Simplifying Complementary Feeding Practices: Experimental Evidence from Rural India

Pre-Analysis Plan

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1 Introduction

1.1 Abstract

In this study, we will evaluate the impact of two communication-based interventions, delivered remotely, on Complementary Feeding practices in rural India. Our interventions aim to simplify information for caregivers, make complementary feeding a social activity, and integrate relevant nutrition heuristics into communication being given to caregivers. We test for these using two experiments; in the first, our treatment is given simplified counselling over the phone, in our second, we assign mothers into moderated groups on WhatsApp. We deploy our experiments in rural Madhya Pradesh, with a sample of 699 mothers.

1.2 Summary

Complementary Feeding (CF) for **6-23 month old children** is crucial for improving nutritional & growth outcomes. Measured as an **adequate diet** fed to a child, CF comprises 4 key components: **Diet diversity (D), Quantity (Q), Frequency (F) & Consistency (C)**. Only 9.09% children across 27 Aspirational Districts are reported to receive an adequate diet; contributing to severity of malnutrition levels in children (under 5 years). Appropriate Complementary Feeding (CF) practices for children can substantially reduce malnourishment rates[1], related burden of disease[2], and break the intergenerational cycle of undernutrition[3]. CSBC is working with NITI Aayog to support program efforts on complementary feeding and will evaluate interventions that can potentially improve adoption of complementary feeding practices.

Indicator of interest: Percentage of children being fed an adequate diet

The threshold for adequate diet is based on that prescribed by the WHO (keeping in mind measurement restrictions) :

- Minimum Diet Diversity: Minimum 4 food groups / day
- Minimum Meal Frequency: 3-4 meals / day
- Consistency: Solid/ Semi-solid food / day
- Quantity: ½ - ¾ bowls of food / day

Based on our qualitative diagnosis, we have designed interventions that we hypothesise would increase the number of **children being fed an adequate diet.** Our three main objectives from the interventions are:

1. Simplifying language of communication for end-user, the caregiver, from technical/ measurement-led language to easy-to-follow, practice-led language (e.g. feed your child ½-¾ cups in a day → feed your child every time you sit down for a meal);
2. Make complementary feeding practice and discussion a visibly social activity -- as opposed to the status quo where CF is an intra-household activity;
3. Emphasising and highlighting the most affected components of complementary feeding (Diet Diversity, Quantity) to caregivers, while also demonstrating the risks associated with non-adherence of complementary feeding, on the child's future. We do this by providing simple rules of thumb to caregivers for different CF components.

This document outlines the analysis plan for a remote lab-in-the-field experiment using a randomized controlled methodology to assess the effectiveness of the proposed interventions in improving the program outcome of children between 6-23 months of age being fed an adequate diet and other immediate outcomes including value perception of CF, social norms surrounding CF, self-efficacy for practicing CF, and intentionality to practice CF.

The experiment comprises two major interventions, phone-based counselling and a WhatsApp-based Mothers Support Group. Given the contemporary public health precautions due to the COVID-19 pandemic, we decided to focus on implementing

interventions that could be reasonably deployed remotely, eliminating any experiment-related potential exposure to participants from COVID-19.

2 Methods

2.1 Experimental Design Overview

Our research design is a straightforward randomised controlled field trial, where mothers with children in the age range 6-23 months are eligible for either the WhatsApp experiment or the Phone Counselling experiment -- depending on whether they have access to WhatsApp and consented to being part of a WhatsApp group.

Our treatments are bookended by a baseline and an endline, where we measure complementary feeding practices, attitudes and intentions, along with standard demographics.
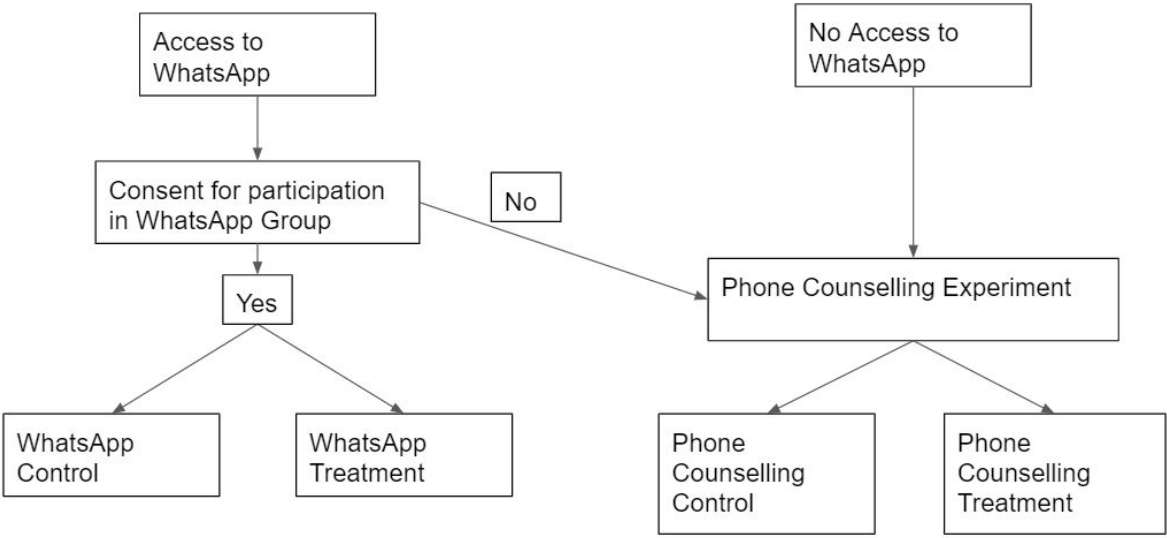

Figure 1: Experimental Design

2.2 Sample Identification

Our sample consists of mothers who have children in the age range of 6-23 months. We partnered with NITI Aayog, the Ministry of Health and Family Welfare and Piramal Swasthya -- who worked with district administration to collate information of childbirths in the eligible age range. These child births are registered by the Auxiliary Nurse Midwife (ANM) and Anganwadi Worker (AWW), who (along with ASHA workers) are responsible for last mile access of the state health machinery to the village level.

The registered details of childbirths were collected by Piramal Swasthya, working with the respective district administrations and shared with CSBC. The sample was then contacted by trained enumerators for a detailed baseline survey, where in addition to vital eligibility criteria (age of child, location), we collected information on feeding practices and associated outcomes, intentions and attitudes.

2.3 Power Analysis

We estimate our required sample sizes based on two studies (Kim et al 2019 and Menon et al 2016) which evaluate impact of communication based interventions on complementary feeding practices in developing contexts. We use the incidence of complementary feeding practices in our target districts (Barwani and Vidisha) from the NITI Aayog's Aspirational District Program data.

Baseline Incidence of outcome variables in **Barwani and Vidisha**	Minimum Diet Diversity (MDD) =0.153 Minimum Meal Frequency (MMF) = 0.135 Minimum Adequate Diversity (MAD) = 0.57	
Planned individuals per cluster (WhatsApp group)	5	
Assumed intracluster correlation (rho)	0.01	
Power	0.80	
Alpha	0.05	
	Case 1	**Case 2**

Benchmark study used	Kim et al 2019 Study sample: ~1350 children per arm in Ethiopia	Menon et al 2016 Study sample: ~500 caregivers per arm in Bangladesh
Assumption: **% increase in outcomes (baseline proportion) from benchmark studies**	MDD: 126% (0.052) MMF: NA MAD: **136% (0.041)**	MDD:: **51% (.321)** MMF: 35% (0.421) MAD: 140% (0.160)
RESULTS		
Estimated per arm sample for each Outcome of interest	MDD: 85 MFF: NA MAD: 245	MDD: 425 MFF: 985 MAD: 235
Estimated Required Sample Size	~245 mothers per treatment arm	~425 mothers per treatment arm

Table 1: Power Calculations

2.4 Data Collection

1. Baseline Survey: Eligible mothers were called, provided informed consent, and asked whether they would be interested in participating in the study. Mothers who provided consent were asked the baseline questions, which collected information on their existing complementary feeding practices, intention, attitudes, and knowledge about complementary feeding. These are all either primary or secondary outcome variables -- we expect that we will see positive movement in these measures between baseline and endline for our treatment groups. In addition to these outcome measures, we also measure useful covariates including demographics, support from other household members and social desirability.

2. WhatsApp Consent Screening: Post the baseline survey, participants who had access to WhatsApp were called and provided informed consent, in order to be added to a WhatsApp group. This step was necessary because the informed consent script at the baseline erroneously omitted information about the possibility of being assigned to WhatsApp groups.

3. Endline Survey: We repeated the baseline instrument, with a few minor edits for length of survey, for all participants who were assigned to the treatment and control groups, after the consent screening stage.

2.5 Treatment Deployment

1. Phone Counselling: Mothers are given counselling on complementary feeding practices via a phone call from trained enumerators. The counselling consists of simplified instructions on CF practices, and calls last about 10 minutes in duration. Mothers are also asked to recall the practices to check their understanding of them. The call script also integrates the consequences of poor compliance of complementary feeding, to make the risks associated salient to mothers. In addition to calls, mothers are also sent three SMS messages on three consecutive days, highlighting the CF practices as well as the consequences of not adhering to appropriate CF practices.

2. WhatsApp Mothers Support Group: Mothers who have access to WhatsApp are randomly assigned to online WhatsApp groups of 3-4 mothers, where trained moderators provide information daily on complementary feeding. The group intervention combines simplified instructions on CF practices along with activities designed to encourage discussion and interaction amongst the mothers. We have also incorporated a few behavioral heuristics to make the need for CF salient to the mothers. We are including three mental models in this intervention:
    - *Growth Mental Model:* In this mental model, our counsellors -- through WhatsApp text posts, say that since the child is at a crucial stage in their life in terms of growth of the body and development of the mind, it is important that they get good nutrition - especially adequate quantity. If enough quantity is not fed, their growth can be impacted.
    - *Starvation Mental Model:* Here, we emphasise that all the parts of a child's body are "hungry" - and not just the stomach. Therefore, it is important to feed the child different kinds of food that are made at home to babies now to feed all parts of their bodies.
    - *Diet Diversity Mental Model*: This model criticizes the similarities in the food that is given to sick adults and healthy children (porridge, rice/lentils) and also stresses that giving all kinds of food will not make the child sick, and in fact, should be encouraged. A healthy baby should be given the same food as a healthy adult.
    - Discussion in the groups was moderated for 14 days -- the treatment duration for this intervention.

2.6 Randomisation

Participants who gave their consent to participate in the WhatsApp groups were marked as eligible to be randomised between the WhatsApp half of the

experimental arms. Participants who did not consent were included in the Phone Counselling half of the experimental arms.

The WhatsApp Mothers Support Group was stratified by the age group that the child falls under (6-11 months or 12-23 months), and whether the mother uses her own phone number for WhatsApp or has to depend on someone else for WhatsApp access.

The Phone Counselling randomisation was stratified by administrative block, age group child, and whether the mother has access to WhatsApp or not.

3 Empirical Analysis

Our analysis will be on basic intention-to-treat, and our models for each intervention are explained below:

3.1 Variables

Our primary outcome measures are measured at the individual level, with the baseline and endline surveys being conducted with the mothers of the children and are listed below. We use a 24-hour food recall survey, where mothers are asked to recall which food items were fed to their child in the past 24 hours. Pilots of the instrument suggested that previous formats, suggested by the The Demographic and Health Surveys (DHS) Program, are somewhat tedious and we restructured them slightly to make it easier and less tedious for enumerators to ask the questions and for respondents to answer.

Outcome Variable	Description (For further details on specific outcome measures, please refer to the CF codebook)	Outcome Measures	Outcome Measure Type
Practice: Feeding Status	Is the child being currently breastfed?	Child being breastfed or not being breastfed Child being breastfed = 1 Child not being breastfed = 0	Binary variable 0/1
Practice: Diet Diversity	Endline survey asks mothers to recall food groups fed in each meal for the previous 24 hours. We ask for for 14 different components -- which are condensed into the 7 WHO recommended food groups (Appendix)	**Minimum dietary diversity (MDD):** Child received 4 or more food groups, across all meals in the previous day = 1 Child did not receive 4 or more food groups, across all meals in the previous day = 1	Binary variable 0/1
Practice: Meal Frequency	Number of meals fed to child in past 24 hours, excluding breastfeeding, water and medicines	**Minimum meal frequency (MMF):** Child being fed minimum number of meals in previous day = 1 Child not being fed minimum number of meals in previous day =0 Note that the minimum number of meals differs depending on age group of child and breastfeeding status 6-11 months and breastfed → 2 meals 12-23 months and breastfed → 3 meals Non-breastfed → 4 meals	Binary variable 0/1
Practice: Food Consistency	'How was the consistency of the meal?'	Dummy variable taking value 1 iff child was fed soft or solid food during the previous day	Categorical variable [Water-like/ Runny, Soft, Solid]
Practice: Food Quantity	'How much was the quantity of the food in the meal?'	Most frequent response for meals fed in past 24 hours	Categorical variable [¼ cup, ½

		cup, ¾ cup]
Combining criteria for MFF and MDD provides us with the definition for an important indicator Minimum Acceptable Diet	**Minimum Acceptable Diet:** Child satisfies both minimum dietary diversity and minimum meal frequency MAD =1 iff MDD == 1 & MMF == 1 MAD = 0 if MDD == 0 OR MMF == 0	Binary variable 0/1

Table 2: Primary Outcome Measures

Following the theory of KAP, our secondary outcomes of interest are items that record knowledge of mothers regarding complementary feeding practices, their attitudes towards complementary feeding -- their risk perceptions, value perceptions of compliance with complementary feeding, self-efficacy around feeding their children, and their intentions to engage in these practices. We hypothesise that movement in our primary practice outcomes will be driven by an increase in the knowledge mothers have about complementary feeding, increased risk perception for non-compliance, as well as increased value perception, self-efficacy and intention.

We will run two analyses with the secondary outcomes that use Likert scale responses. The first analysis (M1) uses the variables as they are, resulting in our dependent variables being categorical in nature. Our second analysis (M2) will create an index for specific constructs, indicating the number of positive responses for that construct in the endline. We will use this index, which is now a discrete variable, as our dependent variable in our regression models. We describe the construction of these measures in the following section.

Outcome Variable	Description (For further details on specific outcome measures, please refer to the CF codebook)	Model 1 (Standard)	Model 2 (Summative Score)
Attitude: Risk Perception (ramifications of not practicing	Risk-perception of non-adherence of complementary feeding on child's health	Outcome measure creation: No manipulation	Outcome measure creation: From 4

CF)	measured on 5-item likert scales. 4 statements are asked to all mothers. 1. If you don't give your child food apart from breastmilk, do you think your child's growth can be affected? 2. If you don't mash the food properly before feeding your child, how severly do you think their growth can be affected? 3. If I do not feed my child foods apart from breastmilk, they might not be able to learn effectively in school. 4. If I do not feed my child foods apart from breastmilk, they might not be grow up to be physically strong.	required. Use ordinal variable as dependent variable	statements, answered on 5-point Likert scale, count of statements with Likert-scale response 3 and above
Attitude: Risk Perception (ramifications of practicing CF)	Risk-perception of adherence of complementary feeding on child's health measured on 5-point likert scales. One statement is asked to mothers. The statement is different for mothers depending on the age of child. 1. Children between the age of 6-11 months have small stomachs so they need just small quantities of food. 2. Children between the age of 6-11 months have thin and small throats so they need thin or water-like food.	Outcome measure creation M1: No manipulation required. Use ordinal variable as dependent variable	Outcome measure creation M2: Outcome measure creation: Binary variables that takes value 1 iff Likert-scale response is 3 and above
Attitude: Value Perception of practicing CF	Attitude towards importance of practice of CF. Mothers are asked to respond to one statement on a 5-point Likert scale. 1. By feeding an infant a diverse range of semi-solid/soft food items at least 3-4 times a day, one can ensure the	Outcome measure creation M1: No manipulation required. Use ordinal variable as dependent variable	Outcome measure creation M2: Outcome measure creation: Binary variable that takes value 1 iff Likert-scale

	infant's long-term physical and cognitive development.		response is 3 and above
Intentions: Intentionality for engaging in CF	Likert-scale responses on intentions, motivation to comply, and behavioural beliefs regarding CF. Mothers are asked to respond to 4 statements on a 5-point Likert scale. 2 statements are common to all mothers, and 2 statements are specific to the age group of child. 1. I plan to feed my infant the different types of food that are made for adults at home. 2. I plan to mash the food to make it soft or semi-solid before feeding it to my infant. 3. I plan to slowly inculcate the habit feeding my infant solid food. 4. I plan to feed my infant semi-solid or soft food at least 3-4 times in a day. 5. For every meal that I feed my infant, I plan to allocate food in a separate plate and feed the infant until he/she feels full. 6. For every meal that I feed my infant, I plan to allocate food in a separate plate and ensure the quantity is equal to the weight of an orange.	Outcome measure creation M1: No manipulation required. Use ordinal variable as dependent variable	Outcome measure creation: From 4 statements, answered on 5-point Likert scale, count of statements with Likert-scale response 3 and above
Knowledge: Knowledge about CF practices	Assessment on the knowledge of CF practices. 3 questions are asked to all mothers	Outcome measure creation: M1: Number of correct responses to the 3 questions	NA

Table 3: Secondary Outcome Measures

The following variables from the baseline will be used as covariates. Wherever data is missing (or incorrect), we will use information collected from the endline survey to fill

in missing values, albeit only for variables that cannot be impacted by our interventions.

Type	Description	Measure creation/ Final variable used
Covariates: Demographics	Age of respondent	No manipulation needed
	Number of previous surviving children	No manipulation needed, discrete variable
	Time to reach nearest healthcare facility	Ordinal variable
	Household income per person before and after COVID-19 lockdown	Logarithm of Sum of household income per person before COVID-19 lockdown and after COVID-19 lockdown
	Education completed	Ordinal variable
	Mobile phone ownership	Indicator variable taking values 1 == mother has own feature phone 2 == mother uses someone else's feature phone 3 == mother has own smartphone 4 == mother uses someone else's smartphone
	Religion	Dummy variable whether respondent is Hindu or non-Hindu
	Caste	Categorical variable for self-reported caste category
	Administrative block	Categorical variable for administrative block respondent belongs to
Covariates: Social Desirability	Self-reported likert scale responses to measure respondents' tendency to indulge in socially desirable behaviours, measured through 5 questions on a binary Yes/No (1/0) response scale. 1. Do you occasionally give up doing something because you don't think you have the ability? 2. Do you occasionally feel like not listening to people even if you know	Sum up responses for all 5 questions, where Yes is coded as 1 and No is coded a 0. Social Desirability Scores is then calculated as follows: Low SDS: Sum is 0-2 Medium SDS: Sum is 3 High SDS: Sum is 4 Very High SDS: Sum is 5

	they are right? 3. Are you sometimes irritated/annoyed by people who ask you to do something for them? 4. Are you always courteous, even to people who are disagreeable/not pleasant? 5. When you make a mistake, are you always willing to admit it?	

Table 4: Control Variables

3.2 Model Specifications

We will perform analysis using the following two methods of analysis for our treatment effects.

1. Standard models :
   In this case, we run regressions using our raw outcome measures, with and without our control variables. We will either use an OLS model or an Ordered Logistic Model, depending on whether the dependent variable is discrete/continuous or an ordinal variable.
   a. Basic OLS/ Ordered Logistic regression: We use OLS for outcomes where the response is a discrete variable, such as meal frequency, or ordered logistic regression for likert-like response variables.
   b. Ordered Logit regression: We will use an ordered logistic model for our dependent variables that use Likert scale responses.

2. Summative score model:
   In this case, we use the new constructed variables, described in Table 3, column 3, as our dependent variables in our treatment effects estimation. This approach allows us to condense multiple survey questions into a score which allows us to estimate the number of positive responses at individual level. We will use an OLS model to estimate differences in the number of positive responses, across the treatment conditions.

3.3 Treatment Effects

3.3.1 Balance Checks

We will check for balance between treatment and control groups for baseline measures that may be correlated with feeding practices.

X_i will be the baseline measures of interest. We will perform this exercise for both our phone counselling experiment and the WhatsApp Mothers Support Group experiment.

For the phone counselling experiment the balance check specification will be:

$$X_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \zeta * whatsapp.user.strata_i + \omega * administrative.block_i + \varepsilon$$

For the WhatsApp Mothers Support Group, the balance check specification will be:

$$X_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \sigma * whatsapp.access.strata_i + \omega * administrative.block_i + \varepsilon$$

Where *age.strata* is an indicator variable for age range of child (6-11 months or 12-23 months), *whatsapp.user.strata* is a binary variable indicating if mother is a WhatsApp user or not (irrespective of whether on their own phone or someone else's phone), *whatsapp.accesss.strata* indicates if the mother uses WhatsApp on their own phone or someone else's phone, and *administrative.block* is an indicator variable for administrative division respondent resides in.

3.3.2 Phone Counselling

We will estimate the following 3 basic models with fixed effects for randomization strata (age group of child, whether mother is a WhatsApp user or not, and administrative block) and robust standard errors.

$$M1: Y_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata + \zeta * whatsapp.user.strata_i + \omega * administrative.block_i + \varepsilon$$

$$M2: Y_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \zeta * whatsapp.user.strata_i + \omega * administrative.block_i \\ + \tau * demographic.covariates_i + \theta * sds.score_i + \varepsilon$$

$$M3: Y_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \zeta * whatsapp.user.strata_i + \omega * administrative.block_i \\ + \tau * demographic.covariates_i + \theta * sds.score_i + \kappa * baseline.measure_i + \varepsilon$$

Y_i are measures described as outcome measures in the Table 2 and 3, *treatment.assigned* assignment is a dummy variable based on whether the subject was assigned to a control or treatment group, and covariates are demographic measures (*demographic.covariates*) and social desirability scores (*sds.score*), utilised as control variables. Since we expect that any improvement in individual behaviour will depend on baseline measurement of the respective behavior, we control for baseline measurement of the outcome of interest in Model 3.

3.3.3 WhatsApp Mothers Support Group

We will estimate the following basic model with fixed effects for randomization strata and clustered standard errors at the WhatsApp group level, to account for clustered random assignment

$$M1: \ Y_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \zeta * whatsapp.access.strata_i$$
$$+ \ \omega * administrative.block_i + \varepsilon$$

$$M2: \ Y_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \zeta * whatsapp.access.strata_i + \omega * administrative.block_i$$
$$+ \tau * demographic.covariates_i + \theta * sds.score_i + \varepsilon$$

$$M3: \ Y_i = \alpha + \beta * treatment.assigned_i + \gamma * age.strata_i + \zeta * whatsapp.access.strata_i + \omega * administrative.block_i$$
$$+ \tau * demographic.covariates_i + \theta * sds.score_i + \kappa * baseline.measure_i + \varepsilon$$

Y_i are our outcome measures, as indicated in Table 2 and 3, *treatment.assigned* is a dummy variable based on whether the subject was assigned to a Mothers Support Group or not, and covariates are demographic and behavioural control variables. As mentioned in the previous section, we expect that any improvement in individual behaviour will depend on baseline measurement of the respective behavior, and we control for baseline measurement of the outcome of interest in Model 3.

3.4 Attrition

To check if respondents who have dropped out of the study sample are balanced by study arm, we will run the balance check using 'individuals attrited from sample' as our outcome measure. This model should tell us if any of our baseline covariates, or, the treatment assignment, or randomization strata can predict whether a participant has dropped out between baseline and endline. We intend to use the Minimum Acceptable Diet (BL_MAD) indicator variable from our baseline

For the phone counselling experiment the attrition check specification will be:

$$Z_i = \alpha + \beta * treatment.assigned_i + \gamma * BL.MAD_i + \delta * BL.MAD_i * treatment.assigned_i + \pi * age.strata_i$$
$$+ \theta * whatsapp.user.strata_i + \kappa * admin.block_i + \varepsilon$$

For the Mothers Support Group experiment the attrition check specification will be:

$$Z_i = \alpha + \beta * treatment.assigned_i + \gamma * BL.MAD_i + \delta * BL.MAD_i * treatment.assigned_i + \pi * age.strata_i$$
$$+ \theta * whatsapp.access.strata_i + \varepsilon$$

Where *Z* is a binary variable indicating if the respondent has left the sample by endline, or has successfully completed the endline survey, *BL.MAD* is a binary variable indicating whether the child is being fed the minimum adequate diet.

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