Quantifying Responsive Feeding of Infants and Young Children: An Analysis from Three Countries: Peru, Nicaragua and Indonesia

Rebecca C. Robert
Hilary Creed-Kanashiro
Margot Marin

August 2020

Table of Contents

Key Words: responsive feeding, infant and young child feeding, Peru, Nicaragua, Indonesia

Contact information: Rebecca C. Robert, Conway School of Nursing, The Catholic University of America, Washington D.C.; robert@cua.edu; 202-319-5502

Abstract

Introduction: Responsive feeding, the age and developmentally appropriate interactions between caregivers and infants and young children (IYC) 6-23 months, represents a critical component of complementary feeding to promote optimal healthy growth and development. A quantitative indicator to measure responsive feeding at a population level is lacking and its development remains urgent. Towards this goal, we examined data on responsive feeding from caregivers of IYC in poor regions of Peru, Nicaragua, and Indonesia where malnutrition remains prevalent. Four dimensions were included to score: 1) opportunities for child self-feeding, 2) talking positively with the child during meal time, 3) encouraging a child who has not eaten enough, and 4) an appropriate response to child refusal. We hypothesized that sufficient variability would exist in responsive feeding scores, that higher responsive feeding scores would be associated with the WHO indicator minimum acceptable diet (MAD), and that self-feeding would not be associated with diarrheal illness.

Methods: Cross-sectional surveys were administered to a random sample of households with IYC 6-23 months by trained field workers as part of a large program evaluation. Topics included socio-demographics, feeding practices, morbidity and responsive feeding questions--based on previous qualitative research and a validation study. Analysis by country included descriptive statistics and generation of a responsive feeding score based on an a priori algorithm. We used multivariate generalized linear modeling with a logit link to examine responsive feeding and the outcome, minimum acceptable diet (MAD). In addition, models were used to examine the association of self-feeding and diarrheal illness.

Results and Discussion: A final sample of 2273 children were included in the analysis from the three countries and grouped into three developmentally appropriate age groups with respect to complementary feeding: 6-8 months, 9-11 months, and 12-23 months. Results demonstrated good variability in the responsive feeding scores produced (-1 to +4) across age groups in all countries. When scores were dichotomized, the majority of informants demonstrated low responsive feeding. Patterns among the dimensions of responsive feeding indicated potential areas for intervention. Importantly, self-feeding was not associated with increased diarrheal morbidity. Results from multivariate models demonstrated an association between responsive feeding MAD in Indonesia, but not in Peru or Nicaragua. In conclusion, this research provides evidence that responsive feeding can be quantified for survey research and supports the use of these dimensions and algorithm in future studies.

Quantifying Responsive Feeding of Infants and Young Children: An Analysis from Three Countries: Peru, Nicaragua and Indonesia

1. Summary of Project Aims

Optimal feeding and care practices in the first 2 years of life promote growth and health, and avoid growth faltering, stunted growth and associated negative consequences. Exclusive breastfeeding for six months and complementary feeding in addition to breastfeeding from 6-23 months define optimal feeding practices (PAHO, 2003). **Responsive feeding** during mealtime, a feeding style defined by age and developmentally appropriate interactions with children by caregivers, represents a key, critical component of complementary feeding. Responsive feeding creates a positive mealtime experience in which to promote optimal food consumption and stimulate IYC development and is recommended internationally (Bentley, Wasser, & Creed-Kanashiro, 2011) (PAHO, 2003, Engle & Menon, 1999; Engle & Pelto, 2011; Black et al., 2017; Silva, Costa, & Giugliani, 2016). To date, most responsive feeding studies have included carefully coded qualitative data from mealtime observations in contexts where undernutrition exists (Abede, Haki, & Haye, 2017; Vazir et al., 2013; Flax et al., 2013). A need exists to develop a quantitative measure (indicator) that characterizes responsive feeding efficiently at a population level, from large scale survey research.

Toward this goal of creating a responsive feeding indicator, prior qualitative research with mealtime observations and a validation study of caregivers' ability to recall feeding style behaviors from the prior day was completed. This research resulted in a series of quantitative survey questions reflective of feeding style (heretofore called responsive feeding questions) covering four dimensions of responsive feeding and a proposed algorithm for calculating a responsive feeding score to indicate high versus low responsive feeding (Creed-Kanashiro et al., 2010, unpublished report). These dimensions include: 1) opportunities for child self-feeding, 2) talking positively with the child during meal time, 3) encouraging a child who has not eaten enough, and 4) an appropriate response to child refusal. The next logical and critical steps in this research trajectory included testing the survey questions in several countries in large scale surveys, scoring the responsive feeding style indicator based on the a priori algorithm, and assessing whether sufficient variability in responses exist to characterize the indicator as useful.

We included the responsive feeding questions in large cross-sectional surveys in Peru, Nicaragua and Indonesia administered during a CARE project evaluation. The purpose of this project was to analyze these data to address the following specific aims:

Specific Aim 1. To determine the variability of responsive feeding scores, based on an algorithm of answers to standardized questions, in populations of caregivers with infants 6-23.9 in three countries: Peru, Nicaragua and Indonesia.
Hypothesis: The responsive feeding score will demonstrate variability within each of three country populations examined, Peru, Nicaragua and Indonesia (possible score range -1 to +4).

Specific Aim 2. To identify any patterns within the caregiver responses to the standardized responsive feeding questions by age group (6-8 months, 9-11 months, 12-23 months) and by country.

Research question: What are the patterns of caregiver responses to the standardized responsive feeding questions by age group (6-8 months, 9-11 months, 12-23 months), and do these patterns differ by country?

Specific Aim 3: To determine the association between age appropriate self-feeding (a component of responsive feeding) and diarrheal illness.

Hypothesis: Self-feeding, a component of responsive feeding, will demonstrate no association with diarrheal illness in children 6-23 months.

Specific Aim 4. To determine the association between responsive feeding and the WHO indicator minimum acceptable diet (MAD), a composite indicator of two other WHO indicators (minimum dietary diversity and minimum meal frequency).

Hypothesis: Higher responsive feeding scores will demonstrate an association with children 6-23 months consuming a minimum acceptable diet.

2. Theoretical/conceptual framework

UNICEF's Extended Model of Care provides the conceptual model in which to situate the study. (Appendix 1). This model illustrates the multiple factors that together determine a child's survival and well-being. At its core sit the many caregiving behaviors that caregivers provide to their infants and young children to ensure adequate nutrient intake, health and ultimately optimal growth and development (Engle & Menon, 1999). Among the caregiving behaviors listed are feeding and psychosocial and cognitive stimulation. The behaviors involved in responsive feeding capture elements of both--stimulating optimal consumption of a healthy diverse diet as well as stimulating the child's social, emotional, verbal and motor development. The four specific dimensions of responsive feeding captured in the survey questions include self-feeding, talking to the child, encouraging the child, and an appropriate response to food refusal. These behaviors link well to the conceptual model. Caregiving via responsive feeding represents an important factor to improve nutrient intake and development of IYC. The model recognizes additional factors, such as the influence of household food security—having sufficient quantity and quality of food--on caregiving feeding behaviors. Similarly, the environmental context in which the caregiver and child live exerts influence on many caregiving behaviors (Engle & Menon, 1999).

The lower half of the model recognizes many resources which influence caregivers to support caregiving behaviors (Engle & Menon, 1999). Through their direct care with caregivers and children, nurses are key players to positively influence caregiving resources and behaviors. Creating a responsive feeding indicator will provide nurses with foundational data to best understand their community and population needs, and evaluate the success of intervention

programs. Our proposed research on responsive feeding will provide additional evidence to support UNICEF's Extended Model of Care.

3. Methods, procedures and sampling

Research Design. This study employed a cross-sectional survey design with data collected from a random sample of households in poor mostly rural areas of three countries, Peru, Nicaragua and Indonesia. Data collection occurred over a two-month period in each country.

Subjects and Setting: The setting for the cross-sectional surveys were poor, mostly rural areas of Peru, Nicaragua and Indonesia, all with high a prevalence of malnutrition in children <2 years. In Peru, communities from two regions of the Andean Highlands were included, namely, Ayacucho and Apurimac. In Nicaragua, four rural districts in the regions of Matagalpa and Jinotega were included, a mountainous area in the North Central region of the country. In Indonesia, the rural districts of Timor Tengah and Belu from West Timor were included. Each country included surveys from the intervention and comparison groups. The intervention group received the CARE Window of Opportunity Intervention aimed at improving caregiver feeding behaviors, nutritional status and growth. The comparison group did not receive the intervention.

Random sampling procedures were employed in each country to select households. The exact strategy varied by country, based on context and the sampling procedures used at baseline. In the two regions of Peru, systematic random sampling was employed based on a sampling frame of all children 6-23 months provided by the community health facility. In Nicaragua, a house to house census identified households in 4 districts (procedure adopted to offset lower than expected number of children). In Indonesia, cluster based random sampling was used, whereby households were selected from a sampling frame that included all children 6-23 months in a health facility's jurisdiction.

Sample size calculations were based on the expected change (%) in well-established complementary feeding and breastfeeding indicators from the baseline to endline. A significance level of 5% and power of 80% were used. A robust sample of 2,431 households was calculated overall. Per country, samples included Peru=782, Nicaragua=707, and Indonesia=944, sufficiently large to complete the aims of this study. Eligible caregivers for the study included those with children 6-23 months who provided informed consent. Exclusion criteria included children with acute or chronic illness that impeded the anthropometric measurement.

Instruments and Data Collection: A standard survey instrument was administered by trained field workers to caregivers of children 6-23 months. Responses were coded during the administration for the majority of questions. For some questions, such as "*What did you say to the child,*" written responses were also recorded, which allowed for later coding of responses or to confirm the coded response. Surveys were translated into the local language and administered by field workers fluent in the local language. Eight questions were asked to

complete the responsive feeding section of the survey that covered four dimensions of responsive feeding: 1) opportunities for child self-feeding, 2) talking positively with the child during meal time, 3) encouraging a child who has not eaten enough, and 4) an appropriate response to child refusal.

Data Management/Analysis: Per standard protocol of the study, each day field workers checked surveys for completeness and submitted them to field supervisors who checked each survey, resolved any questions with the field worker and signed as complete. Data were entered by in-country teams. The databases were sent to the Instituto de Investigación Nutritional where the lead statistician checked and cleaned each database. Descriptive analyses were conducted for each country and included sample characteristics, IYC feeding practices and anthropometric z-scores and diarrheal illness in the past 2 weeks, defined as at least 3 loose/watery stools. The WHO complementary feeding indicators were created from the IYC feeding practice questions according to WHO procedures (World Health Organization, 2008).

For the responsive feeding questions, descriptive analysis was conducted by country. This included generation of an additive score of responsive feeding (range -1 to + 4) using the a priori algorithm created from the validation study mentioned above. This score was then dichotomized into low responsive feeding (-1 to +2), and high responsive feeding (+3 to +4). Cluster analysis was employed to identify patterns of responses for the two dimensions that demonstrated the most variability in responses: 1) talking positively with the child during the meal, and 2) encouraging the child during the meal.

Analysis was conducted on all children aged 6-23 months followed by age-stratification analysis using three groups: 6-8 months, 9-11 months and 12-23 months. These age groups mark different stages of IYC developmental maturity and influence feeding interactions and food consumption.

In each country, age appropriate self-feeding (one of the four elements of responsive feeding measured) and diarrheal illness were examined for any association, first via bivariate chi-square analysis, and second using generalized linear modeling with a logit link within each age group, 6-8 months, 9-11 months, and 12-23 months and controlling for intervention/control group status. In these models, the outcome was diarrhea (yes/no) and the independent variable self-feeding (yes/no).

Finally, in each country, generalized linear modeling with a logit link was used to examine the association between responsive feeding and the WHO feeding indicator, minimum acceptable diet. The WHO indicator, minimum acceptable diet (yes/no), represents a composite indicator of minimum dietary diversity and minimum meal frequency and is frequently used to characterize the diet of children 6-23 months on a population level. Potentially confounding variables such as age, intervention or control community, diarrheal illness and household food security were tested and included in the model as appropriate. AIC values were examined for model fit. All analyses were completed using SPSSv.24 software.

4. Summary of the findings

The final sample for each country included those caregivers of children aged 6-23 months who had begun complementary feeding, and that provided an answer to the responsive feeding questions as shown in Table 1. Nicaragua had more informants in the intervention versus control group because the numbers of IYC were more limited than expected in the control communities. In Indonesia informants that answered "I don't know" or did not have complete information to all of the responsive feeding characteristics (n=59, 6% of total) were compared to those who answered the questions on several demographic variables (n=852). There was no difference in the type of caregiver regarding responses, but a significant difference was found in caregiver education (small effect size) with those responding "I don't know" having a higher proportion in the low education category.

Table 1: Sample size for the analysis by country

Country	Total sample 6-23 months	excluded >=6 months but not yet eating	excluded >=6 months but answered "I don't know" for the 8 responsive feeding questions	excluded >=6 months but did not have complete information for the 8 responsive feeding questions	Sample Intervention group	Sample Control group	**Final Sample for Analysis**
Peru	782	12	0	0	394	376	**770**
Nicaragua	707	50	1	5	480	171	**651**
Indonesia	944	33	56	3	494	358	**852**

Child and caregiver characteristics by country follow. The age groups were similarly spaced across countries with about two-thirds in the 12-23 month group and the rest split between the younger two age groups. Morbidity was prevalent across countries although diarrhea was less common in Indonesia than the Latin American context. Stunting was considerable in all contexts, affecting one-third of children sampled in Peru, one-quarter of children in Nicaragua and almost half of the children in Indonesia. Mothers were the informant for the majority of surveys. Some differences existed in education, and this category was context specific (see footnote Table 2). Household food security measured by the sufficient quantity of food was particularly problematic for Indonesia with one-third of households sampled reported insufficient food quantity.

Table 2. Sample characteristics of children and caregivers by country

	Country		
	Peru (n=770)	Nicaragua (n=651)	Indonesia (n=852)
	n (%) or mean (sd)		
Child age group			
6-8 months	131 (17.0)	90 (13.8)	160 (18.8)
9-11 months	129 (16.8)	115 (17.7)	156 (18.3)
12-23 months	510 (66.2)	446 (68.5)	536 (62.9)
Child Sex			
Male	413 (53.6)	332 (51.0)	425 (49.9)
Female	357 (46.4)	319 (49.0)	427 (50.1)
Child Health			
Diarrhea in past 2 weeks	211 (27.4)	235 (36.1)	106 (12.4)
Cough in past 2 weeks	324 (42.1)	363 (55.8)	470 (55.2)
Mean Height for Age z-score[1]	-1.60 (1.05)	-1.22 (1.34)	-1.88 (1.20)
Stunting[1] (<-2sd height for age z-score)	248 (33.0)	171 (26.3)	394 (46.5)
Mean Weight for Age z-score[2]	-0.56 (.97)	-0.28 (1.08)	-1.79 (1.03)
Underweight[2] (<-2sd weight for age z-score)	50 (6.6)	37 (5.7)	337 (39.6)
Survey informant			
mother	756 (98.2)	604 (92.8)	777 (91.2)
other (e.g. grandmother)			
Informant mean age (sd)	28.4 (7.5)	26.2 (8.6)	29.8 (8.1)
range	16-59	15-76	14-82
Informant education level[3]			
Less education	285 (37.0)	542 (83.3)	218 (25.6)
More education	484 (62.9)	109 (16.7)	634 (74.4)
Household Food security[4]			
Insufficient quantity	42 (5.5)	66 (10.2)	306 (36.0)
Sufficient quantity			

[1]Peru (n=752); Nicaragua (n=649); Indonesia (n=847)
[2]Peru (n=753); Nicaragua (n=651); Indonesia (n=851)
[3]Education covariate defined as Indonesia (up to incomplete primary vs. complete primary or higher); Peru (up to complete primary vs. more than complete primary); Nicaragua (up to incomplete primary vs. complete primary or higher).
[4]Nicaragua (n=648); Indonesia (n=849)

Responsive feeding

Results show that mothers were primarily responsible for having fed the child the main meal of the day on the previous day (Peru 95.3%; Nicaragua 86.6%; and Indonesia 93.5%). The context of the meal included whether the child ate alone or was accompanied by others eating also. The majority in Peru (96.2%) and in Nicaragua (82.2%) were accompanied by the mother or other family member whereas in Indonesia, the proportion was lower (45.5%). Next, results are organized around each of the specific aims of the study.

Specific Aim 1. To determine the variability of responsive feeding scores, based on an algorithm of answers to standardized questions, in populations of caregivers with infants 6-23.9 in three countries: Peru, Nicaragua and Indonesia.

Hypothesis: The responsive feeding score will demonstrate variability within each of three country populations examined, Peru, Nicaragua and Indonesia (possible score range -1 to +4).

Results demonstrated similar variability in the responsive feeding scores of all three countries which ranged from -1 to +4 (Table 3). The majority of caregivers scored between 1 and 3, with ~43% scoring 2, and smaller percentages at lower and upper ends. The score was then dichotomized to a create a lower (-1 to 2) versus higher (3-4) responsive feeding score. Less than one-third of caregivers scored as high responsive feeding.

Table 3. Percentage of continuous and dichotomized responsive feeding scores by country

	Country		
	Peru (n=770)	Nicaragua (n=651)	Indonesia (n=852)
	n (%)		
Responsive feeding scores children 6-23 months			
score (-1)	8 (1.0)	1 (.2)	3 (.4)
score (0)	29 (3.8)	11 (1.7)	15 (1.8)
score (+1)	168 (21.8)	154 (23.7)	235 (27.6)
score (+2)	329 (42.7)	279 (42.9)	373 (43.8)
score (+3)	187 (24.3)	160 (24.6)	210 (24.6)
score (+4)	49 (6.4)	46 (7.1)	16 (1.9)
Dichotomized responsive feeding score			
Low (-1 to 2)	534 (69.4)	445 (68.4)	626 (73.5)
High (3 to 4)	236 (30.6)	206 (31.6)	226 (26.5)

When examined by age group, a larger percentage of younger IYC (6-8 months) had higher responsive feeding scores than did the older two age groups (9-11 month, 12-23 months) across countries. Below are the dichotomized scores (low and high) by age group, with the chi-square statistic demonstrating a significant difference by age group in each country, most pronounced in Indonesia (Table 4).

Table 4. Percentage of IYC with high or low responsive feeding scores (dichotomized score) by age group and country

Country	Dichotomized responsive feeding score n (%)			Chi-square
	6-8 months	9-11 months	12-23 months	
Peru				
Low (-1 to 2)	59 (45.0)	97 (75.2)	378 (74.1)	X^2(2, N = 770) = 43.95, p <.001
High (3 to 4)	72 (55.0)	32 (24.8)	132 (25.9)	Cramer's V=0.24 (small effect size)
Nicaragua				
Low (-1 to 2)	47 (52.2)	89 (77.4)	309 (69.3)	X^2(2, N = 651) = 15.35, p <.001
High (3 to 4)	43 (47.8)	26 (22.6)	137 (30.7)	Cramer's V=0.15 (small effect size)
Indonesia				
Low (-1 to 2)	65 (40.6)	126 (80.8)	435 (81.2)	X^2(2, N = 852) = 109.08, p <.001
High (3 to 4)	95 (59.4)	30 (19.2)	101 (18.8)	Cramer's V=0.35 (medium effect size)

In summary, our hypothesis that responsive feeding scores will demonstrate variability within each of three country populations was supported by these findings.

Specific Aim 2. To identify any patterns within the caregiver responses to the standardized responsive feeding questions by age group (6-8 months, 9-11 months, 12-23 months) and by country.
<u>Research question:</u> What are the patterns of caregiver responses to the standardized responsive feeding questions by age group (6-8 months, 9-11 months, 12-23 months), and do these patterns differ by country?

Five questions were used to address the four responsive feeding dimensions, namely, 1) opportunities for child self-feeding, 2) talking positively with the child during meal time, 3) encouraging a child who has not eaten enough, and 4) an appropriate response to child refusal. Results in Table 5 show that most caregivers did not engage in a negative action during the meal to the child. Similarly, an appropriate response to child refusal (or no response if the child did not refuse) were high in Nicaragua and Indonesia. In Peru this occurred less often. Across countries less than one-quarter initiated positive talking with the child during the meal. While a much higher percentage of informants responded affirmatively to talking with the child during the meal (Peru 80.8%; Nicaragua 48.8%; Indonesia 89.8%), the majority of the responses were just telling the child to eat, and not considered positive talk. However, close to one-half of caregivers engaged in an encouraging action during the meal. Appropriate self-feeding occurred in about half the samples in the Latin American context (Peru and Nicaragua) but this was more limited in Indonesia.

Table 5. Responsive feeding dimensions and caregiver responses by country (children 6-23 months)

	Country		
	Peru (n=770)	Nicaragua (n=651)	Indonesia (n=852)
Responsive feeding dimensions	n (%)		
Talking positively with the child	190 (24.7)	149 (22.9)	97 (11.4)
Encouraging action	414 (53.8)	268 (41.2)	453 (53.2)
Appropriate self-feeding	416 (54.0)	351 (53.9)	317 (37.2)
Appropriate response to child refusal or child did not refuse	605 (78.6)	625 (96.0)	832 (97.7)
No negative action	720 (93.5)	635 (97.5)	825 (96.8)

Next, results are presented by age group in each country. In Peru, differences were found in the youngest age group compared to the older two, whereby generally more responsive feeding was found in the youngest age group. The specific dimensions of appropriate self-feeding demonstrated considerable differences between the youngest and the older two age groups. However, for the youngest age group appropriate self-feeding was considered when the mother fed the entire meal to the child or the child self-fed a little (Table 6). For the older age groups, the lower percentage of appropriate feeding responses generally came from mothers feeding the child vs. allowing the children to self-feed.

Table 6. Responsive feeding dimensions by age group in Peru

PERU	6-8 months (n=131)	9-11 months (n=129)	12-23 months (n=510)
Responsive feeding dimensions	n (%)		
Talking positively with the child	40 (30.5)	31 (24.0)	119 (23.3)
Encouraging action	78 (59.5)	73 (56.6)	263 (51.6)
Appropriate self-feeding	122 (93.1)	41 (31.8)	253 (49.6)
Appropriate response to child refusal or child did not refuse	99 (75.6)	99 (76.7)	407 (79.8)
No negative action	126 (96.2)	120 (93.0)	474 (92.9)

In Nicaragua, results demonstrated similar responses across the dimensions of responsive feeding for the various IYC age groups with the exception of appropriate self-feeding, whereby a high percentage (93.3%) of the youngest group, 6-8 months, met this, but less than 20% met it in the 9-11 month age group and a little more than half in the 12-23 months group (55.4%). Across age groups, talking positively to the child during the meal was quite limited with only about one-quarter of caregivers meeting this dimension, yet almost double of this (~40%) offered an encouraging action during mealtime (Table 7).

Table 7. Responsive feeding dimensions by age group in Nicaragua

NICARAGUA	6-8 months (n=90)	9-11 months (n=115)	12-23 months (n=446)
Responsive feeding dimensions	n (%)		
Talking positively with the child	17 (18.9)	31 (27.0)	101 (22.6)
Encouraging action	38 (42.2)	49 (42.6)	181 (40.6)
Appropriate self-feeding	84 (93.3)	20 (17.4)	247 (55.4)
Appropriate response to child refusal or child did not refuse	88 (97.8)	110 (95.7)	427 (95.7)
No negative action	90 (100)	114 (99.1)	431 (96.6)

In Indonesia, results demonstrated similar responses across the dimensions of responsive feeding for the various IYC age groups with the exception of appropriate self-feeding, whereby a high percentage (97.5%) of the youngest group met this dimension, but less than one-quarter of children in the older two age groups met it. Across age groups, talking positively to the child during the meal was quite limited with only between 7 and 12% meeting this dimension, yet more than half offered an encouraging action during mealtime (Table 8).

Table 8. Responsive feeding dimensions by age group in Indonesia

| INDONESIA	6-8 months (n=160)	9-11 months (n=156)	12-23 months (n=536)
Responsive feeding dimensions	n (%)		
Talking positively with the child	16 (10.0%)	12 (7.7)	69 (12.9)
Encouraging action	91 (56.9%)	91 (58.3)	271 (50.6)
Appropriate self-feeding	156 (97.5)	29 (18.6)	132 (24.6)
Appropriate response to child refusal or child did not refuse	157 (98.1)	151 (96.8)	524 (97.8)
No negative action	156 (97.5)	151 (96.8)	518 (96.6)

Using cluster analysis, several patterns were identified with respect to common responses for two of the responsive feeding dimensions with most variability in Peru and Nicaragua. This included 1) talking positively with the child and 2) encouraging the child. Patterns could either support meeting the dimension or not. Indonesia was not included in this analysis because of only allowing one response per questions, whereas in Peru and Nicaragua multiple answers were allowed (e.g. the informant could be coded for two encouraging actions, if mentioned).

Results for the dimension talking positively with the child revealed three common patterns, which accounted for >90% of the responses in Peru and Nicaragua. The majority pattern for this dimension did not meet *talked positively to the child*, rather the child was either just told to eat or not spoken to at all. The second and third pattens included complimenting the child and talking positively to the child about the food (Table 9). Figure 1 shows the 3 common patterns.

Table 9: Patterns of the responsive feeding dimension **Talking Positively** with the child during the meal by age group: Peru and Nicaragua

Talking Positively Patterns	Child age (months)	Peru (n=770) %	Nicaragua (n=651) %
Just tells the child to eat or not talking (considered *not* positive talk)	6-8	69.5	81.1
	9-11	74.4	73.0
	12-23	76.1	76.0
Compliments the child (considered positive talk)	6-8	7.6	10.0
	9-11	8.5	9.6
	12-23	9.0	8.5
Talks to the child about food (considered positive talk)	6-8	13.7	5.6
	9-11	9.3	7.8
	12-23	6.9	7.0
All other responses	6-8	9.2	3.3
	9-11	7.8	9.6
	12-23	8.0	8.5

Figure 1: Three common patterns of the responsive feeding dimension **Talking Positively** with the child during the meal by age group: Peru and Nicaragua
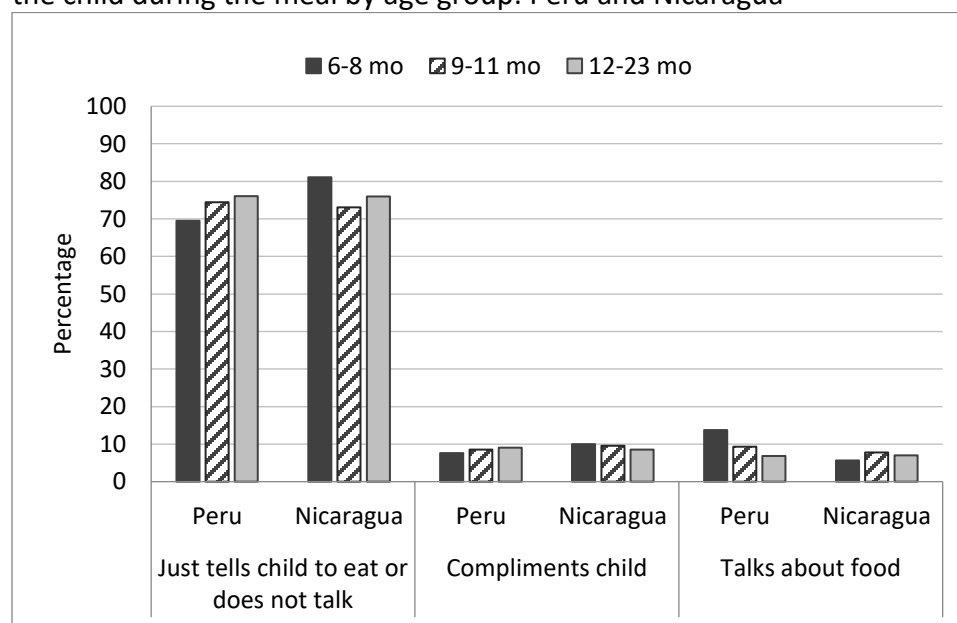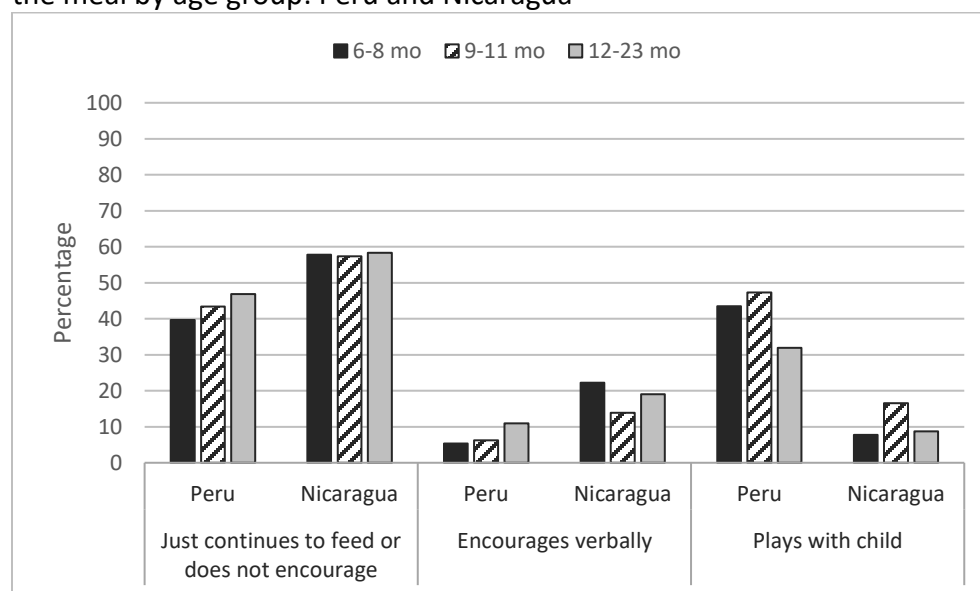

Results for the dimension encourage with the child revealed three common patterns, which accounted for >85% of the responses in Peru and Nicaragua. The majority pattern for this dimension did not meet *encouraged the child*, rather the caregiver just continued to feed the child or did not encourage. The second and third pattens included verbal encouragement and playing with the child (e.g. pretends the spoon is an airplane) (Table 10). Figure 2 shows the 3 common patterns.

Table 10: Patterns of the responsive feeding dimension **Encourage the child** during the meal by age group: Peru and Nicaragua

		Peru (n=770)	Nicaragua (n=651)
Encouragement Patterns	Child age (months)	%	%
Caregiver just continues to feed the child or did not encourage (considered *not* encouragement)	6-8	39.7	57.8
	9-11	43.4	57.4
	12-23	46.9	58.3
Verbal encouragement (considered encouragement)	6-8	43.5	22.2
	9-11	47.3	13.9
	12-23	32.0	19.1
Plays with the child (e.g. pretends the spoon is an airplane) (considered encouragement)	6-8	5.3	7.8
	9-11	6.2	16.5
	12-23	11.0	8.7
All other responses	6-8	11.5	12.2
	9-11	3.1	12.2
	12-23	10.2	13.9

Figure 2: Three common patterns of the responsive feeding dimension **Encourage** child during the meal by age group: Peru and Nicaragua

In summary, the dimensions of responsive feeding were described by age group and country for Peru, Nicaragua and Indonesia. In addition, response patterns were identified for the dimensions talking positively with the child and encouraging the child by age group for Peru and Nicaragua.

Specific Aim 3: To determine the association between age appropriate self-feeding (a component of responsive feeding) and diarrheal illness.

Hypothesis: Self-feeding, a component of responsive feeding, will demonstrate no association with diarrheal illness in children 6-23 months.

Self-feeding is one of the four elements of responsive feeding with the expectation that it increases as children age. This question was scored as a correct feeding practice depending on the age group as follows. For children 6-8 months, either self-feeding "a little time" or not at all (ie. the caregiver feeds) was considered correct. For children 9-11 months, correct self-feeding included "a little time" or "half the time". For children 12-23 months, the responses considered correct for self-feeding were "half the time" or "all the time".

The following results show correct self-feeding in age group by country (Table 11). The majority of children 6-8 months self-fed correctly, with the majority being fed by their caregivers. For children 9-11 months, the majority did not self-feed that should have, and for the oldest age group of children (12-23 months), many did not self-feed or if they did, not the age appropriate amount of time.

Table 11. Percentage of children with correct self-feeding behavior by age and country

	Country		
	Peru (n=770)	Nicaragua (n=651)	Indonesia (n=852)
Correct self-feeding	n (%)		
Children 6-8 months	122 (93.1)	84 (93.3)	156 (97.5)
Children 9-11 months	41 (31.8)	20 (17.4)	29 (18.6)
Children 12-23 months	253 (49.6)	247 (55.4)	132 (24.7)

As noted above in Table 1, diarrhea morbidity was prevalent in the samples, defined as the proportion of children who had experienced at least 3 loose/watery stools per day in the past 2-week period. Nicaragua and Peru had higher a higher proportion of children with diarrhea compared to Indonesia. The following results in Table 12 shows diarrhea percentage by age showing that all age groups experienced it, but some variation did exist, particularly in Nicaragua with higher percentage among the youngest age group.

Table 12. Diarrheal morbidity (%) by age group and country

	Country		
	Peru (n=770)	Nicaragua (n=651)	Indonesia (n=851)[1]
Experienced diarrhea in past 2 weeks	n (%)		
Children 6-8 months	31 (23.7)	39 (43.3)	14 (8.8)
Children 9-11 months	36 (27.9)	45 (39.1)	19 (12.2)
Children 12-23 months	144 (28.2)	151 (33.9)	73 (13.6)
All children 6-23 months	211 (27.4)	235 (36.1)	106 (12.4)

[1] 1 informant answered unknown for child in 12-23 age group, so considered missing

Because of the considerable diarrheal morbidity in these settings and its association with hygiene, a chi-square analysis was conducted to identify any association between self-feeding (ie. child using hands to feed) and diarrhea in the past 2 weeks in the samples. For each of the three countries, contingency tables were constructed for each age group and diarrhea morbidity. Results demonstrated no association between self-feeding and diarrheal morbidity in any age group or country (p >.05), supporting our hypothesis.

We further tested our hypothesis of no association between self-feeding and diarrhea morbidity (YES/NO) by age group in each country using generalized linear models with a logit link, controlling for intervention group (intervention or control). Results demonstrated no association between self-feeding and the odds for diarrhea, controlling for intervention group (Table 13).

Table 13. Association of self-feeding and outcome diarrhea morbidity: generalized linear models by age group and country.

	Country		
	Peru	Nicaragua	Indonesia
	OR (95% CI)		
children 6-8 months **Self-feeding**			
yes	1.12 (.22, 5.86)	.35 (.06, 2.06)	N/A[1]
no (reference)	1.00	1.00	
Intervention group			.77 (.25, 2.34)
intervention	.55 (.24, 1.24)	1.05 (.43, 2.58)	1.00
control (reference)	1.00	1.00	
children 9-11 months **Self-feeding**			
yes	2.21 (.98, 4.95)	1.04 (.39, 2.78)	.21 (.03, 1.63)
no (reference)	1.00	1.00	1.00
Intervention group			
intervention	.90 (.41, 1.97)	1.18 (.51, 2.72)	1.12 (.42, 2.97)
control (reference)	1.00	1.00	1.00
children 12-23 months **Self-feeding**			
yes	.95 (.65, 1.4)	1.26 (.84, 1.87)	.80 (.44, 1.48)
no (reference)	1.00	1.00	1.00
Intervention group			
intervention	.80 (.54, 1.18)	.67 (.43, 1.05)	.53 (.32, .87)*
control (reference)	1.00	1.00	1.00

*<.05; [1]OR extremely high due to the small n in the reference category

In addition, the responsive feeding score, categorized dichotomously as fed responsively (score 3-4) or not fed responsively (score -1 to 2) was analyzed for an association with the outcome of diarrhea using a chi-square analysis. No association was found in Peru (X^2(1, N = 770) = .414, p = .52) or Nicaragua (X^2(1, N = 651) = .172, p = .68), signifying that responsive feeding was independent of diarrhea morbidity (not associated). In Indonesia a significant association was found between <u>*not*</u> responsively feeding and diarrhea (X^2(1, N = 851) = 8.16, p = .004).

In summary, our hypothesis of no association between self-feeding and diarrhea was supported by these findings.

Specific Aim 4. To determine the association between responsive feeding and the WHO indicator minimum acceptable diet (MAD), a composite indicator of two other WHO indicators (minimum dietary diversity (MDD) and minimum meal frequency (MMF)).
Hypothesis: Higher responsive feeding scores will demonstrate an association with children 6-23 months consuming a minimum acceptable diet.

Table 14 shows the proportion of children meeting the indicators of MAD, MDD and MMF by country. Results demonstrate that MMF was met by a higher proportion of IYC than either MDD or MAD across countries. MDD was met by a high percentage of IYC in Peru (92%) but only half in Nicaragua (52%) and less than one-quarter in Indonesia (17%). MDD, the combination indicator was met by a lower percentage across countries, but similar to MDD showed large differences among countries. with Peru the highest, followed by Nicaragua and Indonesia.

Table 14. Percentage of IYC meeting MDD, MMF and MAD by country

	Country		
	Peru	Nicaragua	Indonesia
	n (%)		
Met minimum dietary diversity (MDD)	(n=770) 709 (92.1)	(n=651) 339 (52.1)	(n=852) 146 (17.1)
Met minimum meal frequency (MMF)	(n=756) 681 (90.1)	(n=604) 459 (76.0)	(n=846) 779 (92.1)
Met minimum acceptable diet (MAD)	(n=756) 597 (79.0)	(n=604) 228 (37.7)	(n=846) 108 (12.8)

Generalized linear models were run to determine the association between responsive feeding and meeting MAD (yes/no). The dichotomous responsive feeding variable was used (high responsive feeding +3 to 4 points, low responsive feeding -1 to +2). Within each country, unadjusted models were run with the intervention and control groups together as well as separated. Results demonstrated no association in any of the models between responsive feeding and MAD in all three countries. Results from the unadjusted models with the combined intervention and control groups follow (Table 15)

Table 15. Association between responsive feeding and the outcome, meeting a minimum acceptable diet (MAD), by country: Unadjusted generalized linear models.

	Country		
	Peru (n=756)	Nicaragua (n=604)	Indonesia (n=846)
	n (%)		
Responsive feeding score			
Low (-1 to 2) (reference)	1.00	1.00	1.00
High (3 to 4)	1.23 (.83, 1.82)	1.32 (.93, 1.87)	1.31 (.84, 2.03)

Next, multivariate models were run. Covariates were tested in the models while controlling for intervention group and responsive feeding score. Results of the final multivariate models demonstrated that a high responsive feeding score (versus low) was associated with significantly higher odds of MAD in Indonesia (p = .044), but not in Peru or Nicaragua. The intervention group also had significantly higher odds for MAD in Indonesia and Nicaragua, but not in Peru. Other significant covariates depended on country including child age group, food security, and informant education in Indonesia, diarrheal morbidity in Nicaragua, and food security in Peru (Table 16).

Thus, our hypothesis was partially supported in Indonesia (supported in the adjusted model, but surprisingly not in the unadjusted model), but not in Peru or Nicaragua.

Table 16. Responsive feeding, Intervention group, Child Age Group and other factors associated with the outcome, meeting a minimum acceptable diet (MAD), by country: Multivariate generalized linear models.

	Country		
	Peru (n=756)	Nicaragua (n=604)	Indonesia (n=846)
Variables[1]	n (%)		
Responsive feeding score			
Low (-1 to 2) (reference)	1.00	1.00	1.00
High (3 to 4)	1.32 (.87, 2.00)	1.25 (.87, 1.80)	1.65 (1.01, 2.70)*
Intervention group			
control (reference)	1.00	1.00	1.00
intervention	1.17 (.82, 1.67)	1.76 (1.18, 2.64)**	1.52 (.96, 2.40)
Child age group			
6-8 months (reference)	1.00	1.00	1.00
9-11 months	1.86 (.99, 3.48)	.95 (.52, 1.74)	2.62 (1.02, 6.73)*
12-23 months	1.46 (.91, 2.32)	1.04 (.63, 1.71)	4.67 (2.08, 10.48)***
Household Food security			
Insufficient quantity	1.00	----	1.00
Sufficient quantity	1.96 (1.02, 3.78)*		1.88 (1.12, 3.17)*
Child Health			
No diarrhea in past 2 weeks	----	1.00	----
Diarrhea in past 2 weeks		.56 (.38, .78)**	
Informant education level			
Less education	----	----	1.00
More education			3.06 (1.48, 6.33)**

*p<.05; **p<.01; ***p<.001
[1]Initial variables tested for the multivariate model in each country included all those in the table and in addition, sex of the child, cough in the past 2 weeks, and informant age.

5. Recommendations

Responsive feeding during mealtime is a vital component to optimal feeding and care practices during the first 2 years of life, a time period critical for optimal growth and development. This original research demonstrated that cross-sectional survey questions on responsive feeding analyzed using an a priori algorithm produced good variability in responsive feeding scores (-1 to +4) across age groups, in diverse country settings (Peru, Nicaragua and Indonesia). The responsive feeding score was then dichotomized to indicate low or high responsive feeding (the later being the goal). Results found that the majority of informants engaged in low responsive feeding when they fed their children. Patterns were identified among the responsive feeding dimensions which indicate potential areas for intervention to improve responsive feeding at the population level. Importantly, the responsive feeding dimension of self-feeding was not associated with increased diarrheal morbidity. Finally in multivariate models, responsive feeding was associated with the WHO indicator of MAD in Indonesia, but not in Peru or Nicaragua. In conclusion, this research provides evidence that responsive feeding can be quantified for survey research and supports the use of these dimensions and algorithm in future studies.

Recommendations for further analysis and research from this study include the following:

1. Test the dichotomous responsive feeding score in models with the outcome of minimum dietary diversity and minimum meal frequency using the current datasets.
2. Test a different cut-off point for RF and re-test in models with the outcome MAD using the current datasets.
3. Investigate the current responsive feeding algorithm with larger samples for the younger age groups.
4. Investigate qualitatively as to whether caregivers in different contexts recognize when their child does not eat sufficient quantity (validation was conducted in Peru)
5. Simplify the potential responses to the responsive feeding questions based on those found most frequent across countries.
6. Test the score with developmental outcomes in addition to nutritionally based outcomes.
7. Develop interventions to address and test the different dimensions of responsive feeding that are context specific (e.g. talking positively with the child during the meal, providing opportunities to self-feed).

References

Abebe, Z., Haki, G. D., & Baye, K. (2017). Child feeding style is associated with food intake and linear growth in rural ethiopia. *Appetite, 116*, 132-138. 10.1016/j.appet.2017.04.033 Retrieved from http://proxycu.wrlc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=28461197&site=ehost-live

Bentley, M. E., Wasser, H. M., & Creed-Kanashiro, H. M. (2011). Responsive feeding and child undernutrition in low- and middle-income countries. *The Journal of Nutrition, 141*(3), 502-507. 10.3945/jn.110.130005 [doi]

Black, M. M., Walker, S. P., Fernald, L. C. H., Andersen, C. T., DiGirolamo, A. M., Lu, C., . . . Grantham-McGregor, S. (2017). Early childhood development coming of age: Science through the life course. *Lancet (London, England), 389*(10064), 77-90. 10.1016/S0140-6736(16)31389-7 Retrieved from http://proxycu.wrlc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=27717614&site=ehost-live

Creed-Kanashiro, H. M., Engle, P. L., Bartolini, R., Abad, M., & Marin, M.*Complementary feeding and responsive feeding behaviours and indicators in peru. infant and young child feeding indicators validation study.* (2010). Instituto de Investigacion Nutricional: unpublished report.

Engle, P. L., & Pelto, G. H. (2011). Responsive feeding: Implications for policy and program implementation. *The Journal of Nutrition, 141*(3), 508-511. 10.3945/jn.110.130039 Retrieved from http://proxycu.wrlc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=21270361&site=ehost-live

Engle, p., & Menon, p. (1999). Care and nutrition: Concepts and measurement. *World Development, 27*(8), 1309-1337.

Flax, V. L., Makinen, S., Ashorn, U., Cheung, Y. B., Maleta, K., Ashorn, P., & Bentley, M. E. (2013). Responsive feeding and child interest in food vary when rural malawian children are fed lipid-based nutrient supplements or local complementary food. *Maternal & Child Nutrition, 9*(3), 369-380. 10.1111/j.1740-8709.2011.00377.x [doi]

Pan American Health Organization (PAHO). (2003). *Guiding principles for complementary feeding of the breastfed child.* (). Washington, D.C.: Pan American Health Organization.

Silva, G. A. P., Costa, K. A. O., & Giugliani, E. R. J. (2016). Infant feeding: Beyond the nutritional aspects. *Jornal De Pediatria, 92*(3), S7. 10.1016/j.jped.2016.02.006 Retrieved from http://proxycu.wrlc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=26997355&site=ehost-live

Vazir, S., Engle, P., Balakrishna, N., Griffiths, P. L., Johnson, S. L., Creed-Kanashiro, H., . . . Bentley, M. E. (2013). Cluster-randomized trial on complementary and responsive feeding education to caregivers found improved dietary intake, growth and development among rural indian toddlers. *Maternal & Child Nutrition, 9*(1), 99-117. 10.1111/j.1740-8709.2012.00413.x Retrieved from http://proxycu.wrlc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=22625182&site=ehost-live

World Health Organization. (2008). *Indicators for assessing infant and young child feeding practices. part I: Definitions*. Geneva: WHO Press.

Appendix 1

UNICEF's Extended Model of Care