk and yogurt)	23d	<input type="text"/>
23e	Beans and legumes	23e	<input type="text"/>
23f	Ghee/Oil	23f	<input type="text"/>
23g	Fruits	23g	<input type="text"/>
23h	Sugar	23h	<input type="text"/>
23i	Other foods	23i	<input type="text"/>
23j	If other foods mentioned, specify	23j	_____
Just to reconfirm, your monthly income is Rs. _____, and you spend about Rs. _____ per week on food for the entire family. So, you spend approximately Rs. _____ per month on food for your child. Am I right? How much money do you spend per month on food for your child? Does that mean you spend Rs. _____ per day on food for your child?			
24	How much money would you be willing to spend on your child's food every day?	23	<input type="text"/>
<b>LIVING CONDITIONS</b>			



25	What is the main source of drinking water for members of your household? (11=Piped water into the dwelling, 12=public tap/stand pipe, 13=tube well or bore hole or hand pump, 14=open well, 15=closed well, 16=tanker truck, 17= cart with small tank, 18=surface water river/dam/lake/pond/stream/canal, 19=bottled water, 20=rain water, 21=others)	25	<input type="text"/>
26	If source of water is "other", specify	26	_____
27	What kind of toilet facility does the mother usually use? (11=Flush or pour flush toilet, 12=pit latrine, 15=no toilet facility i.e. uses open space or field, 16=others, 17=drain)	27	<input type="text"/>
28	If toilet facility is "Other", specify	28	_____
29	What is the religion of the head of the household (11= Christian, 12=Muslim, 13=Hindu, 14=None, 16=other, 17=Sikh, 18=Buddhist/neo Buddhist, 19=Jain, 20=Jewish, 21=Parsi/Zoroastrian)	29	<input type="text"/>
30	If the religion is "other", specify	30	_____
31	What is the caste of the father or the head of the household. (11=Jatav, 12=Jaat, 13=Pandit, 14=Brahman, 15=Thakur, 16=Nai, 17=Rajput, 18=Gujjar, 19=Dobi, 20=Chammer, 21=Muslim, 22=Ahir, 23=Saad, 24=Balmiki, 25=Punjabi Jat, 26=Sepera, 27=Harijan, 28=Mali, 29=Jogi, 30=Jat Sapera)	31	<input type="text"/>
32	What is the ethnic group (caste/tribe) of the father or head of the household (11=Scheduled caste, 12= Scheduled tribe, 13= OBC, 14= None of them)	32	<input type="text"/>
33	Does your household have (observe wherever possible)		
33a	Electricity	33a	<input type="checkbox"/>
33b	A mattress	33b	<input type="checkbox"/>
33c	A pressure cooker	33c	<input type="checkbox"/>
33d	A chair	33d	<input type="checkbox"/>
33e	A cot or bed	33e	<input type="checkbox"/>
33f	A table	33f	<input type="checkbox"/>



33g	An electric fan (even not working one)	33g	<input type="checkbox"/>
33h	A radio or transistor(even not working one)	33h	<input type="checkbox"/>
33i	A black and white television (even not working one)	33i	<input type="checkbox"/>
33j	A colour television (even not working one)	33j	<input type="checkbox"/>
33k	A sewing machine (even not working one)	33k	<input type="checkbox"/>
33l	A mobile telephone (even not working one)	33l	<input type="checkbox"/>
33m	Any other telephone (even no working one)	33m	<input type="checkbox"/>
33n	A computer (even not working one)	33n	<input type="checkbox"/>
33o	A refrigerator (even not working one)	33o	<input type="checkbox"/>
33p	A watch or clock (even not working one)	33p	<input type="checkbox"/>
33q	A bicycle (even not working one)	33q	<input type="checkbox"/>
33r	A motorcycle or scooter (even not working one)	33r	<input type="checkbox"/>
33s	An animal-drawn cart (even not working one)	33s	<input type="checkbox"/>
33t	A car (even not working one)	33t	<input type="checkbox"/>
33u	A water pump (even not working one)	33u	<input type="checkbox"/>
33v	A thresher (even not working one)	33v	<input type="checkbox"/>
33w	A tractor (even not working one)	33w	<input type="checkbox"/>
34	What type of fuel does your household mainly use for cooking (11=Electricity, 12=LPG/natural gas, 13=Kerosene, 14=Coal/lignite, 15=Charcoal, 16=Wood, 17=Straw/shrubs/grass, 18=Agricultural crop waste, 19=Dung cakes, 20=Biogas, 21=other)	34	<input type="checkbox"/> <input type="checkbox"/>
35	If cooking fuel is code 21, "other," specify	35	_____
36	How many persons slept in the household last night?	36	<input type="checkbox"/> <input type="checkbox"/>
37	Do you own your house?	37	<input type="checkbox"/>

38	Do you own any other house elsewhere?	38	<input type="checkbox"/>
39	Main material of the floor (observe wherever possible) (11= Mud/clay/earth, 12= Sand, 13= Dung, 14= Raw wood planks, 15= Palm/bamboo, 16= Brick, 17= Stone, 18= Parquet or polished wood, 19= Vinyl or asphalt, 20= Ceramic tiles, 21=Cement, 22=Carpet, 23=Polished stone/marble/granite, 24=other) (observe whenever possible)	39	<input type="checkbox"/> <input type="checkbox"/>
40	If main material of the floor is "other", specify	40	_____
41	Main material of the roof (observe wherever possible)  (11= No roof, 12=Thatch/palm leaf/reed/grass, 13= Mud, 14= Sod/mud and grass mixture, 15= Plastic/polythene sheeting, 16= Rustic mat, 17= Palm/bamboo, 18= Raw wood planks/timber, 19= Unburnt brick, 20= Loosely packed stone, 21= Metal, 22= Wood, 23= Calamine/ cement/concrete, 24= Asbestos sheets, 25=Reinforced cement concrete (RCC) / cement/concrete, 26= Roofing shingles, 27= Tiles, 28= Slate, 29=other)	41	<input type="checkbox"/> <input type="checkbox"/>
42	If main material of the roof is "other", specify	42	_____
43	Main material of the exterior walls (observe wherever possible) (11= No walls, 12= Cane/palm/trunks/ bamboo, 13= Mud, 14=Grass/reeds/ thatch, 15= Bamboo with mud, 16= Stone with mud, 17= Plywood, 18= Cardboard, 19= Unburnt brick, 20= Raw wood/reused wood, 21= Cement/concrete, 22= Stone with lime/cement, 23= Burnt bricks, 24= Cement blocks, 25= Wood planks/ shingles, 26= Metal/ asbestos sheets, 27=other)	43	<input type="checkbox"/> <input type="checkbox"/>
44	If main material of the exterior walls is "other", specify	44	_____
45	Type of window (observe wherever possible) (11= Any window, 12= windows with glass, 13= windows with screen, 14= windows with curtains or shutters, 15=others, 16=no window)	45	<input type="checkbox"/> <input type="checkbox"/>

46	If type of window is "other", specify	46	_____
47	Does any usual member of this household have a bank account or a post office account?	47	<input type="checkbox"/>
48	Does this household have a BPL card?	48	<input type="checkbox"/>
49	Who is the head of your household (11=mother of infant, 12=father of infant, 13=grandmother of infant, 14=grandfather of infant, 15=other)	49	<input type="checkbox"/> <input type="checkbox"/>
50	If head of household is code 15, "other," specify	50	_____
51	How many rooms in your house (including the kitchen) are used for sleeping?	51	<input type="checkbox"/> <input type="checkbox"/>
<b>BREASTFEEDING PRACTICES</b>			
52	Is the child currently breastfed? (1=yes, 2=no)  * if "yes," fill next question with code 99 and go to question 55	52	<input type="checkbox"/>
53	Why is the child not breastfed? (11= mother is not alive, 12 = milk did not flow properly, 13= breastfeeding never initiated because of problems in breast (abscess, cracked nipple, other problem), 14= breastfeeding never initiated because of problem with baby (weak, premature, unable to suck, other problem), 15= mother ill, 16= baby does not suck breast, 17 = baby does not accept breast milk, 18=doctor advised top milk, 19 =mother became pregnant again, 20 = mother feels breastmilk not enough for child, 21= other	53	<input type="checkbox"/> <input type="checkbox"/>
54	If reason is code 21, "other," specify	54	_____
<b>COMPLEMENTARY FEEDING PRACTICES</b>			
55	At what age was the child given liquids (including prelacteals) other than breast milk for the first time? Fill in child's age in number of days.	55	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
56	What was the first liquid other than breast milk that you gave to the child on a regular basis?	56	_____
57	At what age (in months) did you feed the child her/his first food – solid or semi-solid?	57	<input type="checkbox"/> <input type="checkbox"/>

58	What was the first food you gave to your child?		
58a	Fruit	58a	<input type="checkbox"/>
58b	Vegetable	58b	<input type="checkbox"/>
58c	Cereal	58c	<input type="checkbox"/>
58d	Legume	58d	<input type="checkbox"/>
58e	Meat	58e	<input type="checkbox"/>
58f	Organs	58f	<input type="checkbox"/>
58g	Eggs	58g	<input type="checkbox"/>
58h	Milk product	58h	<input type="checkbox"/>
58i	Fish	58i	<input type="checkbox"/>
58j	Oil	58j	<input type="checkbox"/>
58k	Sugar	58k	<input type="checkbox"/>
58l	Milk	58l	<input type="checkbox"/>
58m	Other	58m	<input type="checkbox"/>
58n	If other food mentioned, specify	58n	_____
59	Does your child currently eat foods from the following food groups?		
59a	Fruit	59a	<input type="checkbox"/>
59b	Vegetable	59b	<input type="checkbox"/>
59c	Cereal	59c	<input type="checkbox"/>
59d	Legume	59d	<input type="checkbox"/>
59e	Meat	59e	<input type="checkbox"/>
59f	Organs	59f	<input type="checkbox"/>
59g	Eggs	59g	<input type="checkbox"/>
59h	Fish	59h	<input type="checkbox"/>
59i	Oil	59i	<input type="checkbox"/>
59j	Sugar	59j	<input type="checkbox"/>
59k	Milk	59k	<input type="checkbox"/>
59l	Milk product (yogurt, cheese, paneer, etc.)	59l	<input type="checkbox"/>

59m	Others	59m	<input type="checkbox"/>
59n	If other food mentioned, specify	59n	_____
60	Please provide information on foods you may not feed your child in normal conditions, and why: (Use the following codes for reason for not feeding child the food: 3= Child is allergic to food, 4= Message from family and/or community, 5= Habit from the past, 6= Child falls sick after eating this food, 7= Food taboo/superstition, 10= Other)		
60a	<b>Name of food #1</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	60a	_____  <input type="checkbox"/> <input type="checkbox"/>  _____  <input type="checkbox"/> <input type="checkbox"/>  _____
60b	<b>Name of food #2</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	60b	_____  <input type="checkbox"/> <input type="checkbox"/>  _____  <input type="checkbox"/> <input type="checkbox"/>  _____
60c	<b>Name of food #3</b>  → Reason 1 for not feeding the child the food → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	60c	_____  <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>  _____
60d	<b>Name of food #4</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child	60d	_____  <input type="checkbox"/> <input type="checkbox"/>  _____  <input type="checkbox"/> <input type="checkbox"/>

	<p>the food (optional)</p> <p>If response is "other" (code 10), specify</p>		_____
60e	<p><b>Name of food #5</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60e	<p>_____</p> <p><input type="checkbox"/><input type="checkbox"/></p> <p>_____</p> <p><input type="checkbox"/><input type="checkbox"/></p> <p>_____</p>
60f	<p><b>Name of food #6</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60f	<p>_____</p> <p><input type="checkbox"/><input type="checkbox"/></p> <p>_____</p> <p><input type="checkbox"/><input type="checkbox"/></p> <p>_____</p>
61	How often does your child eat main meals every day (not including breast milk and/or formula milk)	61	<input type="checkbox"/> <input type="checkbox"/>
62	How often does your child eat snacks every day (not including breast milk and/or formula milk)	62	<input type="checkbox"/> <input type="checkbox"/>
63	<p>Generally speaking, how is _____ (child's name) appetite when she/he is healthy?</p> <p>(3=Eats more food than most children his/her age, 4=Eats same amount of food as most children his/her age, 5=Eats less food than most children his/her age, 8=Does not know/remember/answer)</p>	63	<input type="checkbox"/>
64	<p>If your child does not want to finish his/her meal, what do you do?</p> <p>(3= Persuade your child to eat, 4=Force your child to eat, 5= Stop feeding your child, 6=Other, 8= Does not know/remember/answer)</p>	64	<input type="checkbox"/>
65	If response is code 6, "other," specify	65	_____
66	<p>Where do you usually feed your child main meals?</p> <p>[3= Child is fed in a prescribed place (i.e. sitting in a chair or on the mother's lap), 4= Child is fed sitting but not in a prescribed place, 5= Child is fed while</p>	66	<input type="checkbox"/>

	s/he is wandering around, 6=other 8= Does not know/remember/answer)		
67	If response is code 6, "other," specify	67	_____
<b>MATERNAL KNOWLEDGE, ATTITUDES AND PRACTICES RELATING TO COMPLEMENTARY FEEDING</b>			
68	Until what age (in months) should a child be exclusively breastfed?	68	<input type="text"/> <input type="text"/>
69	At what age (in months) should a mother start adding liquids and/or foods other than breast milk to the child's diet? (Fill "00" if at birth, and "77" if never)		
69a	Ghutti	69a	<input type="text"/> <input type="text"/>
69b	Honey	69b	<input type="text"/> <input type="text"/>
69c	Sugar and/or jaggery water	69c	<input type="text"/> <input type="text"/>
69d	Water	69d	<input type="text"/> <input type="text"/>
69e	Top milk	69e	<input type="text"/> <input type="text"/>
69f	Semisolid food	69f	<input type="text"/> <input type="text"/>
69g	Specify the types of semisolid foods appropriate to feed the child at _____ months (age specified in 70e)	69g	_____
69h	Solid food	69h	<input type="text"/> <input type="text"/>
69i	Specify the types of solid foods appropriate to feed the child at _____ months (age specified in 70g)	69i	_____
69j	Other liquids/foods	69j	<input type="text"/> <input type="text"/>
69k	If other liquids/foods mentioned in 70i, please specify	69k	_____
70	What consistency of foods other than liquids are best for a 9-11 month old child? (DO NOT READ THE OPTIONS UNLESS MOTHER NEEDS PROMPTS) (3=Diluted, 4=Thick, 5= Medium, 6= Other, 8= Does not know/remember/answer, 9 = Not applicable)	70	<input type="text"/>
70a	If response is code 6, "other," specify	70a	_____
71	How many main meals (excluding snacks such as fruits, biscuit, fan, etc.) should a 9-11 month old child eat	71	<input type="text"/> <input type="text"/>



	everyday excluding breastmilk or breastmilk substitute?		
72	If a child stops eating, what should be done? (DO NOT READ THE OPTIONS)  (11= Motivate the child with gestures, games, words, 12= Does not motivate the child, 99= Does not apply because does not give child solid foods, 13 = Other, 8= Does not know/remember/answer)	72	<input type="checkbox"/> <input type="checkbox"/>
73	If response is code 13, "other," specify	73	_____
74	What vegetables according to you are best for a child? (fill answers and reasons why below)		
74a	Vegetable 1  Why is _____ (vegetable specified in 74a) good for a child? (1=yes, 2=no, 9= does not know)	74a	_____
74aa	Vegetable has lots of nutrients	74aa	<input type="checkbox"/>
74ab	Helps the child grow well	74ab	<input type="checkbox"/>
74ac	Helps child become healthy	74ac	<input type="checkbox"/>
74ad	Prevents child from falling ill	74ad	<input type="checkbox"/>
74ae	It is good for the child	74ae	<input type="checkbox"/>
74af	It tastes good, and child eats it easily	74af	<input type="checkbox"/>
74ag	Other reason	74ag	<input type="checkbox"/>
74ah	If response is, "other," specify	74ah	_____
74b	Vegetable 2  Why is _____ (vegetable specified in 74b) good for a child? (1=yes, 2=no, 9= does not know)	74b	_____
74ba	Vegetable has lots of nutrients	74ba	<input type="checkbox"/>
74bb	Helps the child grow well	74bb	<input type="checkbox"/>
74bc	Helps child become healthy	74bc	<input type="checkbox"/>
74bd	Prevents child from falling ill	74bd	<input type="checkbox"/>
74be	It is good for the child	74be	<input type="checkbox"/>
74bf	It tastes good, and child eats it easily	74bf	<input type="checkbox"/>



74bg	Other reason	74bg	<input type="checkbox"/>
74bh	If response is, "other," specify	74bh	_____
74c	<b>Vegetable 3</b> Why is _____ (vegetable specified in 74c) good for a child? (1=yes, 2=no, 9= does not know)	74c	_____
74ca	Vegetable has lots of nutrients	74ca	<input type="checkbox"/>
74cb	Helps the child grow well	74cb	<input type="checkbox"/>
74cc	Helps child become healthy	74cc	<input type="checkbox"/>
74cd	Prevents child from falling ill	74cd	<input type="checkbox"/>
74ce	It is good for the child	74ce	<input type="checkbox"/>
74cf	It tastes good, and child eats it easily	74cf	<input type="checkbox"/>
74cg	Other reason	74cg	<input type="checkbox"/>
74ch	If response is, "other," specify	74ch	_____
74d	<b>Vegetable 4</b> Why is _____ (vegetable specified in 74d) good for a child? (1=yes, 2=no, 9= does not know)	74d	_____
74da	Vegetable has lots of nutrients	74da	<input type="checkbox"/>
74db	Helps the child grow well	74db	<input type="checkbox"/>
74dc	Helps child become healthy	74dc	<input type="checkbox"/>
74dd	Prevents child from falling ill	74dd	<input type="checkbox"/>
74de	It is good for the child	74de	<input type="checkbox"/>
74df	It tastes good, and child eats it easily	74df	<input type="checkbox"/>
74dg	Other reason	74dg	<input type="checkbox"/>
74dh	If response is, "other," specify	74dh	_____
74e	<b>Vegetable 5</b> Why is _____ (vegetable specified in 74e) good for a child? (1=yes, 2=no, 9= does not know)	74e	_____
74ea	Vegetable has lots of nutrients	74ea	<input type="checkbox"/>
74eb	Helps the child grow well	74eb	<input type="checkbox"/>
74ec	Helps child become healthy	74ec	<input type="checkbox"/>

74ed	Prevents child from falling ill	74ed	<input type="checkbox"/>
74ee	It is good for the child	74ee	<input type="checkbox"/>
74ef	It tastes good, and child eats it easily	74ef	<input type="checkbox"/>
74eg	Other reason	74eg	<input type="checkbox"/>
74eh	If response is, "other," specify	74eh	_____
75	What fruits according to you are best for a child? (fill answers and reasons why below)		
75a	<b>Fruit 1</b> Why is _____ (fruit specified in 75a) good for a child? (1=yes, 2=no, 9= does not know)	75a	_____
75aa	Fruit has lots of nutrients	75aa	<input type="checkbox"/>
75ab	Helps the child grow well	75ab	<input type="checkbox"/>
75ac	Helps child become healthy	75ac	<input type="checkbox"/>
75ad	Prevents child from falling ill	75ad	<input type="checkbox"/>
75ae	It is good for the child	75ae	<input type="checkbox"/>
75af	It tastes good, and child eats it easily	75af	<input type="checkbox"/>
75ag	Other reason	75ag	<input type="checkbox"/>
75ah	If response is, "other," specify	75ah	_____
75b	<b>Fruit 2</b> Why is _____ (fruit specified in 75b) good for a child? (1=yes, 2=no, 9= does not know)	75b	_____
75ba	Fruit has lots of nutrients	75ba	<input type="checkbox"/>
75bb	Helps the child grow well	75bb	<input type="checkbox"/>
75bc	Helps child become healthy	75bc	<input type="checkbox"/>
75bd	Prevents child from falling ill	75bd	<input type="checkbox"/>
75be	It is good for the child	75be	<input type="checkbox"/>
75bf	It tastes good, and child eats it easily	75bf	<input type="checkbox"/>
75bg	Other reason	75bg	<input type="checkbox"/>
75bh	If response is, "other," specify	75bh	_____

75c	<b>Fruit 3</b> Why is _____ (fruit specified in 75c) good for a child? (1=yes, 2=no, 9= does not know)	75c	_____
75ca	Fruit has lots of nutrients	75ca	<input type="checkbox"/>
75cb	Helps the child grow well	75cb	<input type="checkbox"/>
75cc	Helps child become healthy	75cc	<input type="checkbox"/>
75cd	Prevents child from falling ill	75cd	<input type="checkbox"/>
75ce	It is good for the child	75ce	<input type="checkbox"/>
75cf	It tastes good, and child eats it easily	75cf	<input type="checkbox"/>
75cg	Other reason	75cg	<input type="checkbox"/>
75ch	If response is, "other," specify	75ch	_____
75d	<b>Fruit 4</b> Why is _____ (fruit specified in 75d) good for a child? (1=yes, 2=no, 9= does not know)	75d	_____
75da	Fruit has lots of nutrients	75da	<input type="checkbox"/>
75db	Helps the child grow well	75db	<input type="checkbox"/>
75dc	Helps child become healthy	75dc	<input type="checkbox"/>
75dd	Prevents child from falling ill	75dd	<input type="checkbox"/>
75de	It is good for the child	75de	<input type="checkbox"/>
75df	It tastes good, and child eats it easily	75df	<input type="checkbox"/>
75dg	Other reason	75dg	<input type="checkbox"/>
75dh	If response is, "other," specify	75dh	_____
75e	<b>Fruit 5</b> Why is _____ (fruit specified in 75e) good for a child? (1=yes, 2=no, 9= does not know)	75e	_____
75ea	Fruit has lots of nutrients	75ea	<input type="checkbox"/>
75eb	Helps the child grow well	75eb	<input type="checkbox"/>
75ec	Helps child become healthy	75ec	<input type="checkbox"/>
75ed	Prevents child from falling ill	75ed	<input type="checkbox"/>
75ee	It is good for the child	75ee	<input type="checkbox"/>
75ef	It tastes good, and child eats it easily	75ef	<input type="checkbox"/>

75eg	Other reason	75eg	<input type="checkbox"/>
75eh	If response is, "other," specify	75eh	_____
76	According to you, what is the best way to feed a child? (DO NOT READ THE OPTIONS UNLESS MOTHER NEEDS PROMPTS)  (3= from your own plate and utensils, 4= from the child's own bowl, plate and/or utensils, 5 = Other, 9= Does not apply because does not give child solid foods, 8= Does not know/ remember/ answer)	76	<input type="checkbox"/>
77	If response is code 5, "other," specify	77	_____
78	In what situations should breastfeeding be stopped? (1=yes, 2=no, 8= does not know/remember/answer)	78	
78a	When the child is _____ months old	78a	<input type="checkbox"/>
78ai	Specify age in months mentioned in 78a	78ai	<input type="text"/> <input type="text"/>
78b	When the child starts eating food	78b	<input type="checkbox"/>
78c	When the mother becomes pregnant	78c	<input type="checkbox"/>
78d	When mother is ill	78d	<input type="checkbox"/>
78e	When child is ill	78e	<input type="checkbox"/>
78f	Other situations	78f	<input type="checkbox"/>
78g	If other situations mentioned in 78f, specify	78g	_____
79	What kind of milk should be fed to the child? (1=yes, 2=no, 8= does not know/remember/answer)		
79a	Diluted cow's milk	79a	<input type="checkbox"/>
79b	Undiluted cow's milk	79b	<input type="checkbox"/>
79c	Diluted buffalo milk	79c	<input type="checkbox"/>
79d	Undiluted buffalo milk	79d	<input type="checkbox"/>
79e	Diluted packet milk	79e	<input type="checkbox"/>
79f	Undiluted packet milk	79f	<input type="checkbox"/>

THANK YOU! 😊

## **APPENDIX 4: mHEALTH SUB-STUDY INFORMED CONSENT FORMS AND QUESTIONNAIRES**

### **Appendix 4.1: Information sheet and informed consent form for mothers, mothers-in-law and Anganwadi Workers in focus group discussions**

#### **[Informed Consent Form for focus group discussions with ICDS personnel and/or mothers/caregivers]**

**[Name of PI (specific to country)]: Dr. Sarmila Mazumder**

**[Name of Organization depending on country]: Society for Applied Studies**

**Funder: Anonymous**

**Project: mHealth: A Novel Approach to Improve Child Nutrition in India**

**This Informed Consent Form has two parts:**

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

**You will be given a copy of the full Informed Consent Form**

#### **Part I: Information Sheet**

##### **Introduction**

I am [name of person carrying out focus group], working for the Society for Applied Studies in New Delhi. We are trying to find out how mobile phones can be used for nutrition counselling. We want to use phones to improve the health of young children. I am going to give you information and invite you to be part of this research. You can talk to anyone you feel comfortable with about the research before you decide if you want to take part in it.

This form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me or of another researcher at any time.

##### **Purpose of the research**

The spread of mobile phones in India provides new ways to deliver health services. Using phones for nutrition advice may change the way Anganwadi workers deliver services in your community. Mobile phones are being used as a cheap option in other countries to deliver nutrition tips to improve diets. They are fairly common in your community, so we would like to find ways to use them to improve the health of children. In order to do so, however, we would like to talk to you and others in the community. This is so we can find out the best ways of using mobile phones.

We are asking you to participate in this research project to find out what you think about the using mobile phones for nutrition counselling. We want to know your ideas so we can see how phones may be used with Anganwadi workers and mothers/caregivers in your community.

##### **Type of Research Intervention**

We are asking you to share your thoughts in a group and to answer a few questions on your own. The group talk is a small group of people (about 6-8) who meet and provide answers and opinions to some questions asked by a group leader. My colleague will also separately ask you some questions about yourself and your family. The group talk will be recorded and written down, and will last about an hour or an hour and a half.

### **Participant Selection**

For AWWs: We would like you to join our study because you work within ICDS with mothers and/or caregivers. We feel that your experience can help us understand how mobile phones may be used for nutrition counselling.

### **OR**

For mothers/caregivers: We would like you to join our study because you are a mother or caregiver with a young child. Also, you are living in an area with an Anganwadi worker. Your experiences will really help us understand how mobile phones can be used to improve the health of children in your community.

### **Voluntary Participation**

Your participation in this research is entirely voluntary. It is your choice whether to you want to join the study or not. The choice that you make will not influence your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier.

### **Procedures**

We are asking you to help us learn more the possibility of using mobile phones for nutrition counselling within the ICDS programme in your community. You will be asked to take part in a discussion with 6-8 other persons with similar experiences. This discussion will be guided by [name of moderator].

The group talk will start with my colleague who will make sure you are comfortable. He will also answer any questions you might have. Next, he will ask you questions about mobile phones and counselling. He will make sure to give you time to share your opinions. He will not ask you to share personal beliefs. Also, you will not have to share anything that you are not comfortable with.

The group talk will take place in [location], and no one but the people who join the talk and the moderator will be there. The entire talk will be tape-recorded with a digital recorder, but no-one will be identified by name on any records. The file will be kept on a secure computer. The information recorded is confidential. This means that no one else except but the project coordinator and person asking you questions during the talk will have access to the files. The tapes will be kept for 5 years.

After the group talk, you will be asked to answer some questions about yourself, your family and community. You may ask to move on to the next question if you don't want to answer a specific question. The information you will give is confidential. Your name will not be on the forms, only a number will identify you. Also, no one but the project coordinator and person asking you questions will have access to the information you provide.

### **Duration**

The group talk will be held once and will take one or one and a half hour.

### **Risks**

You will not be at physical or psychological risk if you take part in this study. Also, you should not experience any discomfort resulting from the questions we will ask you. There is a risk that you may share some personal or confidential information by chance. There is also a risk that you may feel

uncomfortable talking about some topics. However, we do not want this to happen. You do not have to answer any question or take part in the talk if you feel the questions are too personal. Also, you can leave the study at any point if talking about certain issues makes you uncomfortable.

### **Benefits**

You will not directly benefit from this study. However, you taking the time to answer our questions will help us find out about how we can use mobile phones to improve child health and counselling.

### **Reimbursements**

You will not have to pay anything to join this study. Also, you will not be paid to participate in the study. However, free refreshments will be available to you during the group talk.

### **Confidentiality**

This study may draw attention from the community. Community members might also ask you questions if you join the study. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key and on a password-secured computer. It will not be shared with or given to anyone except the research sponsors and study investigators.

We will ask you and others in the group not to talk to other people about what was said in the group talk. We will, in other words, ask each of you to keep what was said in the group confidential. You should know, however, that we cannot stop or prevent participants who were in the group from sharing things that should be confidential.

### **Sharing the Results**

Nothing that you tell us today will be shared with anybody outside the study. Also, nothing will be linked to your name. Everything we learn will be shared with you and your community before we share it with everyone else. Each participant will receive a summary of the results.

### **Right to Refuse or Withdraw**

You do not have to take part in this study if you do not want to. Your decision will not affect your job or any evaluations in any way. You may stop participating in the group talk and answering any questions at any time that you wish. Doing so will not affect your job. I will give you an opportunity at the end of the group talk to review what you said. You can ask to change or remove portions of what you said if you do not agree with my notes or if I did not understand you correctly.

### **Who to Contact**

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following: Dr.Sarmila Mazumder: 9811681530, Dr.Sunita Taneja: 9811206456.

This proposal has been reviewed and approved by the Ethics Review Committee Society for Applied Studies, which is a committee whose task it is to make sure that study participants are protected from harm. If you wish to find about more about the ERC, contact on 9582595320.

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

**Part II: Certificate of Consent**

**I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to:**

- be a participant in this study**
- be recorded while participating in focus group discussions**
- my quotes being used for reports and/or publications**

Print Name of Participant \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

Signature of Participant \_\_\_\_\_

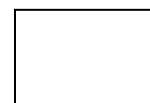
**If illiterate**

**I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely to:**

- be a participant in this study**
- be recorded while participating in focus group discussions**
- his/her quotes being used for reports and/or publications**

Print name of witness \_\_\_\_\_

Thumb print of participant



Signature of witness \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

**Statement by the researcher/person taking consent**

**I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the research study. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.**

Print Name of Researcher/person taking the consent \_\_\_\_\_

Signature of Researcher /person taking the consent \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year



## **Appendix 4.2: Information sheet and informed consent form for mothers and mothers-in-law in mHealth pilot test**

### **[Informed Consent Form for mHealth pilot study with Mothers and Grandmothers]**

**Name of PI: Dr. Sarmila Mazumder**

**Name of Organization: Society for Applied Studies**

**Funder: Anonymous**

**Project: mHealth: A Novel Approach to Improve Child Nutrition in India**

**This Informed Consent Form has two parts:**

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

**You will be given a copy of the full Informed Consent Form**

### **Part I: Information Sheet**

#### **Introduction**

I am [name of person \_\_\_\_\_], working for the Society for Applied Studies in New Delhi. We are trying to find out how mobile phones can be used for nutrition counselling. We want to use phones to improve the health of young children. I am going to give you information and invite you to be part of this research. You can talk to anyone you feel comfortable with about the research before you decide if you want to take part in it.

This form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me or of another researcher at any time.

#### **Purpose of the research**

The spread of mobile phones in India provides new ways to deliver health services. Using phones for nutrition advice may change the way Anganwadi workers deliver services in your community. Mobile phones are being used as a cheap option in other countries to deliver nutrition tips to improve diets. They are fairly common in your community, so we would like to find ways to use them to improve the health of children. In order to do so, however, we would like to talk to you and others in the community. This is so we can find out the best ways of using mobile phones.

We are asking you to participate in this research project to find out what you think about the using mobile phones for nutrition counselling. We want you to use mobile phones for nutrition counselling and know your ideas so we can see how phones may be used with Anganwadi workers, mothers and/or other family members in your community.

#### **Type of Research Intervention**

This study will involve your participation in a group nutrition counselling session, questionnaire, observations, interviews and/or focus group discussions over an 8-week period. We will ask you to give your opinions about using mobile phones for nutrition counselling, as well as ask a few questions about yourself, your family and living conditions. We will also measure your infant's weight.

#### **Participant Selection**

For mothers: We would like you to join our study because you are a mother with a young child. Also, you are living in an area with an Anganwadi worker. Your experiences will really help us understand how mobile phones can be used to improve the health of children in your community.

**OR**

For grandmothers: We would like you to join our study because you are a grandmother with a young grandchild. Also, you are living in an area with an Anganwadi worker. Your experiences will really help us understand how mobile phones can be used to improve the health of children in your community.

### **Voluntary Participation**

Your participation in this research is entirely voluntary. It is your choice whether you want to join the study or not. The choice that you make will not influence your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier.

### **Procedures**

We are asking you to help us learn more the possibility of using mobile phones for nutrition counselling within the ICDS programme in your community. You will be asked to take part in an 8-week long intervention using mobile phones to receive nutrition counselling and feeding advice from Anganwadi workers.

Interviews and/or focus group discussions will start with my colleague/myself. We will make sure you are comfortable. We will also answer any questions you might have. Next, we will ask you questions about using mobile phones for nutrition counselling and give you time to share your knowledge. The questions will be about your perceptions of the mobile phone intervention. We will make sure to give you time to share your opinions. We will not ask you to share personal beliefs. Also, you will not have to share anything that you are not comfortable with.

The discussion will take place in your home or Anganwadi centre, and no one but you and my colleague/myself asking you questions will be there. The entire talk will be tape-recorded with a digital recorder, but you will not be identified by name on any records. The file will be kept on a secure computer. The information recorded is confidential. This means that no one else except but the project coordinator and person asking you questions during the talk will have access to the files. The tapes will be kept for 5 years.

In questionnaires, you will be asked to answer some questions about yourself, your family and community. You may ask to move on to the next question if you don't want to answer a specific question. The information you will give is confidential. Your name will not be on the forms, only a number will identify you. Also, no one but the project coordinator and person asking you questions will have access to the information you provide.

## **Duration**

The intervention will take place over 8 weeks. During this period, your Anganwadi Worker will contact you on the mobile phone for nutrition counselling for your child about 4 times. During this period, study team members may also visit your home.

## **Risks**

You will not be at physical or psychological risk if you take part in this study. Also, you should not experience any discomfort resulting from the questions we will ask you. There is a risk that you may share some personal or confidential information by chance. There is also a risk that you may feel uncomfortable talking about some topics. However, we do not want this to happen. You do not have to answer any question or take part in the talk if you feel the questions are too personal. Also, you can leave the study at any point if talking about certain issues makes you uncomfortable.

## **Benefits**

You will not directly benefit from this study. However, you taking the time to answer our questions will help us find out about how we can use mobile phones to improve child health and counselling.

## **Reimbursements**

You will not have to pay anything to join this study. Also, you will not be paid to participate in the study.

## **Confidentiality**

This study may draw attention from the community. Community members might also ask you questions if you join the study. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key and on a password-secured computer. It will not be shared with or given to anyone except the study's principal investigators and sponsor.

## **Sharing the Results**

Nothing that you tell us today will be shared with anybody outside the study. Also, nothing will be linked to your name. Everything we learn will be shared with you and your community before we share it with everyone else. Each participant will receive a summary of the results.

## **Right to Refuse or Withdraw**

You do not have to take part in this study if you do not want to. Your decision will not affect your job or any evaluations in any way. You may stop participating in the group talk and answering any questions at any time that you wish.

**Who to Contact**

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following: Dr.Sarmila Mazumder: 9811681530, Dr.Sunita Taneja: 9811206456.

This proposal has been reviewed and approved by the Society for Applied Studies Ethics Review Committee, which is a committee whose task it is to make sure that study participants are protected from harm. If you wish to find about more about ERC, contact on 9582595320.

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

**Part II: Certificate of Consent**

**I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to:**

- be a participant in this study**
- be recorded while participating in interviews**
- my quotes being used for reports and/or publications**

Print Name of Participant \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

Signature of Participant \_\_\_\_\_

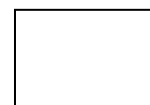
**If illiterate**

**I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely to:**

- be a participant in this study**
- be recorded while participating in interviews**
- his/her quotes being used for reports and/or publications**

Print name of witness \_\_\_\_\_

Thumb print of participant



Signature of witness \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

**Statement by the researcher/person taking consent**

**I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the research study. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.**

Print Name of Researcher/person taking the consent \_\_\_\_\_

Signature of Researcher /person taking the consent \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

## **Appendix 4.3: Information sheet and informed consent form for Anganwadi Workers in mHealth pilot test**

### **[Informed Consent Form for mHealth pilot study with Anganwadi Workers]**

**Name of PI: Dr. Sarmila Mazumder**

**Name of Organization : Society for Applied Studies**

**Funder: Anonymous**

**Project: mHealth: A Novel Approach to Improve Child Nutrition in India**

**This Informed Consent Form has two parts:**

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

**You will be given a copy of the full Informed Consent Form**

### **Part I: Information Sheet**

#### **Introduction**

I am [name of person\_\_\_\_\_], working for the Society for Applied Studies in New Delhi. We are trying to find out how mobile phones can be used for nutrition counselling. We want to use phones to improve the health of young children. I am going to give you information and invite you to be part of this research. You can talk to anyone you feel comfortable with about the research before you decide if you want to take part in it.

This form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me or of another researcher at any time.

#### **Purpose of the research**

The spread of mobile phones in India provides new ways to deliver health services. Using phones for nutrition advice may change the way Anganwadi workers deliver services in your community. Mobile phones are being used as a cheap option in other countries to deliver nutrition tips to improve diets. They are fairly common in your community, so we would like to find ways to use them to improve the health of children. In order to do so, however, we would like to talk to you and others in the community. This is so we can find out the best ways of using mobile phones.

We are asking you to participate in this research project to find out what you think about the using mobile phones for nutrition counselling. We want you to use mobile phones for nutrition counselling and know your ideas so we can see how phones may be used with Anganwadi workers, mothers and/or other family members in your community.

#### **Type of Research Intervention**

This study will involve your participation in delivering a group nutrition counselling session, questionnaire, observations, interviews and/or focus group discussions over an 8-week period. We will ask you to give your opinions about using mobile phones for nutrition counselling, as well as ask a few questions about yourself, your family and living conditions.

## **Participant Selection**

For AWWs: We would like you to join our study because you work within ICDS with mothers. We feel that your experience can help us understand how mobile phones may be used for nutrition counselling.

## **Voluntary Participation**

Your participation in this research is entirely voluntary. It is your choice whether you want to join the study or not. The choice that you make will not influence your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier.

## **Procedures**

We are asking you to help us learn more the possibility of using mobile phones for nutrition counselling within the ICDS programme in your community. You will be asked to take part in an 8-week long intervention using mobile phones to deliver nutrition counselling and feeding advice to mothers and grandmothers.

Interviews and/or focus group discussions will start with my colleague/myself. We will make sure you are comfortable. We will also answer any questions you might have. Next, we will ask you questions about using mobile phones for nutrition counselling and give you time to share your knowledge. The questions will be about your perceptions of the mobile phone intervention. We will make sure to give you time to share your opinions. We will not ask you to share personal beliefs. Also, you will not have to share anything that you are not comfortable with.

The discussion will take place in your home or Anganwadi centre, and no one but you and my colleague/myself asking you questions will be there. The entire talk will be tape-recorded with a digital recorder, but you will not be identified by name on any records. The file will be kept on a secure computer. The information recorded is confidential. This means that no one else except but the project coordinator and person asking you questions during the talk will have access to the files. The tapes will be kept for 5 years.

In questionnaires, you will be asked to answer some questions about yourself, your work experience, family and community. You may ask to move on to the next question if you don't want to answer a specific question. The information you will give is confidential. Your name will not be on the forms, only a number will identify you. Also, no one but the project coordinator and person asking you questions will have access to the information you provide.

## **Duration**

The intervention will take place over 8 weeks. During this period, you will be asked to deliver group nutrition counselling to mothers and to contact them on mobile phones for nutrition counselling for their child about 4 times. During this period, study team members may also visit your Anganwadi Centre.

## **Risks**

You will not be at physical or psychological risk if you take part in this study. Also, you should not experience any discomfort resulting from the questions we will ask you. There is a risk that you may share some personal or confidential information by chance. There is also a risk that you may feel uncomfortable talking about some topics. However, we do not want this to happen. You do not have to answer any question or take part in the talk if you feel the questions are too personal. Also, you can leave the study at any point if talking about certain issues makes you uncomfortable.

## **Benefits**

You will not directly benefit from this study. However, you taking the time to answer our questions will help us find out about how we can use mobile phones to improve child health and counselling.

## **Reimbursements**

You will not have to pay anything to join this study. Also, you will not be paid to participate in the study.

## **Confidentiality**

This study may draw attention from the community. Community members might also ask you questions if you join the study. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key and on a password-secured computer. It will not be shared with or given to anyone except the study's principal investigators and sponsor.

## **Sharing the Results**

Nothing that you tell us today will be shared with anybody outside the study. Also, nothing will be linked to your name. Everything we learn will be shared with you and your community before we share it with everyone else. Each participant will receive a summary of the results.

## **Right to Refuse or Withdraw**

You do not have to take part in this study if you do not want to. Your decision will not affect your job or any evaluations in any way. You may stop participating in the group talk and answering any questions at any time that you wish.

## **Who to Contact**

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following: Dr.Sarmila Mazumder: 9811681530, Dr.Sunita Taneja: 9811206456.

This proposal has been reviewed and approved by the Society for Applied Studies Ethics Review Committee, which is a committee whose task it is to make sure that study participants are protected from harm. If you wish to find about more about the ERC, contact on 9582595320.

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?



**Part II: Certificate of Consent**

**I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to:**

- be a participant in this study**
- be recorded while participating in interviews**
- my quotes being used for reports and/or publications**

Print Name of Participant \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

Signature of Participant \_\_\_\_\_

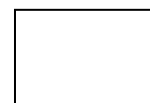
**If illiterate**

**I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely to:**

- be a participant in this study**
- be recorded while participating in interviews**
- his/her quotes being used for reports and/or publications**

Print name of witness \_\_\_\_\_

Thumb print of participant



Signature of witness \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

**Statement by the researcher/person taking consent**

**I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the research study. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.**

Print Name of Researcher/person taking the consent \_\_\_\_\_

Signature of Researcher /person taking the consent \_\_\_\_\_

Date \_\_\_\_\_  
Day/month/year

#### Appendix 4.4: Focus Group Discussion Guide for mothers

TOPIC	QUESTION	PROBE
Mobile phones – Role	<ul style="list-style-type: none"> <li>○ How are mobile phones used in your community?</li> </ul>	
Mobile phones – Acceptability	<ul style="list-style-type: none"> <li>○ How would your family and neighbours feel about you having a mobile phone?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What do you think about getting nutrition advice for your baby on a mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ What do you like about this idea?</li> <li>○ What do you not like about this idea?</li> <li>○ What would you like to learn?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about AWWs using mobile phones to provide nutrition counselling to you?</li> </ul>	<ul style="list-style-type: none"> <li>○ What would work? (e.g. easier to be contacted by AWWs)</li> <li>○ What would not work? (e.g. added stress to have a phone)</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about receiving automated messages about CF advice on the phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ What do you like about this idea?</li> <li>○ What do you not like about this idea?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Should anyone else in your household be targeted to facilitate uptake of CF messages via mobile phones?</li> </ul>	<ul style="list-style-type: none"> <li>○ Mothers-in law?</li> <li>○ Husbands?</li> <li>○ Other relatives?</li> </ul>
Mobile phones – Feasibility	<ul style="list-style-type: none"> <li>○ Please comment on whether it is feasible for you have a mobile phone if the government did not provide it.</li> </ul>	<ul style="list-style-type: none"> <li>○ Sharing the phone with family members?</li> <li>○ Phone credit?</li> <li>○ Electricity for charging phone?</li> <li>○ Others?</li> </ul>
Mobile phones – Other	<ul style="list-style-type: none"> <li>○ Would you like to add something that we have not already discussed?</li> </ul>	

#### Appendix 4.5: Focus Group Discussion Guide for Mothers-in-law

TOPIC	QUESTION	PROBE
Mobile phones – Role	<ul style="list-style-type: none"> <li>○ How are mobile phones used in your community?</li> </ul>	
Mobile phones – Acceptability	<ul style="list-style-type: none"> <li>○ How would you feel about your daughter-in-law having a mobile phone?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ How would your family and neighbours feel about you and your daughter-in-law having a mobile phone?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What do you think about getting nutrition advice on a mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ What do you like about this idea?</li> <li>○ What do you not like about this idea?</li> <li>○ What would you like to learn?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about AWWs using mobile phones to provide nutrition counselling to you for your grandchild?</li> </ul>	<ul style="list-style-type: none"> <li>○ What would work? (e.g. easier to be contacted by AWWs)</li> <li>○ What would not work? (e.g. added stress to have a phone)</li> <li>○ What is the best way this idea could work?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about AWWs using mobile phones to provide nutrition counselling to your daughter-in-law?</li> </ul>	<ul style="list-style-type: none"> <li>○ What would work? (e.g. easier to be contacted by AWWs)</li> <li>○ What would not work? (e.g. added stress to have a phone)</li> <li>○ What is the best way this idea could work?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about receiving automated messages about CF advice on the phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ What do you like about this idea?</li> <li>○ What do you not like about this idea?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Should anyone else in your household be targeted to facilitate uptake of complementary feeding messages via mobile phones?</li> </ul>	<ul style="list-style-type: none"> <li>○ Father of the child?</li> <li>○ Other relatives?</li> </ul>
Mobile phones – Feasibility	<ul style="list-style-type: none"> <li>○ Please comment on whether it is feasible for you or your daughter-in-law to have a mobile phone if the government did not provide it.</li> </ul>	<ul style="list-style-type: none"> <li>○ Sharing the phone with family members?</li> <li>○ Phone credit?</li> <li>○ Electricity for charging phone?</li> <li>○ Others?</li> </ul>
Mobile phones – Other	<ul style="list-style-type: none"> <li>○ Would you like to add something that we have not already discussed?</li> </ul>	

#### Appendix 4.6: Focus Group Discussion Guide for Anganwadi Workers

TOPIC	QUESTION	PROBE
Nutrition counselling	<ul style="list-style-type: none"> <li>How is nutrition counselling currently carried out in your community?</li> </ul>	<ul style="list-style-type: none"> <li>Barriers and facilitating factors?</li> <li>Issues following food-based recommendations?</li> </ul>
Mobile phones – Role	<ul style="list-style-type: none"> <li>How are mobile phones currently used in health promotion activities?</li> </ul>	<ul style="list-style-type: none"> <li>If they are not currently used, how could they be used in their work?</li> </ul>
Mobile phones – Acceptability	<ul style="list-style-type: none"> <li>What do you think about using mobile phones to provide nutrition counselling?</li> </ul>	<ul style="list-style-type: none"> <li>What would work/not work?</li> <li>Advantages to using mobile phones?</li> </ul>
	<ul style="list-style-type: none"> <li>What do you think about using mobile phones for supervisor-AWW supervision?</li> </ul>	<ul style="list-style-type: none"> <li>What would work/not work?</li> <li>Advantages to using mobile phones?</li> </ul>
	<ul style="list-style-type: none"> <li>How would your family and neighbours feel about you having a mobile phone?</li> </ul>	
Mobile phones – Usage	<ul style="list-style-type: none"> <li>What are the best ways that mobile phones can be used within the ICDS programme to support CF activities?</li> </ul>	<ul style="list-style-type: none"> <li>Automated messages for mothers?</li> <li>AWWs providing phone counselling to mothers?</li> <li>Using mobile phones with supervisors to facilitate support for AWWs?</li> <li>Advantages and disadvantages for each idea?</li> </ul>
Mobile phones – Feasibility	<ul style="list-style-type: none"> <li>What would make it easier or more difficult to use phones to support CF activities?</li> </ul>	<ul style="list-style-type: none"> <li>Financially?</li> <li>Feasibility of having one if ICDS does not provide it?</li> <li>Logistically? (Electricity for charging phone, phone credit, not sharing with others, etc.)</li> </ul>
	<ul style="list-style-type: none"> <li>What potential issues would mothers face if provided with mobile phones to receive CF advice?</li> </ul>	<ul style="list-style-type: none"> <li>Sharing the phone with family members?</li> <li>Phone credit?</li> <li>Electricity for charging phone?</li> </ul>
	<ul style="list-style-type: none"> <li>What potential issues would you if using phones for supervisor-AWW supervision?</li> </ul>	<ul style="list-style-type: none"> <li>Prefer face-to-face supervision?</li> </ul>
Mobile phones – Other	<ul style="list-style-type: none"> <li>Who else should be targeted in the household to facilitate uptake of CF messages via mobile phones?</li> </ul>	<ul style="list-style-type: none"> <li>Mothers-in law?</li> <li>Husbands?</li> </ul>
	<ul style="list-style-type: none"> <li>Would you like to add something that we have not already discussed?</li> </ul>	

**Appendix 4.7: Sociodemographic forms for mothers in focus group discussions**  
**mHealth study in Kheri Kalan, Haryana, India**

**SOCIODEMOGRAPHIC FORM FOR MOTHERS IN FOCUS GROUPS**

[Code:1=Yes, 2=No, 9= NA, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
2	Worker Code	2	<input type="text"/> <input type="text"/> <input type="text"/>
3	Woman ID	3	<input type="text"/> <input type="text"/> <input type="text"/>
4	Child ID	4	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
5	Child sex (3=male, 4=female)	5	<input type="text"/> <input type="text"/>
6	Child birth date (dd/mm/yyyy)	6	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
7	Source of birth date data (3= Immunization record, 4= Birth certificate, 5= Mother's recall with events calendar, 6= Mother's recall with confidence, 7= Mother's recall without confidence, 10= Other source, 9=NA)	7	<input type="text"/> <input type="text"/>
8	If source of child's birth date data is "other source", specify	8	_____
9	Age of child in months	9	<input type="text"/> <input type="text"/>
10	Address	10	Subcentre: _____ - PHC: _____
<b>FAMILY CHARACTERISTICS</b>			
11	How many people are currently living in the home, including elderly and young children?	11	<input type="text"/> <input type="text"/>
12	How many of these people in the household are less than 5 years old?	12	<input type="text"/> <input type="text"/>
13	Can you please tell me a little more about people currently living in your home (including you)  <b>*Total number of people here should match response to question 11</b>	13	

13a	<b>Person 1: Name initial</b>	13a	
13a.i	Person 1: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13a.i	<input type="checkbox"/> <input type="checkbox"/>
13a.ii	If relation to child "other relation", specify	13a.ii	_____
13a.iii	Person 1: Sex (3=male, 4=female)	13a.iii	<input type="checkbox"/>
13a.iv	Person 1: Age	13a.iv	<input type="checkbox"/> <input type="checkbox"/>
13a.v	Specify if age is in years or months (3= years, 4= months)	13a.v	<input type="checkbox"/>
13a.vi	Person 1: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13a.vi	<input type="checkbox"/> <input type="checkbox"/>
13a.vii	Person 1: Years of education completed	13a.vii	<input type="checkbox"/> <input type="checkbox"/>
13a.viii	Person 1: Eats at home	13a.viii	<input type="checkbox"/>
13a.ix	Person 1: Sleeps at home	13a.ix	<input type="checkbox"/>
13b	<b>Person 2: Name initial</b>	13b	
13b.i	Person 2: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13b.i	<input type="checkbox"/> <input type="checkbox"/>
13b.ii	If relation to child "other relation", specify	13b.ii	_____
13b.iii	Person 2: Sex (3=male, 4=female)	13b.iii	<input type="checkbox"/>
13b.iv	Person 2: Age	13b.iv	<input type="checkbox"/> <input type="checkbox"/>
13b.v	Specify if age is in years or months (3= years, 4= months)	13b.v	<input type="checkbox"/>
13b.vi	Person 2: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13b.vi	<input type="checkbox"/> <input type="checkbox"/>
13b.vii	Person 2: Years of education completed	13b.vii	<input type="checkbox"/> <input type="checkbox"/>
13b.viii	Person 2: Eats at home	13b.viii	<input type="checkbox"/>

13b.ix	Person 2: Sleeps at home	13b.ix	<input type="checkbox"/>
13c	<b>Person 3: Name initial</b>	13c	
13c.i	Person 3: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13c.i	<input type="checkbox"/> <input type="checkbox"/>
13c.ii	If relation to child "other relation", specify	13c.ii	_____
13c.iii	Person 3: Sex (3=male, 4=female)	13c.iii	<input type="checkbox"/>
13c.iv	Person 3: Age	13c.iv	<input type="checkbox"/> <input type="checkbox"/>
13c.v	Specify if age is in years or months (3= years, 4= months)	13c.v	<input type="checkbox"/>
13c.vi	Person 3: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13c.vi	<input type="checkbox"/> <input type="checkbox"/>
13c.vii	Person 3: Years of education completed	13c.vii	<input type="checkbox"/> <input type="checkbox"/>
13c.viii	Person 3: Eats at home	13c.viii	<input type="checkbox"/>
13c.ix	Person 3: Sleeps at home	13c.ix	<input type="checkbox"/>
13d	<b>Person 4: Name initial</b>	13d	
13d.i	Person 4: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13d.i	<input type="checkbox"/> <input type="checkbox"/>
13d.ii	If relation to child "other relation", specify	13d.ii	_____
13d.iii	Person 4: Sex (3=male, 4=female)	13d.iii	<input type="checkbox"/>
13d.iv	Person 4: Age	13d.iv	<input type="checkbox"/> <input type="checkbox"/>
13d.v	Specify if age is in years or months (3= years, 4= months)	13d.v	<input type="checkbox"/>
13d.vi	Person 4: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13d.vi	<input type="checkbox"/> <input type="checkbox"/>

13d.vii	Person 4: Years of education completed	13d.vii	<input type="checkbox"/> <input type="checkbox"/>
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13d.viii	Person 4: Eats at home	13d.viii	<input type="checkbox"/>
13d.ix	Person 4: Sleeps at home	13d.ix	<input type="checkbox"/>
13e	<b>Person 5: Name initial</b>	13e	
13e.i	Person 5: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13e.i	<input type="checkbox"/> <input type="checkbox"/>
13e.ii	If relation to child "other relation", specify	13e.ii	_____
13e.iii	Person 5: Sex (3=male, 4=female)	13e.iii	<input type="checkbox"/>
13e.iv	Person 5: Age	13e.iv	<input type="checkbox"/> <input type="checkbox"/>
13e.v	Specify if age is in years or months (3= years, 4= months)	13e.v	<input type="checkbox"/>
13e.vi	Person 5: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13e.vi	<input type="checkbox"/> <input type="checkbox"/>
13e.vii	Person 5: Years of education completed	13e.vii	<input type="checkbox"/> <input type="checkbox"/>
13e.viii	Person 5: Eats at home	13e.viii	<input type="checkbox"/>
13e.ix	Person 5: Sleeps at home	13e.ix	<input type="checkbox"/>
13f	<b>Person 6: Name initial</b>	13f	
13f.i	Person 6: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13f.i	<input type="checkbox"/> <input type="checkbox"/>
13f.ii	If relation to child "other relation", specify	13f.ii	_____
13f.iii	Person 6: Sex (3=male, 4=female)	13f.iii	<input type="checkbox"/>
13f.iv	Person 6: Age	13f.iv	<input type="checkbox"/> <input type="checkbox"/>
13f.v	Specify if age is in years or months (3= years, 4= months)	13f.v	<input type="checkbox"/>
13f.vi	Person 6: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13f.vi	<input type="checkbox"/> <input type="checkbox"/>
13f.vii	Person 6: Years of education	13f.vii	<input type="checkbox"/> <input type="checkbox"/>



	completed		
13f.viii	Person 6: Eats at home	13f.viii	<input type="checkbox"/>
13f.ix	Person 6: Sleeps at home	13f.ix	<input type="checkbox"/>
13g	<b>Person 7: Name initial</b>	13g	
13g.i	Person 7: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13g.i	<input type="checkbox"/> <input type="checkbox"/>
13g.ii	If relation to child "other relation", specify	13g.ii	_____
13g.iii	Person 7: Sex (3=male, 4=female)	13g.iii	<input type="checkbox"/>
13g.iv	Person 7: Age	13g.iv	<input type="checkbox"/> <input type="checkbox"/>
13g.v	Specify if age is in years or months (3= years, 4= months)	13g.v	<input type="checkbox"/>
13g.vi	Person 7: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13g.vi	<input type="checkbox"/> <input type="checkbox"/>
13g.vii	Person 7: Years of education completed	13g.vii	<input type="checkbox"/> <input type="checkbox"/>
13g.viii	Person 7: Eats at home	13g.viii	<input type="checkbox"/>
13g.ix	Person 7: Sleeps at home	13g.ix	<input type="checkbox"/>
13h	<b>Person 8: Name initial</b>	13h	
13h.i	Person 8: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13h.i	<input type="checkbox"/> <input type="checkbox"/>
13h.ii	If relation to child "other relation", specify	13h.ii	_____
13h.iii	Person 8: Sex (3=male, 4=female)	13h.iii	<input type="checkbox"/>

13h.iv	Person 8: Age	13h.iv	<input type="text"/> <input type="text"/>
13h.v	Specify if age is in years or months (3= years, 4= months)	13h.v	<input type="text"/>
13h.vi	Person 8: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13h.vi	<input type="text"/> <input type="text"/>
13h.vii	Person 8: Years of education completed	13h.vii	<input type="text"/> <input type="text"/>
13h.viii	Person 8: Eats at home	13h.viii	<input type="text"/>
13h.ix	Person 8: Sleeps at home	13h.ix	<input type="text"/>
13i	<b>Person 9: Name initial</b>	13i	
13i.i	Person 9: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13i.i	<input type="text"/> <input type="text"/>
13i.ii	If relation to child "other relation", specify	13i.ii	_____
13i.iii	Person 9: Sex (3=male, 4=female)	13i.iii	<input type="text"/>
13i.iv	Person 9: Age	13i.iv	<input type="text"/> <input type="text"/>
13i.v	Specify if age is in years or months (3= years, 4= months)	13i.v	<input type="text"/>
13i.vi	Person 9: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13i.vi	<input type="text"/> <input type="text"/>
13i.vii	Person 9: Years of education completed	13i.vii	<input type="text"/> <input type="text"/>
13i.viii	Person 9: Eats at home	13i.viii	<input type="text"/>
13i.ix	Person 9: Sleeps at home	13i.ix	<input type="text"/>
13j	<b>Person 10: Name initial</b>	13j	
13j.i	Person 10: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13j.i	<input type="text"/> <input type="text"/>

13j.ii	If relation to child "other relation", specify	13j.ii	_____
13j.iii	Person 10: Sex (3=male, 4=female)	13j.iii	<input type="checkbox"/>
13j.iv	Person 10: Age	13j.iv	<input type="checkbox"/> <input type="checkbox"/>
13j.v	Specify if age is in years or months (3= years, 4= months)	13j.v	<input type="checkbox"/>
13j.vi	Person 10: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13j.vi	<input type="checkbox"/> <input type="checkbox"/>
13j.vii	Person 10: Years of education completed	13j.vii	<input type="checkbox"/> <input type="checkbox"/>
13j.viii	Person 10: Eats at home	13j.viii	<input type="checkbox"/>
13j.ix	Person 10: Sleeps at home	13j.ix	<input type="checkbox"/>
13k	<b>Person 11: Name initial</b>	13k	
13k.i	Person 11: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13k.i	<input type="checkbox"/> <input type="checkbox"/>
13k.ii	If relation to child "other relation", specify	13k.ii	_____
13k.iii	Person 11: Sex (3=male, 4=female)	13k.iii	<input type="checkbox"/>
13k.iv	Person 11: Age	13k.iv	<input type="checkbox"/> <input type="checkbox"/>
13k.v	Specify if age is in years or months (3= years, 4= months)	13k.v	<input type="checkbox"/>
13k.vi	Person 11: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13k.vi	<input type="checkbox"/> <input type="checkbox"/>
13k.vii	Person 11: Years of education completed	13k.vii	<input type="checkbox"/> <input type="checkbox"/>
13k.viii	Person 11: Eats at home	13k.viii	<input type="checkbox"/>
13k.ix	Person 11: Sleeps at home	13k.ix	<input type="checkbox"/>

13l	<b>Person 12: Name initial</b>	13l	
13l.i	Person 12: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13l.i	<input type="text"/> <input type="text"/>
13l.ii	If relation to child "other relation", specify	13l.ii	_____
13l.iii	Person 12: Sex (3=male, 4=female)	13l.iii	<input type="text"/>
13l.iv	Person 12: Age	13l.iv	<input type="text"/> <input type="text"/>
13l.v	Specify if age is in years or months (3= years, 4= months)	13l.v	<input type="text"/>
13l.vi	Person 12: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13l.vi	<input type="text"/> <input type="text"/>
13l.vii	Person 12: Years of education completed	13l.vii	<input type="text"/> <input type="text"/>
13l.viii	Person 12: Eats at home	13l.viii	<input type="text"/>
13l.ix	Person 12: Sleeps at home	13l.ix	<input type="text"/>
14	What Is your (the mother's) marital status? (3= married/has a partner, 4= single*, 5= separated/divorced/widowed*, 8= does not answer*) <b>* If response is code 4, 5 or 8, skip to question 16</b>	14	<input type="text"/>
15	Do you live with your husband/partner?	15	<input type="text"/>
16	Would you (the mother) mind reading what's on this piece of paper for me? (hand mother piece of paper with line written on it) Can the mother read?	16	<input type="text"/>
17	Would you (the mother) mind writing your address for me? (Give her this piece of paper and pen) Can the mother write?	17	<input type="text"/>
18	Are you (the mother) involved in any income-generating activities?	18	<input type="text"/>
19	What is your annual household income?	19	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

20	Do you (the mother) currently work away from home or regularly leave home at any time during the day?  <b>*If response is code 2 (no), skip question 21 and go to question 22</b>	20	<input type="checkbox"/>
21	When you (the mother) are working or away from home, who takes care of _____ (child's name)?  (3= Mother takes child with her, 4= Family member more than 18 years old, 5= Family member less than 18 years old, 6=friend/neighbour, 7= child stays alone, no one takes care of child, 10= Other, 11= Does not work away from home, 88= Does not know/answer)	21	<input type="text"/> <input type="text"/>
22	How many times <b>per month</b> do you or any other family member buy food?	22	<input type="text"/> <input type="text"/>
23	How much money would you be willing to spend on your child's food <b>every day</b> ?	23	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24	How much money do you spend on the following foods for the household <b>per week</b>	24	
24a	Vegetables	24a	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24b	Cereals	24b	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24c	Snacks	24c	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24d	Animal products (including milk and yogurt)	24d	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24e	Oil	24e	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24f	Other foods	24f	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24g	If other foods mentioned, specify	24g	_____
<b>COMPLEMENTARY FEEDING PRACTICES</b>			
25	At what age was the child given liquids (including prelacteals) other than breast milk for the first time? Fill in child's age in number of days.	25	<input type="text"/> <input type="text"/> <input type="text"/>
26	What was the first liquid other than breast milk that was you gave to the child on a regular basis?	26	_____
27	At what age (in months) did you feed the child her/his first food – solid or semi-solid?	27	<input type="text"/> <input type="text"/>

28	What was the first food you gave to your child?		
28a	Fruit	28a	<input type="checkbox"/>
28b	Vegetable	28b	<input type="checkbox"/>
28c	Cereal	28c	<input type="checkbox"/>
28d	Legume	28d	<input type="checkbox"/>
28e	Meat	28e	<input type="checkbox"/>
28f	Organs	28f	<input type="checkbox"/>
28g	Eggs	28g	<input type="checkbox"/>
28h	Milk product	28h	<input type="checkbox"/>
28i	Fish	28i	<input type="checkbox"/>
28j	Oil	28j	<input type="checkbox"/>
28k	Sugar	28k	<input type="checkbox"/>
28l	Milk	28l	<input type="checkbox"/>
28m	Other	28m	<input type="checkbox"/>
28n	If other food mentioned, specify	28n	_____
29	Does your child currently eat foods from the following food groups?	29	
29a	Fruit	29a	<input type="checkbox"/>
29b	Vegetable	29b	<input type="checkbox"/>
29c	Cereal	29c	<input type="checkbox"/>
29d	Legume	29d	<input type="checkbox"/>
29e	Meat	29e	<input type="checkbox"/>
29f	Organs	29f	<input type="checkbox"/>
29g	Eggs	29g	<input type="checkbox"/>
29h	Fish	29h	<input type="checkbox"/>
29i	Oil	29i	<input type="checkbox"/>
29j	Sugar	29j	<input type="checkbox"/>
29k	Milk	29k	<input type="checkbox"/>
29l	Milk product (yogurt, cheese, paneer, etc.)	29l	<input type="checkbox"/>

29m	Others	29m	<input type="checkbox"/>
29n	If other food mentioned, specify	29n	_____
30	How often does your child eat main meals <b>every day</b> (not including breast milk and/or formula milk)	30	<input type="checkbox"/> <input type="checkbox"/>
31	How often does your child eat snacks <b>every day</b> (not including breast milk and/or formula milk)	31	<input type="checkbox"/> <input type="checkbox"/>
32	Please provide information on foods you may not feed your child in normal conditions, and why: (Use the following codes for reason for not feeding child the food: 3= Child is allergic to food, 4= Message from family and/or community, 5= Habit from the past, 6= Child falls sick after eating this food, 7= Food taboo/superstition, 10= Other)	32	
32a	<b>Name of food #1</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	32a	_____  <input type="checkbox"/> <input type="checkbox"/>  _____  <input type="checkbox"/> <input type="checkbox"/>  _____
32b	<b>Name of food #2</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	32b	_____  <input type="checkbox"/> <input type="checkbox"/>  _____  <input type="checkbox"/> <input type="checkbox"/>  _____
32c	<b>Name of food #3</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify	32c	_____  <input type="checkbox"/> <input type="checkbox"/>  _____

	<p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>		<input type="checkbox"/> <input type="checkbox"/> <hr/>
32d	<p><b>Name of food #4</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	32d	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
32e	<p><b>Name of food #5</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	32e	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
32f	<p><b>Name of food #6</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	32f	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
<b>MOBILE PHONE USE</b>			
33	<p>Do you own a mobile phone?</p> <p>*if response is 2 (no), fill remaining questions with '9'.</p>	33	<input type="checkbox"/>
34	<p>What is the main use for your mobile phone?</p> <p>(3= work use, 4= personal use, 5= emergencies – rarely used, 6=work and personal use)</p>	34	<input type="checkbox"/>



35	Do you ever use your mobile phone for work purposes?	35	<input type="checkbox"/>
36	Do you use your phone for SMS (text messages)?	36	<input type="checkbox"/>
37	How often do you use your mobile phones for phone calls and SMS in a typical week? (answer below) (3= once/day, 4= more than once/day, 5 = 1-3 times/week, 6 = 4-7 times/week, 7 = more than 8 times/week, 10= don't use phone for this purpose, 88 = do not know/remember/answer)	37	
37a	Make phone calls	37a	<input type="checkbox"/> <input type="checkbox"/>
37b	Receive phone calls	37b	<input type="checkbox"/> <input type="checkbox"/>
37c	Send SMS	37c	<input type="checkbox"/> <input type="checkbox"/>
37d	Receive SMS	37d	<input type="checkbox"/> <input type="checkbox"/>
38	Does your mobile phone stay with you most of the time? <b>* If response = 1 (yes), fill question 39 with '9'.</b>	38	<input type="checkbox"/> <input type="checkbox"/>
39	Who usually has the mobile phone most of the time? (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= other, please specify)	39	<input type="checkbox"/> <hr/> -

THANK YOU! ☺

**Appendix 4.8: Sociodemographic forms for mothers-in-law in focus group discussions  
mHealth study in Kheri Kalan, Haryana, India**

**SOCIODEMOGRAPHIC FORM FOR MOTHERS-IN-LAW IN FOCUS GROUPS**

[Code:1=Yes, 2=No, 9= NA, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/>
2	Worker Code	2	<input type="text"/>
3	Woman ID	3	<input type="text"/>
4	Child ID	4	<input type="text"/>
5	Child sex (3=male, 4=female)	5	<input type="text"/>
6	Child birth date (dd/mm/yyyy)	6	<input type="text"/>
7	Source of birth date data (3= Immunization record, 4= Birth certificate, 5= Caregiver's recall with events calendar, 6= Caregiver's recall with confidence, 7= Caregiver's recall without confidence, 10= Other source, 9=NA)	7	<input type="text"/>
8	If source of child's birth date data is "other source", specify	8	_____
9	Age of child in months	9	<input type="text"/>
10	Address	10	Subcentre: _____ _____ PHC: _____ _____
<b>FAMILY CHARACTERISTICS</b>			
11	How many people are currently living in the home, including elderly and young children?	11	<input type="text"/>
12	How many of these people in the household are less than 5 years old?	12	<input type="text"/>
13	Can you please tell me a little more about people currently living in your home (including you)  <b>*Total number of people here should match response to question 11</b>	13	

13a	<b>Person 1: Name initial</b>	13a	
13a.i	Person 1: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13a.i	<input type="checkbox"/> <input type="checkbox"/>
13a.ii	If relation to child "other relation", specify	13a.ii	_____
13a.iii	Person 1: Sex (3=male, 4=female)	13a.iii	<input type="checkbox"/>
13a.iv	Person 1: Age	13a.iv	<input type="checkbox"/> <input type="checkbox"/>
13a.v	Specify if age is in years or months (3= years, 4= months)	13a.v	<input type="checkbox"/>
13a.vi	Person 1: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13a.vi	<input type="checkbox"/> <input type="checkbox"/>
13a.vii	Person 1: Years of education completed	13a.vii	<input type="checkbox"/> <input type="checkbox"/>
13a.viii	Person 1: Eats at home	13a.viii	<input type="checkbox"/>
13a.ix	Person 1: Sleeps at home	13a.ix	<input type="checkbox"/>
13b	<b>Person 2: Name initial</b>	13b	
13b.i	Person 2: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13b.i	<input type="checkbox"/> <input type="checkbox"/>
13b.ii	If relation to child "other relation", specify	13b.ii	_____
13b.iii	Person 2: Sex (3=male, 4=female)	13b.iii	<input type="checkbox"/>
13b.iv	Person 2: Age	13b.iv	<input type="checkbox"/> <input type="checkbox"/>
13b.v	Specify if age is in years or months (3= years, 4= months)	13b.v	<input type="checkbox"/>
13b.vi	Person 2: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13b.vi	<input type="checkbox"/> <input type="checkbox"/>

13b.vii	Person 2: Years of education completed	13b.vii	<input type="text"/> <input type="text"/>
13b.viii	Person 2: Eats at home	13b.viii	<input type="checkbox"/>
13b.ix	Person 2: Sleeps at home	13b.ix	<input type="checkbox"/>
13c	<b>Person 3: Name initial</b>	13c	
13c.i	Person 3: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13c.i	<input type="text"/> <input type="text"/>
13c.ii	If relation to child "other relation", specify	13c.ii	_____
13c.iii	Person 3: Sex (3=male, 4=female)	13c.iii	<input type="checkbox"/>
13c.iv	Person 3: Age	13c.iv	<input type="text"/> <input type="text"/>
13c.v	Specify if age is in years or months (3= years, 4= months)	13c.v	<input type="checkbox"/>
13c.vi	Person 3: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13c.vi	<input type="text"/> <input type="text"/>
13c.vii	Person 3: Years of education completed	13c.vii	<input type="text"/> <input type="text"/>
13c.viii	Person 3: Eats at home	13c.viii	<input type="checkbox"/>
13c.ix	Person 3: Sleeps at home	13c.ix	<input type="checkbox"/>
13d	<b>Person 4: Name initial</b>	13d	
13d.i	Person 4: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13d.i	<input type="text"/> <input type="text"/>
13d.ii	If relation to child "other relation", specify	13d.ii	_____
13d.iii	Person 4: Sex (3=male, 4=female)	13d.iii	<input type="checkbox"/>
13d.iv	Person 4: Age	13d.iv	<input type="text"/> <input type="text"/>
13d.v	Specify if age is in years or months (3= years, 4= months)	13d.v	<input type="checkbox"/>
13d.vi	Person 4: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13d.vi	<input type="text"/> <input type="text"/>

13d.vii	Person 4: Years of education completed	13d.vii	<input type="text"/> <input type="text"/>
13d.viii	Person 4: Eats at home	13d.viii	<input type="checkbox"/>
13d.ix	Person 4: Sleeps at home	13d.ix	<input type="checkbox"/>
13e	<b>Person 5: Name initial</b>	13e	
13e.i	Person 5: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13e.i	<input type="text"/> <input type="text"/>
13e.ii	If relation to child "other relation", specify	13e.ii	_____
13e.iii	Person 5: Sex (3=male, 4=female)	13e.iii	<input type="checkbox"/>
13e.iv	Person 5: Age	13e.iv	<input type="text"/> <input type="text"/>
13e.v	Specify if age is in years or months (3= years, 4= months)	13e.v	<input type="checkbox"/>
13e.vi	Person 5: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13e.vi	<input type="text"/> <input type="text"/>
13e.vii	Person 5: Years of education completed	13e.vii	<input type="text"/> <input type="text"/>
13e.viii	Person 5: Eats at home	13e.viii	<input type="checkbox"/>
13e.ix	Person 5: Sleeps at home	13e.ix	<input type="checkbox"/>
13f	<b>Person 6: Name initial</b>	13f	
13f.i	Person 6: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13f.i	<input type="text"/> <input type="text"/>
13f.ii	If relation to child "other relation", specify	13f.ii	_____
13f.iii	Person 6: Sex (3=male, 4=female)	13f.iii	<input type="checkbox"/>
13f.iv	Person 6: Age	13f.iv	<input type="text"/> <input type="text"/>
13f.v	Specify if age is in years or months (3= years, 4= months)	13f.v	<input type="checkbox"/>

13f.vi	Person 6: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13f.vi	<input type="text"/>
13f.vii	Person 6: Years of education completed	13f.vii	<input type="text"/>
13f.viii	Person 6: Eats at home	13f.viii	<input type="checkbox"/>
13f.ix	Person 6: Sleeps at home	13f.ix	<input type="checkbox"/>
13g	<b>Person 7: Name initial</b>	13g	
13g.i	Person 7: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13g.i	<input type="text"/>
13g.ii	If relation to child "other relation", specify	13g.ii	_____
13g.iii	Person 7: Sex (3=male, 4=female)	13g.iii	<input type="checkbox"/>
13g.iv	Person 7: Age	13g.iv	<input type="text"/>
13g.v	Specify if age is in years or months (3= years, 4= months)	13g.v	<input type="checkbox"/>
13g.vi	Person 7: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13g.vi	<input type="text"/>
13g.vii	Person 7: Years of education completed	13g.vii	<input type="text"/>
13g.viii	Person 7: Eats at home	13g.viii	<input type="checkbox"/>
13g.ix	Person 7: Sleeps at home	13g.ix	<input type="checkbox"/>
13h	<b>Person 8: Name initial</b>	13h	
13h.i	Person 8: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13h.i	<input type="text"/>
13h.ii	If relation to child "other relation", specify	13h.ii	_____
13h.iii	Person 8: Sex (3=male, 4=female)	13h.iii	<input type="checkbox"/>

13h.iv	Person 8: Age	13h.iv	<input type="text"/> <input type="text"/>
13h.v	Specify if age is in years or months (3= years, 4= months)	13h.v	<input type="text"/>
13h.vi	Person 8: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13h.vi	<input type="text"/> <input type="text"/>
13h.vii	Person 8: Years of education completed	13h.vii	<input type="text"/> <input type="text"/>
13h.viii	Person 8: Eats at home	13h.viii	<input type="text"/>
13h.ix	Person 8: Sleeps at home	13h.ix	<input type="text"/>
13i	<b>Person 9: Name initial</b>	13i	
13i.i	Person 9: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13i.i	<input type="text"/> <input type="text"/>
13i.ii	If relation to child "other relation", specify	13i.ii	_____
13i.iii	Person 9: Sex (3=male, 4=female)	13i.iii	<input type="text"/>
13i.iv	Person 9: Age	13i.iv	<input type="text"/> <input type="text"/>
13i.v	Specify if age is in years or months (3= years, 4= months)	13i.v	<input type="text"/>
13i.vi	Person 9: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13i.vi	<input type="text"/> <input type="text"/>
13i.vii	Person 9: Years of education completed	13i.vii	<input type="text"/> <input type="text"/>
13i.viii	Person 9: Eats at home	13i.viii	<input type="text"/>
13i.ix	Person 9: Sleeps at home	13i.ix	<input type="text"/>
13j	<b>Person 10: Name initial</b>	13j	
13j.i	Person 10: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13j.i	<input type="text"/> <input type="text"/>

13j.ii	If relation to child "other relation", specify	13j.ii	_____
13j.iii	Person 10: Sex (3=male, 4=female)	13j.iii	<input type="checkbox"/>
13j.iv	Person 10: Age	13j.iv	<input type="checkbox"/> <input type="checkbox"/>
13j.v	Specify if age is in years or months (3= years, 4= months)	13j.v	<input type="checkbox"/>
13j.vi	Person 10: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13j.vi	<input type="checkbox"/> <input type="checkbox"/>
13j.vii	Person 10: Years of education completed	13j.vii	<input type="checkbox"/> <input type="checkbox"/>
13j.viii	Person 10: Eats at home	13j.viii	<input type="checkbox"/>
13j.ix	Person 10: Sleeps at home	13j.ix	<input type="checkbox"/>
13k	<b>Person 11: Name initial</b>	13k	
13k.i	Person 11: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13k.i	<input type="checkbox"/> <input type="checkbox"/>
13k.ii	If relation to child "other relation", specify	13k.ii	_____
13k.iii	Person 11: Sex (3=male, 4=female)	13k.iii	<input type="checkbox"/>
13k.iv	Person 11: Age	13k.iv	<input type="checkbox"/> <input type="checkbox"/>
13k.v	Specify if age is in years or months (3= years, 4= months)	13k.v	<input type="checkbox"/>
13k.vi	Person 11: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13k.vi	<input type="checkbox"/> <input type="checkbox"/>
13k.vii	Person 11: Years of education completed	13k.vii	<input type="checkbox"/> <input type="checkbox"/>
13k.viii	Person 11: Eats at home	13k.viii	<input type="checkbox"/>
13k.ix	Person 11: Sleeps at home	13k.ix	<input type="checkbox"/>



13l	<b>Person 12: Name initial</b>	13l	
13l.i	Person 12: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13l.i	<input type="text"/>
13l.ii	If relation to child "other relation", specify	13l.ii	_____
13l.iii	Person 12: Sex (3=male, 4=female)	13l.iii	<input type="checkbox"/>
13l.iv	Person 12: Age	13l.iv	<input type="text"/>
13l.v	Specify if age is in years or months (3= years, 4= months)	13l.v	<input type="checkbox"/>
13l.vi	Person 12: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work)	13l.vi	<input type="text"/>
13l.vii	Person 12: Years of education completed	13l.vii	<input type="text"/>
13l.viii	Person 12: Eats at home	13l.viii	<input type="checkbox"/>
13l.ix	Person 12: Sleeps at home	13l.ix	<input type="checkbox"/>
14	What is your (the caregiver's) marital status? (3= married/has a partner, 4= single*, 5= separated/divorced/widowed*, 8= does not answer*) <b>* If response is code 4, 5 or 8, skip to question 16</b>	14	<input type="checkbox"/>
15	Do you live with your husband/partner?	15	<input type="checkbox"/>
16	Would you (the caregiver) mind reading what's on this piece of paper for me? (hand caregiver piece of paper with a line written on it) Can the caregiver read?	16	<input type="checkbox"/>
17	Would you (the caregiver) mind writing your address for me? (Give her this piece of paper and pen) Can the caregiver write?	17	<input type="checkbox"/>
18	Are you (the caregiver) involved in any income-generating activities?	18	<input type="checkbox"/>

19	What is your annual household income?	19	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
20	Do you (the caregiver) currently work away from home or regularly leave home at any time during the day?  <b>*If response is code 2 (no), skip question 21 and go to question 22</b>	20	<input type="checkbox"/>
21	When you (the caregiver) are working or away from home, who takes care of _____ (child's name)?  (3= Caregiver takes child with her, 4= Family member more than 18 years old, 5= Family member less than 18 years old, 6=friend/neighbour, 7= child stays alone, no one takes care of child, 10= Other, 11= Does not work away from home, 88= Does not know/answer)	21	<input type="text"/> <input type="text"/>
22	How many times <b>per month</b> do you or any other family member buy food?	22	<input type="text"/> <input type="text"/>
23	How much money would you be willing to spend on this child's food <b>every day</b> ?	23	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24	How much money do you spend on the following foods for the household <b>per week</b>	24	
24a	Vegetables	24a	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24b	Cereals	24b	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24c	Snacks	24c	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24d	Animal products (including milk and yogurt)	24d	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24e	Oil	24e	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24f	Other foods	24f	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
24g	If other foods mentioned, specify	24g	_____
<b>COMPLEMENTARY FEEDING PRACTICES</b>			
25	At what age was the child given liquids (including prelacteals) other than breast milk for the first time? Fill in child's age in number of days.	25	<input type="text"/> <input type="text"/> <input type="text"/>
26	What was the first liquid other than breast milk that was you gave to the child on a regular basis?	26	_____
27	At what age (in months) did you feed the child her/his first food – solid or semi-solid?	27	<input type="text"/> <input type="text"/>

28	What was the first food you gave to the child?		
28a	Fruit	28a	<input type="checkbox"/>
28b	Vegetable	28b	<input type="checkbox"/>
28c	Cereal	28c	<input type="checkbox"/>
28d	Legume	28d	<input type="checkbox"/>
28e	Meat	28e	<input type="checkbox"/>
28f	Organs	28f	<input type="checkbox"/>
28g	Eggs	28g	<input type="checkbox"/>
28h	Milk product	28h	<input type="checkbox"/>
28i	Fish	28i	<input type="checkbox"/>
28j	Oil	28j	<input type="checkbox"/>
28k	Sugar	28k	<input type="checkbox"/>
28l	Milk	28l	<input type="checkbox"/>
28m	Other	28m	<input type="checkbox"/>
28n	If other food mentioned, specify	28n	_____
29	Does the child currently eat foods from the following food groups?	29	
29a	Fruit	29a	<input type="checkbox"/>
29b	Vegetable	29b	<input type="checkbox"/>
29c	Cereal	29c	<input type="checkbox"/>
29d	Legume	29d	<input type="checkbox"/>
29e	Meat	29e	<input type="checkbox"/>
29f	Organs	29f	<input type="checkbox"/>
29g	Eggs	29g	<input type="checkbox"/>
29h	Fish	29h	<input type="checkbox"/>
29i	Oil	29i	<input type="checkbox"/>
29j	Sugar	29j	<input type="checkbox"/>
29k	Milk	29k	<input type="checkbox"/>
29l	Milk product (yogurt, cheese, paneer, etc.)	29l	<input type="checkbox"/>
29m	Others	29m	<input type="checkbox"/>
29n	If other food mentioned, specify	29n	_____

30	How often does the child eat main meals <b>every day</b> (not including breast milk and/or formula milk)	30	<input type="text"/> <input type="text"/>
31	How often does the child eat snacks <b>every day</b> (not including breast milk and/or formula milk)	31	<input type="text"/> <input type="text"/>
32	Please provide information on foods you may not feed the child in normal conditions, and why: (Use the following codes for reason for not feeding child the food: 3= Child is allergic to food, 4= Message from family and/or community, 5= Habit from the past, 6= Child falls sick after eating this food, 7= Food taboo/superstition, 10= Other)	32	
32a	<b>Name of food #1</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	32a	_____  <input type="text"/> <input type="text"/>  _____  <input type="text"/> <input type="text"/>  _____
32b	<b>Name of food #2</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify  → Reason 2 for not feeding the child the food (optional) If response is "other" (code 10), specify	32b	_____  <input type="text"/> <input type="text"/>  _____  <input type="text"/> <input type="text"/>  _____
32c	<b>Name of food #3</b>  → Reason 1 for not feeding the child the food If response is "other" (code 10), specify	32c	_____  <input type="text"/> <input type="text"/>  _____

	<p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is “other” (code 10), specify</p>		<input type="checkbox"/> <input type="checkbox"/> <hr/>
32d	<p><b>Name of food #4</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is “other” (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is “other” (code 10), specify</p>	32d	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
32e	<p><b>Name of food #5</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is “other” (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is “other” (code 10), specify</p>	32e	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
32f	<p><b>Name of food #6</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is “other” (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is “other” (code 10), specify</p>	32f	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
<b>MOBILE PHONE USE</b>			
33	<p>Do you own a mobile phone?</p> <p><b>*if response is 2 (no), fill ‘9’ till question 39 and go to question 40.</b></p>	33	<input type="checkbox"/> 
34	<p>What is the main use for your mobile phone?</p> <p>(3= work use, 4= personal use, 5= emergencies – rarely used, 6=work and personal use)</p>	34	<input type="checkbox"/> 

35	Do you ever use your mobile phone for work purposes?	35	<input type="checkbox"/>
36	Do you use your phone for SMS (text messages)?	36	<input type="checkbox"/>
37	How often do you use your mobile phones for phone calls and SMS in a typical week? (answer below)  (3= once/day, 4= more than once/day, 5 = 1-3 times/week, 6 = 4-7 times/week, 7 = more than 8 times/week, 10= don't use phone for this purpose, 88 = do not know/remember/answer)	37	
37a	Make phone calls	37a	<input type="checkbox"/> <input type="checkbox"/>
37b	Receive phone calls	37b	<input type="checkbox"/> <input type="checkbox"/>
37c	Send SMS	37c	<input type="checkbox"/> <input type="checkbox"/>
37d	Receive SMS	37d	<input type="checkbox"/> <input type="checkbox"/>
38	Does your mobile phone stay with you most of the time?  <b>* If response = 1 (yes), fill question 39 with '9' and go to question 40.</b>	38	<input type="checkbox"/> <input type="checkbox"/>
39	Who usually has the mobile phone most of the time?  (3= husband, 4= mother of the child, 5= relative/family member, 6= friend, 7= other, please specify)	39	<input type="checkbox"/> <hr/>
40	What is the relationship of caregiver with the child  (3= grandmother, 4= grandfather, 5= father, 6= aunt, 7= uncle, 10= other relative/family friend, 11= other, specify)		<input type="checkbox"/> <input type="checkbox"/> <hr/>

THANK YOU! 😊

**Appendix 4.9: Sociodemographic forms for Anganwadi Workers in focus group discussions**

**mHealth study in Kheri Kalan, Haryana, India**

**SOCIODEMOGRAPHIC FORM FOR ANGANWADI WORKERS IN FOCUS GROUPS**

[Code:1=Yes, 2=No, 9= NA, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
2	Worker Code	2	<input type="text"/> <input type="text"/> <input type="text"/>
3	Anganwadi Worker ID	3	<input type="text"/> <input type="text"/> <input type="text"/>
4	Anganwadi Worker age	4	<input type="text"/> <input type="text"/>
5	Address	5	Subcentre: _____ _____ PHC: _____ _____
<b>EDUCATIONAL &amp; PROFESSIONAL EXPERIENCE</b>			
6	How many years of education do you have?	6	<input type="text"/> <input type="text"/>
7	Do you have educational or formal training in nutrition?	7	<input type="checkbox"/>
8	How many years have you worked as an Anganwadi worker?	8	<input type="text"/> <input type="text"/>
9	How often do you perform the following activities? (see list below)  (3= daily, 4= once a week, 5=1 to 3 times/week, 6= more than 3 times/week, 7= once a month, 10= 2-3 times/month, 11= less than one time/month, 12= more than 4 times/month, 13=never)	9	

9a	Supplementary nutrition	9a	<input type="checkbox"/> <input type="checkbox"/>
9b	Immunization	9b	<input type="checkbox"/> <input type="checkbox"/>
9c	Growth monitoring	9c	<input type="checkbox"/> <input type="checkbox"/>
9d	Referral services	9d	<input type="checkbox"/> <input type="checkbox"/>
9e	Health check-ups	9e	<input type="checkbox"/> <input type="checkbox"/>
9f	Nutrition and health counselling	9f	<input type="checkbox"/> <input type="checkbox"/>
9g	Home visits	9g	<input type="checkbox"/> <input type="checkbox"/>
9h	Educating 3-6 year olds at AWW centre	9h	<input type="checkbox"/> <input type="checkbox"/>
9i	Other, specify	9i	<input type="checkbox"/> <input type="checkbox"/> <hr/> —
10	Have you received training since you started working?  *if response = 2 (no), go to question 14	10	<input type="checkbox"/>
11	Have you since received a refresher training?	11	<input type="checkbox"/>
12	When did you last participate in a refresher training?  (3= Within the past month, 4= 1-6 months ago, 5= 7-12 months ago, 6 = More than 1 year ago, 8= Do not know/remember/answer)	12	<input type="checkbox"/>
13	Did the refresher training include a module on complementary feeding counselling?	13	<input type="checkbox"/>
14	How long is your typical workday? (in hours)	14	<input type="checkbox"/> <input type="checkbox"/>
15	How often do you see your supervisor?	15	<input type="checkbox"/> <input type="checkbox"/>



	(3= Once per week, 4= more than once per week, 5= 1-3 times per month, 6= Once per month, 7= Once every 2 months, 10= Once every 3-6 months, 11= Rarely, 12=Never)		
<b>MOBILE PHONE USE</b>			
16	Do you own a mobile phone?  *if response is 2 (no), if '9' till end.	16	<input type="checkbox"/>
17	What is the main use for your mobile phone?  (3= work use, 4= personal use, 5= emergencies – rarely used, 6=both work and personal use, 8 = do not know/remember/answer)	17	<input type="checkbox"/>
18	Do you ever use your mobile phone for work purpose?	18	<input type="checkbox"/>
19	Do you use your phone for SMS (text messages)?	19	<input type="checkbox"/>
20	How often do you use your mobile phones for phone calls and SMS in a typical week? (answer below)  (3= once/day, 4= more than once/day, 5 = 1-3 times/week, 6 = 4-7 times/week, 7 = more than 8 times/week, 10= don't use phone for this purpose, 88 = do not know/remember/answer)		
20a	Make phone calls	20a	<input type="checkbox"/> <input type="checkbox"/>
20b	Receive phone calls	20b	<input type="checkbox"/> <input type="checkbox"/>
20c	Send SMS	20c	<input type="checkbox"/> <input type="checkbox"/>
20d	Receive SMS	20d	<input type="checkbox"/> <input type="checkbox"/>

21	<p>Does your mobile phone stay with you most of the time?</p> <p>* If response = 1 (yes), fill question 22 with '9'.</p>	21	<input type="checkbox"/>
22	<p>Who usually has the mobile phone most of the time?</p> <p>(3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= other, please specify)</p>	22	<input type="checkbox"/> <hr/> <hr/>

**THANK YOU! 😊**

**Appendix 4.10: Baseline form for mothers in mHealth pilot study**

**mHealth study in Kheri Kalan PHC, Haryana, India**

**BASELINE QUESTIONNAIRE FOR MOTHERS IN PILOT STUDY**

[Code:1=Yes, 2=No, 9= Not applicable, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
2	Worker Code	2	<input type="text"/> <input type="text"/> <input type="text"/>
3	Woman ID	3	<input type="text"/> <input type="text"/> <input type="text"/>
4	Child ID	4	<input type="text"/> <input type="text"/> <input type="text"/>
5	Child sex (3=male, 4=female)	5	<input type="text"/> <input type="text"/>
6	Child birth date (dd/mm/yyyy)	6	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
7	Source of birth date data (3= Immunization record, 4= Birth certificate, 5= Mother's recall with events calendar, 6= Mother's recall with confidence, 7= Mother's recall without confidence, 10= Other source, 9=NA)	7	<input type="text"/> <input type="text"/>
8	If source of child's birth date data is "other source", specify	8	_____
9	Age of child in months	9	<input type="text"/> <input type="text"/>
10	Address (Subcentre codes: 3=Baroli, 4=Nacholi, 5=Jasana, 6=Kheri Kalan, 7=Bhaskola, 10=Faridpur)  (Village codes: 3=Kheri Kalan, 4=Baroli, 5=Prahladpur, 6=Faridpur, 7=Old Sidola, 10=New Sidola, 11=Amipur, 12=Old Bhupani, 13=Mojabad, 14=Rajupura, 15=Phulera)	10	Subcentre: <input type="text"/> <input type="text"/>  Village: <input type="text"/> <input type="text"/>
<b>FAMILY CHARACTERISTICS</b>			
11	How many people are currently living in the home, including elderly and young children?	11	<input type="text"/> <input type="text"/>
12	How many of these people in the household are less than 5 years old?	12	<input type="text"/> <input type="text"/>

13	Can you please tell me a little more about people currently living in your home <b>(including you but excluding your 9-11 month old child)</b>	13	
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13a	<b>Person 1: Name initial</b>	13a	_____
13a.i	Person 1: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13a.i	<input type="checkbox"/> <input type="checkbox"/>
13a.ii	If relation to child "other relation", specify	13a.ii	_____
13a.iii	Person 1: Sex (3=male, 4=female)	13a.iii	<input type="checkbox"/>
13a.iv	Person 1: Age	13a.iv	<input type="checkbox"/> <input type="checkbox"/>
13a.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13a.v	<input type="checkbox"/>
13a.vi	Person 1: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13a.vi	<input type="checkbox"/> <input type="checkbox"/>
13a.vii	Person 1: Years of education completed	13a.vii	<input type="checkbox"/> <input type="checkbox"/>
13a.viii	Person 1: Eats at home	13a.viii	<input type="checkbox"/>
13a.ix	Person 1: Sleeps at home	13a.ix	<input type="checkbox"/>
13b	<b>Person 2: Name initial</b>	13b	_____
13b.i	Person 2: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13b.i	<input type="checkbox"/> <input type="checkbox"/>
13b.ii	If relation to child "other relation", specify	13b.ii	_____
13b.iii	Person 2: Sex (3=male, 4=female)	13b.iii	<input type="checkbox"/>
13b.iv	Person 2: Age	13b.iv	<input type="checkbox"/> <input type="checkbox"/>
13b.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13b.v	<input type="checkbox"/>
13b.vi	Person 2: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13b.vi	<input type="checkbox"/> <input type="checkbox"/>
13b.vii	Person 2: Years of education completed	13b.vii	<input type="checkbox"/> <input type="checkbox"/>
13b.viii	Person 2: Eats at home	13b.viii	<input type="checkbox"/>

13b.ix	Person 2: Sleeps at home	13b.ix	<input type="checkbox"/>
13c	<b>Person 3: Name initial</b>	13c	_____
13c.i	Person 3: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13c.i	<input type="checkbox"/> <input type="checkbox"/>
13c.ii	If relation to child "other relation", specify	13c.ii	_____
13c.iii	Person 3: Sex (3=male, 4=female)	13c.iii	<input type="checkbox"/>
13c.iv	Person 3: Age	13c.iv	<input type="checkbox"/> <input type="checkbox"/>
13c.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13c.v	<input type="checkbox"/>
13c.vi	Person 3: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13c.vi	<input type="checkbox"/> <input type="checkbox"/>
13c.vii	Person 3: Years of education completed	13c.vii	<input type="checkbox"/> <input type="checkbox"/>
13c.viii	Person 3: Eats at home	13c.viii	<input type="checkbox"/>
13c.ix	Person 3: Sleeps at home	13c.ix	<input type="checkbox"/>
13d	<b>Person 4: Name initial</b>	13d	_____
13d.i	Person 4: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13d.i	<input type="checkbox"/> <input type="checkbox"/>
13d.ii	If relation to child "other relation", specify	13d.ii	_____
13d.iii	Person 4: Sex (3=male, 4=female)	13d.iii	<input type="checkbox"/>
13d.iv	Person 4: Age	13d.iv	<input type="checkbox"/> <input type="checkbox"/>
13d.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13d.v	<input type="checkbox"/>
13d.vi	Person 4: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13d.vi	<input type="checkbox"/> <input type="checkbox"/>

13d.vii	Person 4: Years of education completed	13d.vii	<input type="checkbox"/> <input type="checkbox"/>
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13d.viii	Person 4: Eats at home	13d.viii	<input type="checkbox"/>
13d.ix	Person 4: Sleeps at home	13d.ix	<input type="checkbox"/>
13e	<b>Person 5: Name initial</b>	13e	_____
13e.i	Person 5: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13e.i	<input type="checkbox"/> <input type="checkbox"/>
13e.ii	If relation to child "other relation", specify	13e.ii	_____
13e.iii	Person 5: Sex (3=male, 4=female)	13e.iii	<input type="checkbox"/>
13e.iv	Person 5: Age	13e.iv	<input type="checkbox"/> <input type="checkbox"/>
13e.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13e.v	<input type="checkbox"/>
13e.vi	Person 5: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13e.vi	<input type="checkbox"/> <input type="checkbox"/>
13e.vii	Person 5: Years of education completed	13e.vii	<input type="checkbox"/> <input type="checkbox"/>
13e.viii	Person 5: Eats at home	13e.viii	<input type="checkbox"/>
13e.ix	Person 5: Sleeps at home	13e.ix	<input type="checkbox"/>
13f	<b>Person 6: Name initial</b>	13f	_____
13f.i	Person 6: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13f.i	<input type="checkbox"/> <input type="checkbox"/>
13f.ii	If relation to child "other relation", specify	13f.ii	_____
13f.iii	Person 6: Sex (3=male, 4=female)	13f.iii	<input type="checkbox"/>
13f.iv	Person 6: Age	13f.iv	<input type="checkbox"/> <input type="checkbox"/>
13f.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13f.v	<input type="checkbox"/>
13f.vi	Person 6: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13f.vi	<input type="checkbox"/> <input type="checkbox"/>
13f.vii	Person 6: Years of education	13f.vii	<input type="checkbox"/> <input type="checkbox"/>

	completed		
13f.viii	Person 6: Eats at home	13f.viii	<input type="checkbox"/>
13f.ix	Person 6: Sleeps at home	13f.ix	<input type="checkbox"/>
13g	<b>Person 7: Name initial</b>	13g	_____
13g.i	Person 7: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13g.i	<input type="checkbox"/> <input type="checkbox"/>
13g.ii	If relation to child "other relation", specify	13g.ii	_____
13g.iii	Person 7: Sex (3=male, 4=female)	13g.iii	<input type="checkbox"/>
13g.iv	Person 7: Age	13g.iv	<input type="checkbox"/> <input type="checkbox"/>
13g.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13g.v	<input type="checkbox"/>
13g.vi	Person 7: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13g.vi	<input type="checkbox"/> <input type="checkbox"/>
13g.vii	Person 7: Years of education completed	13g.vii	<input type="checkbox"/> <input type="checkbox"/>
13g.viii	Person 7: Eats at home	13g.viii	<input type="checkbox"/>
13g.ix	Person 7: Sleeps at home	13g.ix	<input type="checkbox"/>
13h	<b>Person 8: Name initial</b>	13h	_____
13h.i	Person 8: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13h.i	<input type="checkbox"/> <input type="checkbox"/>
13h.ii	If relation to child "other relation", specify	13h.ii	_____
13h.iii	Person 8: Sex (3=male, 4=female)	13h.iii	<input type="checkbox"/>



13h.iv	Person 8: Age	13h.iv	<input type="text"/> <input type="text"/>
13h.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13h.v	<input type="text"/>
13h.vi	Person 8: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13h.vi	<input type="text"/> <input type="text"/>
13h.vii	Person 8: Years of education completed	13h.vii	<input type="text"/> <input type="text"/>
13h.viii	Person 8: Eats at home	13h.viii	<input type="text"/>
13h.ix	Person 8: Sleeps at home	13h.ix	<input type="text"/>
13i	<b>Person 9: Name initial</b>	13i	_____
13i.i	Person 9: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13i.i	<input type="text"/> <input type="text"/>
13i.ii	If relation to child "other relation", specify	13i.ii	_____
13i.iii	Person 9: Sex (3=male, 4=female)	13i.iii	<input type="text"/>
13i.iv	Person 9: Age	13i.iv	<input type="text"/> <input type="text"/>
13i.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13i.v	<input type="text"/>
13i.vi	Person 9: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13i.vi	<input type="text"/> <input type="text"/>
13i.vii	Person 9: Years of education completed	13i.vii	<input type="text"/> <input type="text"/>
13i.viii	Person 9: Eats at home	13i.viii	<input type="text"/>
13i.ix	Person 9: Sleeps at home	13i.ix	<input type="text"/>
13j	<b>Person 10: Name initial</b>	13j	_____
13j.i	Person 10: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13j.i	<input type="text"/> <input type="text"/>

13j.ii	If relation to child "other relation", specify	13j.ii	_____
13j.iii	Person 10: Sex (3=male, 4=female)	13j.iii	<input type="checkbox"/>
13j.iv	Person 10: Age	13j.iv	<input type="checkbox"/> <input type="checkbox"/>
13j.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13j.v	<input type="checkbox"/>
13j.vi	Person 10: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13j.vi	<input type="checkbox"/> <input type="checkbox"/>
13j.vii	Person 10: Years of education completed	13j.vii	<input type="checkbox"/> <input type="checkbox"/>
13j.viii	Person 10: Eats at home	13j.viii	<input type="checkbox"/>
13j.ix	Person 10: Sleeps at home	13j.ix	<input type="checkbox"/>
13k	<b>Person 11: Name initial</b>	13k	_____
13k.i	Person 11: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13k.i	<input type="checkbox"/> <input type="checkbox"/>
13k.ii	If relation to child "other relation", specify	13k.ii	_____
13k.iii	Person 11: Sex (3=male, 4=female)	13k.iii	<input type="checkbox"/>
13k.iv	Person 11: Age	13k.iv	<input type="checkbox"/> <input type="checkbox"/>
13k.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13k.v	<input type="checkbox"/>
13k.vi	Person 11: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13k.vi	<input type="checkbox"/> <input type="checkbox"/>
13k.vii	Person 11: Years of education completed	13k.vii	<input type="checkbox"/> <input type="checkbox"/>
13k.viii	Person 11: Eats at home	13k.viii	<input type="checkbox"/>
13k.ix	Person 11: Sleeps at home	13k.ix	<input type="checkbox"/>

13l	<b>Person 12: Name initial</b>	13l	_____
13l.i	Person 12: Relation to child (3= mother, 4 = father, 5= brother, 6=sister, 7=cousin, 10= aunt, 11= uncle, 12= grandmother, 13=grandfather, 14= friend, 15 = other relation)	13l.i	<input type="text"/> <input type="text"/>
13l.ii	If relation to child "other relation", specify	13l.ii	_____
13l.iii	Person 12: Sex (3=male, 4=female)	13l.iii	<input type="checkbox"/>
13l.iv	Person 12: Age	13l.iv	<input type="text"/> <input type="text"/>
13l.v	Specify if age is in years or months (3= years, 4= months, 5=days)	13l.v	<input type="checkbox"/>
13l.vi	Person 12: Occupation (3=government service, 4=private service; 5=daily wage, 6=self employed, 7=farming, 10=does not work, 11=student)	13l.vi	<input type="text"/> <input type="text"/>
13l.vii	Person 12: Years of education completed	13l.vii	<input type="text"/> <input type="text"/>
13l.viii	Person 12: Eats at home	13l.viii	<input type="checkbox"/>
13l.ix	Person 12: Sleeps at home	13l.ix	<input type="checkbox"/>
14	What Is your (the mother's) marital status? (3= married/has a partner, 4= single*, 5= separated/divorced/widowed*, 8= does not answer*)  <b>* If response is code 4, 5 or 8, skip to question 16</b>	14	<input type="checkbox"/>
15	Do you live with your husband/partner?	15	<input type="checkbox"/>
16	Would you (the mother) mind reading what's on this piece of paper for me? (hand mother piece of paper with line in Hindi written on it)  Can the mother read?	16	<input type="checkbox"/>
17	Would you (the mother) mind writing your address for me? (Give her this piece of paper and pen and ask to write her address)  Can the mother write?	17	<input type="checkbox"/>  _____ _____
18	Are you (the mother) involved in any income-generating activities?	18	<input type="checkbox"/>
19	What is your annual household income?	19	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

20	Do you (the mother) currently work away from home or regularly leave home at any time during the day?  <b>*If response is code 2 (no), skip question 21 and go to question 22</b>	20	<input type="checkbox"/>
21	When you (the mother) are working or away from home, who takes care of _____ (child's name)?  (3= Mother takes child with her, 4= Family member more than 18 years old, 5= Family member less than 18 years old, 6=friend/neighbour, 7= child stays alone, no one takes care of child, 10= Other, 11= Does not work away from home, 88= Does not know/answer)	21	<input type="text"/> <input type="text"/>
22	How many times <b>per month</b> do you or any other family member buy food?	22	<input type="text"/> <input type="text"/>
23	How much money do you spend on the following foods for the household <b>per week</b>		
23a	Vegetables	23a	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23b	Cereals	23b	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23c	Snacks	23c	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23d	Animal products (including milk and yogurt)	23d	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23e	Beans and legumes	23e	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23f	Ghee/Oil	23f	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23g	Fruits	23g	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23h	Sugar	23h	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23i	Other foods	23i	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
23j	If other foods mentioned, specify	23j	_____
Just to reconfirm, your monthly income is Rs. _____, and you spend about Rs. _____ per week on food for the entire family. So, you spend approximately Rs. _____ per month on food for your child. Am I right? How much money do you spend per month on food for your child? Does that mean you spend Rs. ____ per day on food for your child?			
24	How much money would you be willing to spend on your child's food <b>every day</b> ?	23	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
<b>LIVING CONDITIONS</b>			
25	What is the main source of drinking water for members of your household? (11=Piped water into the dwelling, 12=public tap/stand pipe, 13=tube well)	25	<input type="text"/> <input type="text"/>

	or bore hole or hand pump, 14=open well, 15=closed well, 16=tanker truck, 17= cart with small tank, 18=surface water river/dam/lake/pond/stream/canal, 19=bottled water, 20=rain water, 21=others)		
26	If source of water is "other", specify	26	_____
27	What kind of toilet facility does the mother usually use? (11=Flush or pour flush toilet, 12=pit latrine, 15=no toilet facility i.e. uses open space or field, 16=others, 17=drain	27	<input type="checkbox"/> <input type="checkbox"/>
28	If toilet facility is "Other", specify	28	_____
29	What is the religion of the head of the household (11= Christian, 12=Muslim, 13=Hindu, 14=None, 16=other, 17=Sikh, 18=Buddhist/neo Buddhist, 19=Jain, 20=Jewish, 21=Parsi/Zoroastrian)	29	<input type="checkbox"/> <input type="checkbox"/>
30	If the religion is "other", specify	30	_____
31	What is the caste of the father or the head of the household. (11=Jatav, 12=Jaat, 13=Pandit, 14=Brahman, 15=Thakur, 16=Nai, 17=Rajput, 18=Gujjar, 19=Dobi, 20=Chammer, 21=Muslim, 22=Ahir, 23=Saad, 24=Balmiki, 25=Punjabi Jat, 26=Sepera, 27=Harijan, 28=Mali, 29=Jogi, 30=Jat Sapera)	31	<input type="checkbox"/> <input type="checkbox"/>
32	What is the ethnic group (caste/tribe) of the father or head of the household (11=Scheduled caste, 12= Scheduled tribe, 13= OBC, 14= None of them)	32	<input type="checkbox"/> <input type="checkbox"/>
33	Does your household have (observe wherever possible)		
33a	Electricity	33a	<input type="checkbox"/>
33b	A mattress	33b	<input type="checkbox"/>
33c	A pressure cooker	33c	<input type="checkbox"/>
33d	A chair	33d	<input type="checkbox"/>
33e	A cot or bed	33e	<input type="checkbox"/>
33f	A table	33f	<input type="checkbox"/>
33g	An electric fan (even not working one)	33g	<input type="checkbox"/>
33h	A radio or transistor(even not working one)	33h	<input type="checkbox"/>

33i	A black and white television (even not working one)	33i	<input type="checkbox"/>
33j	A colour television (even not working one)	33j	<input type="checkbox"/>
33k	A sewing machine (even not working one)	33k	<input type="checkbox"/>
33l	A mobile telephone (even not working one)	33l	<input type="checkbox"/>
33m	Any other telephone (even no working one)	33m	<input type="checkbox"/>
33n	A computer (even not working one)	33n	<input type="checkbox"/>
33o	A refrigerator (even not working one)	33o	<input type="checkbox"/>
33p	A watch or clock (even not working one)	33p	<input type="checkbox"/>
33q	A bicycle (even not working one)	33q	<input type="checkbox"/>
33r	A motorcycle or scooter (even not working one)	33r	<input type="checkbox"/>
33s	An animal-drawn cart (even not working one)	33s	<input type="checkbox"/>
33t	A car (even not working one)	33t	<input type="checkbox"/>
33u	A water pump (even not working one)	33u	<input type="checkbox"/>
33v	A thresher (even not working one)	33v	<input type="checkbox"/>
33w	A tractor (even not working one)	33w	<input type="checkbox"/>
34	What type of fuel does your household mainly use for cooking (11=Electricity, 12=LPG/natural gas, 13=Kerosene, 14=Coal/lignite, 15=Charcoal, 16=Wood, 17=Straw/shrubs/grass, 18=Agricultural crop waste, 19=Dung cakes, 20=Biogas, 21=other)	34	<input type="checkbox"/> <input type="checkbox"/>
35	If cooking fuel is code 21, "other," specify	35	_____
36	How many persons slept in the household last night?	36	<input type="checkbox"/> <input type="checkbox"/>
37	Do you own your house?	37	<input type="checkbox"/>
38	Do you own any other house elsewhere?	38	<input type="checkbox"/>
39	Main material of the floor (observe wherever possible) (11= Mud/clay/earth, 12= Sand, 13= Dung,	39	<input type="checkbox"/> <input type="checkbox"/>

	14= Raw wood planks, 15= Palm/bamboo, 16= Brick, 17= Stone, 18= Parquet or polished wood, 19= Vinyl or asphalt, 20= Ceramic tiles, 21=Cement, 22=Carpet, 23=Polished stone/marble/granite, 24=other) (observe whenever possible)		
40	If main material of the floor is "other", specify	40	_____
41	Main material of the roof (observe wherever possible)  (11= No roof, 12=Thatch/palm leaf/reed/grass, 13= Mud, 14= Sod/mud and grass mixture, 15= Plastic/polythene sheeting, 16= Rustic mat, 17= Palm/bamboo, 18= Raw wood planks/timber, 19= Unburnt brick, 20= Loosely packed stone, 21= Metal, 22= Wood, 23= Calamine/ cement/concrete, 24= Asbestos sheets, 25=Reinforced cement concrete (RCC) / cement/concrete, 26= Roofing shingles, 27= Tiles, 28= Slate, 29=other)	41	<input type="checkbox"/> <input type="checkbox"/>
42	If main material of the roof is "other", specify	42	_____
43	Main material of the exterior walls (observe wherever possible) (11= No walls, 12= Cane/palm/trunks/ bamboo, 13= Mud, 14=Grass/reeds/ thatch, 15= Bamboo with mud, 16= Stone with mud, 17= Plywood, 18= Cardboard, 19= Unburnt brick, 20= Raw wood/reused wood, 21= Cement/concrete, 22= Stone with lime/cement, 23= Burnt bricks, 24= Cement blocks, 25= Wood planks/ shingles, 26= Metal/ asbestos sheets, 27=other)	43	<input type="checkbox"/> <input type="checkbox"/>
44	If main material of the exterior walls is "other", specify	44	_____
45	Type of window (observe wherever possible) (11= Any window, 12= windows with glass, 13= windows with screen, 14= windows with curtains or shutters, 15=others, 16=no window)	45	<input type="checkbox"/> <input type="checkbox"/>
46	If type of window is "other", specify	46	_____
47	Does any usual member of this household have a bank account or a post office account?	47	<input type="checkbox"/>
48	Does this household have a BPL card?	48	<input type="checkbox"/>

49	Who is the head of your household (11=mother of infant, 12=father of infant, 13=grandmother of infant, 14=grandfather of infant, 15=other)	49	<input type="text"/> <input type="text"/>
50	If head of household is code 15, "other," specify	50	_____
51	How many rooms in your house (including the kitchen) are used for sleeping?	51	<input type="text"/> <input type="text"/>
<b>BREASTFEEDING PRACTICES</b>			
52	Is the child currently breastfed? (1=yes, 2=no)  <b>* if "yes," fill next question with code 99 and go to question 55</b>	52	<input type="checkbox"/>
53	Why is the child not breastfed? (11= mother is not alive, 12 = milk did not flow properly, 13= breastfeeding never initiated because of problems in breast (abscess, cracked nipple, other problem), 14= breastfeeding never initiated because of problem with baby (weak, premature, unable to suck, other problem), 15= mother ill, 16= baby does not suck breast, 17 = baby does not accept breast milk, 18=doctor advised top milk, 19 =mother became pregnant again, 20 = mother feels breastmilk not enough for child, 21= other)	53	<input type="text"/> <input type="text"/>
54	If reason is code 21, "other," specify	54	_____
<b>COMPLEMENTARY FEEDING PRACTICES</b>			
55	At what age was the child given liquids (including prelacteals) other than breast milk for the first time? Fill in child's age in number of days.	55	<input type="text"/> <input type="text"/> <input type="text"/>
56	What was the first liquid other than breast milk that you gave to the child on a regular basis?	56	_____
57	At what age (in months) did you feed the child her/his first food – solid or semi-solid?	57	<input type="text"/> <input type="text"/>
58	What was the first food you gave to your child?		
58a	Fruit	58a	<input type="checkbox"/>
58b	Vegetable	58b	<input type="checkbox"/>
58c	Cereal	58c	<input type="checkbox"/>



58d	Legume	58d	<input type="checkbox"/>
58e	Meat	58e	<input type="checkbox"/>
58f	Organs	58f	<input type="checkbox"/>
58g	Eggs	58g	<input type="checkbox"/>
58h	Milk product	58h	<input type="checkbox"/>
58i	Fish	58i	<input type="checkbox"/>
58j	Oil	58j	<input type="checkbox"/>
58k	Sugar	58k	<input type="checkbox"/>
58l	Milk	58l	<input type="checkbox"/>
58m	Other	58m	<input type="checkbox"/>
58n	If other food mentioned, specify	58n	_____
59	Does your child currently eat foods from the following food groups?		
59a	Fruit	59a	<input type="checkbox"/>
59b	Vegetable	59b	<input type="checkbox"/>
59c	Cereal	59c	<input type="checkbox"/>
59d	Legume	59d	<input type="checkbox"/>
59e	Meat	59e	<input type="checkbox"/>
59f	Organs	59f	<input type="checkbox"/>
59g	Eggs	59g	<input type="checkbox"/>
59h	Fish	59h	<input type="checkbox"/>
59i	Oil	59i	<input type="checkbox"/>
59j	Sugar	59j	<input type="checkbox"/>
59k	Milk	59k	<input type="checkbox"/>
59l	Milk product (yogurt, cheese, paneer, etc.)	59l	<input type="checkbox"/>
59m	Others	59m	<input type="checkbox"/>
59n	If other food mentioned, specify	59n	_____
60	Please provide information on foods you may not feed your child in normal conditions, and why: (Use the following codes for reason for not feeding child the food: 3= Child is allergic to food, 4= Message from family and/or community, 5= Habit from		

	the past, 6= Child falls sick after eating this food, 7= Food taboo/superstition, 10= Other)		
60a	<p><b>Name of food #1</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60a	<hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/>
60b	<p><b>Name of food #2</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60b	<hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/>
60c	<p><b>Name of food #3</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60c	<hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/>
60d	<p><b>Name of food #4</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60d	<hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/>
60e	<p><b>Name of food #5</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p>	60e	<hr/> <div style="display: flex; justify-content: space-around; width: 100px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <hr/>

	<p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>		<input type="checkbox"/> <input type="checkbox"/> <hr/>
60f	<p><b>Name of food #6</b></p> <p>→ Reason 1 for not feeding the child the food</p> <p>If response is "other" (code 10), specify</p> <p>→ Reason 2 for not feeding the child the food (optional)</p> <p>If response is "other" (code 10), specify</p>	60f	<hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/> <input type="checkbox"/> <input type="checkbox"/> <hr/>
61	How often does your child eat main meals <b>every day</b> (not including breast milk and/or formula milk)	61	<input type="checkbox"/> <input type="checkbox"/>
62	How often does your child eat snacks <b>every day</b> (not including breast milk and/or formula milk)	62	<input type="checkbox"/> <input type="checkbox"/>
63	Generally speaking, how is _____ (child's name) appetite when she/he is healthy? (3=Eats more food than most children his/her age, 4=Eats same amount of food as most children his/her age, 5=Eats less food than most children his/her age, 8=Does not know/remember/answer)	63	<input type="checkbox"/>
64	If your child does not want to finish his/her meal, what do you do? (3= Persuade your child to eat, 4=Force your child to eat, 5= Stop feeding your child, 6=Other, 8= Does not know/remember/answer)	64	<input type="checkbox"/>
65	If response is code 6, "other," specify	65	<hr/>
66	Where do you usually feed your child main meals? [3= Child is fed in a prescribed place (i.e. sitting in a chair or on the mother's lap), 4= Child is fed sitting but not in a prescribed place, 5= Child is fed while s/he is wandering around, 6=other 8= Does not know/remember/answer)	66	<input type="checkbox"/>
67	If response is code 6, "other," specify	67	<hr/>
<b>MATERNAL KNOWLEDGE, ATTITUDES AND PRACTICES RELATING TO COMPLEMENTARY FEEDING</b>			
68	Until what age (in months) should a child be exclusively breastfed?	68	<input type="checkbox"/> <input type="checkbox"/>
69	At what age (in months) should a mother start adding liquids and/or		

	<p>foods other than breast milk to the child's diet? (Fill "00" if at birth, and "77" if never)</p>		
69a	Ghutti	69a	<input type="text"/> <input type="text"/>
69b	Honey	69b	<input type="text"/> <input type="text"/>
69c	Sugar and/or jaggery water	69c	<input type="text"/> <input type="text"/>
69d	Water	69d	<input type="text"/> <input type="text"/>
69e	Top milk	69e	<input type="text"/> <input type="text"/>
69f	Semisolid food	69f	<input type="text"/> <input type="text"/>
69g	Specify the types of semisolid foods appropriate to feed the child at _____ months (age specified in 70e)	69g	_____
69h	Solid food	69h	<input type="text"/> <input type="text"/>
69i	Specify the types of solid foods appropriate to feed the child at _____ months (age specified in 70g)	69i	_____
69j	Other liquids/foods	69j	<input type="text"/> <input type="text"/>
69k	If other liquids/foods mentioned in 70i, please specify	69k	_____
70	<p>What consistency of foods other than liquids are best for a 9-11 month old child? (DO NOT READ THE OPTIONS UNLESS MOTHER NEEDS PROMPTS)</p> <p>(3=Diluted, 4=Thick, 5= Medium, 6= Other, 8= Does not know/remember/answer, 9 = Not applicable)</p>	70	<input type="text"/>
70a	If response is code 6, "other," specify	70a	_____
71	How many main meals (excluding snacks such as fruits, biscuit, fan, etc.) should a 9-11 month old child eat everyday excluding breastmilk or breastmilk substitute?	71	<input type="text"/> <input type="text"/>
72	<p>If a child stops eating, what should be done? (DO NOT READ THE OPTIONS)</p> <p>(11= Motivate the child with gestures, games, words, 12= Does not motivate the child, 99= Does not apply because does not give child solid foods, 13 = Other, 8= Does not know/remember/answer)</p>	72	<input type="text"/> <input type="text"/>

73	If response is code 13, "other," specify	73	_____
74	What vegetables according to you are best for a child? (fill answers and reasons why below)		
74a	<b>Vegetable 1</b>  Why is _____ (vegetable specified in 74a) good for a child? (1=yes, 2=no, 9= does not know)	74a	_____
74aa	Vegetable has lots of nutrients	74aa	<input type="checkbox"/>
74ab	Helps the child grow well	74ab	<input type="checkbox"/>
74ac	Helps child become healthy	74ac	<input type="checkbox"/>
74ad	Prevents child from falling ill	74ad	<input type="checkbox"/>
74ae	It is good for the child	74ae	<input type="checkbox"/>
74af	It tastes good, and child eats it easily	74af	<input type="checkbox"/>
74ag	Other reason	74ag	<input type="checkbox"/>
74ah	If response is, "other," specify	74ah	_____
74b	<b>Vegetable 2</b>  Why is _____ (vegetable specified in 74b) good for a child? (1=yes, 2=no, 9= does not know)	74b	_____
74ba	Vegetable has lots of nutrients	74ba	<input type="checkbox"/>
74bb	Helps the child grow well	74bb	<input type="checkbox"/>
74bc	Helps child become healthy	74bc	<input type="checkbox"/>
74bd	Prevents child from falling ill	74bd	<input type="checkbox"/>
74be	It is good for the child	74be	<input type="checkbox"/>
74bf	It tastes good, and child eats it easily	74bf	<input type="checkbox"/>
74bg	Other reason	74bg	<input type="checkbox"/>
74bh	If response is, "other," specify	74bh	_____
74c	<b>Vegetable 3</b>  Why is _____ (vegetable specified in 74c) good for a child? (1=yes, 2=no, 9= does not know)	74c	_____
74ca	Vegetable has lots of nutrients	74ca	<input type="checkbox"/>

74cb	Helps the child grow well	74cb	<input type="checkbox"/>
74cc	Helps child become healthy	74cc	<input type="checkbox"/>
74cd	Prevents child from falling ill	74cd	<input type="checkbox"/>
74ce	It is good for the child	74ce	<input type="checkbox"/>
74cf	It tastes good, and child eats it easily	74cf	<input type="checkbox"/>
74cg	Other reason	74cg	<input type="checkbox"/>
74ch	If response is, "other," specify	74ch	_____
74d	<b>Vegetable 4</b>  Why is _____ (vegetable specified in 74d) good for a child? (1=yes, 2=no, 9= does not know)	74d	_____
74da	Vegetable has lots of nutrients	74da	<input type="checkbox"/>
74db	Helps the child grow well	74db	<input type="checkbox"/>
74dc	Helps child become healthy	74dc	<input type="checkbox"/>
74dd	Prevents child from falling ill	74dd	<input type="checkbox"/>
74de	It is good for the child	74de	<input type="checkbox"/>
74df	It tastes good, and child eats it easily	74df	<input type="checkbox"/>
74dg	Other reason	74dg	<input type="checkbox"/>
74dh	If response is, "other," specify	74dh	_____
74e	<b>Vegetable 5</b>  Why is _____ (vegetable specified in 74e) good for a child? (1=yes, 2=no, 9= does not know)	74e	_____
74ea	Vegetable has lots of nutrients	74ea	<input type="checkbox"/>
74eb	Helps the child grow well	74eb	<input type="checkbox"/>
74ec	Helps child become healthy	74ec	<input type="checkbox"/>
74ed	Prevents child from falling ill	74ed	<input type="checkbox"/>
74ee	It is good for the child	74ee	<input type="checkbox"/>
74ef	It tastes good, and child eats it easily	74ef	<input type="checkbox"/>
74eg	Other reason	74eg	<input type="checkbox"/>
74eh	If response is, "other," specify	74eh	_____
75	What fruits according to you are best for a child? (fill answers and reasons why below)		

75a	<b>Fruit 1</b> Why is _____ (fruit specified in 75a) good for a child? (1=yes, 2=no, 9= does not know)	75a	<hr/>
75aa	Fruit has lots of nutrients	75aa	<input type="checkbox"/>
75ab	Helps the child grow well	75ab	<input type="checkbox"/>
75ac	Helps child become healthy	75ac	<input type="checkbox"/>
75ad	Prevents child from falling ill	75ad	<input type="checkbox"/>
75ae	It is good for the child	75ae	<input type="checkbox"/>
75af	It tastes good, and child eats it easily	75af	<input type="checkbox"/>
75ag	Other reason	75ag	<input type="checkbox"/>
75ah	If response is, "other," specify	75ah	<hr/>
75b	<b>Fruit 2</b> Why is _____ (fruit specified in 75b) good for a child? (1=yes, 2=no, 9= does not know)	75b	<hr/>
75ba	Fruit has lots of nutrients	75ba	<input type="checkbox"/>
75bb	Helps the child grow well	75bb	<input type="checkbox"/>
75bc	Helps child become healthy	75bc	<input type="checkbox"/>
75bd	Prevents child from falling ill	75bd	<input type="checkbox"/>
75be	It is good for the child	75be	<input type="checkbox"/>
75bf	It tastes good, and child eats it easily	75bf	<input type="checkbox"/>
75bg	Other reason	75bg	<input type="checkbox"/>
75bh	If response is, "other," specify	75bh	<hr/>
75c	<b>Fruit 3</b> Why is _____ (fruit specified in 75c) good for a child? (1=yes, 2=no, 9= does not know)	75c	<hr/>
75ca	Fruit has lots of nutrients	75ca	<input type="checkbox"/>
75cb	Helps the child grow well	75cb	<input type="checkbox"/>
75cc	Helps child become healthy	75cc	<input type="checkbox"/>
75cd	Prevents child from falling ill	75cd	<input type="checkbox"/>
75ce	It is good for the child	75ce	<input type="checkbox"/>
75cf	It tastes good, and child eats it easily	75cf	<input type="checkbox"/>

75cg	Other reason	75cg	<input type="checkbox"/>
75ch	If response is, "other," specify	75ch	_____
75d	<b>Fruit 4</b> Why is _____ (fruit specified in 75d) good for a child? (1=yes, 2=no, 9= does not know)	75d	_____
75da	Fruit has lots of nutrients	75da	<input type="checkbox"/>
75db	Helps the child grow well	75db	<input type="checkbox"/>
75dc	Helps child become healthy	75dc	<input type="checkbox"/>
75dd	Prevents child from falling ill	75dd	<input type="checkbox"/>
75de	It is good for the child	75de	<input type="checkbox"/>
75df	It tastes good, and child eats it easily	75df	<input type="checkbox"/>
75dg	Other reason	75dg	<input type="checkbox"/>
75dh	If response is, "other," specify	75dh	_____
75e	<b>Fruit 5</b> Why is _____ (fruit specified in 75e) good for a child? (1=yes, 2=no, 9= does not know)	75e	_____
75ea	Fruit has lots of nutrients	75ea	<input type="checkbox"/>
75eb	Helps the child grow well	75eb	<input type="checkbox"/>
75ec	Helps child become healthy	75ec	<input type="checkbox"/>
75ed	Prevents child from falling ill	75ed	<input type="checkbox"/>
75ee	It is good for the child	75ee	<input type="checkbox"/>
75ef	It tastes good, and child eats it easily	75ef	<input type="checkbox"/>
75eg	Other reason	75eg	<input type="checkbox"/>
75eh	If response is, "other," specify	75eh	_____
76	According to you, what is the best way to feed a child? (DO NOT READ THE OPTIONS UNLESS MOTHER NEEDS PROMPTS)  (3= from your own plate and utensils, 4= from the child's own bowl, plate and/or utensils, 5 = Other, 9= Does not apply because does not give child solid foods, 8= Does not know/ remember/ answer)	76	<input type="checkbox"/>
77	If response is code 5, "other," specify	77	_____



78	In what situations should breastfeeding be stopped? (1=yes, 2=no, 8= does not know/remember/answer)	78	
78a	When the child is _____ months old	78a	<input type="checkbox"/>
78ai	Specify age in months mentioned in 78a	78ai	<input type="checkbox"/> <input type="checkbox"/>
78b	When the child starts eating food	78b	<input type="checkbox"/>
78c	When the mother becomes pregnant	78c	<input type="checkbox"/>
78d	When mother is ill	78d	<input type="checkbox"/>
78e	When child is ill	78e	<input type="checkbox"/>
78f	Other situations	78f	<input type="checkbox"/>
78g	If other situations mentioned in 78f, specify	78g	<hr/>
79	What kind of milk should be fed to the child? (1=yes, 2=no, 8= does not know/remember/answer)		
79a	Diluted cow's milk	79a	<input type="checkbox"/>
79b	Undiluted cow's milk	79b	<input type="checkbox"/>
79c	Diluted buffalo milk	79c	<input type="checkbox"/>
79d	Undiluted buffalo milk	79d	<input type="checkbox"/>
79e	Diluted packet milk	79e	<input type="checkbox"/>
79f	Undiluted packet milk	79f	<input type="checkbox"/>
<b>7-DAY FOOD FREQUENCY QUESTIONNAIRE</b>			
80	Was your infant's food and liquid intake usual these past 7 days (i.e. week)?		<input type="checkbox"/>
81	How was your infant's food intake unusual? (3=feasting, or more than usual, 4= fasting, or less than usual, 5=other, 9= not applicable)		<input type="checkbox"/>
82	If response to question 81 is code 5 (other), specify		<hr/>
83	Has your child been sick in the past 7		<input type="checkbox"/>

	days?		
84	What type of illness did your child experience in the past 7 days? (3=diarrhoea, 4=vomiting, 5=fever, 6=other, 9=not applicable)		<input type="checkbox"/>
85	If response to question 84 is code 5 (other), specify		_____
86	Did this sickness affect the infant's appetite in the past 7 days?		<input type="checkbox"/>
87	How did sickness affect appetite? (3=increased appetite, 4=decreased appetite, 9=not applicable)		
88	Did your infant breastfeed in the past 7 days?		<input type="checkbox"/>
<p><b>**If response to questions 80 is "1" (yes), then ask about the infant's food and liquid intake for the PAST 7 days and fill question 89.</b></p> <p><b>**If response to questions 86 is "1" (yes) and child's appetite was affected in past week, then ask about the infant's GENERAL WEEKLY food and liquid intake and fill question 89.</b></p>			
89	Please specify how often the infant consumed the following foods and liquids in 7 days and the number of times each day  (3=food and liquid intake for the past 7 days, 4=general weekly intake for foods and liquids)		<input type="checkbox"/>  <b>Days x Times/day</b>
89a	Buffalo milk (undiluted)	89a	<input type="checkbox"/> x <input type="checkbox"/>
89b	Buffalo milk (diluted)	89b	<input type="checkbox"/> x <input type="checkbox"/>
89c	Cow milk (undiluted)	89c	<input type="checkbox"/> x <input type="checkbox"/>
			<b>Days x Times/day</b>
89d	Cow milk (diluted)	89d	<input type="checkbox"/> x <input type="checkbox"/>
89e	Packet milk (undiluted)	89e	<input type="checkbox"/> x <input type="checkbox"/>
89f	Packet milk (diluted)	89f	<input type="checkbox"/> x <input type="checkbox"/>
89g	Formula milk	89g	<input type="checkbox"/> x <input type="checkbox"/>
89h	Kheer	89h	<input type="checkbox"/> x <input type="checkbox"/>
89i	Curd	89i	<input type="checkbox"/> x <input type="checkbox"/>
89j	Lassi/chachh	89j	<input type="checkbox"/> x <input type="checkbox"/>
89k	Egg	89k	<input type="checkbox"/> x <input type="checkbox"/>

89l	Meat/fish/chicken	89l	<input type="checkbox"/> x <input type="checkbox"/>
89m	Rajma	89m	<input type="checkbox"/> x <input type="checkbox"/>
89n	Chana	89n	<input type="checkbox"/> x <input type="checkbox"/>
89o	Other whole pulses (lobia, soyabean)	89o	<input type="checkbox"/> x <input type="checkbox"/>
89p	Sabut dals (sabut moong, sabut black urad dal)	89p	<input type="checkbox"/> x <input type="checkbox"/>
89q	Split dals	89q	<input type="checkbox"/> x <input type="checkbox"/>
89r	Dal water	89r	<input type="checkbox"/> x <input type="checkbox"/>
89s	Bajra	89s	<input type="checkbox"/> x <input type="checkbox"/>
89t	Dalia	89t	<input type="checkbox"/> x <input type="checkbox"/>
89u	Roti	89u	<input type="checkbox"/> x <input type="checkbox"/>
89v	Parantha	89v	<input type="checkbox"/> x <input type="checkbox"/>
89w	Bread	89w	<input type="checkbox"/> x <input type="checkbox"/>
89x	Biscuit	89x	<input type="checkbox"/> x <input type="checkbox"/>
89y	Rusk	89y	<input type="checkbox"/> x <input type="checkbox"/>
89z	Fan	89z	<input type="checkbox"/> x <input type="checkbox"/>
89aa	Sevian	89aa	<input type="checkbox"/> x <input type="checkbox"/>
89ab	Halwa	89ab	<input type="checkbox"/> x <input type="checkbox"/>
89ac	Khichri (enquire about dal used)	89ac	<input type="checkbox"/> x <input type="checkbox"/>  Dal used: _____
			<b>Days x Times/day</b>
89ad	Potato	89ad	<input type="checkbox"/> x <input type="checkbox"/>
89ae	Rice	89ae	<input type="checkbox"/> x <input type="checkbox"/>
89af	Rice water	89af	<input type="checkbox"/> x <input type="checkbox"/>
89ag	Spinach	89ag	<input type="checkbox"/> x <input type="checkbox"/>
89ah	Methi	89ah	<input type="checkbox"/> x <input type="checkbox"/>
89ai	Bathua	89ai	<input type="checkbox"/> x <input type="checkbox"/>
89aj	Sarson	89aj	<input type="checkbox"/> x <input type="checkbox"/>
89ak	Chaulai	89ak	<input type="checkbox"/> x <input type="checkbox"/>

89al	Pudina	89al	<input type="checkbox"/> x <input type="checkbox"/>
89am	Red-yellow coloured vegetables (carrot, pumpkin)	89am	<input type="checkbox"/> x <input type="checkbox"/>
89an	Other vegetables	89an	<input type="checkbox"/> x <input type="checkbox"/>
89ao	Papaya	89ao	<input type="checkbox"/> x <input type="checkbox"/>
89ap	Guava	89ap	<input type="checkbox"/> x <input type="checkbox"/>
89aq	Mango	89aq	<input type="checkbox"/> x <input type="checkbox"/>
89ar	Orange	89ar	<input type="checkbox"/> x <input type="checkbox"/>
89as	Banana	89as	<input type="checkbox"/> x <input type="checkbox"/>
89at	Apple	89at	<input type="checkbox"/> x <input type="checkbox"/>
89au	Grapes	89au	<input type="checkbox"/> x <input type="checkbox"/>
89av	Cheeku	89av	<input type="checkbox"/> x <input type="checkbox"/>
89aw	Other fruits	89aw	<input type="checkbox"/> x <input type="checkbox"/>
89ax	Juices	89ax	<input type="checkbox"/> x <input type="checkbox"/>
89ay	Ghee	89ay	<input type="checkbox"/> x <input type="checkbox"/>
89az	Oil	89az	<input type="checkbox"/> x <input type="checkbox"/>
89ba	Butter	89ba	<input type="checkbox"/> x <input type="checkbox"/>
89bb	Sugar	89bb	<input type="checkbox"/> x <input type="checkbox"/>
89bc	Honey	89bc	<input type="checkbox"/> x <input type="checkbox"/>
89bd	Sago	89a	<input type="checkbox"/> x <input type="checkbox"/>
			<b>Days x Times/day</b>
89be	Ice cream (milk/without milk)	89b	<input type="checkbox"/> x <input type="checkbox"/>
89bf	Namkeen	89c	<input type="checkbox"/> x <input type="checkbox"/>
89bg	Cerelac	89d	<input type="checkbox"/> x <input type="checkbox"/>
89bh	Mithai	89e	<input type="checkbox"/> x <input type="checkbox"/>
89bi	Dry Fruits	89f	<input type="checkbox"/> x <input type="checkbox"/>
<b>MOBILE PHONE USE</b>			
90	Do you own a mobile phone?	90	<input type="checkbox"/>
91	If you do not own a mobile phone, do you use another family member's mobile phone?	91	<input type="checkbox"/>

	*if response is 2 (no) for questions 90 AND 91, fill '9' till end.		
92	If response to question 17 is 1 (yes), specify which family member's mobile phone is used  (3=husband, 4=brother-in-law, 5=sister-in-law, 6=father-in-law, 7=mother-in-law, 8=shared by everyone at home, 10=other, please specify)	92	<input type="text"/> <input type="text"/> <hr/>
93	What is the main use for your mobile phone?  (3= work use, 4= personal use, 5= emergencies – rarely used, 6=both work and personal use, 8 = do not know/remember/answer)	93	<input type="text"/>
94	Do you ever use your mobile phone for work purpose?	94	<input type="text"/>
95	Do you use your phone for SMS (text messages)?	95	<input type="text"/>
96	How often do you use your mobile phones for phone calls and SMS in a typical week? (answer below)  (3= once/day, 4= more than once/day, 5 = 1-3 times/week, 6 = 4-7 times/week, 7 = more than 8 times/week, 10= don't use phone for this purpose, 88 = do not know/remember/answer)	96	
96a	Make phone calls	96a	<input type="text"/> <input type="text"/>
96b	Receive phone calls	96b	<input type="text"/> <input type="text"/>
96c	Send SMS	96c	<input type="text"/> <input type="text"/>
96d	Receive SMS	96d	<input type="text"/> <input type="text"/>
97	Does your mobile phone stay with you most of the time?  * If response = 1 (yes), fill question 22 with '9'.	97	<input type="text"/>
98	Who usually has the mobile phone most of the time?  (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= other, please specify)	98	<input type="text"/> <hr/>
99	How much money do you spend on your mobile phone per month?	99	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

**Appendix 4.11: Baseline form for Anganwadi Workers in mHealth pilot study  
mHealth study in Kheri Kalan PHC, Haryana, India**

**BASELINE QUESTIONNAIRE FOR ANGANWADI WORKERS IN PILOT STUDY**

[Code:1=Yes, 2=No, 9= NA, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
2	Worker Code	2	<input type="text"/> <input type="text"/> <input type="text"/>
3	Anganwadi Worker ID	3	<input type="text"/> <input type="text"/> <input type="text"/>
4	Anganwadi Worker age	4	<input type="text"/> <input type="text"/>
5	Address (Subcentre codes: 3=Baroli, 4=Nacholi, 5=Jasana, 6=Kheri Kalan, 7=Bhaskola, 10=Faridpur)  (Village codes: 3=Kheri Kalan, 4=Baroli, 5=Prahladpur, 6=Faridpur, 7=Old Sidola, 10=New Sidola, 11=Amipur, 12=Old Bhupani, 13=Mojabad, 14=Rajupura, 15=Phulera)	5	Subcentre: <input type="text"/> <input type="text"/>  Village: <input type="text"/> <input type="text"/>
<b>EDUCATIONAL &amp; PROFESSIONAL EXPERIENCE</b>			
6	How many years of education do you have?	6	<input type="text"/> <input type="text"/>
7	Do you have educational or formal training in nutrition?	7	<input type="text"/>
8	How many years have you worked as an Anganwadi worker?	8	<input type="text"/> <input type="text"/>
9	How often do you perform the following activities? (see list below) (3= daily, 4= once a week, 5=1 to 3 times/week, 6= more than 3 times/week, 7= once a month, 10= 2-3 times/month, 11= less than one time/month, 12= more than 4 times/month, 13=never)		
9a	Supplementary nutrition	9a	<input type="text"/> <input type="text"/>
9b	Immunization	9b	<input type="text"/> <input type="text"/>
9c	Growth monitoring	9c	<input type="text"/> <input type="text"/>
9d	Referral services	9d	<input type="text"/> <input type="text"/>

9e	Health check-ups	9e	<input type="checkbox"/>
9f	Nutrition and health counselling	9f	<input type="checkbox"/>
9g	Home visits	9g	<input type="checkbox"/>
9h	Educating 3-6 year olds at AWW centre	9h	<input type="checkbox"/>
9i	Governmental programs (e.g. Kishori Kanya Yojna, etc.)	9i	<input type="checkbox"/>
9j	Register work	9j	<input type="checkbox"/>
9k	Other, specify	9k	<input type="checkbox"/>
<hr/> <hr/>			
10	Have you received training since you started working? *if response = 2 (no), go to question 14	10	<input type="checkbox"/>
11	Have you since received a refresher training?	11	<input type="checkbox"/>
12	When did you last participate in a refresher training? (3= Within the past month, 4= 1-6 months ago, 5= 7-12 months ago, 6 = More than 1 year ago, 8= Do not know/remember/answer)	12	<input type="checkbox"/>
13	Did the refresher training include a module on complementary feeding counselling?	13	<input type="checkbox"/>
14	How long is your typical workday? (in hours)	14	<input type="checkbox"/>
15	How often do you see your supervisor? (3= Once per week, 4= more than once per week, 5= 1-3 times per month, 6= Once per month, 7= Once every 2 months, 10= Once every 3-6 months, 11= Rarely, 12=Never)	15	<input type="checkbox"/>
<b>MOBILE PHONE USE</b>			
16	Do you own a mobile phone?	16	<input type="checkbox"/>

17	If you do not own a mobile phone, do you use another family member's mobile phone?  *if response is 2 (no) for questions 16 AND 17, fill '9' till end.	17	<input type="checkbox"/>
18	If response to question 17 is 1 (yes), specify which family member's mobile phone is used  (3=husband, 4=brother-in-law, 5=sister-in-law, 6=father-in-law, 7=mother-in-law, 8=shared by everyone at home, 10=other, please specify)	18	<input type="checkbox"/> <input type="checkbox"/> <hr/>
19	What is the main use for your mobile phone?  (3= work use, 4= personal use, 5= emergencies – rarely used, 6=both work and personal use, 8 = do not know/remember/answer)	19	<input type="checkbox"/>
20	Do you ever use your mobile phone for work purpose?	20	<input type="checkbox"/>
21	Do you use your phone for SMS (text messages)?	21	<input type="checkbox"/>
22	How often do you use your mobile phones for phone calls and SMS in a typical week? (answer below)  (3= once/day, 4= more than once/day, 5 = 1-3 times/week, 6 = 4-7 times/week, 7 = more than 8 times/week, 10= don't use phone for this purpose, 88 = do not know/remember/answer)	22	
22a	Make phone calls	22a	<input type="checkbox"/> <input type="checkbox"/>
22b	Receive phone calls	22b	<input type="checkbox"/> <input type="checkbox"/>
22c	Send SMS	22c	<input type="checkbox"/> <input type="checkbox"/>
22d	Receive SMS	22d	<input type="checkbox"/> <input type="checkbox"/>
23	Does your mobile phone stay with you most of the time?  * If response = 1 (yes), fill question 22 with '9'.	23	<input type="checkbox"/>
24	Who usually has the mobile phone most of the time?  (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= other, please specify)	24	<input type="checkbox"/> <hr/>



			_____				
25	How much money do you spend on your mobile phone per month?	25	<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>				

**THANK YOU! ☺**

**Appendix 4.12: Mobile phone call log for Anganwadi Workers in mHealth pilot study**

Anganwadi Worker Name: \_\_\_\_\_ Anganwadi Worker Phone number: 

--	--	--	--	--	--	--	--	--	--

 Village: \_\_\_\_\_

Date	Specify type of call (write "received" or "dialed")	Phone number you dialed or received call from	Time call ended	Call duration (in minutes)	Was mother on the call? (tick ✓ if yes)	Was grandmother on the call? (tick ✓ if yes)	Specify if other family members were on the call	Any comments or observations

**Appendix 4.13: Endline dietary diversity and maternal knowledge questionnaire**

**mHealth study in Kheri Kalan PHC, Haryana, India**

**ENDLINE DIETARY DIVERSITY AND KNOWLEDGE QUESTIONNAIRE FOR MOTHERS IN PILOT STUDY**

[Code:1=Yes, 2=No, 9= Not applicable, 8= Does not know/remember/answer]

1	Date of filling (dd/mm/yyyy)	1	<input type="text"/>
2	Worker Code	2	<input type="text"/>
3	Woman ID	3	<input type="text"/>
4	Child ID	4	<input type="text"/>
5	Address (Subcentre codes: 3=Baroli, 4=Nacholi, 5=Jasana, 6=Kheri Kalan, 7=Bhaskola, 10=Faridpur)  (Village codes: 3=Kheri Kalan, 4=Baroli, 5=Prahladpur, 6=Faridpur, 7=Old Sidola, 10=New Sidola, 11=Amipur, 12=Old Bhupani, 13=Mojabad, 14=Rajupura, 15=Phulera)	5	Subcentre: <input type="text"/>  Village: <input type="text"/>
<b>MATERNAL KNOWLEDGE, ATTITUDES AND PRACTICES RELATING TO COMPLEMENTARY FEEDING</b>			
6	Until what age (in months) should a child be exclusively breastfed?	6	<input type="text"/>
7	At what age (in months) should a mother start adding liquids and/or foods other than breast milk to the child's diet? (Fill "00" if at birth, and "77" if never)	7	
7a	Ghutti	7a	<input type="text"/>
7b	Honey	7b	<input type="text"/>
7c	Sugar and/or jaggery water	7c	<input type="text"/>
7d	Water	7d	<input type="text"/>
7e	Top milk	7e	<input type="text"/>
7f	Semisolid food	7f	<input type="text"/>
7g	Specify the types of semisolid foods appropriate to feed the child at _____	7g	

	months (age specified in 70e)		_____
7h	Solid food	7h	_____
			<input type="checkbox"/> <input type="checkbox"/>
7i	Specify the types of solid foods appropriate to feed the child at _____ months (age specified in 70g)	7i	_____
			_____
7j	Other liquids/foods	7j	_____
			<input type="checkbox"/> <input type="checkbox"/>
7k	If other liquids/foods mentioned in 70i, please specify	7k	_____
			_____
8	What consistency of foods other than liquids are best for a 9-11 month old child? (DO NOT READ THE OPTIONS UNLESS MOTHER NEEDS PROMPTS)  (3=Diluted, 4=Thick, 5= Medium, 6= Other, 8= Does not know/remember/answer, 9 = Not applicable)	8	<input type="checkbox"/>
8a	If response is code 6, "other," specify	8a	_____
			_____
9	How many main meals (excluding snacks such as fruits, biscuit, fan, etc.) should a 9-11 month old child eat everyday excluding breastmilk or breastmilk substitute?	9	<input type="checkbox"/> <input type="checkbox"/>
10	If a child stops eating, what should be done? (DO NOT READ THE OPTIONS)  (11= Motivate the child with gestures, games, words, 12= Does not motivate the child, 99= Does not apply because does not give child solid foods, 13 = Other, 8= Does not know/remember/answer)	10	<input type="checkbox"/> <input type="checkbox"/>
10a	If response is code 13, "other," specify	10a	_____
			_____
11	What vegetables according to you are best for a child? (fill answers and reasons why below)		
11a	<b>Vegetable 1</b>	11a	_____
			_____

	Why is _____ (vegetable specified in 74a) good for a child? (1=yes, 2=no, 9= does not know)		
11aa	Vegetable has lots of nutrients	11aa	<input type="checkbox"/>
11ab	Helps the child grow well	11ab	<input type="checkbox"/>
11ac	Helps child become healthy	11ac	<input type="checkbox"/>
11ad	Prevents child from falling ill	11ad	<input type="checkbox"/>
11ae	It is good for the child	11ae	<input type="checkbox"/>
11af	It tastes good, and child eats it easily	11af	<input type="checkbox"/>
11ag	Other reason	11ag	<input type="checkbox"/>
11ah	If response is, "other," specify	11ah	_____
<hr/>			
11b	<b>Vegetable 2</b>	11b	_____
	Why is _____ (vegetable specified in 74b) good for a child? (1=yes, 2=no, 9= does not know)		_____
11ba	Vegetable has lots of nutrients	11ba	<input type="checkbox"/>
11bb	Helps the child grow well	11bb	<input type="checkbox"/>
11bc	Helps child become healthy	11bc	<input type="checkbox"/>
11bd	Prevents child from falling ill	11bd	<input type="checkbox"/>
11be	It is good for the child	11be	<input type="checkbox"/>
11bf	It tastes good, and child eats it easily	11bf	<input type="checkbox"/>
11bg	Other reason	11bg	<input type="checkbox"/>
11bh	If response is, "other," specify	11bh	_____
<hr/>			
11c	<b>Vegetable 3</b>	11c	_____
	Why is _____ (vegetable specified in 74c) good for a child? (1=yes, 2=no, 9= does not know)		_____
11ca	Vegetable has lots of nutrients	11ca	<input type="checkbox"/>
11cb	Helps the child grow well	11cb	<input type="checkbox"/>

11cc	Helps child become healthy	11cc	<input type="checkbox"/>
11cd	Prevents child from falling ill	11cd	<input type="checkbox"/>
11ce	It is good for the child	11ce	<input type="checkbox"/>
11cf	It tastes good, and child eats it easily	11cf	<input type="checkbox"/>
11cg	Other reason	11cg	<input type="checkbox"/>
11ch	If response is, "other," specify	11ch	_____
11d	<b>Vegetable 4</b> Why is _____ (vegetable specified in 74d) good for a child? (1=yes, 2=no, 9= does not know)	11d	_____
11da	Vegetable has lots of nutrients	11da	<input type="checkbox"/>
11db	Helps the child grow well	11db	<input type="checkbox"/>
11dc	Helps child become healthy	11dc	<input type="checkbox"/>
11dd	Prevents child from falling ill	11dd	<input type="checkbox"/>
11de	It is good for the child	11de	<input type="checkbox"/>
11df	It tastes good, and child eats it easily	11df	<input type="checkbox"/>
11dg	Other reason	11dg	<input type="checkbox"/>
11dh	If response is, "other," specify	11dh	_____
11e	<b>Vegetable 5</b> Why is _____ (vegetable specified in 74e) good for a child? (1=yes, 2=no, 9= does not know)	11e	_____
11ea	Vegetable has lots of nutrients	11ea	<input type="checkbox"/>
11eb	Helps the child grow well	11eb	<input type="checkbox"/>
11ec	Helps child become healthy	11ec	<input type="checkbox"/>
11ed	Prevents child from falling ill	11ed	<input type="checkbox"/>
11ee	It is good for the child	11ee	<input type="checkbox"/>
11ef	It tastes good, and child eats it easily	11ef	<input type="checkbox"/>
11eg	Other reason	11eg	<input type="checkbox"/>
11eh	If response is, "other," specify	11eh	_____

12	What fruits according to you are best for a child? (fill answers and reasons why below)		
12a	<b>Fruit 1</b>	12a	_____
	Why is _____ (fruit specified in 75a) good for a child? (1=yes, 2=no, 9= does not know)		_____
12aa	Fruit has lots of nutrients	12aa	<input type="checkbox"/>
12ab	Helps the child grow well	12ab	<input type="checkbox"/>
12ac	Helps child become healthy	12ac	<input type="checkbox"/>
12ad	Prevents child from falling ill	12ad	<input type="checkbox"/>
12ae	It is good for the child	12ae	<input type="checkbox"/>
12af	It tastes good, and child eats it easily	12af	<input type="checkbox"/>
12ag	Other reason	12ag	<input type="checkbox"/>
12ah	If response is, "other," specify	12ah	_____
			_____
12b	<b>Fruit 2</b>	12b	_____
	Why is _____ (fruit specified in 75b) good for a child? (1=yes, 2=no, 9= does not know)		_____
12ba	Fruit has lots of nutrients	12ba	<input type="checkbox"/>
12bb	Helps the child grow well	12bb	<input type="checkbox"/>
12bc	Helps child become healthy	12bc	<input type="checkbox"/>
12bd	Prevents child from falling ill	12bd	<input type="checkbox"/>
12be	It is good for the child	12be	<input type="checkbox"/>
12bf	It tastes good, and child eats it easily	12bf	<input type="checkbox"/>
12bg	Other reason	12bg	<input type="checkbox"/>
12bh	If response is, "other," specify	12bh	_____
			_____
12c	<b>Fruit 3</b>	12c	_____
	Why is _____ (fruit specified in 75c) good for a child? (1=yes, 2=no, 9=		_____

	does not know)		
12ca	Fruit has lots of nutrients	12ca	<input type="checkbox"/>
12cb	Helps the child grow well	12cb	<input type="checkbox"/>
12cc	Helps child become healthy	12cc	<input type="checkbox"/>
12cd	Prevents child from falling ill	12cd	<input type="checkbox"/>
12ce	It is good for the child	12ce	<input type="checkbox"/>
12cf	It tastes good, and child eats it easily	12cf	<input type="checkbox"/>
12cg	Other reason	12cg	<input type="checkbox"/>
12ch	If response is, "other," specify	12ch	_____
			_____
12d	<b>Fruit 4</b>	12d	_____
	Why is _____ (fruit specified in 75d) good for a child? (1=yes, 2=no, 9= does not know)		_____
12da	Fruit has lots of nutrients	12da	<input type="checkbox"/>
12db	Helps the child grow well	12db	<input type="checkbox"/>
12dc	Helps child become healthy	12dc	<input type="checkbox"/>
12dd	Prevents child from falling ill	12dd	<input type="checkbox"/>
12de	It is good for the child	12de	<input type="checkbox"/>
12df	It tastes good, and child eats it easily	12df	<input type="checkbox"/>
12dg	Other reason	12dg	<input type="checkbox"/>
12dh	If response is, "other," specify	12dh	_____
			_____
12e	<b>Fruit 5</b>	12e	_____
	Why is _____ (fruit specified in 75e) good for a child? (1=yes, 2=no, 9= does not know)		_____
12ea	Fruit has lots of nutrients	12ea	<input type="checkbox"/>
12eb	Helps the child grow well	12eb	<input type="checkbox"/>
12ec	Helps child become healthy	12ec	<input type="checkbox"/>
12ed	Prevents child from falling ill	12ed	<input type="checkbox"/>
12ee	It is good for the child	12ee	<input type="checkbox"/>



12ef	It tastes good, and child eats it easily	12ef	<input type="checkbox"/>
12eg	Other reason	12eg	<input type="checkbox"/>
12eh	If response is, "other," specify	12eh	_____
13	According to you, what is the best way to feed a child? (DO NOT READ THE OPTIONS UNLESS MOTHER NEEDS PROMPTS)  (3= from your own plate and utensils, 4= from the child's own bowl, plate and/or utensils, 5 = Other, 9= Does not apply because does not give child solid foods, 8= Does not know/remember/ answer)	13	<input type="checkbox"/>
13a	If response is code 5, "other," specify	13a	_____
14	In what situations should breastfeeding be stopped? (1=yes, 2=no, 8= does not know/remember/answer)		
14a	When the child is _____ months old	14a	<input type="checkbox"/>
14ai	Specify age in months mentioned in 78a	14ai	<input type="checkbox"/> <input type="checkbox"/>
14b	When the child starts eating food	14b	<input type="checkbox"/>
14c	When the mother becomes pregnant	14c	<input type="checkbox"/>
14d	When mother is ill	14d	<input type="checkbox"/>
14e	When child is ill	14e	<input type="checkbox"/>
14f	Other situations	14f	<input type="checkbox"/>
14g	If other situations mentioned in 78f, specify	14g	_____
15	What kind of milk should be fed to the child? (1=yes, 2=no, 8= does not know/remember/answer)		
15a	Diluted cow's milk	15a	<input type="checkbox"/>
15b	Undiluted cow's milk	15b	<input type="checkbox"/>
15c	Diluted buffalo milk	15c	<input type="checkbox"/>
15d	Undiluted buffalo milk	15d	<input type="checkbox"/>

15e	Diluted packet milk	15e	<input type="checkbox"/>
15f	Undiluted packet milk	15f	<input type="checkbox"/>
<b>7-DAY FOOD FREQUENCY QUESTIONNAIRE</b>			
16	Was your infant's food and liquid intake usual these past 7 days (i.e. week)?	16	<input type="checkbox"/>
17	How was your infant's food intake unusual? (3=feasting, or more than usual, 4=fasting, or less than usual, 5=other, 9= not applicable)	17	<input type="checkbox"/>
18	If response to question 81 is code 5 (other), specify	18	_____
19	Has your child been sick in the past 7 days?	19	<input type="checkbox"/>
20	What type of illness did your child experience in the past 7 days? (3=diarrhoea, 4=vomiting, 5=fever, 6=other, 9=not applicable)	20	<input type="checkbox"/>
21	If response to question 84 is code 5 (other), specify	21	_____
22	Did this sickness affect the infant's appetite in the past 7 days?	22	<input type="checkbox"/>
23	How did sickness affect appetite? (3=increased appetite, 4=decreased appetite, 9=not applicable)	23	<input type="checkbox"/>
24	Did your infant breastfeed in the past 7 days?	24	<input type="checkbox"/>
<p><b>**If response to questions 16 is "1" (yes), then ask about the infant's food and liquid intake for the PAST 7 days and fill question 25.</b></p> <p><b>**If response to questions 22 is "1" (yes) and child's appetite was affected in past week, then ask about the infant's GENERAL WEEKLY food and liquid intake and fill question 25.</b></p>			
25	Please specify how often the infant consumed the following foods and liquids in 7 days and the number of times each day  (3=food and liquid intake for the past 7 days, 4=general weekly intake for foods and liquids)	25	<input type="checkbox"/>  <b>Days x Times/day</b>

25a	Buffalo milk (undiluted)	25a	<input type="text"/> x <input type="text"/>
25b	Buffalo milk (diluted)	25b	<input type="text"/> x <input type="text"/>
25c	Cow milk (undiluted)	25c	<input type="text"/> x <input type="text"/>
25d	Cow milk (diluted)	25d	<input type="text"/> x <input type="text"/>
25e	Packet milk (undiluted)	25e	<input type="text"/> x <input type="text"/>
25f	Packet milk (diluted)	25f	<input type="text"/> x <input type="text"/>
25g	Formula milk	25g	<input type="text"/> x <input type="text"/>
25h	Kheer	25h	<input type="text"/> x <input type="text"/>
25i	Curd	25i	<input type="text"/> x <input type="text"/>
25j	Lassi/chachh	25j	<input type="text"/> x <input type="text"/>
25k	Egg	25k	<input type="text"/> x <input type="text"/>
25l	Meat/fish/chicken	25l	<input type="text"/> x <input type="text"/>
25m	Rajma	25m	<input type="text"/> x <input type="text"/>
25n	Chana	25n	<input type="text"/> x <input type="text"/>
25o	Other whole pulses (lobia, soyabean)	25o	<input type="text"/> x <input type="text"/>
25p	Sabut dals (sabut moong, sabut black urad dal)	25p	<input type="text"/> x <input type="text"/>
25q	Split dals	25q	<input type="text"/> x <input type="text"/>
25r	Dal water	25r	<input type="text"/> x <input type="text"/>
25s	Bajra	25s	<input type="text"/> x <input type="text"/>
25t	Dalia	25t	<input type="text"/> x <input type="text"/>
25u	Roti	25u	<input type="text"/> x <input type="text"/>
			<b>Days x Times/day</b>
25v	Parantha	25v	<input type="text"/> x <input type="text"/>
25w	Bread	25w	<input type="text"/> x <input type="text"/>
25x	Biscuit	25x	<input type="text"/> x <input type="text"/>
25y	Rusk	25y	<input type="text"/> x <input type="text"/>
25z	Fan	25z	<input type="text"/> x <input type="text"/>

25aa	Sevian	25aa	<input type="checkbox"/> x <input type="checkbox"/>
25ab	Halwa	25ab	<input type="checkbox"/> x <input type="checkbox"/>
25ac	Khichri (enquire about dal used)	25ac	<input type="checkbox"/> x <input type="checkbox"/> Dal used: _____
25ad	Potato	25ad	<input type="checkbox"/> x <input type="checkbox"/>
25ae	Rice	25ae	<input type="checkbox"/> x <input type="checkbox"/>
25af	Rice water	25af	<input type="checkbox"/> x <input type="checkbox"/>
25ag	Spinach	25ag	<input type="checkbox"/> x <input type="checkbox"/>
25ah	Methi	25ah	<input type="checkbox"/> x <input type="checkbox"/>
25ai	Bathua	25ai	<input type="checkbox"/> x <input type="checkbox"/>
25aj	Sarson	25aj	<input type="checkbox"/> x <input type="checkbox"/>
25ak	Chaulai	25ak	<input type="checkbox"/> x <input type="checkbox"/>
25al	Pudina	25al	<input type="checkbox"/> x <input type="checkbox"/>
25am	Red-yellow coloured vegetables (carrot, pumpkin)	25am	<input type="checkbox"/> x <input type="checkbox"/>
25an	Other vegetables	25an	<input type="checkbox"/> x <input type="checkbox"/>
25ao	Papaya	25ao	<input type="checkbox"/> x <input type="checkbox"/>
25ap	Guava	25ap	<input type="checkbox"/> x <input type="checkbox"/>
25aq	Mango	25aq	<input type="checkbox"/> x <input type="checkbox"/>
25ar	Orange	25ar	<input type="checkbox"/> x <input type="checkbox"/>
25as	Banana	25as	<input type="checkbox"/> x <input type="checkbox"/>
25at	Apple	25at	<input type="checkbox"/> x <input type="checkbox"/>
25au	Grapes	25au	<input type="checkbox"/> x <input type="checkbox"/>
			<b>Days x Times/day</b>
25av	Cheeku	25av	<input type="checkbox"/> x <input type="checkbox"/>
25aw	Other fruits	25aw	<input type="checkbox"/> x <input type="checkbox"/>
25ax	Juices	25ax	<input type="checkbox"/> x <input type="checkbox"/>
25ay	Ghee	25ay	<input type="checkbox"/> x <input type="checkbox"/>

25az	Oil	25az	<input type="text"/> x <input type="text"/>
25ba	Butter	25ba	<input type="text"/> x <input type="text"/>
25bb	Sugar	25bb	<input type="text"/> x <input type="text"/>
25bc	Honey	25bc	<input type="text"/> x <input type="text"/>
25bd	Sago	25bd	<input type="text"/> x <input type="text"/>
25be	Ice cream (milk/without milk)	25be	<input type="text"/> x <input type="text"/>
25bf	Namkeen	25bf	<input type="text"/> x <input type="text"/>
25bg	Cerelac	25bg	<input type="text"/> x <input type="text"/>
25bh	Mithai	25bh	<input type="text"/> x <input type="text"/>
25bi	Dry Fruits	25bi	<input type="text"/> x <input type="text"/>

**THANK YOU! 😊**

**Appendix 4.14: Endline phone use assessment form for mothers in mHealth pilot study  
mHealth Pilot Study in Kheri Kalan PHC, Haryana, India**

**ENDLINE PHONE USE ASSESSMENT FORM FOR VISIT WITH MOTHERS**

[Yes =1; No=2; 8=Does not know; 9=Not applicable]

1	Date (dd/mm/yyyy)	1	<input type="text"/>
2	Subcentre (Subcentre codes: 3=Baroli, 4=Nacholi, 5=Jasana, 6=Kheri Kalan, 7=Bhaskola, 10=Faridpur)	2	<input type="text"/>
3	Village (Village codes: 3=Kheri Kalan, 4=Baroli, 5=Prahladpur, 6=Faridpur, 7=Old Sidola, 10=New Sidola, 11=Amipur, 12=Old Bhupani, 13=Mojabad, 14=Rajupura, 15=Phulera)	3	<input type="text"/>
4	Worker code	4	<input type="text"/>
5	Mother ID	5	<input type="text"/>
6	Mother's mobile phone number	6	<input type="text"/>
7	Corresponding AWW mobile phone number	7	<input type="text"/>
<b>CONTEXT</b>			
8	Do you still have your mobile phone?	8	<input type="text"/>
9	If response to question 8 is 2, "no," then what date did you lose your phone?	9	<input type="text"/>
10	If response to question 8 is 2, "no," then how did you lose your phone?	10	_____
11	Is your mobile phone damaged?	11	
12	If response to question 11 is 1, "yes," then what date did you damage your phone?	12	<input type="text"/>
13	If response to question 11 is 1, "yes," then what is the damage to your phone?	13	_____
14	If response to question 11 is 1, "yes,"	14	_____

	then how did the damage to your phone happen?		
15	Is the mobile phone kept with you at all times?	15	<input type="checkbox"/>
16	If response to question 15 is 2, "no," then who keeps the mobile phone? (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= other, please specify)	16	<input type="checkbox"/> _____ _____
17	What is the current balance on your mobile phone?	17	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
18	Have you recharged your phone with credit since you were given the mobile phone?	18	<input type="checkbox"/>
19	If response to question 18 is 1, "yes," then how who recharged the mobile phone? (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7=mother herself 8= other, please specify)	19	<input type="checkbox"/> _____ _____
20	How many times has the phone been recharged?	20	<input type="checkbox"/>
21	How much money was the phone recharged with the first time?	21	<input type="text"/> <input type="text"/> <input type="text"/>
22	How much money was the phone recharged with the second time?	22	<input type="text"/> <input type="text"/> <input type="text"/>
23	How much money was the phone recharged with the third time?	23	<input type="text"/> <input type="text"/> <input type="text"/>
24	How much money was the phone recharged with the fourth time?	24	<input type="text"/> <input type="text"/> <input type="text"/>
<b>REACH</b>			
25	Have you called the AWW on her mobile phone since the group counselling meeting?	25	<input type="checkbox"/>





**Appendix 4.15: Endline phone use assessment form for Anganwadi Workers in mHealth pilot study**

**mHealth Pilot Study in Kheri Kalan PHC, Haryana, India**

**ENDLINE PHONE USE ASSESSMENT FORM FOR VISIT WITH ANGANWADI WORKERS**

[Yes =1; No=2; 8=Does not know; 9=Not applicable]

1	Date (dd/mm/yyyy)	1	<input type="text"/>
2	Subcentre (Subcentre codes: 3=Baroli, 4=Nacholi, 5=Jasana, 6=Kheri Kalan, 7=Bhaskola, 10=Faridpur)	2	<input type="text"/>
3	Village (Village codes: 3=Kheri Kalan, 4=Baroli, 5=Prahladpur, 6=Faridpur, 7=Old Sidola, 10=New Sidola, 11=Amipur, 12=Old Bhupani, 13=Mojabad, 14=Rajupura, 15=Phulera)	3	<input type="text"/>
4	Worker code	4	<input type="text"/>
5	AWW ID	5	<input type="text"/>
6	AWW mobile phone number	6	<input type="text"/>
7	Five corresponding mothers' mobile phone numbers:		
7a	Mother #1	7a	<input type="text"/>
7b	Mother #2	7b	<input type="text"/>
7c	Mother #3	7c	<input type="text"/>
7d	Mother #4	7d	<input type="text"/>
7e	Mother #5	7e	<input type="text"/>
<b>CONTEXT</b>			
8	Has another similar mobile phone for nutrition counselling intervention been implemented in this area since we started this study?	8	<input type="text"/>
9	Do you still have your mobile phone?	9	<input type="text"/>
10	If response to question 9 is 2, "no," then what date did you lose your phone?	10	<input type="text"/>
11	If response to question 9 is 2, "no," then how did you lose your phone?	11	<input type="text"/>

12	Is your mobile phone damaged?	12	
13	If response to question 12 is 1, "yes," then what date did you damage your phone?	13	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
14	If response to question 12 is 1, "yes," then what is the damage to your phone?	14	_____
15	If response to question 12 is 1, "yes," then how did the damage to your phone happen?	15	_____
16	Is the mobile phone kept with you at all times?	16	<input type="checkbox"/>
17	If response to question 16 is 2, "no," then who keeps the mobile phone? (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= other, please specify)	17	<input type="checkbox"/> _____ _____
18	What is the current balance on your mobile phone?	18	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
19	Have you recharged your phone with credit since you were given the mobile phone?	19	<input type="checkbox"/>
20	If response to question 19 is 1, "yes," then how who recharged the mobile phone? (3= husband, 4= mother-in-law, 5= relative/family member, 6= friend, 7= AWW herself 8= other, please specify)	20	<input type="checkbox"/> _____ _____
21	How many times has the phone been recharged?	21	<input type="checkbox"/>
22	How much money was the phone recharged with the first time?	22	<input type="text"/> <input type="text"/> <input type="text"/>
23	How much money was the phone recharged with the second time?	23	<input type="text"/> <input type="text"/> <input type="text"/>
24	How much money was the phone recharged with the third time?	24	<input type="text"/> <input type="text"/> <input type="text"/>
25	How much money was the phone recharged with the fourth time?	25	<input type="text"/> <input type="text"/> <input type="text"/>
<b>REACH</b>			
26	Have you called mothers on their mobile phone since the group counselling meeting?	26	<input type="checkbox"/>

**33.** Please tear filled sheets from AWW call log diary and affix to this questionnaire. Query AWW if any script in the diary is difficult to read and make clarifying notations.

**34. Comments and/or additional observations**

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**Appendix 4.16: mHealth pilot study – Endline infant weight form**

<b>Child</b>	<b>Date</b>	<b>Infant Weight (grams)</b>	<b>Infant Weight (grams)</b>
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<b>ID</b>	<b>(dd/mm/yyyy)</b>	<b>measurement #1</b>	<b>measurement #2</b>
001			
002			
003			
004			
005			
006			
007			
008			
009			
010			
011			
012			
013			
014			
015			
016			
017			
018			
019			
020			
021			
022			
023			
024			
025			
026			
027			
028			
029			
030			

<b>Child ID</b>	<b>Date (dd/mm/yyyy)</b>	<b>Infant Weight (grams) measurement #1</b>	<b>Infant Weight (grams) measurement #2</b>
031			
032			

033			
034			
035			
036			
037			
038			
039			
040			
041			
042			
043			
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060			

**Appendix 4.17: mHealth pilot study - Endline in-depth interview guide for mothers**

TOPIC	QUESTION	PROBE
Mobile phones – Usability	○ What did you think about getting nutrition advice on a mobile phone?	○ Was it useful? Why or why not? ○ Easy to understand?
	○ Did the AWW contact you on your phone for issues other than dietary advice?	○ Scheduling meetings? ○ Giving other information?
	○ Did you call AWWs during the 6-week study period?	○ Is yes, then why? Did it help? ○ If no, then why?
	○ Which family members spoke to the AWW as well when you were talking to her on the phone?	○ Mother-in-law? ○ Father? ○ Sister-in-law? ○ How did they talk – did they hand over the phone, was it on loudspeaker? ○ Who ended the phone conversation? Did mother get a scope to talk? ○ If mother said no family members were on the phone, ask if the family members were interested to know about the conversation afterward. Why? Also, who was interested?
	○ Did you contact your AWW on the phone for something other than dietary advice?	○ Did you use the phone to schedule a time to meet? ○ Did you contact her when your child was ill? ○ Was it used for emergency calls? If so, then how?
Mobile phones – Acceptability	○ Did you have your own phone at the start of the study?	○ Did it stay with you most of the time? If not, then where did it stay?
	○ How did you feel about having a mobile phone so your local Anganwadi worker could contact you?	○ Added stress to have a phone? ○ Was it useful? Why or why not? ○ Was it convenient? Why or why not? ○ Did it make you feel important in the family? Why or why not?
	○ How did your family and neighbors feel about you having a mobile phone?	○ Did they appreciate you having the phone? Why or why not?

		<ul style="list-style-type: none"> <li>○ Were they jealous? Why or why not?</li> <li>○ Were they irritated? Why or why not?</li> <li>○ Did children play with your phone? If so, how?</li> <li>○ Was the phone used for listening to music?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about interacting with your local Anganwadi worker through a mobile phone in the future?</li> </ul>	<ul style="list-style-type: none"> <li>○ Too expensive?</li> <li>○ Inconvenient?</li> <li>○ Prefer face-to-face?</li> <li>○ Did she or you not respond to calls?</li> <li>○ Were there network problems? If so, tell me about it</li> <li>○ Does it save time? Why or why not?</li> <li>○ Was it good or bad that you could be contacted anytime? Why?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What do you think about nutrition counselling being conveyed on the phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ Clarity?</li> <li>○ Comprehension?</li> <li>○ Audibility?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Did you face any inconveniences or problems when having the mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ Were there any nuisance calls or blank calls? If yes, then tell me about them.</li> <li>○ Were there any disturbances at night on your phone? If yes, then tell me about it</li> </ul>
Mobile phones – Feasibility	<ul style="list-style-type: none"> <li>○ Did you ever share your phone with anyone or let someone borrow it?</li> </ul>	<ul style="list-style-type: none"> <li>○ If so, who did you share it with? Why?</li> <li>○ Was the phone primarily kept with you?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Did you share your mobile phone number with any family, relatives and/or friends?</li> </ul>	<ul style="list-style-type: none"> <li>○ Did they start contacting you on this number? Why or why not?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Did your local Anganwadi worker ever have trouble reaching you on your mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ If so, why?</li> <li>○ If so, then did she follow up with you? (Repeated calls, home visits, etc.)</li> </ul>
	<ul style="list-style-type: none"> <li>○ Did you ever have trouble or any issues reaching the Anganwadi worker on her mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ If so, why?</li> <li>○ If yes, then what did you do? (repeated calls, visits to the Anganwadi centre, etc.)</li> </ul>

	<ul style="list-style-type: none"> <li>○ Did your phone function properly during these 6 weeks? If not, then why?</li> </ul>	<ul style="list-style-type: none"> <li>○ Was there any damage to the phone? If so, why?</li> <li>○ Were there network problems?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Is it feasible for you to have a mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ Financially?</li> <li>○ Logistically? (electricity for charging phone, not sharing with others, etc.)</li> </ul>
	<ul style="list-style-type: none"> <li>○ If you already owned a mobile phone, how did you manage having two phones?</li> </ul>	<ul style="list-style-type: none"> <li>○ What was easy?</li> <li>○ What was difficult?</li> <li>○ How do you propose solving the dilemmas raised by having two phones, if there are any?</li> </ul>
Mobile phones – Other	<ul style="list-style-type: none"> <li>○ What did you think about the face-to-face nutrition counselling meeting with your Anganwadi worker in this programme prior to starting phone counselling?</li> </ul>	<ul style="list-style-type: none"> <li>○ Do you think it was required? Why or why not?</li> <li>○ Did it help? Why or why not?</li> <li>○ If we were to do it again, what changes would you make to the face-to-face nutrition counselling meeting?</li> </ul>
	<ul style="list-style-type: none"> <li>○ If this programme using mobile phones were to be expanded in the future for nutrition counselling, what should be done differently?</li> </ul>	<ul style="list-style-type: none"> <li>○ Should your husband also have been included? Or any other family members?</li> <li>○ What did you think about the format of face-to-face meeting followed with phone calls?</li> <li>○ How much monthly phone credit is sufficient?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Would you like to add something about using mobile phones for nutrition counselling that we have not already discussed?</li> </ul>	<ul style="list-style-type: none"> <li>○</li> </ul>
Dietary recommendations	<ul style="list-style-type: none"> <li>○ Do you have the pictorial card with dietary recommendations? If so, please show me</li> </ul>	<ul style="list-style-type: none"> <li>○ If the mother does not have it, then ask her why</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think of the pictorial card with the dietary recommendations?</li> </ul>	<ul style="list-style-type: none"> <li>○ Was it helpful? Why or why not?</li> <li>○ Did you refer to it after the face-to-face meeting?</li> <li>○ What did you like about this card?</li> <li>○ What did you dislike about this card?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Do you have bowl and spoon given to help in feeding your child? If so, please show me</li> </ul>	<ul style="list-style-type: none"> <li>○ If the mother does not have them, then ask her why</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think of having a separate spoon and bowl for your child?</li> </ul>	<ul style="list-style-type: none"> <li>○ Was it helpful? Why or why not?</li> <li>○ Did you use it after the face-to-face meeting?</li> <li>○ What did you like about having separate utensils for your child?</li> </ul>



	<ul style="list-style-type: none"> <li>○ What did you think of the recommendations that the AWW told you about in the face-to-face meeting and over the phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ Has your child’s eating habits changed since this programme started? Why or why not?</li> <li>○ How have your child’s eating habits changed? Please explain</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think about the breastfeeding recommendation?</li> <li>○ What did you think about the recommendation to feed roti, rice and/or sevia?</li> <li>○ What did you think about the recommendation to feed dal, rajma, and/or chane?</li> <li>○ What did you think about the recommendation to feed green leafy vegetables?</li> <li>○ What did you think about the recommendation to feed ghee and/or oil?</li> <li>○ What did you think about the recommendation to feed undiluted milk, chaach and/or curd?</li> <li>○ What did you think about the recommendation to feed fruit?</li> <li>○ What did you think about the recommendation to feed egg?</li> <li>○ Would you like to add anything else about these dietary recommendations that we have not already discussed?</li> </ul>	<ul style="list-style-type: none"> <li>○ For EACH SPECIFIC recommendation, ask:</li> <li>○ Was it easy or difficult to follow the specific recommendation? Why or why not?</li> <li>○ What did your family think of the recommendation? Did your mother-in-law and/or husband say anything positive or negative about it?</li> <li>○ Do you plan on following this recommendation in the future? Why or why not?</li> <li>○ Is there a way this recommendation could be improved?</li> <li>○ Is there a way this recommendation could be communicated and/or explained better?</li> <li>○ Did you share this recommendation with anyone? Why or why not?</li> </ul>

**Appendix 4.18: mHealth pilot study - Endline in-depth interview guide for Anganwadi Workers**

TOPIC	QUESTION	PROBE
Mobile phones – Usability	<ul style="list-style-type: none"> <li>○ What did you think about giving nutrition advice to mothers on a mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ Easier to advise mothers?</li> <li>○ Difficult to explain concepts?</li> <li>○ Were there any network issues? Please tell me about it</li> <li>○ Were mothers available on the phone? Did they pick up?</li> </ul>

		<p>Was it switched off?</p> <ul style="list-style-type: none"> <li>○ Did these phone calls make you busier?</li> <li>○ Did these phone calls decrease your work load?</li> <li>○ Was it easy or difficult to keep track of the 5 mothers you had to counsel on the phone?</li> <li>○ How did you feel about repeating messages to individual mothers on the phone?</li> <li>○ Was it easy or difficult to remember the messages to promote on the phone with mothers?</li> <li>○ Did your house work suffer due to these phone calls?</li> </ul>
	○ What other ways did you use your mobile phone?	<ul style="list-style-type: none"> <li>○ Contacting mothers for other issues, e.g. scheduling meetings, etc.</li> <li>○ Contacting supervisors?</li> <li>○ Personal calls?</li> <li>○ Listening to music?</li> <li>○ Listening to songs?</li> <li>○ Listening to the news?</li> </ul>
	○ Did you receive calls from mothers in the 6-week study period?	<ul style="list-style-type: none"> <li>○ How did you feel about them calling you?</li> <li>○ Did you speak to other family members on these calls? If yes, then which family members? Was this call one-on-one or on loudspeaker?</li> </ul>
	○ Why did mothers contact you on the phone?	<ul style="list-style-type: none"> <li>○ Nutrition advice? If so, specify queries</li> <li>○ Questions that mother's family members had raised?</li> <li>○ Other issues?</li> </ul>
	○ Did you receive calls from the mother's family members in the 6-week study period?	<ul style="list-style-type: none"> <li>○ How did you feel about them calling you?</li> <li>○ Why did they call you?</li> <li>○ What did you talk about with them?</li> </ul>
Mobile phones – Acceptability	○ Did you have your own phone at the start of the study?	○ Did it stay with you most of the time? If not, then where did it stay?
	○ How did you feel about having a mobile phone to contact mothers in your area?	<ul style="list-style-type: none"> <li>○ Added stress to have a phone?</li> <li>○ Easier to reach mothers?</li> <li>○ Did you avoid home visits?</li> <li>○ Did this save time? Why or why not?</li> </ul>
	○ How did your family and neighbors feel about you having	○ Did they appreciate you having the phone? Why or why not?

	a mobile phone?	<ul style="list-style-type: none"> <li>○ Were they jealous? Why or why not?</li> <li>○ Were they irritated? Why or why not?</li> <li>○ Did children play with your phone? If so, how?</li> </ul>
	○ What did your ICDS supervisor and/or CDPO think about you having a phone for counselling?	<ul style="list-style-type: none"> <li>○ Did she have any issues to you taking calls during a meeting?</li> <li>○ Did they think it was useful or an inconvenience? Why? Please explain</li> </ul>
	○ What do you think about interacting with mothers on a mobile phone in the future?	<ul style="list-style-type: none"> <li>○ Too expensive?</li> <li>○ Prefer face-to-face? Why or why not?</li> <li>○ Easier to reach mothers?</li> <li>○ Difficult to reach mothers/caregivers?</li> <li>○ Did she or you not respond to calls?</li> <li>○ Were there network problems? If so, tell me about it</li> <li>○ Does it save time? Why or why not?</li> <li>○ Was it good or bad that you could be contacted anytime? Why?</li> </ul>
	○ What do you think about nutrition counselling being conveyed on the phone?	<ul style="list-style-type: none"> <li>○ Clarity?</li> <li>○ Comprehension?</li> <li>○ Audibility?</li> </ul>
	○ Did you face any inconveniences or problems when having the mobile phone?	<ul style="list-style-type: none"> <li>○ Were there any nuisance calls or blank calls? If yes, then tell me about them.</li> <li>○ Were there any disturbances at night on your phone? If yes, then tell me about it</li> </ul>
Mobile phones – Feasibility	○ Did you ever share your phone with anyone or let someone borrow it?	<ul style="list-style-type: none"> <li>○ If so, who did you share it with? Why?</li> <li>○ Was the phone primarily kept with you?</li> </ul>
	○ Did you share your mobile phone number with any family, relatives and/or friends?	<ul style="list-style-type: none"> <li>○ Did they start contacting you on this number? Why or why not?</li> </ul>
	○ Did you ever have trouble reaching any mothers on their mobile phone?	<ul style="list-style-type: none"> <li>○ If so, why?</li> <li>○ Did you follow up with them? (Repeated calls, home visits, etc.)</li> </ul>

	<ul style="list-style-type: none"> <li>○ Did mothers ever have trouble contacting you?</li> </ul>	<ul style="list-style-type: none"> <li>○ Is so, why? Please tell me about it</li> <li>○ If so, then did the mother follow up with you? (Repeated calls, home visits or visits to Anganwadi Centre, etc.)</li> </ul>
	<ul style="list-style-type: none"> <li>○ Did your phone function properly during these 6 weeks? If not, then why?</li> </ul>	<ul style="list-style-type: none"> <li>○ Was there any damage to the phone? If so, why?</li> <li>○ Were there network problems?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Is it feasible for you to have a mobile phone?</li> </ul>	<ul style="list-style-type: none"> <li>○ Financially?</li> <li>○ Logistically? (Electricity for charging phone, not sharing with others, etc.)</li> </ul>
	<ul style="list-style-type: none"> <li>○ If you already owned a mobile phone, how did you manage having two phones?</li> </ul>	<ul style="list-style-type: none"> <li>○ What was easy?</li> <li>○ What was difficult?</li> <li>○ How do you propose solving the dilemmas raised by having two phones, if there are any?</li> </ul>
Mobile phones – Other	<ul style="list-style-type: none"> <li>○ What did you think about the face-to-face nutrition counselling meeting with mothers and grandmothers in this programme prior to starting phone counselling?</li> </ul>	<ul style="list-style-type: none"> <li>○ Do you think it was required? Why or why not?</li> <li>○ Did it help? Why or why not?</li> <li>○ If we were to do it again, what changes would you make to the face-to-face nutrition counselling meeting?</li> </ul>
	<ul style="list-style-type: none"> <li>○ If this programme using mobile phones were to be expanded in the future for nutrition counselling, what should be done differently?</li> </ul>	<ul style="list-style-type: none"> <li>○ Should husbands also have been included? Or any other family members?</li> <li>○ What did you think about the format of face-to-face meeting followed with phone calls?</li> <li>○ How much monthly phone credit is sufficient?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Would you like to add something about using mobile phones for nutrition counselling that we have not already discussed?</li> </ul>	
Dietary recommendations – acceptability	<ul style="list-style-type: none"> <li>○ Do you have the pictorial card with dietary recommendations? If so, please show me</li> </ul>	<ul style="list-style-type: none"> <li>○ If the Anganwadi worker does not have it, then ask her why</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think of the pictorial card with the dietary recommendations?</li> </ul>	<ul style="list-style-type: none"> <li>○ Was it helpful? Why or why not?</li> <li>○ Did you refer to it after the face-to-face meeting?</li> <li>○ What did you like about this card?</li> <li>○ What did you dislike about this card?</li> </ul>
	<ul style="list-style-type: none"> <li>○ Do you have bowl and spoon given to help you explain the recommendations? If so, please show me</li> </ul>	<ul style="list-style-type: none"> <li>○ If the Anganwadi worker does not have them, then ask her why</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think of a spoon and bowl to demonstrate and explain dietary explanations to mothers?</li> </ul>	<ul style="list-style-type: none"> <li>○ Was it helpful? Why or why not?</li> <li>○ Did you use it after the face-to-face meeting?</li> <li>○ What did you like about having these aids?</li> </ul>

	<ul style="list-style-type: none"> <li>○ What did you think of the dietary recommendations that you promoted with mothers?</li> </ul>	<ul style="list-style-type: none"> <li>○ Are they appropriate for the community?</li> <li>○ Do you have an idea of how the mothers' infants' eating habits changed? Please explain</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think about the breastfeeding recommendation?</li> </ul>	<ul style="list-style-type: none"> <li>○ For each recommendation, ask:</li> <li>○ Was it easy or difficult to explain this recommendation to mothers? Why?</li> <li>○ Did you think it was easy or difficult for mothers to follow the specific recommendation? Why or why not?</li> <li>○ What did the mothers' families think of the recommendation? Did you hear anything about the mothers, mother-in-laws and/or husbands saying anything positive or negative about it? Please explain</li> <li>○ Do you plan on giving this recommendation to mothers in the future? Why or why not?</li> <li>○ Do you think mothers in this study will follow this recommendation in the future? Why or why not?</li> <li>○ Is there a way this recommendation could be improved?</li> <li>○ Is there a way this recommendation could be communicated and/or explained better?</li> </ul>
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed roti, rice and/or sevan?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed dal, rajma, and/or chane?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed green leafy vegetables?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed ghee and/or oil?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed undiluted milk, chaach and/or curd?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed fruit?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ What did you think about the recommendation to feed egg?</li> </ul>	
	<ul style="list-style-type: none"> <li>○ Would you like to add anything else about these dietary recommendations that we have not already discussed?</li> </ul>	

**Appendix 4.19: mHealth pilot study – Forms for documenting mobile phones returned**

Kheri Kalan Village, Kheri Kalan Subcentre

Study team member code:

ID – specify if Child or AWW ID	Mobile phone number	Date mobile phone returned (dd/mm/yy)	Signature or thumb print of participant returning phone
AWW #1	9811125055		
Child #1	9811127401		
Child #2	9811105586		
Child #3	9811103911		
Child #4	9811098239		
Child #5	9811096037		

## mHealth Pilot Study – Form for documenting phones returned

Kheri Kalan Village, Kheri Kalan Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #2	9811020885		
Child #6	9811120922		
Child #7	9811123857		
Child #8	9811123949		
Child #9	9654497803		
Child #10	9654496011		

## mHealth Pilot Study – Form for documenting phones returned

Baroli Village, Baroli Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #3	9811129632		
Child #11	9654488155		
Child #12	9654493690		
Child #13	9654493811		
Child #14	9654462732		
Child #15	9654496681		



## mHealth Pilot Study – Form for documenting phones returned

Prahladpur Village, Baroli Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #4	9811367560		
Child #16	9654422836		
Child #17	9654494341		
Child #18	9654494970		
Child #19	9654495347		
Child #20	9654497543		

## mHealth Pilot Study – Form for documenting phones returned

Faridpur Village, Faridpur Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #5	9811369172		
Child #21	9654497342		
Child #22	9654462381		
Child #23	9654456862		
Child #24	9654452686		
Child #25	9654456580		

## mHealth Pilot Study – Form for documenting phones returned

Faridpur Village, Faridpur Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #6	9811370240		
Child #26	9654455972		
Child #27	9654453699		
Child #28	9654456703		
Child #29	9654456802		
Child #30	9654461775		

## mHealth Pilot Study – Form for documenting phones returned

Old Sidola Village, Jasana Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #7	9811129157		
Child #31	9654457205		
Child #32	9654457353		
Child #33	9654458049		
Child #34	9654458054		
Child #35	9654458104		

## mHealth Pilot Study – Form for documenting phones returned

New Sidola Village, Jasana Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #8	9811349506		
Child #36	9654458900		
Child #37	9654458635		
Child #38	9654459835		
Child #39	9654464072		
Child #40	9654499453		

## mHealth Pilot Study – Form for documenting phones returned

Old Bhupani Village, Bhaskola Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #9	9811349467		
Child #41	9654473552		
Child #42	9654472860		
Child #43	9654472810		
Child #44	9654471870		
Child #45	9654471627		

## mHealth Pilot Study – Form for documenting phones returned

Mojabad Village, Bhaskola Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #10	9811133256		
Child #46	9654470984		
Child #47	9654470943		
Child #48	9654469531		
Child #49	9654468988		
Child #50	9654468176		

## mHealth Pilot Study – Form for documenting phones returned

Rajupura Village, Nacholi Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #11	9811134320		
Child #51	9654468150		
Child #52	9654467943		
Child #53	9654465623		
Child #54	9654465940		
Child #55	9654465816		



## mHealth Pilot Study – Form for documenting phones returned

Phulera Village, Nacholi Subcentre

Study team member code:

<b>ID – specify if Child or AWW ID</b>	<b>Mobile phone number</b>	<b>Date mobile phone returned (dd/mm/yy)</b>	<b>Signature or thumb print of participant returning phone</b>
AWW #12	9811134218		
Child #56	9654467130		
Child #57	9654465560		
Child #58	9654465348		
Child #59	9654464260		
Child #60	9654464240		