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DOES INTRODUCTION OF A BOWL IMPROVE THE VOLUME OF CHILD MEALS IN SAMFYA DISTRICT ZAMBIA?

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Executive Summary

A child's experience with nutrition during the first two years of life, the first 1,000 days, mostly determines her or his adult nutritional status; stunting that develops during this period, if not corrected, will persist for a lifetime. In 2012, the Ministry of Health (MOH), Ministry of Child Development, Maternal and Child Health (MCDMCH) and the National Food and Nutrition Commission (NFNC) launched a national First 1,000 Most Critical Days Program (First 1,000 MCDP) to reduce the high rates of stunting in children. Critical to influence a child's growth and nutritional status and reduce stunting are numerous feeding practices. The amount of food a child consumes is one of these practices. In low-income settings like Zambia, mothers often feed small portions based on misunderstandings or traditions that underestimate the amount a child can (or should) eat. No data exist to document the extent of this problem in Zambia, but experiences from other countries with similar conditions suggest that the problem is widespread. Aligning to this national program, the U.S. Agency for International Development (USAID)-funded Communications Support for Health (CSH) project designed and implemented a nutrition communication program with selected Civil Society Organizations (CSOs) in their communities to pilot communication activities and behavior change products to improve infant and young child feeding (IYCF) for later inclusion in the First 1,000 MCDP.

Mothers participating in the CSH Nutrition Program attended bimonthly peer group meetings, led by a Nutrition Promoter. Group activities included cooking demonstrations, games, and discussions to help caregivers adapt key 1,000 Day practices to their own everyday situations and to encourage them to use the CSH products that included a specially designed, graduated, child feeding bowl to help mothers visualize meal volumes. Prior to the adoption of the CSH products by the National First 1,000 MCDP, the child feeding bowl was the subject of a rigorous review of its effectiveness to increase meal volumes among infants and young children (IYC) 6-24 months.

A randomized controlled trial was conducted, with three treatment groups, to test the effectiveness of the bowl for increasing meal volumes in comparison with a standard bowl and a control. All groups received counseling on age-appropriate meal volumes specific to the IYC. Each child was visited once for the baseline interview and the introduction of the treatment, and then again for a follow-up visit done by the same research assistant 7 to 10 days after the first visit. At the first visit, research assistants measured the volumes served and fed to each child at the first two meals of the day. Following the second meal they provided the randomized treatment to the caregiver, including appropriate age-based counseling, and set an appointment to return the next week. At the follow-up visit, research assistants measured the volume of the first two meals of the day and, following the second meal, they provided nutrition counseling on the child's overall diet. Every household received the specially designed child feeding bowl at this time if they did not have it already.

Over 300 children in Samfya District, Zambia (one of the CSO project areas) were screened for enrollment. Children were excluded if they were malnourished, sick with diarrhea, cough and/or fever, or were older or younger than the study desired age group (9 to 17 months). 237 mother-child pairs were included in the study and randomized for treatment.

Key Findings:

The hypothesis that introducing the specially designed child feeding bowl would improve amounts of food consumed at mealtime was not proven in this study. However, providing a separate bowl for use in child feeding resulted in a substantial and statistically significant increase in the mean amount of food

consumed. The baseline to follow-up change over two meals was 52 ml—nearly 4 tablespoons—greater in the standard bowl group in comparison with the change in the control group. All groups received the same counseling, so the introduction of a separate bowl was the sole factor responsible for an increase in food consumed; this is an important finding in light of the overall low amounts for food consumed by IYC at each meal. (Notably, except for the morning meal at the follow-up visit, in no treatment group did the percentage of children consuming the minimum recommended volume exceed 20%.)

Providing an IYC with a separate bowl undoubtedly helps the caregiver to visualize the amount of food served and consumed and, presumably, results in more attention to child feeding. But the lack of effect from the child feeding bowl was confusing considering the effect observed with the standard bowl. Possible explanations and their implications along with recommendations for the child feeding bowl and its use include:

The standard bowl was much larger than the child feeding bowl. The standard bowl may have been effective simply because it was larger.

The concept of feeding the *minimum* was not well understood. Caregiver responses suggested that many were unclear that the graduations on the child feeding bowl show the *minimum* amount of food the child needs to eat. A different counseling approach for building understanding of the graduations as minimums might produce a different result.

Responsive feeding must be emphasized. While a bowl alone helps improve the amount consumed, it does not ensure that the IYC consumes an *adequate* quantity of food; the caregiver must play an active role to ensure the child consumes enough food.

Adding an additional meal at 9 months must be emphasized. The recommended food amounts used to create the child feeding bowl presume the increase in feeding frequency to three times daily from 9 months onwards. Casual observations during the study as well as DHS data suggest that households often consume only two meals per day, and child feeding frequency (the number of daily meals) is often less than recommended.

The shape or design of the child feeding bowl can be improved to better accommodate the Zambian feeding style. The shape or design of the child feeding bowl could be modified to better accommodate the Zambian feeding style. For example, the shape of the child feeding bowl makes finger feeding inconvenient. Difficulty in using the bowl for finger feeding may have interfered with the potential benefits of having a separate bowl to visualize the amount of food being fed. Additionally, mid-day meals usually comprise *nshima* and relish, and normally are fed using two containers. Combining *nshima* and relish in the child feeding bowl is difficult due to the small diameter of the bottom section of the bowl (amount to feed infants 6-8 months). The standard bowl has a much larger diameter and gently sloping sides, allowing more room for placing *nshima* and relish without actually mixing them together. The design of the child feeding bowl could be improved to accommodate this common food practice.

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Many individuals made this study a reality, the most important being the caregivers in Samfya who allowed us into their homes more than once to observe mealtimes. They were generous and interested participants making the field work a pleasure.

The study team providing technical leadership, study oversight, data analysis and report writing was Thomas Schaetzel (Senior Advisor, Nutrition and Agriculture), Marcia Griffiths (President) and Melissa Antal (Community Nutrition Specialist) from the Manoff Group and Attracta Tembo (Nutrition Advisor, CSH).

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We dedicate this study to Abraham Zulu, our friend and colleague.

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Acronyms

ANCOVA	Analysis of Co-variance
CSH	Communications Support for Health Program
CSO	Civil Society Organizations
DHS	Demographic and Health Survey
GFC	Group Focused Consultants
HAZ	Height for Age Z-score
IYC	Infant and Young Children
MCDMCH	Ministry of Community Development, Maternal and Child Health
MCDP	First 1,000 Most Critical Days Program
ml	milliliters
MOH	Ministry of Health
NFNC	National Food and Nutrition Commission
USAID	United States Agency for International Development
WAZ	Weight for Age Z-score
WHZ	Weight for Height Z-score

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Background

Why Increase Meal Volumes?

A child's experience with nutrition during the first two years of life mostly determines her or his adult nutritional status; stunting that develops during this period, if not corrected, will persist for a lifetime. Proper feeding during these two years thus is highly important and, in theory, straight forward: children simply need to consume sufficient energy and nutrients to meet their needs for activity, metabolism, and growth. Even with adequate resources, however, meeting these requirements in practice can be difficult because many factors influence whether a child receives adequate amounts of food of adequate quality.

The amount of food an infant and young child (IYC) receives is influenced by three factors: whether there are adequate resources for obtaining food; the amount of food fed at each meal, and the number of daily meals. While many families face real resource constraints, the amount of food that children younger than two years consume is relatively small and the majority of Zambian households is able to provide it. Little information exists about the size of meals that Zambian IYC receives, but information on meal frequency from the Demographic and Health Survey (DHS) shows that large numbers of children are not fed frequently enough: 55.5% of IYC are fed with minimally adequate frequency. At 6-8 months nearly three-quarters of infants meet the minimum standard, but at the ages of 9-11 months, when the number of daily meals should rise, the percentage meeting the minimum falls to 43.5%, rising only slightly to just over 50% meeting the minimum during the second year of life. Thus more than half of IYC are not being fed often enough from 9 through 23 months, and 1 in 4 infants 6-8 months fail to meet the minimum meal frequency standard. The low feeding frequency means that when children do eat, the amount they consume must meet at least the minimum recommended volume, or appropriate amount.

Meeting the nutritional requirements of an IYC also requires adequate dietary quality, both in terms of nutrient availability, and energy and nutrient density. The 2007 DHS shows the percentage of IYC meeting a minimum standard for dietary diversity is 68.6% overall, ranging from 50.6% among children 6-8 months to 68.6% among children 9-11 months, to roughly 75% in the second year of life. Thus, the majority of children in Zambia meet a minimum standard of dietary diversity. At the same time, formative research conducted for the Communications Support for Health (CSH), a United States Agency for International Development (USAID) Project in Zambia, found that the quality of food that children receive often is of low energy and nutrient density, as IYC are fed watery porridge or *nshima* with substantial amounts of soup or broth. When the energy and nutrient density of a child's diet is low, ensuring that the child consumes an appropriate amount at each meal is even more important.

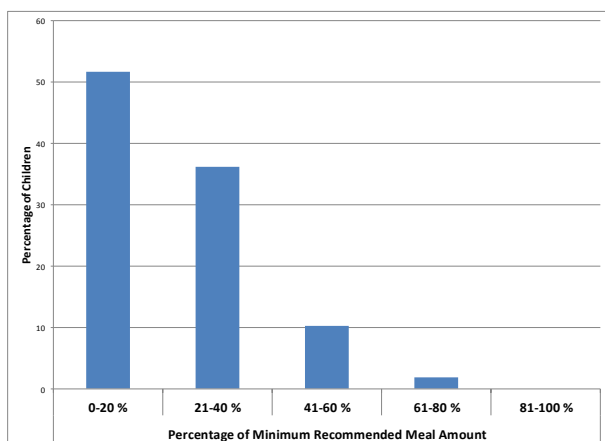
The child's growth and nutrition suffer substantially if in addition to feeding low energy/nutrient density foods or not feeding often enough, caregivers feed *smaller amounts* than the child needs. Growing children have high energy and nutrient needs but small stomachs, so their stomach needs to be filled often and filled to capacity at each meal—especially when the food is of low energy and nutrient density. In fact, IYC naturally tend to increase the amount they consume at each meal to make up for foods of low energy density or for inadequate meal frequency¹. If inadequate meal amounts prevent this natural

¹ Fox *et al*, 2006

response, with even a few days of inadequate amounts a child may become anorexic, not feeling hungry and consuming even less.

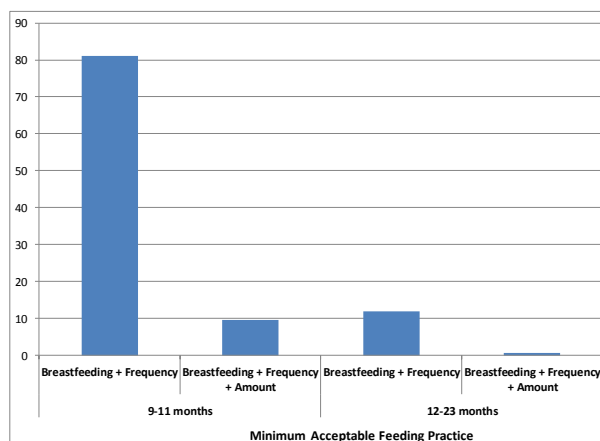
In low-income settings like Zambia, mothers often feed small portions based on misunderstandings or traditions that underestimate the amount a child can (or should) eat. No data exist to document the extent of this problem in Zambia, but experiences from other countries with similar conditions suggest that the problem is widespread. The following example from Andhra Pradesh in India (Figure 1) demonstrates the percentage of children who received the appropriate amount of food. Virtually no children consumed as much as 80% of the recommended minimum amount, and more than half of children assessed consumed less than 20% of the recommendation.

Figure 1. Percentage of recommended meal amount consumed by children aged 12-23 months in Andhra Pradesh.



Source: Srikantiah, S unpublished data

Figure 2. Feeding practices for Honduran infants and young children 9-23 months participating in AIN-C.



Source: BASICS III AIN-C Evaluation Report

A similar example, from an evaluation of USAID support to the AIN-C program in Honduras (Figure 2), shows the percentage of children whose mothers reported following a recommendation for a minimum number of tablespoons of food. Among children 9-11 months nearly all were breastfeeding and receiving the recommended number of meals, but only 10% met the feeding recommendation when factoring in the amount fed at each meal. Among children in their second year the situation was worse, with barely 10% receiving an appropriate number of meals (with breast milk) and almost none meeting the standard based on meal amounts.

One way to improve the amount fed at each meal might be to help mothers visualize how much they should try to feed in a meal—an amount that would at least ensure that the child’s stomach is reasonably full after each meal. The Manoff Group devised a “child feeding bowl” for this very purpose over twenty years ago in El Salvador and since then it has been adapted for use in at least six countries. The bowl has “stepped” graduations indicating the minimum amount to be fed from 6-8 months, 9-11 months, and 12-23 months.

Introducing a Child Feeding Bowl in Zambia

In 2012, the Ministry of Health (MOH), Ministry of Child Development, Maternal and Child Health (MCDMCH) and the National Food and Nutrition Commission (NFNC) launched a national First 1,000 Most

Critical Days Program (First 1,000 MCDP). Aligning to this national program, the USAID-funded CSH project designed and implemented a nutrition communication program with selected Civil Society Organizations (CSOs) in their communities to improve nutrition-related practices and care-seeking behaviors. One aim of the CSH program was to pilot communication activities and behavior change products for the First 1,000 MCDP. Mothers participating in the CSH Nutrition Program attended bimonthly peer group meetings, led by a Nutrition Promoter. A guide was developed to support these community volunteers to conduct peer group meetings based on a 13-part radio series. Activities included cooking demonstrations, games, and discussions to help caregivers to adapt key 1,000 Day practices to their own everyday situations and to encourage them to use the CSH products. The CSH products included a reminder card with key nutrition-related practices summarized by age group, a child feeding mat, a meal planning game and a specially designed, graduated, child feeding bowl to help mothers visualize meal volumes.

Using the design of previous graduated feeding bowls, the shape and amounts of the gradations were specifically adapted to the Zambian context, in consultation with NFNC and non-government nutrition stakeholders working in Zambia. The Zambian bowl's three volume measurements are in accordance to norms established by the World Health Organization (WHO) and United Nations Child Fund (UNICEF)². Each gradation corresponds to the approximate functional gastric capacity of most children: 125 ml at the ages of 6-8 months (assuming two meals/day), 150 ml at 9-11 months (assuming three meals/day) and 250 ml for the 12-23 months (assuming three meals/day). Using this bowl to feed their child, mothers have a visual "target" amount to feed.

Prior to the adoption of the CSH products by the National First 1,000 MCDP, the child feeding bowl was the subject of a rigorous review of its effectiveness to increase meal volumes among IYC 6-24 months.

Methods

In August and September of 2014, a randomized controlled trial was approved and conducted to assess the effectiveness of the child feeding bowl for prompting feeding of the recommended age-appropriate meal volumes. The study was led by The Manoff Group, under the USAID-supported CSH project and conducted in partnership with NFNC and Group Focused Consultants (GFC), a local CSO operating in Samfya with nutrition programming funding from CSH.

Study Area

The site selected for the study was Samfya, Luapula Province in Zambia. Three main factors influenced the study location: first, CSH was working in this area with a strong implementing partner, GFC; second, households are relatively close to each other and the distance between the town of Samfya and the communities is reasonable for daily travel by research assistants and, third the government was active in the area with community-based growth promotion programming. Study communities included were Chakaba, Chikombola, Chilemu, Chilumba, Chilupula, Chisalo, Chitambo, Kabanga, Kamangu, Kapo Bwala, Kapitolo, Kasoma, Katulwende, Kosta, Kulelwa, Lupili, Malombola, Maximo, Nshindano, Sambwa, Shimaleba, Yonda, and Yuku. In each community, either GFC or the government had an active nutrition program.

² World Health Organization and UNICEF. (2006) Infant and young child feeding counselling: an integrated course.

Ethical Review

The ERES Converge Ethical Review Board approved the study on August 24, 2014. Further approvals and notifications were provided to NFNC, the Ministry of Health and the District Commissioner and the District Medical Officer in Samfya. All study participants were fully informed of the purpose of the study and what to expect through participating, and that they were free to withdraw at any time. All individuals who participated or were photographed gave written consent.

Study Design and Data Collection

The study aimed to test whether use of the specially designed, graduated child feeding bowl indicating appropriate meal volumes increases the amount of food consumed by IYC participating in a community nutrition program.

Three study groups were formed:

- 1) caregivers and IYC using the child feeding bowl,
- 2) caregivers and IYC using a standard bowl—one bought on the local market (to isolate the effect of using the child feeding bowl with marked volumes for age from the effect of introducing a separate bowl in a setting where IYC generally are not fed from a separate bowl), and
- 3) caregivers continuing with their usual practice (to isolate the effect of using a separate bowl from the effect of receiving infant and young child feeding counseling).

Caregivers in all groups were counselled on appropriate meal volumes according to their child's age. Enrollment of caregivers and IYC was restricted to IYC ages 9-18 months because during these ages the recommended meal volumes increase most substantially.

Box 1: Features of the child feeding bowl versus the standard bowl.



The primary comparisons were:

1. Mean meal volume for IYC whose mothers use a standard bowl, versus mean meal volume for children whose mothers do not receive a bowl;
2. Mean meal volume for IYC whose mothers use the child feeding bowl vs. mean meal volume for children whose mothers do not receive a bowl, and;
3. Mean meal volume for IYC whose mothers use the child feeding bowl vs. mean meal volume for children whose mothers use a standard bowl.

Mothers of children in the selected communities and within the restricted age group were screened for inclusion in the study. Prior to screening, informed consent was obtained. The screening questionnaire was completed and those qualifying for the study arranged a time for meal observation the following day. Exclusion criteria applied during the screening process were malnutrition (WAZ, HAZ, or WHZ < -2), or illness (current fever, diarrhea or cough that affected appetite). Additionally, mothers were excluded if they were not available for the follow up visit, scheduled for approximately one week later. Any child identified at screening as severely underweight or severely ill was referred to the health center.

A standard process was used to randomize the mother-child pairs into treatment groups. Lists of children who met the screening criteria were ranked from youngest to oldest. Then every three children in rank order were randomly assigned to one of the three treatments.

Each household was visited twice. At the first visit, research assistants administered a short survey about general feeding practices and basic demographic information. Meal volume was observed and measured for the first and second meals of the day. Following the second meal all study participants received the same standardized nutrition counseling on the appropriate, age-based quantity of food the child should eat at each meal. Additionally, all mothers received a reminder card showing pictorial demonstrations of the adequate amounts. Seven to ten days later research assistants returned to the household to observe and measure the first and second meals of the day.

Research assistants used the following standard process to measure meal volume using the bowl that the mother used to feed the infant or young child, a non-toxic grease pencil, and a graduated cylinder:

1. The research assistant observed the mother filling the child's bowl, and marked the upper level of food using a grease pencil. If mothers using the graduated feeding bowl filled it to the top of the relevant graduation for the child's age marking was not necessary (the volume of the bowl is known).
2. The research assistant observed, from a non-interfering distance, the mother feeding the meal. There was no time pressure placed on the caregiver to complete feeding.
3. When feeding was finished, the research assistant again used the grease pencil to mark the level of remaining food.
4. After asking the mother to remove any uneaten food from the bowl and thoroughly cleaning the child's bowl, the research assistant: a) filled the bowl with water up to the "full" grease pencil mark, then measured and recorded this volume of water using the graduated cylinder; and b) filled the bowl with water up to the "finished" grease pencil mark, then measured and recorded this volume of water using the graduated cylinder.
5. If the child ate more than one bowlful of food the research assistant noted the full amount and then the amount in the additional serving on the recording form.
6. If the child consumed food from more than one bowl, the research assistant marked the bowls separately and then followed steps 1-4.

For those caregivers who were not planning to feed their child using a separate bowl, the research assistants asked if they could use a bowl or plate in the household on this occasion because they needed to be able to measure what the child consumes. Also, if the child was eating foods that could not easily be measured by marking the level on the bowl, the research assistants were equipped with rulers to measure the width, length and depth of the piece of food (bread, banana or very stiff *nshima*). If a child was served amorphous foods in a container (for example, yogurt) or served a drink, the volumes were measured using the process described above.

Sample size was determined using the sample size calculator for ANCOVA developed by JH McDonald at the University of Delaware.³ Volume-based estimates of IYC meal size were not available from the literature, so weight-based estimates were used for estimating sample size. Mean weight of a consumed meal was estimated, using data from Lukmanji et al (1988) and Mosha and Svanberg (1990), to be 236g, with a standard deviation of 105g. To detect a 20% change in meal weight (47g) at $\alpha = 0.05$ with 80% power requires 40 individuals in each group if the intra-individual correlation between baseline and follow-up meals is 0.50 (a higher correlation, which is likely, would require fewer individuals per group). To allow for multiple comparisons between groups, a Bonferroni-type adjustment was made, using $\alpha = 0.05/3$ for three comparisons, giving an estimated 53 individuals needed for each group. To allow for exclusion of sick or severely malnourished children (whose diminished appetites impact feeding habits), drop-out and other loss to follow-up 65 caregiver-IYC pairs were enrolled for each group.

Prior to data collection, twenty research assistants and three supervisors were trained over three days. The training program included intensive practice on measuring food volumes and counseling, and a field test of the study materials. Eighteen research assistants were selected from the group and the remaining two were made alternates. Throughout the data collection, supervisors provided spot checks and observed interviews and meal measurements throughout the study. Each day research assistants met with supervisors to make sure all forms were complete and submitted.

Data Management and Analysis

Meal amount calculations were performed by computer to avoid calculation errors in the field. All data were entered twice, after which the two databases were checked against each other for agreement. Correction of discrepancies found through this comparison logic checks were made, with individual data forms reviewed against inputted data for values found to be erroneous or questionable. Prior to analysis, records with implausible values remaining after the logic check and review process were dropped. Statistical analysis was performed using STATA version 12.

Results

Characteristics of Participants

A total of 186 mother-child pairs were entered into the analysis. No differences between groups were found at baseline for caregiver's age, IYC age, or food security status (Household Hunger Score). The median age of caregivers was 26 years, with 65% younger than 30 years and nearly 42% younger than 25 (Table 1). Infants and children were enrolled if they were between the ages of 9 and 19 months, and the mean age was 13.1 months. Approximately 40% of participants were infants (under 12 months old) (Table 2).

³ (available at <http://udel.edu/~mcdonald/statancova.html>)

Table 1. Age distribution (years) of caregivers by treatment group.

Caregiver's Age (years)	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
< 20	6 (9.1)	9 (13.2)	11 (21.2)	26 (14.0)
20-24	23 (34.9)	18 (26.5)	14 (26.9)	55 (29.6)
25-29	16 (24.2)	18 (26.5)	6 (11.5)	40 (21.5)
30-34	12 (18.2)	12 (17.7)	13 (25.0)	37 (19.9)
35-39	6 (9.1)	8 (11.8)	5 (9.6)	19 (10.2)
40+	3 (4.6)	3 (4.4)	3 (5.8)	9 (4.8)
Total	66 (100.0)	68 (100.0)	52 (100.0)	186 (100.0)

Table 2. Age distribution (months) of infants and children by treatment group.

Infant/Child Age (months)	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
9-11	27 (40.9)	30 (44.1)	17 (32.7)	74 (39.8)
12-19	39 (59.1)	38 (55.9)	35 (67.3)	112 (60.2)
Total	66 (100.0)	68 (100.0)	52 (100.0)	186 (100.0)

Food insecurity was common among the study population, with roughly 44% of households experiencing moderate hunger, and 21% experiencing severe hunger according to the Household Hunger Score (Table 3).⁴

⁴ See www.fantaproject.org

Table 3. Food insecurity among study participants, according to the Household Hunger Score, by treatment group.

Household Hunger	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
Some hunger	40.9	44.1	48.1	44.0
Severe hunger	24.2	19.1	19.2	21.0

Most households had a total of two children under five years, and one child (the index child) under two years. At the same time, most households also tended to have more than two individuals of adult age who could serve as caregivers for the child (Table 4).

Table 4. Mean number in household of children under 5 years and 2 years, and adults, by treatment group and total.

Household Members	Treatment			Total
	Child Feeding Bowl	Standard Feeding Bowl	No Bowl	
Children under 5 years	2.1	1.9	2.1	2.0
Male	1.1	0.9	1.2	1.0
Female	1.0	1.0	0.8	1.0
Children under 2 years	1.2	1.1	1.2	1.2
Male	0.6	0.6	0.8	0.6
Female	0.5	0.6	0.5	0.5
Adults 19 years and older	2.4	2.5	2.6	2.5
Male	1.0	1.1	1.1	1.1
Female	1.4	1.4	1.5	1.4

The majority of participants lived in houses with brick walls, thatch roofs, and mud floors. By far the majority of households obtained water for drinking and cooking from a well, although the most common well source for households in the child feeding bowl and no bowl groups was a well contained within their dwelling. The most common source for the standard bowl group was a protected well outside the dwelling (Table 5).

Table 5. Dwelling construction and water source, by treatment group.

Dwelling characteristic	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
Wall construction				
Mud	21.4	16.4	6.9	15.4
Brick	65.7	69.9	75.9	70.2
Cement	12.9	13.7	17.2	14.4
Roof Construction				
Thatch	64.3	63.0	60.3	62.7
Tin/iron sheets	35.7	37.0	39.7	37.3
Floor construction				
Mud	57.1	64.4	63.8	61.7
Cement	41.4	34.3	34.5	36.8
Tile	1.4	1.4	1.7	1.5
Water source				
Pipe within dwelling	7.1	9.6	7.0	8.0
Pipe outside dwelling, on property	4.3	5.5	1.8	4.0
Well within dwelling	32.9	20.6	36.8	29.5
Well outside dwelling, protected	27.1	35.6	29.9	31.0
Well outside dwelling, unprotected	24.3	16.4	19.3	20.1
Pond, river	4.3	12.3	5.3	7.5

Feeding Style

Feeding style was consistent across all groups. Caregivers stayed close to the IYC in almost all cases (Table 6). Children ate primarily while seated on the caregiver’s lap at both meals, with a higher percentage seated on the ground at the mid-day meal than at the morning meal (Figures 4 and 5). Children’s food overwhelmingly was kept on the floor or ground, almost always on a plastic mat, regardless of whether or not caregivers used a bowl (Figures 6 and 7),.

Table 6. Location of caregiver, by treatment group and total.

Caregiver “close during feeding”	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
Baseline Morning	93.9	98.5	100.0	97.3
Follow-up Morning	97.0	97.1	100.0	97.9
Baseline Mid-day	95.5	92.7	100.0	95.7
Follow-up Mid-day	98.5	95.6	92.3	95.7

Figure 3. Location of infant/child at morning meal.

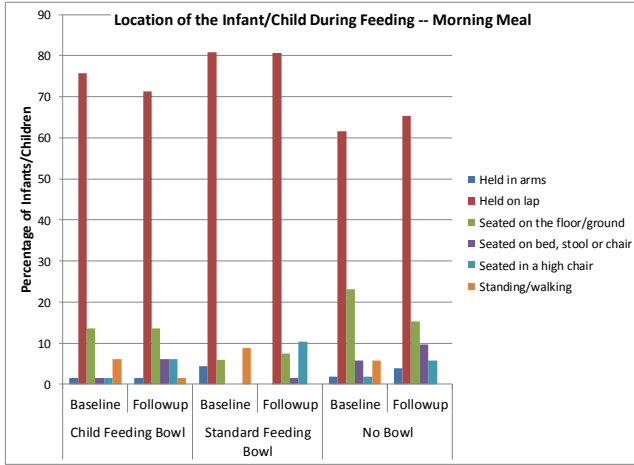


Figure 4. Location of infant/child at mid-day meal.

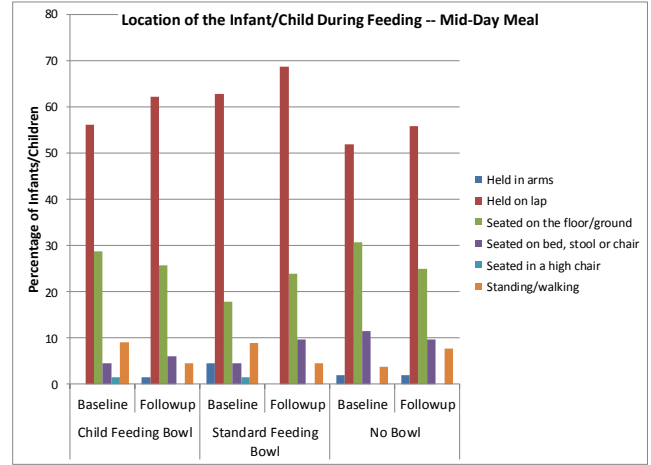


Figure 5. Location of bowl/plate during morning meal.

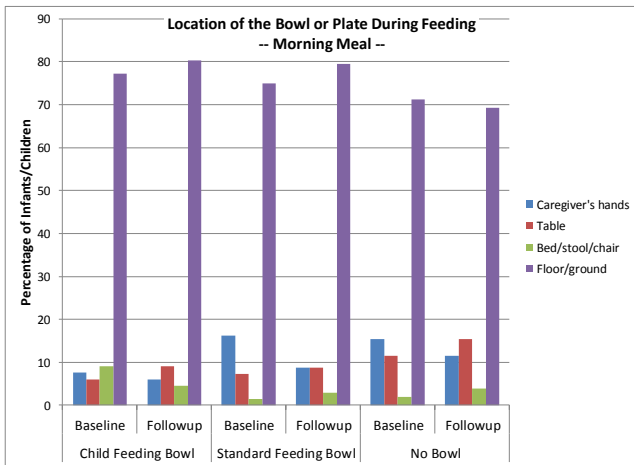
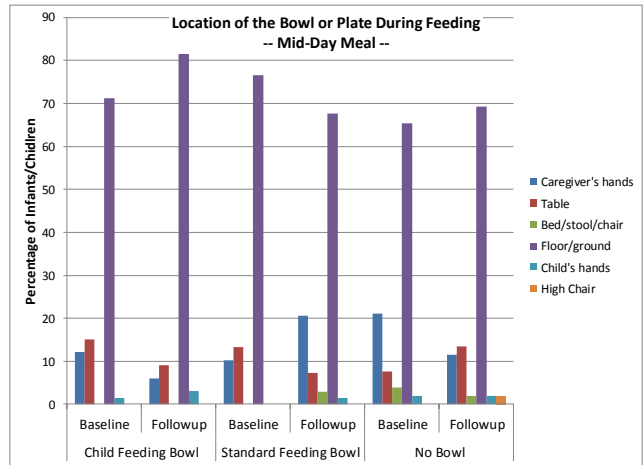


Figure 6. Location of bowl/plate at mid-day meal.



Caregivers primarily performed feeding, with very little self-feeding by the IYC, although IYC involvement was higher for mid-day meals with 60+ percent exclusive caregiver feeding than for morning meals with 80+ percent mother feeding only (Figures 8 and 9). Accordingly, children’s practice of eating with their fingers was much higher for the mid-day meals than for the morning meals (Table 7). Caregivers also fed using their fingers, and this was much more common at the mid-day meal than at the morning meal. The use of a spoon for feeding was far more common at the morning meal than at the mid-day meal, reflecting the nature of the usual diet (using spoons to feed porridge at the morning meal, and using hands to eat *nshima* and relish at the mid-day meal). No differences were seen between treatment groups in the frequency of spoon use. No caregivers used a fork to feed an IYC, and use of a cup, glass or bottle to serve food was rare.

Figure 7. Self-feeding vs. caregiver feeding at morning meal.

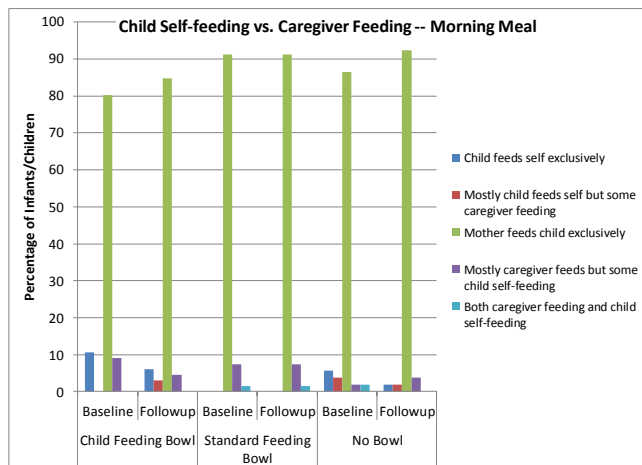


Figure 8. Self-feeding vs. caregiver feeding at midday meal

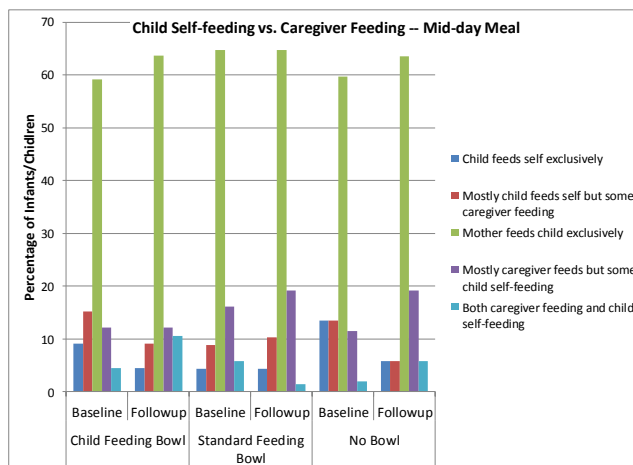


Table 7. Feeding with fingers and utensils, and cup/glass/bottle use, by meal and treatment.

Feeding Characteristics	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
Child ate with own fingers				
Baseline Morning	13.6	1.5	7.7	7.5
Follow-up Morning	10.6	2.9	1.9	5.4
Baseline Mid-day	40.9	32.4	40.4	37.6
Follow-up Mid-day	39.3	36.8	36.5	37.6
Child fed from caregiver's fingers				
Baseline Morning	6.1	4.4	3.9	4.8
Follow-up Morning	10.6	4.4	7.7	7.5
Baseline Mid-day	74.2	89.7	75.0	80.1
Follow-up Mid-day	86.4	80.9	82.7	83.3
Child fed from large spoon				
Baseline Morning	33.3	48.5	38.5	40.3
Follow-up Morning	27.3	41.2	34.6	34.4
Baseline Mid-day	3.0	4.4	3.9	3.8
Follow-up Mid-day	1.5	7.4	1.9	3.8
Child fed from small spoon				
Baseline Morning	48.5	45.6	51.9	48.4
Follow-up Morning	57.6	52.9	57.7	55.9
Baseline Mid-day	4.6	1.5	0.0	2.2
Follow-up Mid-day	4.6	4.4	5.8	4.8
Child fed using cup, glass or bottle				

Feeding Characteristics	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
Baseline Morning	3.0	1.5	1.9	2.2
Follow-up Morning	1.5	1.5	0.0	1.1
Baseline Mid-day	4.6	0.0	3.9	2.7
Follow-up Mid-day	0.0	0.0	0.0	0.0

While most caregivers encouraged the child to eat, the percentage who encouraged the IYC to finish all of the food served was far lower. The percentage of caregivers encouraging the IYC to finish all of their food increased the most in the standard bowl group, and this practice increased for both meals. Among the child feeding bowl group a slight increase in encouragement to finish was seen at the mid-day meal, with a decrease in this practice at the morning meal. Encouragement to finish all of the food decreased in the no bowl group for the mid-day meal, with no change for the morning meal.

Figure 9. Caregiver encouragement during morning meal

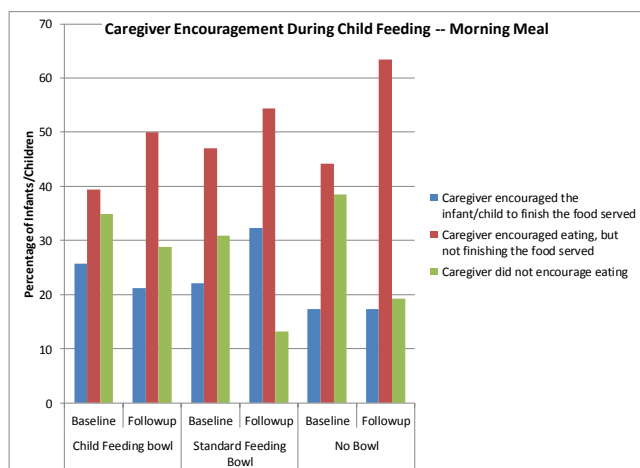
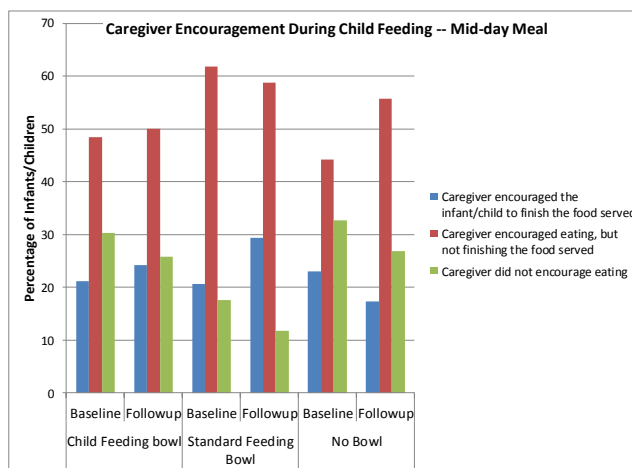


Figure 10. Caregiver encouragement during midday meal.



Food Consistency

No differences were found between treatment groups for the consistency of complementary food. The most common morning food was porridge, with the majority of caregivers feeding food classified by research assistants as “thick”. The most common mid-day meal was *nshima* with relish, with data collectors classifying the majority of meals as “solid”.

Table 8. Consistency of complementary food, by meal and treatment.

Meal and Consistency	Treatment			Total (%)
	Child Feeding Bowl (%)	Standard Feeding Bowl (%)	No Bowl (%)	
Baseline Morning				
Liquid	2.9	0.0	5.2	2.5
Runny	4.4	13.7	6.9	8.5
Thick	75.0	80.8	75.9	77.4
Solid	17.4	5.5	12.1	11.5
Follow-up Morning				
Liquid	2.9	2.7	0.0	2.0
Runny	7.1	6.9	1.7	5.5
Thick	75.7	78.1	77.6	77.1
Solid	14.3	12.3	20.7	15.4
Baseline Mid-Day				
Liquid	2.9	0.0	1.7	1.5
Runny	1.4	1.4	3.5	2.0
Thick	17.1	21.9	19.0	19.4
Solid	78.6	76.7	75.9	77.1
Follow-up Mid-day				
Liquid	0.0	1.4	1.7	1.0
Runny	2.9	0.0	0.0	1.0
Thick	22.9	34.3	22.4	26.9
Solid	74.3	64.4	75.9	71.1

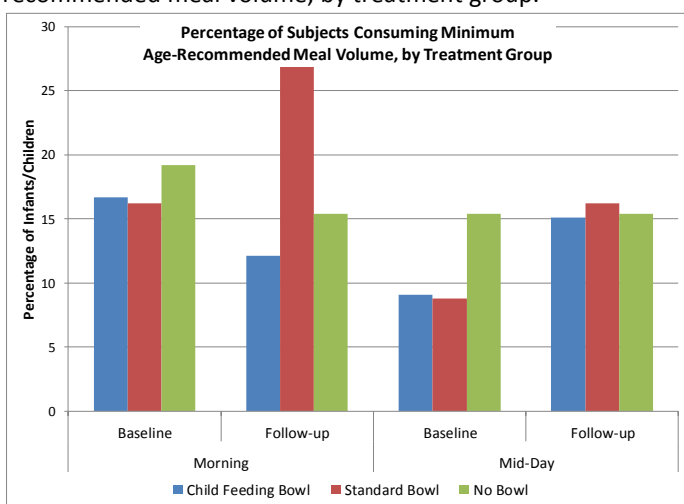
Meal Amounts

The amount of food *consumed* by IYC was very small (Table 9), never exceeding 125 ml, on average, at any meal. The MOH guidelines for meal amounts are to feed at least ½ cup (125ml) to infants 9-11 months, and ¾ to 1 cup (188 to 250ml) to children 12-24 months. The percentage of IYC consuming the minimum recommended amount for their age at each meal was calculated using the cutoffs of 125 ml for 9-11 months and 200 ml for 12+ months (Figure 12). The difference in proportion meeting the minimum volume was significant (χ^2) at $\alpha = 0.05$. Notably, however, except for the morning meal at the follow-up visit, in no treatment group did the percentage of children consuming the minimum recommended volume exceed 20%.

Table 9. Mean and median amount of food consumed (ml) by meal by treatment group.

Meal		Treatment			Total (ml)
		Child Feeding Bowl (ml)	Standard Feeding Bowl (ml)	No Bowl (ml)	
Baseline Morning	Mean	112.7	107.6	134.0	116.8
	Std Dev	55.5	52.5	56.3	55.4
	Median	119.5	102.5	136.5	119.5
Baseline Mid-day	Mean	105.4	93.1	114.2	103.3
	Std Dev	56.4	50.0	52.7	53.5
	Median	111.0	95.5	111.0	104.0
Follow-up Morning	Mean	114.5	143.5	136.4	131.2
	Std Dev	45.5	55.1	72.9	58.8
	Median	120.0	130.0	131.5	124.0
Follow-up Mid-day	Mean	112.6	120.9	123.4	118.7
	Std Dev	51.4	54.5	47.5	51.5
	Median	110.5	116.5	123.5	120.0

Figure 11. Percentage of IYC consuming minimum age-recommended meal volume, by treatment group.



Although the meal amount consumed was, in general, less than the MOH guidelines (at least ½ cup (125ml) for infants 9-11 months, and ¾ to 1 cup (188 to 250ml) for children (12-23 months), the amount served at each meal tended to be sufficient for meeting requirements. Table 10 shows, for morning and mid-day meals at baseline and at follow-up, the mean volume served to IYC according to their age and treatment group at the morning and mid-day meals. For all groups, and all meals, the mean starting amount is sufficient for meeting the recommended volume intake of 125 ml for infants (9 to 11 months), and 188 to 250 ml for children

(12+ months). In general the amount served to children is larger than the amount provided for infants, but the increase is small in comparison to the increase in the recommended amounts by age.

Comparison between baseline and follow up show:

- The amount served to infants declined from baseline to follow-up for both meals in all treatment groups, with the largest decline seen in the no bowl group.
- Among children, the amount served increased at both meals for the standard bowl group, and only at the mid-day meal for the no bowl group.
- The amount served decreased from baseline to follow-up for both meals for children in the child feeding bowl group.

Table 10. Mean and median amount of food served (ml) by meal by treatment group.

Meal		Treatment							
		Child Feeding Bowl (ml)		Standard Feeding Bowl (ml)		No Bowl (ml)		Total (ml)	
		< 12m	12+ m	< 12m	12+ m	< 12m	12+ m	< 12m	12+ m
Baseline Morning	Mean	185.7	228.0	241.8	221.2	225.7	251.3	217.8	233.1
	Std Dev	80.3	78.2	101.4	121.0	68.5	80.1	89.4	81.1
Follow-up Morning	Mean	169.0	200.5	222.0	234.8	194.7	233.3	196.4	222.6
	Std Dev	66.7	58.2	69.0	102.7	70.2	78.4	71.4	82.8
Morning meal change	Mean	-16.7	-27.4	-19.8	13.6	-31.1	-18.1	-21.4	-10.5
	Std Dev	88.3	74.1	105.5	105.8	87.5	101.3	94.3	95.5
Baseline Mid-day	Mean	181.4	210.5	192.6	203.8	214.0	198.0	193.7	204.2
	Std Dev	105.8	112.7	91.6	121.0	108.3	89.8	100.4	108.3
Follow-up Mid-day	Mean	172.3	202.6	191.3	205.2	192.1	205.5	184.6	204.4
	Std Dev	51.7	68.7	80.6	72.9	58.1	101.9	65.9	81.3
Mid-day meal change	Mean	-9.2	-7.9	-1.4	1.4	-21.9	7.5	-9.1	0.2
	Std Dev	95.7	102.5	98.2	111.5	104.0	101.3	97.7	106.8

Comparison of Meal Amount Changes from Baseline to Follow-up

The change in combined meal volume (morning meal plus mid-day meal) from baseline to follow-up are shown in Table 11 (positive numbers indicate increase in meal volume from baseline to follow-up). Meal volume increased far more in the standard bowl group than in either the child feeding bowl or the no bowl groups. Analysis of covariance, testing treatment differences between mean meal volume at follow-up while controlling for meal volume at baseline, is shown in Table 12. The analysis shows a strong treatment effect, and also demonstrates the influence of baseline meal volume on follow-up meal volume.

Table 11. Mean and median difference (ml) of combined morning and mid-day meal volume from baseline to follow-up, by treatment group

	Treatment			
	Child Feeding Bowl	Standard Feeding Bowl	No Bowl	Total

	Treatment			Total
	Child Feeding Bowl	Standard Feeding Bowl	No Bowl	
Mean	9.1	63.7	11.6	29.8
Std Dev	93.1	97.4	99.3	99.4
Median	0.5	66.5	8.5	20.5

Table 12. Analysis of covariance testing of differences between treatment groups in follow-up meal volume.

Factor	Partial Sum of Squares	Degrees of Freedom	Mean square	F	Prob > F
Model	264,021.061	3	88,007.021	13.23	0.0000
Treatment	64,802.113	2	32,401.057	4.87	0.0087
Baseline Meal Volume	210,402.969	1	210,402.969	31.62	0.0000
Residual	1,210,878.580	182	6,653.179		

Table 13. Pairwise comparison of treatment group mean differences in meal amount from baseline to follow-up.

Comparison	Value	Std Err	t*	P > t	95% Confidence Interval	
					Lower	Upper
Standard Bowl vs. Child Feeding Bowl	54.6	16.7	3.28	0.004	15.3	94.0
Child Feeding Bowl vs. No Bowl	-2.6	17.9	0.14	0.989	-44.8	39.7
Standard Bowl vs. No bowl	52.1	17.8	2.9	0.011	10.1	94.1

* Adjusted for multiple comparisons using Tukey method

Multiple range comparisons between individual treatments were performed using means of paired differences (Table 13). In comparison with the no bowl group, the change in combined meal volume of morning and mid-day meals from baseline to follow-up was not different in the child feeding bowl group, but was 52.1 ml greater in the standard bowl group. Comparison of the change in the standard bowl group to the child feeding bowl group showed an increase 54.6 ml (almost 4 tablespoons) greater in the standard bowl group.

Child Feeding Bowl Use and Impressions

Among caregivers in the child feeding bowl group, an overwhelming majority reported using the bowl (99%), and nearly the same percentage reported using the bowl daily. Daily use, however, did not seem to refer to feeding of all meals from the bowl, as 93% reported using the bowl to feed porridge yet 83% reported using it to feed *nshima*. Use of the graduated bowl for the feeding of *nshima* was 10% less common than for porridge, perhaps because of difficulty feeding both *nshima* and relish from the narrow bowl.

Table 14. Percentage of caregivers using the graduated bowl for different purposes.

Type of use	Percentage
Used the graduated bowl	98.6
Used the graduated bowl daily	97.0
Used the graduated bowl to feed	
Porridge	92.9
<i>Nshima</i>	82.9

Caregivers were asked to respond to a series of questions concerning the purpose of the graduations on the child feeding bowl. Responses were not exclusive, so caregivers were able to respond to more than one purpose, giving somewhat confusing results. Seventy-one percent of respondents responded affirmatively when asked if they were associated with the amount of food to feed according to an IYC age. Only 65%, however, responded affirmatively when asked whether the graduations were associated with the *minimum* amount of food to be fed according to an IYC age.

Table 15. Understanding of the child feeding bowl graduations.

Response concerning the purpose of the bowl graduations	Percentage
Graduations are associated with the amount of food for infant/child's age	71.2
Graduations are associated with the minimum amount of food for infant/child's age	65.2

Caregiver Reactions to the Child Feeding Bowl

Caregivers were asked to comment on their experience with the child feeding bowl. The overwhelming majority of those who provided comments stated that they were “happy”, “pleased” or “excited” to have and use the bowl. A smaller number gave responses that suggest that they clearly understood the bowl's concept, such as the bowl “helped...to understand how much food to give”, and “it will make mothers encourage those children who don't eat to eat the required standard for the baby to grow well”.

Some caregivers gave responses that demonstrate that they did not understand the child feeding bowl's “minimum amount” concept. For example, several caregivers mentioned that their child did not finish all the food in the child feeding bowl (the concept is for mothers to patiently feed until all the food has been consumed). Two mentioned that they would prefer to have another bowl for *nshima* (the concept is that the bowl represents the total volume of food to consume, so using two bowls would double the meal amount). One caregiver asked what she should do if the IYC wanted to eat more than the amount indicated by the bowl, and one caregiver mentioned that she liked the bowl because “she now knows that she is not over feeding her baby” (the bowl indicates a minimum amount—feeding beyond that amount is not “over feeding”). Additionally, three caregivers commented that the graduated bowl was “too small.”

Conclusions and Recommendations

The hypothesis that introducing the specially designed child feeding bowl would improve amounts of food consumed at mealtime was not proven in this study. However, providing a separate bowl for use in child feeding resulted in a substantial and statistically significant increase in the mean amount of food consumed. The baseline to follow-up increase over two meals was 52 ml—nearly 4 tablespoons-- in comparison with IYC who received the same counseling but no bowl. The introduction of a separate bowl

was the sole factor responsible for an increase in food consumed; this is an important finding in light of the overall low amounts for food consumed by IYC at each meal.

Providing an IYC with a separate bowl undoubtedly helps the caregiver to visualize the amount of food served and consumed and, presumably, results in more attention to child feeding. But, if the standard bowl motivates caregivers to feed larger amounts of food, why would the specially designed child feeding bowl not have a similar effect? In this section, we discuss possible explanations and their implications along with recommendations for the child feeding bowl and its use.

The standard bowl was much larger than the child feeding bowl.

One possibility why the two bowls did not produce similar results may be the disparity between the physical size of the bowls. The standard feeding bowl, selected because it was the closest match to the child feeding bowl available on the local market, was much larger. The standard feeding bowl holds a maximum volume of 500 ml, while the child feeding bowl holds a maximum of 350 ml (with the mark indicating the meal amount for children 12-23 months at 250 ml.) Caregivers were free to re-fill the child feeding bowl but did so infrequently. The standard bowl may have been effective simply because it was larger.

The concept of feeding the *minimum* was not well understood.

Caregivers did not seem to understand the concept that the gradations on the child feeding bowl show the *minimum* amount of food the child needs to finish. This may have resulted in less food consumed in the child feeding bowl group. Several participants remarked that the child feeding bowl was small. Others said that it enabled them to assess whether they were feeding their child too much. These comments and responses shown in Table 15 suggest that caregivers did not properly understand that the amounts indicated by the bowl graduations were *minimum* amounts to feed at a given age. Thus, caregivers may not have tried to feed the entire minimum amount or may have actually limited the amount that IYC consumed because they misunderstood the purpose of the graduations. A different counseling approach for building understanding of the graduations as minimums might produce a different result.

Responsive feeding must be emphasized.

The child feeding bowl is designed to help caregivers feed at least the minimum amount recommended for an IYC based on his or her age by being a visual aid. However, despite the finding that introduction of a bowl increases meal amounts, this does not guarantee that every child consumes meals of adequate volume. For example, despite the standard bowl motivating caregivers to feed more food, the actual amounts of food consumed were far too small in all groups, and this occurred despite an adequate amount of food served. The fact that the majority of children did not consume all of the food offered and that more caregivers in the standard bowl group encouraged their IYC to finish their food highlights another important program point: responsive feeding that motivates children to finish their food needs reinforcing in counseling provided to caregivers. While a bowl alone helps improve the amount consumed, it does not ensure that the IYC consumes an *adequate* quantity of food; the caregiver must play an active role to ensure the child consumes the right amount.

Adding an additional meal at 9 months must be emphasized.

The recommended food amounts used to create the child feeding bowl presume the increase in feeding frequency to three times daily from 9 months onwards. Casual observations during the study as well as DHS data suggest that households often consume only two meals per day, and child feeding frequency (the number of daily meals) is often less than recommended. For that reason, feeding the appropriate

number of daily meals should be emphasized or the amounts of food demarcated in the child feeding bowl enlarged.

The shape or design of the child feeding bowl can be improved to better accommodate the Zambian feeding style.

The shape or design of the child feeding bowl could be modified to better accommodate Zambian feeding style. For example, finger feeding, by either the caregiver or the child self-feeding, was more common than spoon-feeding for the mid-day meal of *nshima* in most cases. The shape of the child feeding bowl makes finger feeding inconvenient, especially when the amount of food in the bowl is small. Difficulty in using the bowl for finger feeding may have interfered with the potential benefits of having a separate bowl to visualize the amount of food being fed.

Additionally, mid-day meals usually comprise *nshima* and relish, and normally are fed using two containers. Caregivers may have had difficulty visualizing a single meal volume for both *nshima* and relish, and some requested a second bowl for keeping *nshima*. Combining both *nshima* and relish in the child feeding bowl is difficult due to the small diameter of the bottom section of the bowl (amount to feed infants 6-8 months). The standard bowl has a much larger diameter and gently sloping sides, allowing more room for placing *nshima* and relish without actually mixing them together. The design of the child feeding bowl could be improved to accommodate this common food practice.