ASSESSMENT OF SUPPLEMENTAL FEEDING WITH A LOCALLY-PRODUCED READY-TO-USE-FOOD: THE *BYOKULIA BISEMEYE MU BANTU* PROGRAM IN BUNDIBUGYO, UGANDA

Scott Bradley Ickes

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Approved by:
Alice Ammerman (Chair)
Linda Adair
Margaret Bentley
Sudhanshu Handa
Harsha Thirumurthy

Abstract

Scott Ickes
Assessment of supplemental feeding with a locally-produced ready-to-use-food: The *Byokulia Bisemeye mu Bantu* Program in Bundibugyo, Uganda

(Under the direction of Alice Ammerman, Linda Adair, Margaret Bentley, Sudhanshu Handa, and Harsha Thirumurthy)

Background. Low quality complementary foods and caregiver feeding practices contribute to child growth faltering throughout the developing world. Ready-to-use foods (RUF) are energy dense products that do not require cooking and have been effectively used to treat malnutrition. However, studies report low consumption of distributed rations by targeted children. The factors that affect RUF consumption rates and the impact of RUF supplementation on caregiver feeding practices and children's dietary adequacy are not well understood.

Methods. This study was conducted among participants in the *Byokulia Bisemeye mu Bantu* (BBB) supplemental feeding program in Bundibugyo, Uganda. First, to identify the key factors that affect home-based RUF consumption we interviewed caregivers (n=30), RUF producers (n=8) and program staff (n=10) involved in the BBB program. Secondly, to examine RUF consumption patterns and the demographic predictors of RUF consumption, we conducted 24-hour dietary recalls from 135 children during supplementation. Thirdly, we assessed the program impact on caregiver feeding practices and children's diet adequacy by conducting dietary recalls and a feeding practice survey among 61 Post-Program and 61 Comparison caregiver-child dyads.

Results. RUF was offered to targeted children by 86% of caregivers, and was included in 46% of targeted children's meals. Program children were offered 35% of the 128 g/day RUF supplement. Qualitative findings indicate that intrahousehold RUF sharing may compromise the nutrient delivery to targeted children. Logistic regression analysis indicates that caregivers with more birth children were less likely to

offer RUF to targeted children, and that more frequent program attendance was associated with a greater likelihood of feeding RUF. Post Program children were more likely to meet their dietary requirements, were fed more frequently, and had greater dietary diversity than Comparisons. The diet adequacy of Program children's diet adequacy did not change significantly after RUF rations were discontinued.

Conclusions. RUF is well received by caregivers of underweight children; however, a large proportion of distributed RUF may fail to reach targeted children. Caregivers are challenged to feed RUF to targeted children, especially in larger households. Programs that offer complementary feeding education with RUF may promote lasting benefits to child feeding practices and dietary adequacy.

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LIST OF TERMS AND ABBREVIATIONS

Term	Definition
AI	Adequate Intake: a recommended average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group of apparently healthy people that are assumed to be adequate, used when an RDA cannot be determined.
BBB	*Byokulia Bisemeye mu Bantu*, Lubwisi for "Good food for people"
Complementary feeding	Feeding children solids or semi-solids in combination with breast milk
EAR	Estimated average requirement: the average daily nutrient intake level estimated to meet the requirement of half of the healthy population in a particular life stage and gender group.
EER	Estimated energy requirement
DRI	Dietary Reference Intakes
HAZ	Height-for-age z score, used to assess children's linear growth
IYCF	Infant and Young Child Feeding
MUAC	Middle upper arm circumference, a diagnostic criteria of nutritional status
RDA	Recommended Daily Allowances: the daily nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98%) healthy individuals in a particular life stage and gender group.
RUF	Ready-to-use-food
Stunting	Length-for-age < -2 standard deviations below WHO reference median
Supplementary food	Provision of food by an outside entity to a child's family, ultimately to enhance the child's nutrient intake
Under nutrition	Weight-for-age Z-score <-2
WAZ	Weight-for-age Z-score
WHM	World Harvest Mission, the organization that operates the BBB program

CHAPTER ONE

Introduction and Study Overview

Overview

Ready-to-use foods (RUF) are energy-dense, lipid-based pastes that do not require refrigeration or preparation, designed to treat and prevent malnutrition in the developing world. Although feeding with RUF can effectively support the rehabilitation and prevention of child malnutrition, few studies have examined the practical aspects of home-based feeding with RUF. Understanding the culturally-influenced RUF consumption practices and the broader impacts of program participation on caregiver feeding practices and children's dietary adequacy is critical to inform RUF dosage recommendations the planning of large-scale community programs.

This study seeks to identify the factors that affect appropriate home-based RUF use, quantify the contribution of RUF to targeted children's diets, and to evaluate the impact of participation in an RUF-supported supplemental feeding program on caregiver feeding practices and children's diet quality. The study will be conducted among participants in the *Byokulia Bisemeye mu Bantu* (BBB) program in the Bundibugyo district of Uganda's western region. The BBB program is a 10-week supplemental feeding program that provides caregivers of underweight children with a locally produced RUF and complementary feeding education.

Specific Aims

Aim 1: Identify the key facilitators and barriers that influence in-home RUF consumption by program beneficiaries using individual interviews and structured observations among caregivers and staff involved in the BBB program. We will document caregiver perceptions and feeding practices, using these data to develop a conceptual framework and education messages to improve RUF-related feeding practices that will be offered to the community-partner for program improvement.

Aim 2: Conduct a quantitative diet analysis using 24-hour dietary recalls collected during program participation from 200 children ages 6 to 59 months who have been enrolled in the BBB program between May 2008 and July 2009.

Aim 2a. Examine the nutrient contribution of the RUF to the overall diet and assess the diet quality of BBB participants according to:

a. proportions of total energy and protein from the RUF supplement and home-produced foods
b. percent adequacy of energy, protein, and key micronutrients required for catch-up growth
c. achievement of a minimally acceptable diet according to WHO-recommended Infant and Young Child Feeding guidelines

Aim 2b. Identify the socio demographic factors and feeding practices associated with RUF consumption and feeding frequency among BBB participants.

Aim 3. Assess the impact of supplemental feeding program participation on caregiver feeding practices and children's diet quality through a post-program caregiver survey and comparison of dietary recall data collected during and after participation in the BBB program.

Background

Poor complementary feeding practices and the provision of low-energy and low-nutrient dense foods contribute to growth faltering throughout the developing world, where over 32% of children are stunted (a height-for-age z-score < -2) (Bhutta et al, 2008; Lin et al, 2008; Shrimpton et al, 2001). Undernutrition (weight-for-age z score <-2), a composite index of height-for-age and weight-for-height that takes into account both acute and chronic malnutrition, accounts for over 50% of child deaths worldwide (Caulfield et al, 2004; Pelletier et al, 1999). Effective interventions are available to reduce stunting, micronutrient deficiencies, and child deaths; however the effectiveness of these efforts is contingent on the inclusion of evidence-based program components and attention to the cultural contexts that influence child feeding practices (Dewey & Adu-Afarwuah, 2008; Engle et al, 2000).

In areas with a high prevalence of food insecurity, complementary feeding interventions that provide food rations, not just education, may be more effective (Dewey & Adu-Afarwuah, 2008). Energy-dense, lipid-based pastes that do not require refrigeration or preparation, collectively known as ready-to-use-foods (RUF), developed in the past decade, may provide a feasible food supplement for a variety of nutrition interventions (Briend, 2001, 2002). Initially, designed and demonstrated to be effective to treat severe malnutrition in hospital or outpatient settings (Diop et al, 2003; Collins & Sadler, 2002; Sandige, et al 2004), RUFs are being modified and more broadly applied to treat moderate malnutrition (Patel et al., 2005) and stunting (Maleta et al, 2004), to prevent moderate and severe wasting (Isanaka et al., 2009), and to support breastfeeding replacement feeding for HIV+ mothers (van der Horst et al., 2009) in population-based settings.

Although RUF-based feeding programs can promote multiple positive outcomes related to malnutrition treatment and prevention, clinical trials have reported low overall intake of the distributed RUF rations which likely impair potential improvements in nutrient intake (Maleta et al., 2004; Flax et al., 2008). In-home RUF feeding practices and the factors influencing these behaviors need to be identified and culturally specific messages to target these factors need to be developed and tested.

Child undernutrition: global and regional exposures and health consequences

A variety of nutrition-related factors contribute to under-nutrition and corresponding childhood illness and mortality. These factors include poverty, agricultural instability, poor complementary feeding practices, infection, early life growth restriction, and poor hygiene and home care environments. Nutrition-related factors taken collectively have been estimated to contribute to 35% of child deaths and 11% of the total disease burden, measured in disability-adjusted life years (DALYs).

Review of interventions to improve complementary feeding

A recent review of the efficacy and effectiveness of complementary feeding interventions in developing countries provides a helpful overview of important intervention factors (Dewey & Adu-Afarwuah, 2008).Complementary feeding interventions take on a variety approaches toward improving child growth, including education and counseling about feeding, food supplementation, fortification or

home-fortification of complementary foods, and food processing technologies to increase energy density or enhance nutrient quality of complementary foods. With many different intervention components and a wide variety of potential outcomes, it is difficult to make generalized conclusions about the impact of complementary feeding interventions. While growth is the most commonly used outcome measure, it may be a less sensitive indicator of intervention benefit because of constraints (i.e. child height) that may limit the extent that a child's growth can respond to post-natal interventions.

Education. The most common messages of complementary feeding interventions that include education are about 1) continued breastfeeding during complementary feeding; 2) use of thicker porridges instead of thinner porridges and soups; 3) use of animal source foods; 4) dietary diversity; and 5) hygiene. Complementary feeding interventions with education messages that promote consumption of energy-rich animal source foods (i.e. chicken liver, egg, or fish) appear to be most effective or child growth, suggesting that infants need foods with high micronutrient density, especially from 6-12 months. Two studies have examined education only versus education plus the provision of a food supplement and found that groups receiving education plus the supplement achieved greater growth outcomes than education alone groups (Bhandari et al., 2004; Roy et al., 2005).

Education interventions have been shown to be effective when delivered through multiple channels. Optimal design of education delivery depends on existing infrastructure and local communication channels. The most effective educational interventions employ a small number of carefully selected specific key messages than can easily be adopted by the target population, rather than giving general advice about child feeding (Dewey & Adu-Afarwuah, 2008). Messages should be based on needs assessment and formative research within the target group to identify practices most in need of improvement and amenable to change (PAHO/WHO, 2003). Aim 1 of the current study will seek to develop specific messages about RUF consumption for consideration by the program administration. Nearly all effective education interventions include education on hygiene and continue breastfeeding, which are essential to reduce morbidity.

Micronutrient fortification, and home-fortification of complementary foods. Interventions in which

micronutrient fortification is the sole component can be effective at improving iron and vitamin A status, but they generally have little impact on growth (Dewey & Adu-Afarwuah, 2008). Fortification can be done at home, through the provision of products like micronutrient Sprinkles, or given through a fortified complementary food product (i.e. an RUF).

Home fortification offers several advantages over centrally processed RUFs. First, the dose of iron can be tailored to the age of the infant, which is higher from 6 to 12 months, than for 12-19 months. Second, home fortification allows families to continue feeding home-prepared or purchased complementary foods as the basis for the child's diet. Third, the cost of home-fortification products is likely to be lower than RUFs.

Even when a commercially produced RUF is available and affordable, the child also needs to consume other foods to achieve a diverse diet and eventually make the transition to family foods (Dewey & Adu-Afarwuah, 2008).

Increasing energy density of complementary foods. Strategies to increase the energy density of complementary foods have mixed outcomes. Interventions appear to be more effective in settings where the traditional food is low in energy density and children cannot compensate for the low energy density of transitional complementary foods by consuming larger quantities of eating more regularly (John & Gopaldas, 1993; Moursi et al, 2003b). It is important to consider the effect on increasing complementary food energy density on children's overall daily energy intake, including energy from breast milk. Increasing in energy intake will not necessarily be associated with increased micronutrient intake, so other efforts to improving dietary adequacy should be considered in combination with this approach (Dewey & Adu-Afarwuah, 2008).

Appropriate dosage of supplemental food rations. Provision of food can be expensive, and thus it is important to identify options that will have a large impact at the lowest possible cost. As summarized in the 2008 Dewey review, ten efficacy trials provided additional energy supplement at a main component of the intervention, ranging from 108 kcal/day for children 6 to 12 months (Adu-Afarwuah et al., 2007) to 1510 kcal/day for children 9-18 months (Obutulu, 2003).

Kuusipala et al. found that moderately malnourished infants randomized to supplementation with either a milk-powder based or soy-based RUF ranging from 23 to 397 kcals/day had better growth and anemia outcome than controls. The broad range of dosage and similar growth effect across dosage levels make suggest that more research is needed to inform appropriate dosage recommendations (2006).

A key consideration in choosing dosage amounts in complementary feeding interventions should be to avoid the displacement of breast milk for children below 12 months. According to the 1998 WHO/UNICEF report, the energy needs of children are 682, 830, and 1092 for ages 6 to 8 months, 9-11 months, and 12-23 months, respectively. The energy required from complementary foods for these same age groups is 269, 451, and 746kcals, respectively (Dewey & Brown, 2003). For children ages 6-12 months, attention needs to be made to not exceed children's dietary requirements with food rations to risk displacement of breast milk. Dosages should be set to allow for consumption of home-prepared complementary foods (Dewey & Adu-Afarwuah, 2008).

Summary. Many complementary feeding strategies can be used and there is no single best approach that can be recommended universally because constraints and opportunities vary with settings. The magnitude of response to an intervention will vary with the characteristics of the target population, such as age and nutritional deficiency and quality of the intervention. Interventions targeted towards children over 2 years of age are likely to achieve lower growth outcomes. Given that it is more difficult to reverse the effects of malnutrition on stunting.

Nutrient requirements for undernourished children ages 6 to 59 months.

Energy. Energy requirements to support infant and young child growth must support physical activity levels and energy deposition consistent with good health. Energy requirements for infants and children vary according to age, gender, feeding mode, and physical activity level (FNB/IOM, 2005). In the case of moderately malnourished children, energy intakes need to be higher than current energy expenditure to support catch up growth. The Estimated Energy Requirement (EER) for children is designed to support basal metabolism, physical activity, growth (energy deposition), thermoregulation, and the thermic effect of feeding. **Table 1.1** lists the EER for children 6 -59 months, which are taken from the 2005 Institute of

Medicine report, based on the median weight of the reference population. The following formulae allow for individual EERs to be calculated for each individual based on age and body weight. These formulas are suitable for body weights within 2 standard deviations of the WHO mean.

Protein. To evaluate protein adequacy among the group of BBB children, the proportion of individuals not meeting the estimated average requirement (EAR) will be calculated to estimate the prevalence of inadequacy (Murphy et al, 2006). For healthy children, the age specific EAR is listed in **Table 1.2**. Moderately malnourished children are recommended to consume 25.6g of protein per day (FNB/IOM, 2005)

The BBB RUF is sufficient to meet this requirement; however, after children exit the BBB program and no longer receive the food ration, it is unknown how their household foods can support their protein needs.

Micronutrients. Adequate intakes (AI) are the only available Dietary Reference Intakes for infants 7-12 months for vitamin A, folate, vitamin C, and calcium. These values are determined from full-term infants born to well-nourished mothers.. Since the amount that AIs exceed actual requirements is unknown, they are not sufficient to use as an adequacy cut point. Instead, AIs can be used to evaluate the mean intake for a group and make recommendations to increase intake. EAR have been set for this age group for iron and zinc. For children 12-49 months, EAR values exist for all micronutrients of interest in the analysis of BBB children's diets, except for calcium, where the AI will be used. When the EAR is available, it is more accurate to compare the usual intake distributions to the EAR which covers 50% of the population than for the RDA, which would over estimate the risk of deficiency (Carriquiry, 1999). The AI and EAR for these selected micronutrients are provided in Table 5 in the Aim 2 methods section.

The 2007 UDHS reported that 62% of children ages 6-35 months consumed foods rich in vitamin A in the day before the survey, and 36% of children ages 6-29 months had received a vitamin A supplement in the past 6 months. For iron, only 30% of children ages 6-35 months consumed iron rich foods the day before the survey, and < 6% received an iron supplement in the past 7 days.

Supplemental feeding with ready-to-use-food

Effective supplemental feeding can improve the nutritional status of moderately malnourished children in experimental (Rivera et al, 1991) and home-based settings (Maleta et al., 2004), though results are not conclusive across all interventions (Allen & Gillespie, 2001). The type of food ration that supplemental feeding programs use is important in promoting energy intake. Programs that provide cereal-legume mixtures resembling indigenous staples to be prepared as porridge may reduce intake of the staple food in the child's diet and have no overall impact on children's energy intake (Maleta et al, 2004).

Several studies have now evaluated RUF as a complementary food to target under nutrition and stunting. Increases in weight and length gain have also been reported among undernourished and stunted children supplemented with RUF at home (Patel et al., 2005; Kuusipalo et al, 2006; Phuka et al., 2008).

The comparative results of RUF to supplementation with corn soy blend are inconclusive. A one-year complementary feeding trial in Malawi found that feeding 256 kcal/d of RUF does not have a significantly larger effect than corn soy blend on mean weight gain in all infants, but did improve linear growth in the most disadvantaged individuals and decreased the incidence of severe stunting (Phuka et al., 2008). Another Malawi-based study compared two eight-week supplementary feeding regimens in children at risk of malnutrition and found that children receiving RUF were more likely to recover (58% vs 22%; difference 36%; 95% confidence interval [CI] 20-52) and had greater rates of weight gain (3.1 g/kg/d vs 1.4 g/kg/d; difference 1.7; 95% CI 0.8-2.6) than children receiving corn/soy-blend (Patel et al., 2005).

Adu-Afarwuah et al., found that, while all three micronutrient supplements tested in their Ghana-based trial had positive effects on motor milestone acquisition by 12 months compared with controls, only the group receiving RUF (108 kcal/d) demonstrated improved growth outcomes (2007).

Preliminary evaluation data from the BBB program indicate growth results comparable to other RUF-based supplemental feeding regimens. The mean daily weight gain (SD) of BBB children from April-September 2008 was 7.5 (9.2) g/day (Jilcott et al, 2009). Maleta et al reported weight gain (SD) of 3.3 (3.4) g/day during 12-week supplementation with 500 kcal/d of RUF among underweight and stunted children ages 42-59 months (2004). Flax et al reported weight gain (SD) of 11.9 (6.0) g/day with 12-week supplementation with 250 kcal/d of RUF among underweight children ages 6-17 months (2008). Despite different age inclusion criteria, the constant median growth rate reference after 6 months allow for growth

velocity comparisons across age groups (WHO, 2006).

While these studies suggest that RUF formulations may be a potential avenue for community-level management of undernutrition, the wide variety of dosages and similarly modest improvement in growth across trials suggest that more information is needed to understand proper dosage for supplemental feeding, and potential barriers to improved growth among study populations.

RUF utilization in home-based settings

Several studies suggest that home-based RUF utilization for targeted children is poor, but depends on the method of feeding and preparation. The low delivery rates of RUF to targeted children may impair growth outcomes. Flax et al. reported that underweight children ages 6-17 months (n=16) who were given 250 kcal of RUF gained a mean (standard deviation) of 11.9 (16.6) grams/day over 12 weeks, however, 81% of participants still had WAZ < -2.0 at follow up (2008). This longitudinal observation study conducted in rural Malawi examined how RUF use affects other feeding patterns and described how caregivers fed RUF to their undernourished children at home. Underweight children (ages 6 to 17 months) received RUF for 12 weeks. Twelve-hour observations were conducted before supplementation and during four periods of RUF use. RUF was fed to children about two times per day; each serving was 15–20g. The spread was first used mainly alone as a between-meal snack, and then became integrated into the typical complementary feeding pattern by being mixed with porridge. Introduction of RUF reduced the number of plain porridge meals, but did not decrease the total number of meals or breastfeeds per day and did not change the daily mean time caregivers spent on feeding. Wastage of RUF was higher when mixed into normal porridge instead of being consumed alone (26.6% wasted vs. 1.2%). When RUF was introduced into infant diets, the mean times per day children ate plain porridge decreased (from 1.5 to 0.3, $P < 0.001$), while the mean times they had all other food types, including breast milk were unchanged (Flax et., 2008).

In a prospective growth trial, Maleta et al. reported that underweight and stunted children ages 42 to 60 months who were provided with 92 kcal/day of RUF gained a mean (standard deviation) of 3.3(3.5) grams/day during and 3.6(4.0) grams/day, which was significantly different from the Maize and Soy flour group only following supplementation. Dietary recall analysis revealed that children received only 30% of the supplementary RUF and 43% of the maize and soy flour blend provided (2004).

The amount of RUF wasted when it is mixed with porridge or other foods may reduce the population impact of an intervention. The specific cultural factors and caregiver perceptions of RUF are likely to play a large role in feeding norms, and need to better understood in order to be effectively targeted with education messages.

RUF supplementation and the caregiver feeding routine

RUF supplementation can become part of the caregiver feeding routine, does not displace other foods, and can increase energy consumption**.** In the Maleta et al. supplemental feeding trial, the RUF group did not reduce their intake of staple foods and hence had a higher intake of energy, fat, iron and zinc, while energy intake from staple foods in the maize and soy group declined on average 614 kJ/day (147 kcals) during supplementation (95% CI, 15–1,237 kJ; $P = 0.056$) (2004). Flax et al. reported that RUF was fed two times per day on average, and was included in 31% of meals and snacks. There was a large difference in the mean time it took to feed RUF alone and when mixed with porridge (5.4 vs. 14.5 min, 95% CI for the difference 5.6 to 12.5, $P < 0.001$) (2008). This is an important consideration to investigate as messages are developed as logistical considerations such as poor access to fuel wood and the labor involved in food preparation may preclude preparation of more frequent separate meals. Because RUF easily becomes part of the feeding routine, does not replace other foods, and does not take extra caregiver time to prepare, it is a feasible candidate food to be integrated into community-based nutrition interventions.

Child nutrition in Uganda

The most extensive data describing the nutrition status and feeding practices of children in Uganda is found in the 2006 Uganda Demographic Health Survey report (UDHS), part of a worldwide Demographic Health Survey project. The UDHS is a nationally representative survey of 8,531 women ages 14-59, and 2503 men aged 15-54; in addition, the 2006 UDHS collected data on the nutritional status of children by measuring the height and weight of all children under five years of age in a sub-sample of one in three households selected for the survey. The report assessed nutrition status based on the 2006 WHO growth standards, generated from the WHO Multi-center Growth Reference Study (Uganda Bureau of Statistics (UBOS) & Macro International Inc., 2007; World Health Organization [WHO], 2006).

Of children under five in Uganda, 38% are stunted and 15% are severely stunted, 6% are wasted (weight-for height < -2 z scores), and 16% are underweight. Stunting increases with the age of the child through the first 3 years of life, and is especially rapid after 6 months: 13% of children 6-8 months are stunted, compared with 45% ages 18-23 months. Rural children are more likely to be stunted than urban (40% versus 26%). Maternal education and socioeconomic status are directly related with stunting prevalence.

We conducted an anthropometric survey of children aged from 6 to 59 months, informed by guidelines for two-stage cluster sampling to estimate the nutrition status in the Bundibugyo District of western Uganda. We randomly selected three of the ten sub-counties in the district and ten villages within each sub-county. In total, we measured 432 boys and 454 girls and found an overall wasting prevalence of 2.7%, a prevalence of underweight of 17%, and a stunting prevalence of 44.8% (Jilcott et al, 2007).

UNICEF and WHO recommend the introduction of solid food to infant diets around 6 months, as breast milk is no longer sufficient to maintain optimal growth. However, increased exposure to infection and inappropriate and/or inadequate feeding practices contribute to the faltering nutrition status of children after 6 months in most developing countries, particularly in Sub-Saharan Africa (Uganda Bureau of Statistics (UBOS) & Macro International Inc., 2007).The introduction of weaning foods around 6 months of age in Uganda corresponds to a rapid increase in underweight prevalence, affecting 11% of children under 6 months, and 30% of children 9-11 months.

Theoretical basis for the BBB program

Built upon the socio-ecologic framework and adapted from the UNICEF framework on the cause of malnutrition, **Figure 1.1** illustrates that childhood stunting and moderate malnutrition in Uganda are manifestations of multi-sectoral problems developing from three different levels of causal factors:

1) Immediate causes of malnutrition are inadequate dietary intake (related to both type and method of feeding complementary food), and infectious disease (i.e. diarrhea); 2) underlying causes include household food security, feeding norms (i.e. poor IYFC practices), maternal health and education (which may affect food preparation and hygiene), and inadequate health services (poor growth monitoring, low vaccination rate, unsanitary health facilities); and 3) basic causes include political factors (corruption

within health services, existing government programs), agricultural practices (arability of the land, crop selection), and the physical environment (seasonality, climate change, violence). Poverty, the most substantial basic cause in the model, is related to nearly all causes of malnutrition and stunting and becomes an outcome of the illness as the cycle of poor development ensues. This model proposes that childhood nutritional status and development is guided by systems of relationships or layers of the environment that provide continual interaction.

Within the BBB program, infant feeding practices are likely to be influenced by caregiver knowledge and attitudes towards complementary feeding, their interpersonal relationships and patterns of decision-making. The aims of the present study will seek to understand the immediate and underlying causal factors of undernutrition in the population of children and families enrolled in the BBB program. These factors are described and contextualized to Uganda in the section below.

Inadequate dietary intake. Insufficient consumption of total energy, protein, and various micronutrients all contribute to under nutrition. In the absence of fortification, the densities of iron, zinc, and vitamin B6 are often inadequate deficiencies in developing counties include Vitamin A, C, zinc, and folate. (Dewey & Brown, 2003).

The diversity of infant and young child diets, assessed by a seven-food group indicator of diversity, strongly predicts children's micronutrient status (Moursi et al, 2003a). A study of infant and young child feeding knowledge and practices in western Uganda reported that 42% of caregivers reported less than optimal complementary feeding frequency (< twice per day) for children ages 12-23 months (Wamani et al, 2005).

Household food security and agricultural practices. In areas with a high prevalence of food insecurity, supplemental feeding interventions that provide food rations, not just education, may be more effective (Dewey & Adu-Afarwuah, 2008). Household food security is closely linked with agricultural practices and environmental conditions. Ugandan regions experience two predominant climates, which play a major role in regional food security status **(Figure 1.2).**

A Unimodal climate, typical in the eastern region, is characterized by one main annual harvest

followed by a six-month period without rainfall and a three-month "hunger" season. A bimodal climate, common is most other regions including Bundibugyo, experiences two annual harvests, cyclic rainy and dry seasons, but no hunger season.

The Famine Early Warning Systems Network (FEWS NET) is a national food security surveillance for Uganda, and helps steer regional food assistance programs from organizations like the World Food Program. While FEWS NET estimates the food security status of western Uganda to be "generally food secure," the higher than average rates of stunting in Bundibugyo complicate this assessment.

Food expenditures may increase as well, placing additional strain on fixed household incomes. Nominal crop prices remain above 5-year averages and higher than 2007 prices. Prices are likely to remain high due to high local and regional demand and high transportation costs (Famine Early Warning Systems Network (FEWS NET) and the United States Agency for International Development, 2009). An assessment of perceived household food security of families in the BBB program will help provide a context for the diet analysis and growth of the BBB children.

Feeding norms: Infant and young child feeding practices. Typical feeding practices include a high level of initiation of breastfeeding by the first day of life (86% nationwide, 90% in the west), a long duration of mixed breast feeding with solid foods combined with little or no provision of animal source foods, a low frequency of total complementary feeding occasions per day, and low diversity of complementary foods. More than half (54%) of children receive additional liquids other than breast milk during the first 3 days of life. By 24 months, over half of children are still breast feeding. Most children are fed water, other milk, and complementary foods starting from very young ages. The most common foods eaten by children 6-23 months include grains (83%) and foods from legumes and nuts (57%) (Uganda Bureau of Statistics (UBOS) & Macro International Inc., 2007).

The UDHS report also makes use of a summary indicator that describes the quality of infant and young child feeding practices (IYCF). The IYCF indicator is designed for children ages 6-23 months and includes three key practices: 1) initiation of feeding solid/semisolid foods from age 6 months, 2) increasing the amount and variety of foods, and 3) increasing the frequency of feeding as the child gets older, while

maintaining frequent breastfeeding (World Health Organization [WHO]., 2008). In 2006, only 23% children ages 6 to 23 months met all three IYCF guidelines. This figure was higher in the western region, where 31% met these guidelines; however, these figures are likely lower in Bundibugyo, which is substantially poorer and less developed than the rest of the western region due to geographic isolated by the Rwenzori Mountains. IYCF practices are mediated by socio-demographic characteristics; feeding in accordance with the IYCF practices increases markedly with mother's educational status and wealth quintile. Feeding practices to children in Uganda are poor and present one of the largest modifiable points of intervention for children under five.

Feeding frequency and energy density of complementary food are both associated with children's energy intake. In a recent study of healthy Bangladeshi children ages 8-11 months, energy intakes from complementary foods were significantly predicted by both energy density of the food and feeding frequency (Islam et al, 2008). Providing complementary foods of sufficient energy density proves difficult in Uganda given the typical weaning food. Traditional corn porridge contains only 10% solids and must be consumed in large quantities to deliver an appreciable caloric load (Gibson et al, 1998).

Maternal health and education. According to 2006 DHS estimates, 20% of Uganda women receive no education and only 10% complete primary school. Women in rural areas are 2.5 times more likely to have received no education than those living in urban settings. In western Uganda fewer than 9% of women complete primary school—the third lowest region in the country. The percentage of women receiving no education in the western region is the second highest in the country, behind only the northern region which suffers chronic insecurity (UBOS & Macro International Inc., 2007). Only one study to date has examined the socio-economic predictors of IYCF practices in western Uganda, and found that only maternal education and household asset index correlated with feeding practices (Wamani et al, 2005). This study was conducted in the Hoima district of Uganda, which is considerably more developed than Bundibugyo.

Fertility and cultural marriage patterns also play a role in child nutrition. The median age of a women's first marriage in western Uganda is the lowest in the country (approximately 17 years). Women in western Uganda are also the most likely to be in a polygamous marriage with two or more co-wives (11%). The fertility rate in Uganda of 6.7 is the highest of any country in eastern and southern Africa. The western

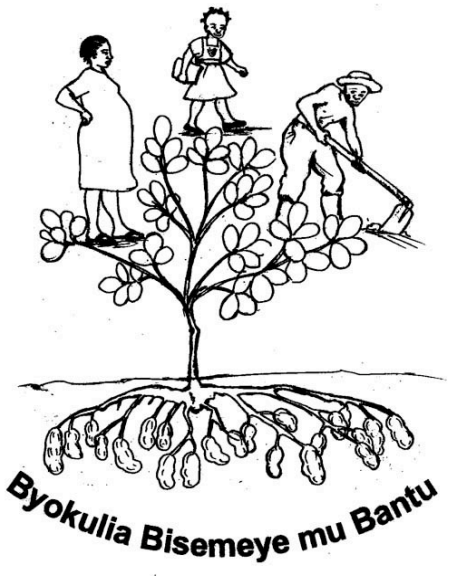
region has the highest mean number of children (7.8) ever born to women ages 40-49.

Study Population and design

Overview of the Byokulia Bisemeye mu Bantu (BBB) Program

Operated by World Harvest Mission, the Byokulia Bisemeye mu Bantu (BBB) Program (meaning "Good Food for People") is a community-based feeding program in Bundibugyo, Uganda that uses a locally sourced and produced RUF to supplement the diets of moderately malnourished children, aged 6 to 59 months.

Indigenous speakers of Lubwisi, the dominant local language, provided input for an appropriate project logo and developed the program name. The logo was designed by a Ugandan graphic artist and used on printed shirts and official program correspondence). The logo was designed to convey the role of good maternal and infant nutrition in academic achievement in young children, as well as the value of educating women, both necessary for combating under-nutrition.



The program was designed to: (1) empower caregivers by providing nutrition education, (2) provide RUF and community-based care for underweight children, (3) increase sustainability by using local food and local health workers, and (4) increase capacity for local community groups to produce RUF as a micro enterprise.

Children are enrolled in ten-week cycles and are given a weekly dosage of a peanut and soy-based RUF (128g/day) that provides 680 kilocalories and 30.5g of protein per day plus a multivitamin supplement with iron and a de-worming pill. Since its inception in 2007, the BBB program has enrolled 312 underweight and stunted children. BBB program participants, ages 5-29 months, pooled from 3 10-week program cycles (n=119) between March and December 2008, gained 7.5(9.2) grams per day (Jilcott et al, 2009).

Caregivers receive education, delivered by volunteer community health workers and local health

center staff about: (1) the influence of early nutrition on school performance later in life, (2) antenatal nutrition, (3) growth monitoring, (4) importance of breastfeeding, (5) healthy complementary feeding, (6) responsive feeding, (7) recovery feeding after illness, and (8) hygiene. Behavior change theory is illustrated using the "BBB" of behavior change: (1) *B*elieve benefits; (2) *B*reak down barriers; and (3) *B*egin now (goal-setting).

Production process and nutrient composition of the BBB ready-to-use-food

The RUF is prepared by roasting groundnuts and soybeans in a metal pot over a charcoal fire. Groundnuts are then skinned and hand-ground. Soybeans are first pounded using the local mortar and pestle and then ground into soybean flour. *Moringa oleifera* leaves are then mixed into the groundnut paste as they are widely available in Bundibugyo and have high micronutrient content (Price, 2000). Caregivers bring moringa leaves to the health center during weekly BBB program visits. Leaves are then dried on local dryers. Production teams were given instructions on hygiene and packaging. To assist in quality control, the RUF is packaged in 2 separate bags—containing (1) roasted soybean flour and (2) groundnut paste mixed with moringa leaf powder, each weighing 440 grams. All materials were locally purchased. In addition to the RUF, each child receives a month's supply of multivitamin, folic acid, and iron tablets, as well as one high dose of Vitamin A and a de-worming pill upon enrollment.

A comparative nutrient composition of soy flour, BBB peanut paste, total BBB food supplement (combined soy flour and BBB peanut paste), commercial RUTF (Plumpy'nut) and corn soy blend (common food ration in supplemental feeding programs) is shown in **Table 1.3**. All values are per 100 grams. The BBB food supplement consisted of 47% roasted peanut paste, 3% dried moringa powder, and 50% roasted soy flour, totaled 900 grams, and provided the child approximately 682 kilocalories per day. Energy density of the combined BBB supplement (groundnuts, moringa, and soy flour) was 5.3 kilocalories per gram (21.5 kilojoules per gram) and contained 19.5 g of protein.

To date, the logistical considerations of the BBB program have limited age-specific dosing, which may seem problematic given the large age-range of the program population. However, most children in the BBB program are younger than 3 years. If the dosage were consumed in full, the BBB RUF would provide 150% of the requirements for protein for a moderately malnourished child.

Aim 1 Research Design and Methods

Identify the key facilitators and barriers that influence in-home RUF consumption by program beneficiaries using individual interviews and structured feeding observations among caregivers and staff involved in the BBB program. We will document caregiver perceptions and feeding practices, using these data to develop a conceptual framework and education messages to improve RUF-related feeding practices such as dosage, feeding frequency, and preparation methods that will be offered to the community-partner for program improvement.

The purpose of the research in this section to identify the attitudes, experiences, and perceived barriers related to child feeding and the operation of the BBB program, and specifically to identify facilitators and barriers to RUF utilization. To capture the spectrum of participants in the BBB program—from RUF production, distribution, and the ultimate delivery to the child—the qualitative research in this aim will include participants from all four case groups involved in the BBB program. Individual interviews and observations with caregiver-child dyads will provide insight into perceptions and experiences with feeding the RUF to their children, and actual feeding practices. Caregivers will also be asked to recollect and interpret the health and feeding messages from the BBB program and potential barriers to adequate nutrient delivery to the child. Interviews and direct observations of health center staff will identify the current feedback and reinforcement practices of health center staff and any complementary feeding messages delivered through weekly program meetings. Production team interviews will provide insight the RUF production process and cultural beliefs about the RUF from both program and non-program participants. Finally, interviews with the Agricultural Extension workers employed by World Harvest Mission will provide insight into issues surrounding the management and sustainability of the BBB program. Built on the findings from these four perspectives, a conceptual framework will be constructed to organize the processes and factors that influence child feeding with RUF and to develop culturally-appropriate feeding messages to promote RUF utilization and child nutrient consumption.

In order to assess the multiple levels of influence in the question of program utilization and child feeding practices, the following questions to guide this aim are organized by the socio ecologic framework:

<u>Individual level</u>

- What are the current RUF-related feeding behaviors?
- What challenges do caregivers face in feeding their children the RUF?
- How do RUF production team members understand the purpose of their work?
- What are the attitudes of health center staff towards the BBB program?

Interpersonal level

- How do caregivers within the BBB program interact around issues related to young child feeding?
- Which household members, including other children, influence caregiver feeding of the BBB child?

Institutional level

- What are the current educational messages that caregivers receive about RUF consumption?
- How are these messages perceived and implemented by caregivers?
- How does the interaction with BBB health center staff influence their feeding practices?
- What challenges does WHM face in operating the BBB program?

Community level

- What are barriers to appropriate RUF use?
- How do cultural feeding practices affect local RUF use and consumption?
- How do community members perceive caregivers who are enrolled in the BBB program?
- How do community members perceive the RUF supplement?

Methods, participants, eligibility criteria, and recruitment procedures

Data for Aim 1 will be collected through semi-structured interviews, structured observations, and focus groups among participants from the BBB program, including caregivers, health center staff, agricultural extension workers, and RUF production team members. Access to the study population has been permitted through an agreed partnership with World Harvest Mission (WHM) in Bundibugyo, Uganda, the organization that operates the BBB program, and through the Bundibugyo District Health Office, the local government office within the Uganda Ministry of Health that oversees district community health programs. All subjects will be recruited using purposive sampling among the entire population of BBB program participants and program staff to achieve the sample sizes outlined in **Table 1.4**.

Interviews

We will recruit caregiver-infant pairs during their weekly clinics (weeks 1-10) in a private office after caregivers receive their weekly food ration and will schedule an interview either at home or another location specified by the caregiver. Health center staff will be recruited in private at their clinics, and will be interview at the clinic or other location. Production team members will be recruited during weekly production days at one of four production sites, and interviewed at the site or other location. Recruitment scripts are provided in Appendices.

Participation in interviews will be voluntary and written informed consent will be obtained from health center staff, extension workers, and production team members. Verbal consent will be obtained from caregivers due to low literacy rates among this group. Due to the lack of private and quiet settings to conduct interviews and to minimize coercion to participate of respond to questions in a way perceived as favorable to researchers, all caregiver interviews will take place at caregiver homes or the home of a trusted friend, specified by the caregiver.

Assessment tools and procedures

In-depth interviews will use a semi-structured interview guide to gain insights into individual BBB program participants. Interview guides were developed from preliminary interviews conducted by BBB program staff in 2007 and from the literature on infant and young child feeding practices and supplemental feeding program delivery in Uganda. Interview guides are provided in Appendices. This research tool is useful for understanding individual's experience using interactive conversations with an open-ended structure. Attitudes, feeding strategies, and challenges encountered will be of focus.

Analysis of qualitative data

All interviews will be conducted and audio recorded in Lubwisi or Lukonjo by a trained research assistant. Audio recordings will be transcribed into Lubwisi/Lukonjo, and translated into English by a translator. A third party will translate the interviews back into Lubwisi for comparison of the original verbatim transcript to ensure accuracy of the data (Sandelowski, 1994; Temple & Young, 2004). Observations, non-verbal communications, and other contextual factors made during interviews will be recorded, transcribed verbatim, and translated as they contribute to the interpretation of manuscripts.

Baguma Charles, the on-site BBB evaluation project manager will proofread all Lubwisi/Lukonjo manuscripts and English translations with the qualitative staff to ensure transcripts accurately represent participant responses. All participants will be given a de-identified evaluation study number which will be recorded along with the date at the top of each transcript. No other identifying information will be recorded. Audio recordings will be expunged after transcription, translation, and analysis is complete. One copy of each transcript will remain in a locked filing cabinet with Mr. Charles in Bundibugyo, Uganda. A second electronic copy will be stored on the server at the UNC Center for Health Promotion and Disease Prevention for further analysis.

Interpretation of the findings

Reading and coding. Translated interview transcripts will be read and re-read to understand the entirety of the discussion before descriptive summaries of concepts and emergent themes are recorded. Qualitative findings will be summarized within four days of data collection to ensure topics needing exploration are incorporated into the fieldwork. Data codes will be assigned to emergent concepts and themes to facilitate compassion between caregivers and to build constructs for the conceptual framework of factors affecting RUF intake. Data codes will be both deductive (developed from the literature) and inductive (created in the field to label new concepts emerging from interviews) (Ulin et al, 2005). The coding process will be performed using NVIVO software and will be performed with the field team in Uganda, which consists of three trained interviewers.

Data display and data reduction. After the coding process, a report will be constructed for each code containing all blocks of text and information tied to that code. This report will include different dimensions of the coded theme, including cross-case differences. Next, visual matrices will be used to distill the data, highlighting the most essential concepts and relationships.

Development of the conceptual framework. The conceptual framework is a visual diagram of the most important dependent variables in a field study (shown in boxes) and of the relationships (shown by arrows). The plot of these relationships is directional, assuming that some factors exert and influence on others (Ulin

et al, 2005).Through identification of the inter-relationships of factors affecting dietary behavior, conceptual models can be used to guide the development of behavior change communication interventions (Creed-Kanashiro et al, 2003).

For the purpose of this study, we will use the adapted UNICEF framework (**Figure 1.1**) to explore the immediate and underlying factors affecting RUF intake and overall nutrient consumption among the children in the BBB population. For example, if a negative perception of the RUF is associated with low frequency of RUF feeds, the following schematic may be drawn, indicating that the caregiver preparation method and perception of the RUF negatively influences the frequency of RUF feeds. Associated analytic text will accompany the core concepts to describe meaning to the connection among factors affecting RUF intake, and will consciously omit the factors that are influential on nutrient consumption and RUF.

Development of RUF feeding messages. Following the analysis of the interview and observation data, culturally-specific messages to promote RUF feeding will be developed to fit within broader complementary feeding messages of the BBB program. As a guiding principle for the education message development, it is important to focus on a small number of carefully selected, specific key messages than can easily be adopted by the target population, rather than giving general advice about child feeding (Dewey et al, 2008).

These messages developed from this Aim will be informed by specific barriers (both observed and expressed) from the qualitative research, and will be developed alongside health center staff and agricultural extension workers to ensure clarity, feasibility, and cultural appropriateness. Possible target issues include frequency, dosage, and storage of RUF, and strategies to pair RUF with staple foods in appropriate ratios to ensure adequate protein consumption. These messages will be recommended to World Harvest Mission for consideration as part of the BBB program education curriculum.

Aim 1 strengths and limitations

The major limitation of this qualitative study is the small sample size of the caregiver interviews. The sample size is limited by the size of the BBB program, which enrolls a maximum of 50 caregivers per 10-week cycle. It will be likely be infeasible to sample more than 35 caregivers due to the timing of the

data collection and necessary location of caregiver interviews. In order to conduct this qualitative research aim, we must train Lubwisi and Lukonjo speakers in qualitative methods and have them moderate the interviews. Secondly, caregivers may fail to give honest responses about the negative aspects of their participation in the BBB program or the RUF for fear of receiving differential treatment during the remainder of their time in the program. This potential limitation will be addressed through a thorough explanation of the independence of the evaluation research team from the BBB program leadership, and the strict confidentiality of what is shared during interviews and observations.

Qualitative interviews will open a window into the experiences of BBB program participants and staff and offer an opportunity to voice their thoughts and opinions. To date, there have been no such interviews with BBB program participants or RUF beneficiaries at large. This process will give us a much richer understanding of the challenges caregivers encounter with using RUF rations, general feeding dilemmas in the household, and overall experiences with the BBB program.

Aim 2 Research Design and Methods

Aim 2a. Examine the nutrient contribution of the RUF to the overall diet and assess the diet quality of BBB participants according to:

a. proportions of total energy and protein from the RUF supplement and home-produced foods
b. percent adequacy of energy, protein, and key micronutrients required for catch-up growth
c. achievement of a minimally acceptable diet according to WHO-recommended Infant and Young Child Feeding guidelines

Aim 2b. Identify the socio demographic factors and feeding practices associated with RUF consumption and feeding frequency among BBB participants.

Dietary intake is a chief determinant of weight gain and a useful measure of supplemental feeding program effectiveness. The objective of Aim 2 is to assess the mean nutrient intake and dietary adequacy of children enrolled in the BBB program.

Subjects, recruitment procedures, and data collection

All caregivers enrolled in the BBB program will be recruited at the clinic to participate in dietary recall interviews to document their child's diet. The recruitment script is provided in Appendices. Dietary recalls will be performed at the clinic or at caregiver homes. A minimum of two diet recalls will be

obtained for each child on non-consecutive days, spaced no more than 10 days apart, during participation in the BBB program. Usual intake will be calculated by taking the mean of each nutrient for each child. A minimum of two recalls is needed to produce an average and to estimate within person variation; therefore, children within only one recall will be excluded from the analysis. Following program completion and after a minimum of four weeks elapsed time, two additional dietary recalls will be obtained on non-consecutive days, spaced no more than 10 days apart.

Assessing infant and young child diets

Twenty diet recalls are a validated and accepted dietary assessment tool for infants and young children and will capture typical diet composition and feeding patterns among BBB children (Ruel et al, 2003b). Multiple intake records for each child reduces within-person variability and gives greater power to determine usual energy, macronutrient, and micronutrient intake. Recalls performed on non-consecutive days are likely to give more accurate estimates of within-person variation than consecutively collected recalls (Willet, 1998).

Diet recalls will be conducted by trained field workers in Lubwisi or Lukonjo, depending on the preferred language of the caregiver. Recalls will not be conducted following local holidays, where meals atypical to the child's normal diet would confound normal dietary assessment. Recalls will be conducted using the multiple pass method to maximize the thoroughness of the recalled food and recorded in English. The multiple pass method asks progressively detailed questions to recount all of the food items within a meal, summarizes the food items, and then asks if any other foods were consumed with the meal. Standard plates, bowls, cups, and spoons with fraction markings (i.e. a plate divided into 8 sections) that are commonly used to feed young children in Bundibugyo will be used to help caregivers estimate the amount of food offered and consumed. The pre-tested dietary recall data collection instrument **(Appendix 1)** will contain the following parameters for each food consumed:

- Time of Day
- Name of Food/Dish or Beverage (including breast milk) given
- Cooking Method (where applicable)
- Amount of Ingredients
- Amount of Ingredients from free food ration (All, some, none)
- Amount of Food/Dish or Beverage given or length of time breastfed
- Size of Portion consumed from the total prepared (e.g. ¼, ½, All)
- How Given (e.g. cup, bottle, by hand, plate, bowl, spoon)

Diet recall data analysis

Using the mean observed intake of the two dietary recalls, nutrient values can be calculated using the net weight consumed for each, except in the cases of dishes that do not normally have recipes, where the pre-determined nutrient value of the food will be assigned based on the estimated size and amount of the food consumed.

Nutritional values of foods can be obtained from local or international sources; in most cases, an adapted Malawi Food Database will be used. This database was composed by UNC Nutrition team based on existing national databases and databases from other studies and has nutrient content of both individual food items as well as mixed dishes based on standard recipes. The nutrient value for the BBB RUF has been analyzed by the Makerere University Department of Food Science and Technology.

Dietary data will be coded as portion sizes and proportions of mixed dishes in grams and entered into a database for analysis. Weights of the individual food ingredients and dishes consumed by the study population will be obtained in February 2009 by recording the mean weight in grams of three separate dishes or individual food portions. Nutrients of relevance to childhood nutrition status and necessary to support catch up growth for the BBB program population will be chosen for analysis, and are outlined in **Table 1.5**. All nutrients listed below will be considered as continuous variables.

Calculating nutrient content and dietary adequacy

Total energy consumption will be calculated for each child from the average of their two diet recalls. Energy needs will be calculated on an individual bases using the Estimated Energy Requirement (EER) formulas in **Table 1.5**. Children's energy consumption will be summarized as percent adequacy by comparing their observed intake (average from recalls) to their EER. Given the bimodal agricultural climate in Bundibugyo, seasonality is not expected to play a role in dietary consumption and will not be incorporated into this analysis. However, the month of the recall will be recorded

Using calculated estimates from the 24-hour recalls, usual energy and protein intakes will be summarized with descriptive statistics. Next, the distribution of energy intakes will be summarizes as a percentage of the age- specific EER (WHO, 1985; WHO/UNICEF, 1998). To determine the prevalence of

energy deficiency within the sample group, the proportion of children with consumption levels below their personal EER will be reported. To evaluate protein consumption, intake will be summarized as a percent of the EAR for moderately malnourished children. The percent of each group with intakes below their personal EAR will be reported since it closely approximates the prevalence of inadequate intakes.

Micronutrients identified as problematic among moderately malnourished children 6-59 months in Uganda are selected for analysis. These include vitamin A, vitamin B6, folate, vitamin C, iron, zinc, and calcium.

For children ages 6 to 59 months, EARs are available for all of the above micronutrients except calcium, where the adequate intake (AI) will be used. Intakes of protein and micronutrients will be summarized using descriptive statistics and then evaluated as percent EAR (FNB/IOM, 1998a, 1998b, 2000b). Bioavailability of iron and zinc can be categorized as high, medium, and low as per FAO and WHO standards depending on food source and other dietary components to more accurately estimate intake of these nutrients (Dewey et al, 2004).

Ready-to-use food consumption

The following aspects of RUF consumption will be captured in the diet recall data collection and analysis. The nutrient composition of the BBB RUF is provided in Table 3.

- Presence of RUF in an eating occasion
- Amount of RUF offered
- Amount of RUF consumed
- Amount of water added to RUF
- Method of feeding RUF
- Number of RUF feeding occasions per day
- Ratio of RUF inclusion in meals: total eating occasions
- Proportion of total energy, protein, and fat from RUF

Choice of number of eating occasions versus number of meals

Assessment of daily number of meals depends directly on the definition of a "meal," which often varies across cultures. For some, a meal is defined according to the volume and type of food consumed. For others, the time of day it is consumed is important in defining a meal. The term "eating occasions" helps to eliminate difficulties caused by different definitions of "meal," the term still requires careful attention to cultural factors when interpreting results. The same is true of attempts to make cross-cultural comparisons

of results (Swindale & Ohri-Vachaspati, 2005). Use of the outcome "eating occasions" indicator in conjunction with the dietary diversity indicators helps strengthen individual dietary assessment.

Indicator of Infant and Young Child Feeding Practices

Infant and children's diets will also be assessed according an Infant and Young Child Feeding (IYCF) indicator, which can be abstracted from the dietary recalls. In recent years, the International Food Policy Research Institute and Macro International have developed the IYCF practices indicator to approximate diet quality. The IYCF indicator assesses children's diets according to four main categories: 1) breastfeeding status, 2) dietary diversity, 3) feeding frequency, and 4) consumption of milk of milk-based products. The matrix in **Table 1.6** outlines how the IYCF practices indicator will be calculated. The IYCF indicator will be calculated as a binary outcome (0=No, 1=Yes) for whether all 3 recommended behaviors were achieved. The 2006 Demographic Health Survey Final Report for Uganda contains regional specific data that will be compared to the study population.

Analysis plan

Usual intakes of all nutrients will be summarized with descriptive statistics. For energy, protein, iron, and zinc, usual nutrient intakes can be interpreted as a percent of the estimated energy requirement EAR to determine the proportion at risk of deficiency. For the micronutrients with only adequate intake values (AI), the mean intake of the age category group will be compared to the age-specific AI to see if a general increase in intakes should be recommended. To examine the individual contributions of nutrient intakes from RUF or home-prepared complementary foods, nutrient values will be stratified according to the category of the food source.

Within person variation

The degree of random within person variation varies between nutrients. Total energy intake varies least within a person because of internal homeostatic mechanisms that can regulate intake. As protein intake is highly correlated with energy intake this nutrient also have limited within person variability. Micronutrient intakes are not regulated by internal mechanisms and therefore have the greatest day-to-day

variation within an individual. The daily diet is influenced by multiple socio-demographic and environmental variables. The number of foods available to children of low-income households in Bundibugyo is limited. Economic constraints likely increase within person variability, due to varying states of food security and reduce between person variability (Bhargava & Bouis, 1992). Multiple diet recalls per person attempts to account for this characteristic in the study population.

Diet composition and feeding patterns

RUF preparation methods, dosage, and meal spacing will be of particular interest in the examination of dietary patterns in the BBB population. Diet composition will be summarized across the sample to generate a comprehensive list of all foods consumed by the sample and the frequency with which they were reported (type); 2) the number of different foods eaten by children (variety); and 3) the average amount of each food consumed (quantity). Family meal patterns will be summarized to detail the number of meals and snacks children consume in a day, and the time of day at which they are consumed.

Evaluating group dietary adequacy of the children in the BBB program

Descriptive statistics will be reported for the total intake of each nutrient investigated. Group mean intake should not be compared to the EAR to assess group adequacy for any nutrient. Instead, two methods are available to evaluate diet adequacy among groups of people. In the full probability approach, the probability of inadequacy is calculated for each child as the area under the requirement curve to the right of the intake level (Murphy & Poos, 2002). The information helps to determine the average probability of inadequacy, which closely approximates the group prevalence of inadequacy (Murphy & Poos, 2002). In order for this method to be accurate, day-to-day variation must be minimized either using statistical programs or increasing the number of recalls per individual to approximate usual intake.

The cut point method determines the proportion of the population with usual intakes below the EAR by examining the distribution of a nutrient within a group with respect to the EAR cut point. When day-today variation is removed from the data this method very closely approximates the group prevalence of inadequacy (Murphy & Poos, 2002). The EAR cut point can approximate the prevalence of inadequacy when: 1) intakes and requirements are independent; 2) the requirement distribution is symmetrical; and 3)

there is greater individual variation in the sample's intake distribution than their requirement distribution (Carriquiry, 1999).

To approximate usual intake within this sample, the two dietary recalls collected for each child will be averaged to produce one mean value. Observed average intakes will be compared to the recommended intake level for energy (EER), protein (EAR), iron and zinc (EAR) to determine the prevalence of inadequacy from the group proportion falling below the respective DRI cut-point (See Figure 3). In addition, this approach will also be taken for children above 12 months, for whom EAR values are available for vitamin A, B6, folate, and vitamin C. Because energy intake is strongly dependent on an individuals' requirement, the EER will calculated for each individual based on their body size and need, and the proportion of individuals achieving their EER will be reported.

For the 6-12 month age group, the group mean intake of vitamin A, B6, folate, vitamin C, and calcium will be compared to the published AI values for the 6-12 month age group, and for all children in the case of calcium. To determine if a child's observed intake differs significantly from the dietary recommended, a one-tailed t-test will be performed. The initial descriptive statistics will provide an assessment of the quality of the diet for the BBB children.

The shaded area of the usual intake distribution represents the proportion of individuals in the group whose intakes are below the Estimated Average Requirement (EAR), while the non-shaded area represents the proportion with usual intakes above the EAR. (Murphy & Poos, 2002).

<u>*The special case for iron*</u>. Iron requirements are assumed to have a non-normal distribution within all age and gender groups according to current DRIs. To assess the dietary intakes of children, the probability of inadequacy must be determined for each infant based on a comparison of their intake to the "probability of adequacy" values in the Institute of Medicine report on iron (FNB/IOM, 2002).

Aim 2 Strengths and limitations

The main limitation in this aim is due to the inherent risk in self-reported dietary assessment, which could misrepresent a child's dietary quality, and RUF use in either the positive or negative direction. The large variance across the study population during the formative phase of this work has reported both

adequate and insufficient dietary patterns as well as appropriate (efficient) and inappropriate (inefficient) uses of the RUF supplement. This data suggest that caregivers in this population report honest recollections of children's diets and use of the BBB RUF food supplement.

The use of multiple dietary recalls is a strength of the study methodology. Single or widely spaced recalls are not likely to be as reliable as multiple observations in providing information on what was actually eaten during the entire supplementation period. The detail of information collected from the diet recalls will enable examination of the amount of RUF supplement offered and consumed, which is a unique feature of this study.

This aim is well-designed to examine the nutritional adequacy of moderately malnourished children enrolled in an ongoing, community-based supplemental feeding program. As the key antecedent to growth and recovery, understanding children's dietary adequacy during program participation will aid in the interpretation of growth outcomes and help to explain how the RUF is being utilized by caregivers with their malnourished children.

Aim 3 Research Design and Methods

> Assess the impact of supplemental feeding program participation on caregiver feeding practices and children's diet quality through a post-program caregiver survey and comparison of dietary recall data collected during and after participation in the BBB program.

Study Population. All PP caregivers who participated in the 10 wk BBB Supplemental Feeding Program between October 2007 and June 2009 will be eligible for recruitment. Comparison Group (CG) caregivers will be eligible if they resided in or near Bundibugyo, have at least one child between the age of 6 and 59 mo, and never participated in the BBB program. Recruitment of all participants took place at caregiver homes. A convenience sample will be obtained for both study groups and CG participants will be recruited within the major sub-counties represented by the BBB program participants: Ndugutu, Bubandi, and Busaru. All surveys and dietary recalls were conducted in either Lubwisi or Lukonjo, the two primary local languages, depending on the language preference of the caregiver. Program records will be used to obtain village locations for PP participants. CG caregivers will be randomly sampled in the sub-counties targeted by the BBB program, with an emphasis on recruiting CG participants from the major villages that are represented in the BBB program. Verbal informed consent will be obtained after explaining the study

purpose. One 24 h dietary recall will obtained for each participating child immediately following the caregiver survey. A second 24 h dietary recall will be obtained on a non-consecutive day, within 10 d of the original recall to account for within person variation (Willet, 1998).

Caregiver survey. Qualitative caregiver interviews from Aim 1 and additional interviews conducted in February 2009 will be used to inform the development of a structured caregiver survey. The surveys will address five main dimensions: 1) child care practices, 2) nutrition education, 3) community awareness of the BBB program, 4) willingness to purchase RUF, and 5) food purchasing and home production practices.

Assessment of Dietary Diversity Scores (DDS) and Infant and Young Child Feeding (IYCF) Practices will be calculated as explained in the methods for Aim 2. Nutrient densities per 100 kcal will be computed for each child, as 100 times the ratio of the mean nutrient intake over two day of recall divided by mean caloric intake over the two day of recall. Dietary nutrient density is independent of energy intake, and therefore provides additional information about the quality of children's diets. Energy density requirements are a function of energy needs, gastric capacity, and number of meals per day.

For a sub sample of 41of the PP participants, dietary information will be collected for two observations taken during program participation. Mean nutrient values from the two 24 h recalls obtained during program participation were used to compare dietary adequacy during and after program participation, using separate age-specific requirements based on the age at the day of recall.

Statistical Analysis. Between-group comparisons for dietary adequacy, child feeding practices, and home food production purchasing behaviors were made using T-tests for proportions and simple logistic regression analysis using Stata 9.0 (Stata Corp. College Station, TX). Regression models will be specified according to significant demographic differences between PP and CG groups that are believed to relate to the outcome of interest. Potential confounders included child age, gender, presence of mother in the household, presence of father in the household, paternal and maternal education, parity, birth order, parental marital status, primary method of food acquisition, maternal occupation, paternal occupation, number of total children at the compound, distance to drinking water source, distance to health center, and socioeconomic status (estimated by the production of cash crops, participation in a small business, and the

quality of building materials of the home).

It is hypothesized that for all comparisons, the PP group would have higher dietary adequacy, a greater likelihood of achieving a "minimally acceptable diet," according to WHO-recommend IYCF standards, and exhibit more diverse home food production and purchasing behaviors. Therefore, a 1-tailed T-test was used, with $p<0.05$ considered statistically significant for these analyses.

Table 1.1. Estimate energy requirements (EER) for protein for children ages 6 to 59 months. Adapted from FNB/IOM, 2005.

EER = Total energy requirement + energy deposition	
Age	**Dosage recommendation for healthy children**
6–12 months	(89 × weight [kg] − 100) + 22 kcal
13–24 months	(89 × weight [kg] − 100) + 20 kcal
36-59 months (girls)	135.3 - (30.8 x age [y]) + PA x (10.0 x weight [kg] + 934 x height [m]) + 20 kcal
36-59 months (boys)	88.5 – (61.9 X age [y]) + PA x (26.7 x weight [kg] + 903 x height [m]) + 20 kcal
PA= 1.00 if PAL is estimate to be >= 1.0 <1.4 (sedentary)	*PA = 1.26 is PAL is estimated to be >= 1.6 <1.9 (active)*
PA = 1.13 if PAL is estimated to be >= 1.4 <1/6 (low active)	*PA = 1.42 is PAL is estimated to be >= 1.9 < 2.5 (very active)*

Table 1.2. Estimate Average Requirements (EAR) for children ages 6 to 59 months. Adapted from FNB/IOM, 2005.

Age	Dosage recommendation for healthy children
6–12 months	1.0 g/kg/d
13–36 months	0.87 g/kg/d
48-59 months (girls and boys)	0.76 g/kg/d

Table 1.3. Comparative selective nutrient analysis per 100 grams of soy flour, BBB peanut paste, total BBB food supplement (soy flour plus BBB paste), commercial ready-to-use therapeutic food, and corn soy blend. *Source: Jilcott, Ickes, Ammerman, & Myhre, 2009.*

Parameter	*Soy Flour*	*BBB Paste*	*Total BBB supplement*	*Plumpy'nut (RUTF)*	*Corn Soy Blend*
Total Energy (kcal)	439	623	543.9	543	376
Crude fat (g)	21	21	39.6	33	7
Crude protein (g)	38	21	27.9	13	17
Dietary fiber (g)	2	13	11.8	NA	9
Vitamin C (mg)	0	87	49.8	NA	40
Vitamin A (iu)	110	220	176	800	2612
Aflatoxin content (ppb)	NA	0	0	NA	NA

Table 1.4. Case definitions and available sample size of eligible interview participants

Participant	*Definition*	*Sample ratio (intended/available)*
Caregiver-child dyads	Caregiver of child currently enrolled in BBB program who attends child to weekly program or cares for child in the home.	30/50 (interviews) 25/50 (observations)
Health Center Staff	Staff at health centers who actively participate in recruitment, education, anthropometric tracking, or food distribution.	8/10 (interviews)
Production Team Members	Persons who regularly (>=1 /wk) in the production of the BBB food from either the Bundimulinga, Bugankere, Busaru, or Basunga production sites.	8/12 (focus group) 8/12 (interviews)
Agricultural extension workers	Employees of World Harvest Mission BundiNutrition team who work with or have knowledge about the BBB program.	2/4 (interviews)

Table 1.5. Variables used in quantitative dietary analysis. Source: Food and Nutrition Board & Institute of Medicine, 1998a, 1998b, 2000b, 2005; World Health Organization, 1985; World Health Organization & The United Nations Children's Fund, 1998.

Variable	Expected total intake 7-12 months	Expected total intake 1-3 years	Expected total intake 4-5 years
Dependent variable			
% adequacy	100%		
Independent variables			
Energy consumption	(89 X weight -100) + 22	(89 X weight -100) + 20	Boys: 135.3 - (30.8 x age) + PA x (10.0 x weight + 934 x height) + 20 Girls: 88.5 – (61.9 X age) + PA x (26.7 x weight + 903 x height) + 20
Protein consumption g/kg/day	1.0 25.6 for mod. malnutrition	0.87 25.6 for mod. malnutrition	0.76 25.6 for mod. malnutrition
Vitamin A ug/day	500*	210	275
Vitamin B6 mg/day	0.3*	0.4	0.5
Folate ug/day	80*	120	160
Vitamin C g/day	50*	13	22
Iron mg/day	6.9	3.0	4.1
Zinc mg/day	2.5	2.5	4.0
Calcium mg/day	270*	500*	800*

Table 1.6. Tabulation matrix for assessing the Infant and Young Child Feeding (IYCF) indicator

ID Number			
	BREASTFED		
Today's date (MM/DD/YY)	(1) Breastfeeding	**1**	
	(2) Fed 3+ food groups		
Birth date (MM/DD/YY)	(3) Fed minimum number of times		**3 IYCF?**
	TOTAL		**0 1**
Age (MM)			
	NON-BREASTFED		
	(1) Fed 4+ food groups		
	(2) Fed milk of milk products		
	(3) Fed 4 times or more		**3 IYCF?**
	TOTAL		**0 1**

Food groups include:
a. infant formula, milk other than breast milk, cheese or yogurt, or other milk products
b. matoke and foods made from grains, roots, and tubers, including porridge, fortified baby food from grains
c. vitamin A-rich fruits and vegetables
d. other fruits and vegetables
e. eggs
f. meat, poultry, fish, and shellfish (and organ meats); g. legumes and nuts
h. foods made with oil, fat, or butter

Feeding occasions for breastfed children should be at least twice a day for breastfed infants 6-8 months and at least 3 times a day for children 9-23 months

"Milk or milk-based products" include commercial infant formula; fresh, tinned, and powdered animal milk; and cheese, yogurt, and other milk products.

Figure 1.1. Conceptual model of the causes of moderate malnutrition in Bundibugyo, Uganda and placement of study objectives are placed within the model to demonstrate the factors examined in the current project. Adapted from the 1990 UNICEF Framework on the causes of malnutrition. [United Nations Children's Fund [UNICEF], 199O)

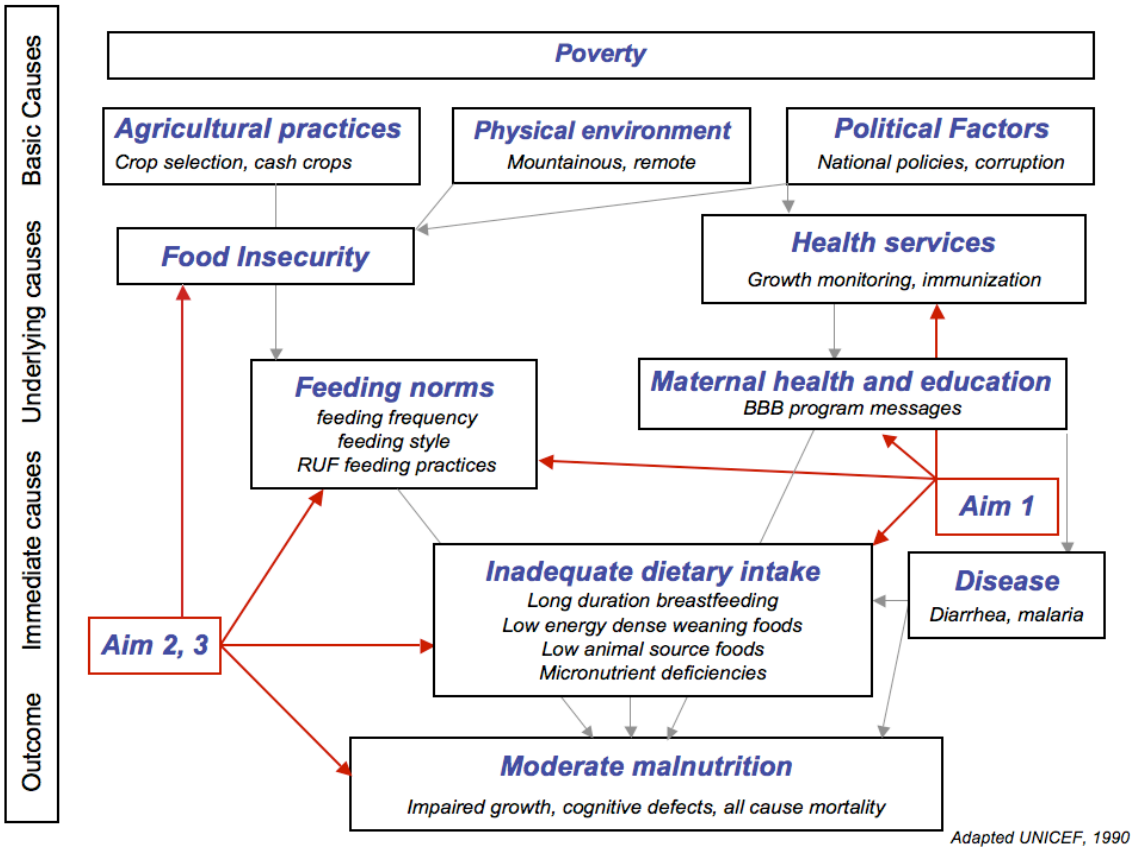


Figure 1.2. The bimodal agricultural process in Uganda. Source: Famine Early Warning Systems Network (FEWS NET) and the United States Agency for International Development, 2009.

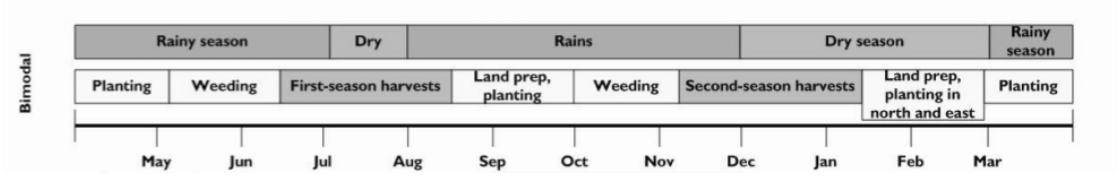
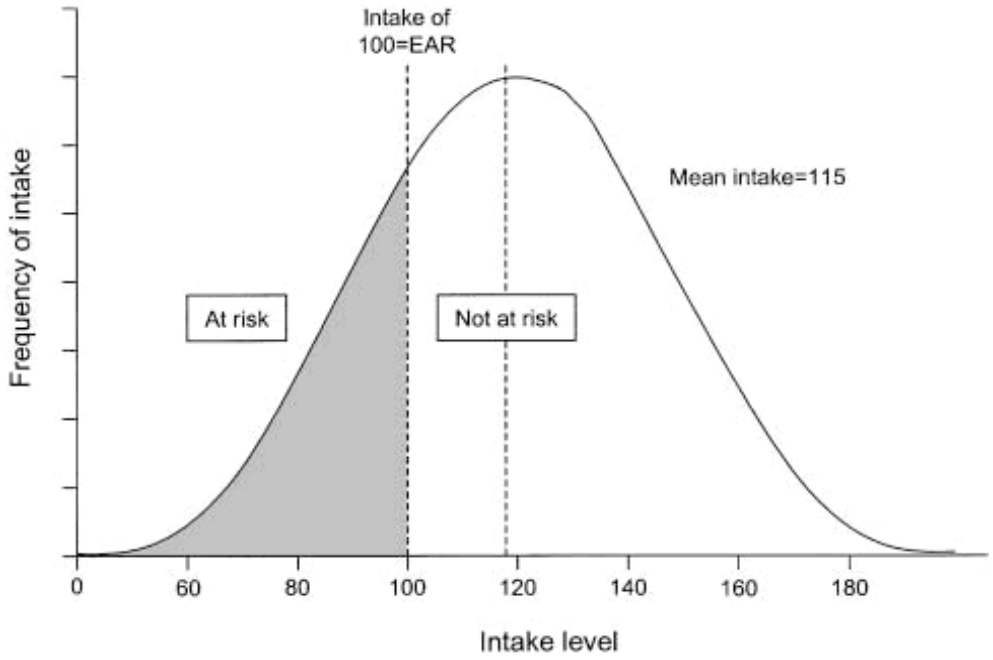


Figure 1.3. The Estimated Average Requirement (EAR) cut-point method.



CHAPTER 2

Examination of facilitators and barriers to home-based supplemental feeding with ready-to-use food for underweight children in western Uganda

Abstract

Poor complementary feeding practices and low quality complementary foods are significant causes of growth faltering and child mortality throughout the developing world. Ready-to-use foods (RUF) are energy dense, lipid-based products that do not require cooking or refrigeration, that have been used to prevent and treat malnutrition among vulnerable children. The effectiveness of these products in improving child nutritional status depends on household use by caregivers. To identify the key facilitators and barriers that influence appropriate in-home RUF consumption by supplemental feeding program beneficiaries, we conducted individual interviews among caregivers (n=80), RUF producers (n=8) and program staff (n=10) involved in the *Byokulia Bisemeye mu Bantu* (BBB) supplemental feeding program in Bundibugyo, Uganda. By documenting caregiver perceptions and feeding practices related to RUF, we develop a conceptual framework of factors that affect appropriate feeding with RUF. Findings suggest that locally produced RUF is well received by caregivers and children, and is perceived by caregivers and the community to be a healthy supplemental food for malnourished children. However, child feeding practices, including sharing of RUF within households, compromise the nutrient delivery to the intended child. Caregivers noted personal illness as a common challenge to regular program attendance, underscoring the importance of child nutrition programs to simultaneously address maternal health and nutrition. Interventions and educational messages informed by this study can help to improve RUF delivery to targeted beneficiaries.

Introduction

Although Ready-to-use (RUF)-supported complementary feeding programs can both prevent and treat malnutrition (Lin et al, 2008, Matilsky et al, 2009), clinical trials have reported low consumption of

the distributed rations by targeted children. Little is known about factors associated with low consumption of RUF rations. To date, the method of RUF preparation (i.e. excessive dilution) and overly sweet taste are the only documented factor associated with the low-intake of RUF by program beneficiaries (Flax et al, 2008, 2009). Inadequate RUF consumption may limit adequate nutrient intake and catch-up growth (Maleta et al, 2004). In order to develop culturally sensitive messages to improve the consumption of distributed RUF rations, home-based RUF feeding practices and factors influencing these practices need to be understood.

Operated by World Harvest Mission (WHM), the *Byokulia Bisemeye mu Bantu* (BBB) Program (Lubwisi for "Good Food for People") is a community-based feeding program in Bundibugyo, Uganda that uses a locally sourced and produced RUF to supplement the diets of underweight children, aged 6 to 59 months. RUF is produced by four production teams, which are located near the two health centers that operate the BBB program. Production teams use hand-powered grinders to prepare two products—1) roasted groundnut (peanut) paste mixed with dried moringa powder and 2) roasted soy flour. Leaves of the *Moringa oleifera* tree, chosen because of high micronutrient content and local availability, are brought to the clinic weekly by caregivers, then transported to production teams to be dried and ground into powder (Price & Davis, 2000). The RUF is delivered to two local health centers by WHM-employed Agricultural Extension Workers, and distributed by health center staff. These two products are delivered in two plastic bags, kept separate to regulate to proportion of ingredients, and are combined by caregivers into a homogeneous paste. Children are enrolled in ten-week program cycles. At weekly visits, local health center staff distribute a weekly ration of RUF, multivitamins with iron, and provide nutrition education and growth monitoring. A single dose of vitamin A and de-worming treatment is provided upon enrollment. Weights and lengths are recorded in the program register and Ugandan Child Health Card, if available. The weekly RUF dosage (128 g/day) provides 620 kcal and 29.5 g of protein per day. This delivery method differs from other RUF products, such as Plumpy'doz©, which is distributed as one product in foil sachets or plastic jars.

Caregivers in the BBB program receive weekly education, delivered by community health workers and health center staff, on the following topics: (1) the impact of early nutrition on school performance later in life, (2) antenatal nutrition, (3) growth monitoring, (4) breastfeeding, (5) healthy complementary

feeding, (6) feeding children with an attentive, responsive feeding style, (7) recovery feeding after illness, and (8) hygiene (Jilcott et al. 2009). Behavior change strategies are conveyed using the "BBB" approach, developed from the Health Belief Model and Social Cognitive Theory constructs: (1) *B*elieve benefits (perceived benefits); (2) *B*reak down barriers (perceived barriers, self-efficacy); and (3) *B*egin now (goal setting, cues to action) (Glanz et al. 2002). Initial messages specific to the RUF were to feed the food to the enrolled child only, either directly without cooking or as a thick porridge. For commercially produced RUF products, basic instructions are often listed on the product packaging. These messages are often limited to feeding RUF directly to children with no cooking.

Follow-up anthropometric analysis of post-program children (n=61) indicated that 72% of children remained underweight, defined as a weight-for-age Z score (WAZ) <-2 of the WHO Multicentre Growth Reference (unpublished data). Preliminary observational evidence of diluted RUF preparation raised concerns over caregiver feeding practices and subsequent nutrient delivery to enrolled children (Jilcott et al, 2009). Despite being accepted by caregivers as a healthy complementary food for undernourished children, intervention trials report that targeted children may consume less than 40% of distributed rations (Maleta et al, 2004; Flax et al, 2008).

The purpose of this study was to identify the barriers, facilitators, and cultural factors that affect in-home feeding with RUF, distributed in the context of moderate malnutrition. These factors were used to inform culturally specific messages to promote RUF consumption by underweight children, and to provide evidence for nutrition program improvement strategies.

Participants and Methods

Setting. Bundibugyo is in the western region of Uganda, separated from the rest of the country by the Rwenzori Mountains, and bordering the Democratic Republic of Congo. With no paved roads or electricity, Bundibugyo is one of Uganda's least developed districts, and consistently ranks among the lowest districts for health services and child health indicators in Uganda. The majority of families rely on subsistence farming; some cultivate cocoa and coffee as cash crops. Cooking is done over open fire, from wood gathered by women and children, or with charcoal in metal grills. Water for washing and drinking is collected into jerry cans where taps are available, and from the local rivers in remote villages.

The Bakonjo and Babwisi are the two predominant people groups in the 290,000-person district, which includes 52,500 (18%) children less than 5 years. The prevalence of stunting (Height-for-age Z score (HAZ) < - 2) is 45%, compared to the national prevalence of 38% (Jilcott et al, 2007). Maternal education is directly related to stunting prevalence. In western Uganda, over 95% of women do not complete primary school, and 25% have never received any formal education at all. (UBOS and Macro International Inc., 2007). Fertility and cultural marriage patterns also play a role in child nutrition. Women in western Uganda also are the most likely to be in a polygamous marriage with two or more co-wives (11%). With a mean number of 7.3 total births per woman, western Uganda has one of the highest birth rates worldwide, and the median age of a woman's first marriage (17 years) is the lowest in the county (UBOS and Macro International Inc., 2007).

Participant recruitment and data collection. A total of 48 semi-structured, in-depth interviews were conducted with caregivers (CG), health center staff (HC), RUF production team members (PT), and WHM agricultural extension workers (AE) **(Table 2.1)** from June-July 2008, and again in February 2009. In addition, one focus group was conducted among RUF production team members. In July-August 2009, a follow-up survey was conducted among a new set of caregivers (n=50) after they exited the program to further investigate findings that arose from the initial interviews and focused specifically on the issue of sharing RUF within households, and barriers to program adherence.

Caregivers were recruited at health centers following weekly program meetings. No participants declined participation. Participants gave their preference for the interview location: at the health center, home, or alternative place specified by the participant. Informed consent was obtained from all participants, who were assured that shared information would be kept confidential and that participation in interviews would not affect any services received from the health center or their relationship with World Harvest Mission. Human subjects' approval was obtained from Institutional Review Board at the corresponding author's university, and from the Bundibugyo District Health Office.

Interview questions were posed in English and translated by a trained Ugandan social worker into Lubwisi or Lukonjo, the two predominant local dialects, according to the preferred language of the participant. Responses were translated back to the interviewer. Field notes were taken during each interview to note visual cues and body language that may add to the interpretation of results. Members of

the research team were not employed by World Harvest Mission, and were in no way involved in the delivery of the BBB program during the research period.

Research questions and development of interview guides and caregiver survey. In order to assess the multiple levels of influence regarding BBB program utilization and child feeding practices, the social ecologic framework was used to guide the core research questions (**Table 2.2**). Specific interview guides (**Table 2.3**) were developed to include overlapping questions in order to investigate corroboration or dissonance across participant groups. Findings from the qualitative study were used to guide the development of the structured caregiver survey.

Data coding and analysis. All interviews were audio-recorded, translated, and transcribed into English, and back translated to the local language to check for accuracy and clarity. Revisions were then made to the English transcripts as needed. Transcripts were read and coded by two separate analysts using AtlasTi Software Version 6.0 (Berlin, Germany). Codes were developed deductively from the interview guides and inductively from emergent themes from the interview data. After agreeing upon preliminary codes, a minimum inter-rater reliability of > 0.9 was established by testing for mutual agreement of code assignment with a sample of ten transcripts. Direct text quotes were extracted from transcripts with participant identification numbers in order to link quotes with demographic data. Data reduction was accomplished by organizing representative quotes within each theme into schematic matrices to provide a visual display of themes. Related themes were grouped together under dimensions of the social ecological framework. Triangulation of findings from multiple participant categories was used to identify and interpret interview responses.

Survey data was tabulated into an electronic database and response frequencies were noted. Demographic information was linked to both the interview findings and survey results in order to examine responses based on household and participant characteristics. Selected survey questions that provided further insight into qualitative interview findings are presented.

Development of conceptual framework and feeding messages. From the study findings, a conceptual

framework was developed using the grounded theory approach to visually depict the interrelationships of the most important factors related to RUF feeding practices. This framework was used to guide the development of feeding messages to be incorporated into the BBB program curriculum to improve RUF consumption patterns. As a guiding principle for the development of education messages, we focused on a small number of specific key messages that can be implemented easily by the target population, instead of general advice about child feeding (Dewey et al, 2008).

Results

Fifty codes were identified from the interview guides and from the participant responses to highlight themes related to RUF feeding practices. These codes were grouped into 5 families: 1) Caregiver perceptions and child reactions to RUF; 2) Perceptions of the BBB program's effects on child growth and health; 3) Child feeding routine; 4) Factors affecting program adherence; and 5) Recall and interpretation of feeding education.

1. Caregiver perceptions and child reactions to RUF

Acceptability. Caregivers perceived the RUF positively, noting that the food helps malnourished children with "weak bodies" to "gain strength", "improve stomach problems," or "gain weight." Most participants reported high acceptability of the RUF, commenting that their child "likes the food so much" and "eats the food well." A mother with twins in the program noted that the RUF affected her children's energy levels: "When I fed them with this food they enjoyed it a lot and started playing (CG 8)."

Perceived purpose of the RUF and comparison to home foods. While caregivers noted that the RUF was similar to the foods they usually feed young children in that the ingredients were all available locally, they commented that the RUF contained "more vitamins," and was a higher quality food than can be made at home, where only wooden mortar and pestle are typically available for processing food.

Mothers appreciated the "smooth" texture of the RUF, "ground well" for small children in the hand-powered grinders. In contrast to home foods, caregivers remarked that the RUF had a longer preservation life and could be prepared in more ways than traditional foods. Most producers noted that the

key quality of the RUF was its "smooth texture" and "softness" compared to other local complementary foods.

Opinions about the content of the RUF. Most caregivers had no suggestions to improve the BBB food. When asked how they would feel if the two foods were mixed together in one bag, there were mixed responses. Caregivers in favor of combining the foods noted that they usually feed groundnuts and soy flour together, so combining the two beforehand would make little difference. Caregivers opposed to combining the foods valued the multiple preparation options available to them with two separate ingredients. Some providers also valued being able to control when they feed the soy flour to the children, as this product was less enjoyable than the groundnut paste. While most caregivers noted that the food lasted about one week, until the next distribution, many commented that the groundnut paste was finished before the soy flour.

Caregivers had mixed reactions to the moringa powder mixed into the groundnut paste. While most respondents felt that the moringa powder distinguished the RUF from other local foods and made the food "like medicine" that helped the child "grow up well," some others complained about the negative taste and acceptability:

> "My child does have problems digesting the moringa. Yesterday's groundnut paste especially had a lot of moringa and thus I am afraid to give this to my child. Therefore, I usually feed the child soybean flour because I assume that the other food [groundnut paste with moringa] may cause the child diarrhea…The moringa is good for you but when there is too much, it means that the food does not taste good anymore (CG 4)."

Some caregivers noted the BBB program taught them that moringa could be fed to young children. With this knowledge, and since moringa was abundant in home gardens, caregivers notes that they have started including it in other child meals.

2. Perceptions of the BBB program's effects on child growth and health Many caregivers felt that the BBB program was critical to improving the health of their children, who were "sickly", "weak," or "malnourished" before the program. A direct connection between the child's weight and health was clearly understood by all caregivers who often desired for their children to increase their "kilos" or "put on more weight." Caregivers often noted an increase in their children's appetites after the program began, crediting

the acceptability by their children and high nutritional quality of the RUF. All caregivers understood the weekly weighing to be a way to monitor children's growth, "to see if we have been feeding our children well." However, children's weights were not always clearly communicated. Caregivers sometimes needed to ask health workers the weight or read the value from the book, which was problematic for parents who could not read. Health center staff discussed the child's progress with parents, and would ask questions about the child's health and feeding, especially if the weight decreased from the previous week or did not improve over time. Staff noted that the program improved the way the health centers treat malnutrition; workers felt more empowered in their growth monitoring and nutrition education skills.

It was often community members whose concern about a child's appearance prompted caregivers to seek help for their malnourished children. Several caregivers learned about the BBB program from their neighbors and friends, while some caregivers received questions from neighbors about how they could enroll their children in the program. Community members noted a direct connection between the RUF and improving nutrition. This finding is important in the study context as malnutrition is sometimes attributed to non-biological factors such as evil spirits. One production team member noted the effects of the RUF:

> "When [the RUF] is given to a child—even when he had been terribly malnourished—he gains energy and good health. Even when the hair had started to become brown or reddish, it starts to change by being black and dark."

Seen as a good tasting and useful food for helping children "grow well and gain energy", neighbors of caregivers and RUF producers inquired about where they could get the RUF for their own families.

> "When other people, mostly women, find when I have prepared this food for my children and they are feeding, they always get spoon and eat some, so they say the food is good and continue to say 'that is why this food is helping your children.' So they encourage me to continue feeding my children with this food since it tastes good (CG 8)."

When caregivers were asked how their children's growth has been affected by the RUF, most noted some improvement in their children's weight. Improvements were also attributed to other complementary foods that they began feeding as a result of the education and encouragement they received from the BBB program, such as avocados, eggs, and greens, but also noted that these foods were difficult for them to obtain due to "lack of money."

In cases where children did not gain weight during the program, caregivers attributed lack of

improvement to pre-existing, mostly unexplained health conditions, "Despite the fact that the child is feeding on BBB food, he is not improving. So there are definitely other factors involved here as well (CG 4)." Others felt only partially encouraged by their child's improvement: "I think my child is still sick and not yet healthy. Despite him feeding on this food, my child is still weak (CG 20)."

Production teams and other community members also recognized improvements in children's weights and energy levels, and reinforced these positive reactions to the RUF. One production team leader noted that program participants noticed different responses to the BBB RUF compared to other local foods fed to children:

> "Sometimes the people ask us for what we put in soy flour to make it different and good for the children. This is because they have their soy beans in the village and try to feed them to their children, but there is no change brought (PT 3)."

3. Child feeding routine

RUF and the caregiver feeding schedule. Caregivers reported that the RUF was easily incorporated into the normal child feeding routine. Some caregivers credited the BBB program and RUF with helping them get on a "regular feeding schedule" with their children. While some reactively fed children when they began to cry, many caregivers' noted regular daily schedules for child feeding:

> "I always wake up early in the morning to cook for them and feeding them at eight. After they eat, I go to my garden to dig. I come back at noon, cook for them again and also prepare the evening family food and their food separately… I always come back quickly and in time from the garden because I always think about my children's feeding and care when I am digging (CG 18)."

One health worker remarked that most caregivers feed both RUF and breast milk to their children; however, the RUF helps when the mother is separated from the child.

> "But what others do is to only cook for their children in the morning the food they can eat for the long time the moms are gone for gardening. So what happens is that almost half of the day the child does not breastfeed but only feeds off the BBB, which alone cannot make the child grow well. Also some mothers only feed their children only this BBB and don't supplement it, so that one also stops a child from growing well (Health Center Staff 7)."

RUF preparation. Preliminary research findings in the study setting suggested that preparation and excessive dilution of RUF may impair nutrient intake form the RUF. Therefore, the issue of RUF preparation was explicitly explored. In general, most caregivers cooked the RUF, and this method was the recommended procedure from health center staff. Some caregivers noted instructions from health center

staff to use small pieces of groundnut paste as snacks for children, while others did not recall such messages. Feeding RUF directly to children was mostly an occasional approach used to pacify a crying child, and was met with mixed reactions. Some children "loved it right from the bag" and "immediately stopped crying." However, in a culture where nearly all foods are boiled before eating, some caregivers feared that the "uncooked" groundnut paste would cause diarrhea or more severe sickness, or was simply not accepted by children.

> "The child sometimes eats the real [uncooked] paste when he sees his mother cooking it. But other members of the family always want to stop him since it is not good to eat the uncooked paste. I have not received any education about this [feeding the RUF with no preparation]. We [the family] assume that if the child continues eating the uncooked groundnut paste, he or she will die. (CG 15)"

Despite pre-cooking the ingredients during production, some producers also felt that the RUF could not be eaten without additional cooking. As one producer noted, "This food needs to be cooked for babies because it might not be easy for their digestion if it is not cooked (Production Team Member 4)."

Integration of RUF into family foods. All caregivers reported feeding other foods in addition to the RUF; however, many noted that more of their child's food came from the BBB program than from family foods, and that their children preferred the RUF to other foods. The most common complementary foods fell into three categories: 1) starch-based staples (boiled green bananas, boiled cassava flour, rice, Irish potatoes, sweet potatoes, millet flour); 2) protein-based "sauces" (groundnut sauce, beans, soy beans, fresh fish, amaranth, boiled cassava leaves); and 3) nutrient-rich "supplements" (eggs, tomatoes, avocadoes, papayas, passion fruits).

In most cases, RUF was prepared as porridge or as a "sauce" mixed with a starch-based staple food. **Table 2.4** summarizes the most common RUF recipes, ingredients, and preparation techniques. More so than breakfast or lunch, the evening meal was the occasion for additional supplements to the children's RUF-based meals, including foods from the family meal such as cooked greens, beans, and fish.

Most caregivers noted feeding complementary foods between two and four times a day, in addition to regular breastfeeding. Caregivers who reported breastfeeding their children were asked how the RUF has affected their breastfeeding schedule. No caregivers reported a reduction in breastfeeding after starting the program, and some noted that the RUF helped them to supplement their breast milk, which they

felt was no longer enough to feed their growing child.

Many caregivers reported preparing separate meals and using separate bowls for the enrolled child to better "monitoring how this child is eating" and to improve hygiene. "I want to see my child in good health. I have to make sure when I am cooking, I stay around my child's food so that there is no contamination to make my child sick again (CG 13)." Despite the considerable time taken to prepare the RUF, caregivers were not discouraged by the preparation of separate meals for the enrolled children.

> "I prepare [the RUF] and the family food together. But the child's food [the RUF] gets ready first because it is easy to cook, and we were told not to overcook it. So as the family food continues to get ready, I start feeding my twins. My twins eat first (CG 18)."

Sharing. Caregivers in the initial interviews were asked if anyone besides the enrolled child consumed the RUF. While many caregivers could recall instructions from the health center staff to feed to the food to only the targeted child, sharing of RUF was explicitly reported by several of the initially interviewed caregivers. To further investigate the issue of sharing, an open-ended question was included in a follow-up survey, which asked caregivers: "Was it ever a challenge to you to feed the RUF to only the child enrolled in the program?" to which 34 of 50 (68%) of caregivers replied positively. The primary reasons for this challenge, assessed in a subsequent close-ended question, ranged from food insecurity to the cultural norm of food sharing **(Table 2.5).**

Caregivers were then asked to describe this challenge in their own words. The responsibility of feeding many young children within a household added strain on caregiver's ability to feed the RUF to only one child. One 28-year old mother whose child was discharged from program one month prior to interview noted the strong cultural value to sharing food with everyone present at mealtime:

> "Every time I prepare the BBB food—or any other food—I call all of the other children who are the same age as this one, because these children are too much used to each other. This one (pointing to the child who participated in the BBB program) cannot eat the [RUF] with the other children just looking. They have to share it." (CG 30)."

> "His other brothers would give me a hard time when I gave [the RUF] to him while they observed without any food for them. I sometimes prepared the food [RUF] as family sauce (CG 44)."

Providing a protein rich, more expensive "sauce" to round out an otherwise starch-based diet was a challenge for caregivers. Hence the RUF was sometimes used when sauce could not be obtained for families. "If I would run short of sauce, I would get some of her food [RUF] to supplement ours (CG 65)."

A second mother described her preparation style as a way to stretch the RUF "I add dodo [amaranth], tomatoes, cabbage—but small quantities for each of these things. Sometimes, I put more ingredients into this food, so that it can feed more people (CG 13)."

In the case of households where sharing was not reported, caregivers recounted measures such as using a separate bowl, or setting aside a separate feeding time in order to ensure that the RUF was given only to the one child enrolled in the program.

4. Factors affecting regular program adherence Caregivers walked between 500 meters and ten kilometers each week to one of the health centers to participate in the BBB Program**.** An attendance record abstracted from the program register indicated that among caregivers interviewed and surveyed (n=80) the mean ± SE attendance rate was 7.4 ± 0.3 out of 10 visits. Caregivers cited transportation to the program as a barrier to participation, particularly during bad weather. Health center staff noted that some caregivers come from far distances, especially those residing in the Democratic Republic of Congo, arrive late to the program, or "are disturbed by the soldiers at the border who do not let them through." Caregivers with several young children also reported that it was sometimes difficult to attend the program when the enrolled child or another child in the household was sick. Program staff complained that some caregivers missed distribution days, which they believed slowed children's recovery. Staff suggested that to increase enrollment and improve attendance they could "sensitize communities" by doing outreach and home visits, especially in remote villages.

A question was included in the follow up survey to further understand barriers to program attendance. Seventy-four percent (37 of 50) of caregivers noted that it was a challenge to attend the BBB program every week, citing difficulties with transportation (46%), failure to complete all activities instructed by health center staff (30%), or sickness of the child (15%), personal sickness (22%), and the need to tend to domestic chores and gardening (14%). As one mother noted: "I would forego most of my domestic chores and garden work every Tuesday for the program. I always felt tension about bringing the child every week to the health unit because it frustrated some of my working schedule days and plans." (CG 45)

The length of the program was also frustrating to some caregivers, who had to leave other children

to attend the program. “Leaving home other children without a caregiver kept me upset at the health unit every time there was a delay.” (CG 51)

5. Recall and interpretation of feeding education Health center staff described the content of the program education, which emphasized continued breastfeeding, variety, hygiene, responsive feeding, meal size, thickness of complementary foods, and feeding frequency. While health center staff noted that they would educate caregivers to “not depend on the BBB food alone in feeding” children, but to also feed children soft, nutrient-rich foods such as avocados, eggs, and greens, most caregivers reported that they were unable to purchase these foods, despite wishing to provide these foods for their children.

At the time of the interviews, all caregivers had been present at a minimum of three program sessions. When asked to explain the activities of the BBB program, both caregivers and health center staff recalled feeding education as a key program component. Most caregivers summarized the education in terms of providing good care and proper feeding for their children, noting both specific points (i.e. feed the child at least three times a day) and general concepts (i.e. to take good care of the child when feeding). While a few caregivers noted that their long commute to the health center occasionally caused them to miss the education, there was an overall strong recall and understanding of messages. The most commonly recalled feeding and care topics were meal frequency, diversity of complementary foods, “monitoring children when they eat,” and maintaining good hygiene.

> “They teach us about how you should cook well the child’s food, clean well the saucepan in which the child’s food is cooked, clean well the plates where the child will eat the food from, when you cook the food you bring soy [flour] and gnut paste mix them together, cover the food while on fire, and when the food gets ready you find a place to sit and begin feeding a child (CG 2).”

Several mothers knew to avoid excessive dilution when preparing the RUF, “…so that the food is not too watery and the food can therefore be able to stay in the child’s stomach for a longer period of time (CG 14).” Caregivers also noted that an appropriate meal size could limit leftovers that may not be consumed: “We put a small amount of water for us to cook little and just enough for him so that he eats it all and does not leave anything. We don’t want to waste the child’s food and we want him to always eat all the food that he is given at the health center (CG 22).”

To explore differences in the depth and content of understanding of educational messages based

on attendance rates, we divided the 80-person caregiver sample into "low" (fewer than 5 sessions) and "high" (five or more sessions) attendance rate groups. All caregivers interviewed and surveyed could recall at least one education message about child feeding. However, caregivers with higher attendance raters recalled a broader variety of child feeding messages.

Conceptual framework of factors affecting ready-to-use food consumption. The key barriers and facilitators to appropriate supplemental feeding with RUF **(Table 2.6)** were organized into a conceptual framework **(Figure 2.1)** that describes the relationships between these factors and their effect on nutrient delivery to children. Briefly, caregiver motivation to improve children's weight and health encourages regular feeding with RUF. Caregiver preparation of RUF can contribute positively to appropriate child feeding by ensuring good hygiene and by encouraging other nutrient rich foods to be added to child meals. Preparation of RUF may also use up a larger portion of the distributed ration at one time, may be more likely to be get shared with other children, and may be diluted with water which reduces the nutrient density of the RUF. Structural factors such as long commutes to the program clinic, combined with the competing demand of household responsibilities, may prohibit caregivers to regularly obtain the RUF at weekly program visits.

RUF feeding education messages. In response to the barriers presented in the conceptual framework, three feeding messages were developed for the BBB program curriculum (**Table 2.7**) in order to improve RUF consumption by children.

Discussion

Initially designed and demonstrated to be effective to treat severe malnutrition in hospital or outpatient settings (Diop et al, 2003; Collins & Sadler, 2002; Sandige et al, 2004), RUFs have been modified and more broadly applied to treat moderate malnutrition (Patel et al, 2005) and stunting (Maleta et al, 2004), to prevent moderate and severe wasting (Isanaka et al, 2009), and to support breastfeeding replacement feeding for HIV positive mothers (van der Horst et al, 2009). With this broad application, it becomes increasing important to understand the cultural factors that affect RUF consumption in home-

based settings.

To our knowledge, this is just the second qualitative study among recipients of ready-to-use food (Flax et al, 2009), and the first within an ongoing community-based supplemental feeding program supported by RUF. The purpose of this study was to identify the barriers and facilitators that affect in-home feeding with RUF, distributed to treat under nutrition. These factors were used to inform culturally specific messages to promote RUF consumption by underweight children, and to provide evidence for nutrition program improvement strategies.

By conducting interviews in the local language using indigenous speakers who were trained in qualitative research methods and research ethics, we were able to gain insights from multiple participants groups who supply, administer, and participate in the BBB supplemental feeding program to access a wide spectrum of program processes and influences.

Health center staff and caregivers differed in their child feeding pattern descriptions. While staff believed that caregivers fed RUF irregularly and without any additional supplements, caregivers credited the RUF with enhancing the regularity of child feeding. Moreover, caregivers described measures taken to maintain a clean food storage and feeding environment when using the RUF, which they learned from program education. This finding underscores the critical need for RUF-supported programs to provide educational support for care and responsive feeding, which plays a large role in children's energy consumption, development, and weight gain (Engle et al, 2000). Caregivers and health center staff both described the issue of RUF sharing: health center staff suspected that much of the allocation RUF were not getting to families with many children and caregivers described the reasons behind the challenge of giving RUF to only one child. Producers and caregivers expressed consistent attitudes towards cooking the RUF before feeding it to children provided an additional measure of food safety.

Both caregiver and health center staff noted program attendance as a key barrier RUF delivery. Into addition to long commutes—acknowledged by health center staff—caregivers were frustrated by the length of program sessions, which sometime started late and caused them to forgo work and child care responsibilities at home. Moreover, caregivers described the challenge pf maintaining their personal health. During a typical program session, caregivers —mainly women—commute up to 10 kilometers by foot in hot conditions, and sacrifice an entire afternoon to attend the program. These foregone commitments and

the strong relationship between maternal health and children's nutrition, underscores the importance of supplemental feeding programs to include supportive incentives for caregivers, when resources allow.

One recent study indicated that Malawian caregivers were more likely to withhold RUF supplements during illness compared to corn soy blend, due to the sweetness of the RUF supplement (Flax et al, 2009). RUFs that contain less or no sugar and that more closely resemble locally available foods, such as the supplement examined in the present study, may be less likely to be withheld during illness, and may provide a wider range of possibilities for caregivers to incorporate supplements into children's daily diets.

Limitations. The study may have been affected by a social desirability bias, in that caregivers may have failed to give critical responses about the negative aspects of their participation in the BBB program or the RUF for fear of receiving differential treatment from health centers or from program staff. To address such fears, caregivers were ensured confidentiality. As findings of the current study include a variety of responses around the issue of sharing RUF—an issue that would be expected to elicit biased responses—we believe the study findings were not heavily affected by such a bias. It is evident that the strong cultural value of eating from a shared bowl in western Uganda affects RUF distribution within households.

Conclusions. As RUF production scales up throughout the developing world to support a multinational trend towards community-based management of malnutrition, the practical aspects of in-home feeding with RUF need to be understood in various cultural settings. The results of this study provide evidence that is both particular to the study setting and generally applicable to similar remote, rural regions where caregivers face the ongoing challenge of feeding their children adequately. The education that accompanies free food rations in complementary feeding interventions should continue to be informed by culturally relevant research, as presented in this study. Future studies that assess the adequacy of nutrition program beneficiaries' diets after program discharge will be helpful to understand the potential for food rations, including RUF, delivered in combination with education, to promote long-term improvement in dietary adequacy and child feeding practices of malnourished and at-risk children.

Key Messages:

- Locally-produced ready-to-use food is well-received by Ugandan caregivers as a supplemental food for underweight children.
- Sharing of RUF rations for home-based use is common, and is likely to reduce the intended dosage of RUF to targeted children.
- Ready-to-use foods used in home-based settings are likely to be prepared with additional cooking and altered through the addition of other supplemental ingredients.
- Education messages should highlight preparation styles that minimize dilution to encourage maximum nutrient delivery to children.
- Longitudinal research is needed to examine the effect of ready-to-use food-based supplemental feeding programs on caregiver feeding practices, after free supplements are no longer provided.

Chapter 2 References

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Table 2.1 Case definitions and sample size of participants

Participant	***Case definition***	***Sample size (method)***
Caregiver-child dyads (Currently enrolled)	Caregiver of child currently enrolled in BBB program that brings child to weekly program or cares for child in the home.	30 (interviews)
Caregiver-child dyads (Post-program)	Caregiver of child who was previously enrolled in BBB program.	50 (surveys)
Health Center Staff	Staff at health centers who actively participate in recruitment, education, anthropometric tracking, or food distribution.	8 (interviews)
Production Team Members	Persons who regularly (≥1 /week) produce the BBB food at any of the four production sites.	8 (interviews) 8 (focus group)
Agricultural extension workers	Employees of World Harvest Mission BundiNutrition team who work with or have knowledge about the BBB program.	2 (interviews)

Table 2.2 Core research questions used to develop interview guides, based on the social ecological framework

Individual level
• What are the current RUF-related feeding behaviors?
• What challenges do caregivers face in feeding RUF to their children?
• What are the attitudes of health center staff towards the BBB program?
• How do RUF production team members understand the purpose of their work?
Interpersonal level
• What child feeding issues and practices do caregivers discuss with one another?
• Which household members, including other children, influence caregiver feeding of the targeted child?
Institutional level
• What are the current educational messages that caregivers receive about RUF consumption?
• How are these messages perceived and implemented by caregivers?
• How does the interaction with BBB health center staff influence complementary feeding practices?
• What challenges does World Harvest Mission face in operating the BBB program?
Community level
• How do cultural feeding practices affect local RUF use and consumption?
• How do community members perceive caregivers who are enrolled in the BBB program?
• How do community members perceive the RUF supplement?

Table 2.3 Sample of interview questions posed to caregivers, health center staff, extension workers, and RUF production team members involved in the BBB program

Caregivers
• Who is the RUF for? What do you think the purpose of the food is for your child? • What are all of the ways that your child takes (eats) the soy flour/groundnut paste? • Do you do anything to prepare these foods? Tell me about these preparations. • Does your child share the food with other siblings or children in the compound? • How does the RUF fit into the overall diet of your child? • Tell me about any ways that using the groundnut paste or soy flour with your child has affected other foods that s/he eats. • Do you remember hearing any nutrition or health messages during your child's time in the BBB program? What did those messages mean to you? • Is there anything that you would like the BBB program to change about the RUF that you receive?
Health Center Staff
• What is the purpose of the BBB program? What is the purpose of the ready-to-use food (RUF) that you distribute? • What kinds of things do you discuss with the caregivers in the BBB project? • Tell me about how you educate the caregivers about the RUF that you distribute. • What are all of the ways that the caregivers feed the two foods to their children? • What do caregivers think about the RUF that they receive? • Tell me how you understand how well a child is growing as he or she continues through this program. • How do the parents understand their child's growth progress throughout the program?
Agricultural Extension Workers
• How is the RUF that you distribute supposed to be used by caregivers? • How do the caregivers actually feed the RUF to their children? • What messages do the Health Center staffs deliver during the weekly program?
RUF Production Team Members
• What is the purpose of the RUF product that you produce? • How do you get the ingredients to make the RUF? • Tell me about any problems you have with obtaining the ingredients and/or making the RUF. • Tell me about how the community feels about the RUF product. Has anyone asked to purchase the RUF? • Tell me about the ways people use the RUF in their homes. Why do some caregivers prepare or cook the RUF for their children?

Table 2.4 Frequent recipes that contain the *Byokulia Bisemeye mu Bantu* (BBB) ready-to-use food (RUF)

Name of RUF Recipe	**Ingredients and preparation**
Katoga and RUF	One or more of the following staples: Mashed boiled green bananas (matoke), Irish potatoes, maize flour (posho), or rice, mixed with boiled groundnut paste and/or soy flour (1-3 Tb each, plus water). Sometimes includes palm oil, tomatoes, onions, boiled cabbage or greens (i.e. amaranth), and salt.
Kahunga and RUF	A thick dough of boiled cassava flour, mixed with boiled groundnut paste (1-3 Tb, plus water) and/or boiled soy flour (1-3 Tb, plus water).
Porridge	Boiled water with soy flour (1-3 Tb), sugar, and sometimes groundnut paste (1-3Tb).
Directly "as bread"	A piece of un-prepared groundnut/moringa paste.

Table 2.5 Survey responses that highlight the primary reason that giving RUF to only one child is challenging for caregivers (n=50)

Primary reason that feeding RUF to only one child is a challenge	Response	Percent
"It is part of our culture. I cannot feed the food only to one child."	10	20%
"The child in the program did not eat the food."	3	6%
"After the one child finished eating, I gave the food to other children."	10	20%
"There was not enough other food around to feed the other children."	11	22%

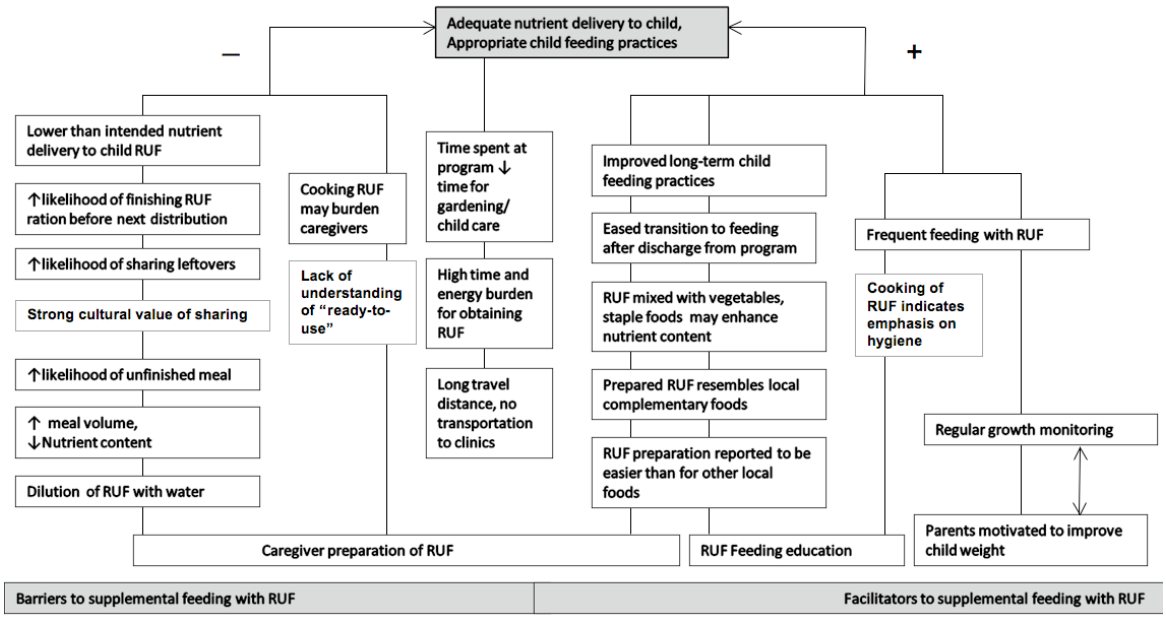
Table 2.6 Barriers and facilitators to RUF consumption

Barriers to RUF consumption	*Facilitators to RUF consumption*
• Cultural beliefs and economic constraints of families promote sharing of RUF with non-program children • Addition of water to RUF by caregivers, may risk contamination of food and dilute nutrient content • Preparation of RUF may add burden to caregiver cooking duties • Soy and Groundnut RUF supplements not always consumed together, affecting nutrient quality of supplement • Travel to weekly programs is burdensome; caregiver illness and foregone household responsibilities affect attendance, RUF acquisition	• Caregivers credit RUF with gains in children's weight and strength • Caregivers report that children enjoy the taste of RUF • Relative to other complementary foods, caregivers find RUF easy to prepare • RUF resembles local groundnut paste and soy flour, which encourages consumption • RUF perceived as "special food" for the malnourished children • Strong caregiver recall of RUF feeding and child nutrition messages

Table 2.7 Key barriers to RUF consumption and corresponding program messages

Barrier to RUF Consumption	*Recommended Feeding Message*
RUF was often used as sauce on top of staple foods, rarely eaten directly, and heavily diluted with water during cooking.	"Feed the RUF to your child as a thick sauce in small amounts so that she can finish all that you prepare. If you add water, boil and cool the RUF before feeding"
Soy and Groundnut RUF supplements not always consumed together, affecting nutrient composition and quality of supplement.	"Mix groundnut paste and soy flour bags together at the clinic so they can always be eaten together."
Caregivers unaware that they can bring home foods to grind at RUF production team sites	"Bring your ground nuts and soybeans to a production team near your home to make smooth foods for your child."

Figure 2.1 Conceptual framework of barriers and facilitators to ready-to-use-food consumption



CHAPTER THREE

Ready-to-use food (RUF) improves dietary intakes but not nutritional adequacy of children in rural Uganda

Abstract

While supplemental feeding with ready-to-use food (RUF) can help to treat malnutrition, the amount of RUF given to targeted children in home-based settings and the factors that affect RUF use within households are not well understood. Such knowledge can help inform RUF dosage guidelines and program education components. We assessed the contribution of RUF to the children's diets by conducting a diet assessment of 135 children, ages 6 to 59 months, whose caregivers received 680 kcals/day (126 grams/day) of a peanut and soy-based RUF in a 10 week supplemental feeding program in Bundibugyo, Uganda. Two 24 hour dietary recalls were administered for recruited children. Demographic data and program attendance records were obtained for caregivers. The amount of RUF fed to targeted children only 34.7% of the distributed ration. Of the amount of RUF offered to targeted children, 90.7% was consumed. Dietary Reference Intakes (DRI) for total energy were met by 94.7% of children, while only 61.5% met their DRI for protein required for catch-up growth. The number of birth children was associated with a decreased likelihood of feeding any RUF (assessed as a binary outcome) to targeted children [OR (95%) = 0.66 (0.52, 0.91), p=0.006]. The number of weeks in attendance at the program was associated with a greater likelihood of feeding RUF to children [OR (95%) 1.40 (1.03, 1.89), p=0.034]. The factors associated with RUF consumption identified in this study may be useful for developing policies related to RUF distribution in order to improve delivery to intended children.

Introduction

Supplemental feeding programs (SFP) can be an effective strategy to address undernutrition (Dewey & Adu-Afarwuah, 2008). Generally, these programs seek to address the underlying and proximate factors related to undernutrition: food insecurity, chronic dietary inadequacy, poor childcare, and infection. Ready-to-use foods—energy-dense, lipid-based pastes that do not require cooking or refrigeration—are increasingly being

used to support supplemental feeding programs in community-based settings for the prevention and treatment of malnutrition (Maleta et al, 2004; Isanaka et al, 2009). While it has long been understood that supplemental food rations distributed in resource-restricted settings are likely to be diverted within households (Beaton & Ghassemi, 1982), the proportion of distributed supplemental rations that are received by targeted children is largely undocumented, due to lack of consumption data in most program reports and studies (Navarro-Colorado et al, 2008). Characterizing the patterns of RUF consumption can provide important insights into tailoring dosage levels for such programs, or in modifying programs to maximize the nutrient delivery to intended recipients.

The purpose of this study was to (1) examine the nutrient contribution of the RUF to the overall diet, (2) quantify the proportion of distributed RUF that was consumed by the targeted child, and (3) assess the diet quality of SFP participants. Fourthly, we assessed the socio-demographic and behavioral factors associated with RUF consumption among SFP beneficiaries. These questions were addressed among caregivers and children enrolled in the *Byokulia Bisemeye mu Bantu* (BBB) SFP in Bundibugyo, Uganda. The BBB program enrolls caregivers and underweight children (Weight-for-age Z (WAZ) score <-2) in 10-week program cycles, to provide 126 grams/day (680 kilocalories) of a locally produced peanut and soy-based RUF, complementary feeding education and growth monitoring.

Subjects and methods

Setting. Bundibugyo is one of four districts in Uganda's western region and the only district in the west with no paved roads or electricity. With the Democratic Republic of Congo to the west and the Rwenzori mountains to the east, the district faces substantial geographic isolation from the rest of the country. The majority of families rely on subsistence farming; some cultivate cocoa and coffee as cash crops. Cooking is done over open fire, from wood gathered by women and children, or with charcoal in metal grills. Water for washing and drinking is collected into jerry cans where taps are available, and from local rivers in remote villages.

The Bakonjo and Babwisi are the two predominant people groups in the 290,000-person district, which includes 52,500 (18%) children less than 5 y. The prevalence of stunting (Height-for-age Z score (HAZ) < - 2) is 45%, compared to the national prevalence of 38% (Jilcott et al, 2007). Maternal education is directly related to stunting prevalence. In western Uganda, over 95% of women do not complete primary school, and 25% have

never received any formal education at all. (7). Fertility and cultural marriage patterns also play a role in child nutrition. Western Uganda has the country's highest rate of polygamous marriage (11%). With a mean number of 7.3 total births per woman, western Uganda has one of the highest birth rates worldwide, and the median age of a woman's first marriage (17 years) is the lowest in the county. Of children in Uganda ages 6 to 8 months, nearly 80% are fed complementary foods, and over 98% are still breastfed (UBOS & Macro International, 2007).

S*tudy Participants and Data Collection*. Children are regularly recruited for BBB program enrollment through word of mouth, publicity at local schools and churches, and routine weighing of outpatients at health centers. All caregivers who enrolled in the BBB program between June 2008 and June 2009 were eligible for participation in the study. Study personnel were present during each weekly program for the duration of the study. All diet recalls were conducted between weeks 4 and 7 of the 10 week program, to assess RUF consumption after at least one month of complementary feeding education and instruction on feeding RUF to children. Over the course of each 10 wk program cycle, two interview contacts were made with each caregiver. Dietary recalls administered on the day of the program were conducted at health centers (65%), and assessed children's dietary intake on the day immediately prior to the program, six days since the last distribution. Recalls administered later in the week were conducted at caregiver homes (35%), and assessed children's dietary intake 3-4 days after RUF distribution.

Each week, a random sample of the caregivers present at the program was recruited to provide 24-hour dietary recall information for the child enrolled in the program. Caregivers who were absent from the program were recruited at their homes using contact information provided in the program register. Trained health center staff assessed children's anthropometric measurements. Weights were measured to the nearest 0.1 kg with a hanging Salter scale. Length was measured to the nearest 0.1 cm using a length board for children 6 to 24 month or < 65 cm. Height was measured using fixed measuring tapes with a head board for children > 24 month or > 65 cm.

Verbal informed consent was obtained prior to the dietary assessment. Demographic surveys and dietary recalls were conducted in either Lubwisi or Lukonjo, the two primary local languages, depending on the preference of the caregiver. After agreeing to participate, caregivers were interviewed following the daily

program, or at a later day within the same week. The time of the initial interview was based on caregiver availability. Follow-up recalls were scheduled at the conclusion of the first recall, and were conducted on non-consecutive days within a ten-day period to approximate usual food consumption, and to account for within person variation. This method of scheduling recalls allowed us to obtain dietary information for children on most days of the week, so that variation in the elapsed time since RUF distribution, as rations are more likely to be depleted on days immediately prior to the next distribution. Study personnel trained in diet assessment methods performed all dietary recall measurements.

Information collection during dietary recall included the name and time of each meal, and the ingredients and method of preparation for each food item. Next, the portion size offered and amount consumed by the child of interest were estimated using standard local utensils (e.g. tablespoon, 800-milliliter plate, 500-milliliter cup). Cups and plates were marked with fraction lines that divided the utensil into fifths to assist caregivers in estimating portion sizes. De-identified dietary recalls and demographic surveys were scanned, transmitted electronically and entered into an electronic database for analysis. The study was approved by the Health Institutional Review Board at the University of the Corresponding Author, and by the Bundibugyo District Health Office.

Program components of the BBB Supplemental Feeding Program. Operated by World Harvest Mission in the Bundibugyo District of Uganda, the BBB program operates in two health centers and enrolls 50 underweight (weight-for-age Z Score (WAZ) < -2) children ages 6 to 59 mo per 10 wk cycle. At each weekly visit caregivers receive child growth monitoring, a weekly supply of RUF, children's multivitamin with iron, and nutrition education. Education is delivered by community health workers and health center staff and covers: 1) the impact of early nutrition on school performance later in life, 2) antenatal nutrition, 3) growth monitoring, 4) the importance of breastfeeding, 5) healthy complementary feeding practices, 6) using an attentive, responsive child feeding style, 7) feeding children during and after illness, and 8) hygiene practices (Jilcott et al, 2009). Caregivers receive 680 kcal/d of a peanut and soy-based RUF. The dosage of RUF is standard across age strata to simplify RUF procurement and distribution logistics. Initial messages specific to the RUF were to feed the food to the enrolled child only, either directly without cooking or as a thick porridge.

Nutrient composition of Ready-to-use-Food supplement. RUF was made locally using hand-powered grinders to prepare two products—1) roasted groundnut (peanut) paste mixed with dried *Moringa oleifera* leaf powder (440 g) and 2) roasted soy flour (440 g). Each product was distributed in a plastic bag and was mixed by caregivers into a single bag at the conclusion of each program session. The combined RUF product resembles peanut butter. Per 100 g, the combined RUF product contained 543.9 kcal, 39.6 g fat, 27.9 protein, 11.8 g fiber, 49.8 mg vitamin C, 176 iu vitamin A, 0.43 g vitamin B6, 124.5 g folate, 142.8 g calcium, 4.3 g iron, and 3.2 g Zn.

Assessment of Dietary Diversity and Infant and Young Child Feeding (IYCF) Practices. World Health Organization IYCF guidelines were used to assess whether a child was fed a "minimally adequate diet" for children ages 6 to 24 mo. Breastfed children were considered to have a minimally adequate diet if they were fed three or more food groups and were fed the age-specific minimum number of times per day (≥ 2 for children 6-8 month, ≥ 3 for children ages 9-23 month). Non-breastfed children met the criteria for a minimally adequate diet if they consumed a minimum of four food groups, consumed milk or milk-based products, and were fed a minimum of four times (Arimond et al, 2005). A food group was counted if a child consumed at least 1 gram of a food item from any of the following eight groups: 1) infant formula, milk other than breast milk, cheese, yogurt, or other milk products; 2) matoke or foods made from grains, roots, and tubers, including porridge or fortified baby food from grains; 3) vitamin A-rich fruits or vegetables; 4) other fruits; 5) other vegetables; 6) eggs; 7) meat, poultry, fish, shellfish, organ meats); 8) legumes and nuts; and 9) foods made with oil, fat, or butter. A Dietary Diversity Score (DDS) was calculated by summing the nine food groups (Kennedy & Nantel, 2009). Because micronutrient adequacy was of interest in the present study, red palm oil was considered a vitamin-A rich fruit/vegetable.

Assessment of Dietary Adequacy. Nutrient values were represented as the mean from the two 24 hour recalls, obtained on non-consecutive days. Food items were coded and assigned nutrient values compiled from the Tanzania Food Consumption Table (FCT), Malawi FCT, and USDA Nutrient Database (Lukmanji et al, 2008; USDA, 2009; Gibson, 2004). Portion weights were estimated by multiplying the estimated portion size by the unit weight in grams (obtained from field measurements taken in February 2009, or from the USDA or

Tanzania FCT, when available). Total daily nutrient intakes were calculated for nutrients of particular interest to child growth: energy, protein, vitamin C, vitamin A, vitamin B6, zinc, iron, and folate.

The probability of adequate intake for each selected nutrient was calculated using the cut-point method, which compared each child's nutrient consumption with his or her age-specific Dietary Reference Intake (DRI), or Adequate Intake (AI), in the case of calcium (Murphy et al, 2006). DRI and AI values were obtained from the Food and Nutrition Board and Institute of Medicine guidelines (Food and Nutrition Board 1997, 1998a, 1998b, 2000a, 2000b, 2002, 2005). Values for absorbed calcium were adjusted by multiplying the total grams of calcium consumed by an absorption factor of 0.32 for all food groups. Iron absorption was calculated using absorption factors of 0.06 and 0.11 from plant and animal sources, respectively (Arimond et al, 2005).

Measurement of socio-demographic variables. Demographic data were obtained using a survey modified from the Uganda Demographic and Health Survey (UBOS & Macro International, 2007), and was conducted during the first 24 hour recall with each caregiver-child dyad. Questions were posed to caregivers and coded into closed-ended categories. Variables assessed included caregiver parity, the total number of children living at the compound, and the education, presence, occupation, and marital status of the targeted child's parents. Socioeconomic status constructs included building materials of the house and roof, existence of a household business, primary means of food acquisition (own garden, market purchases, or market transfers), and whether the household cultivated cash crops. Caregivers estimated the distance to the nearest clean water source (in meters) and health center (in 500 m increments).

Modeling Dietary Consumption. A multivariate regression model was created to estimate the association of selected socio-demographic factors with RUF consumption. Due to the substantial proportion of children who did not consume any RUF over the days of observation (14.1%), a two-part regression model was used. Part one of the model used logistic regression to examine the factors associated with no RUF consumption by comparing non-consumers with consumers (minimum of 1 gram of RUF on either day). Part two used multivariate linear regression to examine the factors associated with the level of RUF consumption (coded continuously), conditional on consuming at least 1 g of RUF in either study day. As the factors associated with

no daily consumption may differ markedly from the factors associated with varying levels of RUF consumption, we tested factors separately in each scenario.

Statistical analysis. All data analysis was conducted on Stata 9.0 (Stata Corp, College Station, TX). Potential confounders in the regression models were selected based on findings from an earlier qualitative study (under review) and theoretical knowledge of factors that affect child nutrition in developing countries. Regression coefficients were considered statistically significant if the 95% confidence interval did not overlap with the null. Because non-linear models estimate a coefficient for interaction terms that is unequal to the magnitude and direction of the interaction, interaction terms in the logistic model were tested for significance using a Stata macro developed by Ai and Norton (2003). Comparisons of means across age strata were made using a one-way analysis of variance test. Differences were considered statistically significant if $p < 0.05$.

Results

Study population. Of the 180 children who participated in the program between June 2008 and June 2009, we recruited 135 child-caregiver dyads into the study. Nearly 40% of maternal caregivers received no formal education in their lifetimes and the mean ± SE number of children at caregiver compounds was 7.8 ± 0.4. Sixty caregivers (44%) were in polygamous unions or separated, divorced, or widowed **(Table 3.1).** At the time of program entry 78% of children were underweight (WAZ score < -2) and 87% were stunted (height-for-age Z (HAZ) score < -2). The proportion of children classified as underweight increased to 86.7% after 10 weeks of program participation (p=0.043). Height data at baseline and 10 weeks was available for 68 of the 135 children enrolled in the study. Of these children, 89.7% were stunted (HAZ < -2) during and after program participation (p=1.000); 23.5% were moderately wasted (weight-for-length Z Score < -2) at baseline, compared to 29.4% at 10 weeks (p=0.437).

RUF preparations. The RUF was always cooked, using three primary recipes: 1) a thick porridge; 2) "katoga"-cooked as paste mixed with boiled and mashed plantains; and 3) a sauce served over a starch-based staple, such as posho (maize), kahunga (a thick dough of boiled cassava), Irish potatoes, or rice. RUF was less frequently mixed into other protein-rich sauces like boiled kidney beans. The serving size of RUF (mean ± SE 32.9 ±1.2)

was similar across recipes; however, the proportion of energy from protein and fat is highest when RUF is consumed as porridge, and is lower for "katogo" and "sauce" preparations.

RUF consumption patterns. A high proportion of children (85.9%) consumed RUF on at least one of the observation days, while 74.8% of children consumed RUF on both observation days. The amount and frequency of RUF offered to and consumed by targeted children was estimated based on two days of dietary recall for each child **(Figure 3.1)**. RUF was offered to targeted children 1.3 ± 0.07 times per day (mean ± SE). The mean ± SE amount of RUF offered to children was 41.5 ± 2.4 grams day.

Caregivers offered RUF 1.33 ± 0.07 (mean ± SE) times per day, and RUF was included in 45.7% ± 2.8 (mean ± SE) of targeted children's meals. Of the 650 kcal per day ration distributed at the clinic, only 34.7% was offered to targeted children. Because dietary consumption data was not collected for other members of the household, it is unknown who consumed the remaining portion of RUF. The mean ± SE kcal of RUF offered to children was 226.2 ±13.0 kcal per day and did not vary substantially according to children's age. Infants 6-8 mo were offered 239.3 ± 37.6 kcal per day, while children 36 to 59 mo were offered 233.2 kcal per day. The amount of RUF offered to children did not vary by degree of underweight **(Table 3.2)**: pair wise comparisons according to WAZ score category with WAZ < -3 as the referent indicated no significant differences. Of the 84% of children offered RUF on either day, the percentage of the ration offered was 40.5 ± 1.8 % (mean ± SE). Of children offered any RUF (n=100), 90.7% ±1.0 (mean ± SE) of the amount offered to the child was consumed.

To estimate the nutrient contribution of RUF to the overall diet, the mean amount of selected nutrients consumed from RUF was divided by the mean total amount consumed of that nutrient over two days of recall **(Table 3.3).** The contribution of RUF to the children's total energy intakes (including children who did not consume RUF) declined with increasing child age ranging from 29.5% of total calories consumed by infants (6-8 mo) to 15.7% of total calories consumed among toddlers (36-59 mo). The percent of total protein calories from RUF varied similarly across age strata. As estimated over 2 days of dietary recall, RUF contributed 55.0% of total calories from protein to children's diets among children 6-8 mo, and 28.7% of total protein energy among children 36-59 mo. Similar trends across age strata were observed for each of the selected micronutrients.

Infant and Young Child Feeding (IYCF) Practices during supplementation. Among children ages 6 to 24 months, 64 of 108 (59.2%) met the criteria for a "minimally acceptable diet" according to WHO standards for meals per day, breastfeeding, and dietary diversity. Seventy-six of 108 (70.3%) of children were fed the minimum number of times per day, based on their age and breast feeding status. Among children under 12 months, 40 of 53 (75.47%) were still breastfeeding. Among all children under 24 months who were not breastfed (31 of 108, 28.7%), none were fed milk or milk products. Sixty-five of 109 (59.6%) of children ages 6 to 24 mo consumed a minimally adequate diet on both days of recall, according to the summary indicator of IYFC practices.

Dietary diversity. The mean ± SE DDS was 4.58 ± 0.13. DDS increased with age. DDS means ± SE within each age strata were: 6-8 months: 3.93 ±0.37; 9-11 months: 4 ± 0.31; 12-23 mo: 4.61 ±0.18; 24-35 mo: 5.14 ± 0.33; and 36 to 59 mo: 5.5 ±0.38. Mean dietary diversity did not vary according to weight-for-age score (mean DDS ± SE = 4.71 ± 0.26 for children with WAZ > -2, and 4.58 ± 0.09 for children with WAZ <-2, p=0.554), or whether any RUF was offered to children (mean DDS± SE =4.60 ± 0.10 for non-RUF consumers, and 4.68 ± 0.17 for RUF consumers, p=0.745).

Dietary adequacy during supplementation. Over two days of dietary recall, 94.8% of the study population met their age-specific energy requirements, while 61.5% met their protein requirement for catch-up growth **(Table 3.3).** Over 80% of children met their DRI for folate, Vitamin B6, vitamin A, vitamin C, iron, and zinc. Only 20% of children met the Adequate Intake level for calcium. Estimations of adequacy stratified by age indicated that children ages 6 to < 12 months were less likely to meet their DRI for vitamin A, vitamin C, iron, zinc, and protein required for catch-up growth **(Table 3.3**) than children greater than 12 months. Children under 12 months were less likely to consume their DRI for protein for catch-up growth [OR (95%)= 0.40 (0.19, 0.88)], vitamin C [OR (95%)= 0.01 (0.00, 0.89)], vitamin A [OR (95%)= 0.09 (0.03, 0.28)], zinc [OR (95%)= 0.26 (0.09, 0.74], and iron [OR (95%)= 0.02 (0.01, 0.02)], when controlling for gender, maternal education, and presence of father in the home.

Diet adequacy did not vary substantially according to the severity of underweight **(Table 3.4)**. Logistic regression analysis indicted that WAZ was not associated with the probability of adequacy for any of the

nutrients examined.

Demographic and behavioral predictors of nutritional status. The level of RUF consumption, represented as the mean intake in grams of RUF consumed over two days of recall was coded into four categories: 0 grams, 1 to < 25 grams, 25 to < 50 grams, and ≥ 50 grams. Multivariate linear regression indicated that an increasing level of RUF consumption was not significantly associated with higher nutritional status, measured by WAZ after 10 weeks of program participation, when adjusted for age of the targeted child, maternal education, and number of the children in the household (ß = - 0.034, p > | t | = 0.625) **(Table 3.5).** The proportion of children consuming greater than 50 g of RUF per day was similar across WAZ strata: 40.0% of children with WAZ < -3, 42.9% of children with WAZ < -2, 42.9% of children with WAZ < -1, and 25.0% of children with WAZ ≥ -1. Pairwise comparisons of programs across WAZ strata, with WAZ < -3 as the referent, indicated no significant results.

Demographic predictors of RUF consumption. The number of children born to the caregiver was independently associated with not consuming RUF [OR (95%) = 0.66 (0.52, 0.91), p=0.006], and the number of weeks in attendance at the program was associated with a greater likelihood of feeding RUF to children [OR (95%) 1.40 (1.03, 1.89), p=0.034], when controlling for age, gender, weight-for-age Z score, and presence of the father in the home, maternal education, and primary means of food acquisition **(Table 3.6)**. Among caregivers who fed any amount of RUF, no demographic variables were significantly associated with an increased amount of RUF offered to children including presence of father in the home, markers of socioeconomic status, and number of children.

Discussion

The purposes of this study were to (1) examine feeding patterns with RUF, (2) assess the contribution of RUF to children's overall diets, and (3) determine the nutrient adequacy of children's diets while receiving RUF from an ongoing community-based supplemental feeding program. Potential socio-demographic predictors of RUF consumption levels were also explored.

RUF was offered to a large majority of study participants; however a large proportion of the distributed

RUF was not offered to targeted children. Targeted children consumed nearly all of the portions offered to them, and the RUF contributed substantially to the overall energy and protein of children's diets.

To our knowledge, this is the first study to examine RUF consumption patterns in an ongoing community-based program. A similar proportion of the distributed RUF rations was given to targeted children in a Malawi-based experimental growth trial: Maleta et al reported that underweight and stunted children ages 42 to 60 months who were provided with 543 kcal/day of a peanut, oil, sugar, and milk-powder or of 531 kcal/day of maize and soy-flour blend received only 30% of the supplementary RUF and 43% of the maize and soy flour blend provided (2004). The authors suggest that diversion of supplies within households was likely, despite the provision of similar rations to all young malnourished children in the household. Our findings may provide insight into the challenge of targeting RUF rations in community programs to underweight children in regions of the world with moderate food insecurity and high rates of child undernutrition.

The BBB program provides 650 kcal/day to all enrolled children, ages 6 to 59 months. RUF doses are not calculated according to child age in order to simplify RUF procurement and program administration logistics. However, the fact that identical amounts of RUF were given to all children allowed us to explore the contribution of RUF to children's diets, given a constant amount of RUF distributed to children. We found that while total energy consumption increased with age, the amount of RUF consumed by children did not vary across age groups. This finding suggests that a culturally driven ceiling may exist, which may limit the amount of high quality, protein-rich complementary foods given to children. In the study context, caregivers may prioritize feeding special foods to infants and children under 24 months. It is also possible that caregivers with older children who are underweight may have additional young children to feed. In either case, this finding underscores the importance of providing nutrition education that emphasizes the changing dietary needs of children as they grow and age, including the type of foods and nutrients needed.

Although most children in the study were fed adequate amounts of energy, a large percentage (40%) of children still failed to meet their DRI for protein required for catch up growth. The amount of protein from the RUF distributed in the BBB program (35.1 grams) exceeds the amount of protein required for catch up growth (26.5 grams). It is likely that sharing of RUF food rations within households impairs targeted children from receiving the adequate nutrients needed to recover from being malnourished. Moreover, the results of the dietary analysis indicate that a large majority of children do not meet their Adequate Intake levels for calcium.

RUF products that do not contain milk powder do little to address the high levels of calcium deficiency. It should be noted that the nutrient analysis presented her does not account for the multivitamin with iron supplement distributed in combination with the RUF, as the focus of the present study was to assess the impact of the food supplement on children's dietary adequacy. The results indicate that for non-micronutrient fortified RUF products, vitamin supplementation is likely to be required to promote micronutrient adequacy.

Findings from our previous qualitative work (under review) were supported in the present study: caregivers with more children were less likely to feed RUF to the targeted child and higher program attendance was associated with a greater likelihood of feeding RUF to the targeted children. Addressing issues of program adherence is important for program planners. Families with malnourished children are already likely to be poorer; therefore, caregivers in these households may be particularly challenged with the decision to attend a nutrition program or tend to domestic and gardening work to sustain their livelihoods.

The implications of these findings suggest that household size may be a useful characteristic to consider in order to maximally improve the diets of malnourished children. Historically, some supplemental feeding programs for malnourished children have provided nutritional support for other household members (including caregivers) in determining food rations. The Humanitarian Charter and Minimum Standards in Disaster Response Sphere Standards advise that household sharing needs to be addressed when determining the supplemental feeding amounts for moderately malnourished children who are treated with take-home rations (2009). These findings raise important ethical questions that underpin the philosophy of supplemental feeding programs to target only one child. Should the programmatic value of improving the nutritional status of one vulnerable life take priority over caregiver's value for honoring their culture and caring for the group? When dealing with supplemental food versus pharmaceutical products, ethical questions such as this become more complex.

Limitations. Due to time limitation for data collection and overall study budget, we were limited to collecting two dietary recalls per child to estimate actual food intake. Moreover, the logistical challenge of reaching caregiver homes led us to conduct the majority (65%) of recalls at health centers during the program day, when most of the enrolled caregivers were present at one location. The recalls conducted at the health centers assessed the child's food consumption on the day immediately prior to the program, and may represent a worst-case

scenario of RUF consumption, given that the rations may have been depleted earlier in the week. Note was made on data forms if RUF rations had been exhausted earlier in the week, which occurred in only one instance.

Two dietary recalls collected on non-consecutive days improves the ability to account for within person variation in food consumption (Kennedy et al, 2007). However, we were limited by imperfect estimates of portion quantities, inability to account for the inherent nutrient variation within foods, and uncertainty about the actual shape of nutrient requirement distributions used to estimate the probability of adequacy (Daniels et al, 2009). The error in reporting amounts of RUF in recipes may have varied according to the method of preparation in such a way that the ability to recall the amount of specific ingredients may decline for recipes with more ingredients.

Self-reported dietary assessment may also misrepresent a child's dietary quality and RUF consumption as a result of social desirability bias. The moderate proportion (14%) of caregivers who did not feed any RUF to children on either day of recall suggests that social desirability bias may have been minimal as not feeding RUF is contradictory to the BBB program messages. Our study found no demographic variables that were significantly associated with the amount of RUF offered to children among caregivers who offered any amount of RUF to children. This finding may have been limited by the relatively small degree of variation in the mean amount of RUF offered over two days of recall (**Figure 3.1**).

Conclusions. While RUF is well-received by caregivers and offered to the majority of underweight children enrolled in an ongoing supplemental feeding program, a large proportion of the distributed RUF was not offered to targeted children. Caregivers are challenged to feed RUF to only one child, especially in larger households. It is clear that supplemental RUF does not solve the problem of food insecurity. Education messages to accompany RUF distribution may help improve RUF consumption by targeted children. Understanding caregiver RUF feeding patterns and addressing issues that may prevent rations from getting to targeted children may improve RUF programs in regions of moderately high food insecurity.

Chapter 3 References

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TABLE 3.1 Demographic characteristics of study participants.[1]

	Percent
Child age in months, mean ± SE	18.4 ± 0.9
6 to < 9 mo	10%
9 to <12 mo	21%
12 to < 24 mo	49%
24 to < 37 mo	13%
37 to < 60 mo	7%
Prevalence underweight (Weight-for-age z-score <-2)[2]	78%
Prevalence stunted (Height-for-age z-score <-2)[2]	87%
Prevalence moderate wasted (Weight-for-length z-score <-2) [2]	26%
Percent male	54%
Percent with living father	96%
Percent with father present in the home	56%
Highest Paternal Education, mean (SE)	5.7 ± 0.3
None	19%
Some primary	54%
Some secondary	16%
Completed O-Level	12%
Percent with living mother	98%
Percent with mother or grandmother present in the home	90%
Highest Maternal Education, mean ± SE	2.8 ± 0.2
None	39%
Some primary	57%
Some secondary	3%
Completed O-Level	1%
Building Materials of home	
Percent with tin roof	73%
Percent with mud walls, no cement or bricks	93%
Number of birth children, mean ± SE	4.2± 0.2
One	10.40%
2 to 4	50.40%
5 or more	39.30%
Number of children at compound, mean ± SE	7.9 ± 0.4
Percent > 500m from water source	43%
Percent > 3000m from health facility	44%
Caregiver marital status (%)	
Married, monogamous	56%
Separated/Divorced/Widowed/Polygamous	44%
Primary Means of food acquisition (%)	
Garden only	4%
Garden and some market purchase	41%
Garden and market transfers	50%
Percent growing cash crops	94%

[1] Unless otherwise noted, reported values are percentages.

[2] Anthropometric indices were calculated using the new WHO growth standards (WHO Multicentre Growth Reference Study Group, 2005).

TABLE 3.2 Percentage of children achieving age-specific Dietary Reference Intakes (DRIs) while receiving ready-to-use-food (RUF) supplement, by age group [1,2]

Nutrient	6-8 mo (n=14)	9-11 mo (n=28)	12-23 mo (n=66)	24-36 mo (n=17)	36-59 mo (n=10)	All children n=135
Total Energy	92.9%	96.4%	93.9%	100.0%	90.0%	94.80%
Protein	100.0%	100.0%	98.5%	100.0%	100.0%	99.30%
Protein, required for catch-up growth	35.7%	53.6%	65.2%	70.6%	80.0%	61.50%
Folate	100.0%	100.0%	87.9%	100.0%	100.0%	94.10%
Vitamin B6	100.0%	100.0%	100.0%	100.0%	100.0%	100.00%
Vitamin A	64.3%	64.3%	90.9%	100.0%	100.0%	84.40%
Vitamin C	42.9%	64.3%	97.0%	100.0%	100.0%	85.20%
Iron	42.9%	53.6%	92.4%	100.0%	100.0%	80.70%
Zinc	64.3%	78.6%	87.9%	100.0%	100.0%	85.90%
Calcium	19.2%	28.6%	15.2%	11.8%	10.0%	19.20%

[1] DRIs obtained from the Food and Nutrition Board and Institute of Medicine Dietary Reference Intake Reports published in 1997, 1998a, 1998b, 2000a, 2000b, 2002, and 2005.

[2] Nutrient intake calculated as the mean of two 24-hour recalls taken on non-consecutive days.

TABLE 3.3 Contribution of RUF to overall child diet for selected nutrients, by age group[1]

	6-8 mo (n=14)	9-11 mo (n=28)	12-23 mo (n=66)	24-36 mo (n=17)	36-59 mo (n=10)
Proportion of total calories	0.295 ± 0.082	0.248 ± 0.031	0.201 ± 0.026	0.115 ± 0.020	0.157 ± 0.038
Proportion of total protein calories	0.550 ± 0.123	0.469 ± 0.060	0.403 ± 0.062	0.247 ± 0.051	0.287 ± 0.045
Proportion of total folate	0.374 ± 0.081	0.354 ± 0.048	0.301 ± 0.035	0.175 ± 0.033	0.175 ± 0.033
Proportion of total vitamin B6	0.234 ± 0.051	0.218 ± 0.036	0.160 ± 0.019	0.111 ± 0.022	0.090 ± 0.013
Proportion of total vitamin A	0.216 ± 0.093	0.168 ± 0.031	0.099 ± 0.014	0.071 ± 0.014	0.051 ± 0.008
Proportion of total vitamin C	0.505 ± 0.112	0.442 ± 0.067	0.410 ± 0.058	0.216 ± 0.041	0.231 ± 0.040
Proportion of total iron	0.355 ± 0.098	0.284 ± 0.037	0.231 ± 0.027	0.148 ± 0.031	0.138 ± 0.020
Proportion of total zinc	0.524 ± 0.121	0.400 ± 0.055	0.322 ± 0.054	0.215 ± 0.050	0.187 ± 0.025
Proportion of total calcium	0.530 ± 0.140	0.386 ± 0.057	0.400 ± 0.133	0.252 ± 0.059	0.196 ± 0.038

[1] Nutrient contribution of RUF calculated as the mean nutrient amount from RUF consumed divided by the mean total amount of the nutrient consumed from all complementary foods over two days of dietary recall.

TABLE 3.4 Amount of RUF and percentage of children achieving age-specific Dietary Reference Intakes (DRIs) while receiving ready-to-use-food (RUF) supplement, by underweight status[1,2,]

Nutrient	WAZ[3] < -3 (n=47)	WAZ < -2 (n=33)	WAZ < -1 (n-16)	WAZ > -1 (n=3)
RUF offered (g)[4]	41.5±4.0	33.2±5.0	42.9 ±5.9	38.1 ±19.4
Total Energy	95.7%	97.0%	87.5%	66.7%
Protein	97.9%	100.0%	100.0%	100.0%
Protein, required for catch-up growth	53.2%	54.5%	62.5%	33.3%
Folate	95.7%	90.9%	100.0%	66.7%
Vitamin B6	100.0%	100.0%	100.0%	100.0%
Vitamin A	85.1%	81.8%	87.5%	66.7%
Vitamin C	80.9%	90.9%	81.3%	33.3%
Iron	80.9%	81.8%	75.0%	33.3%
Zinc	85.1%	81.8%	75.0%	66.7%
Calcium	10.6%	18.2%	31.3%	33.3%

[1] DRIs obtained from the Food and Nutrition Board and Institute of Medicine Dietary Reference Intake Reports published in 1997, 1998a, 1998b, 2000a, 2000b, 2002, and 2005.

[2] Nutrient intake calculated as the mean of two 24-hour recalls taken on non-consecutive days.

[3] WAZ: Weight-for-Age Z score

[4] Values are mean ± SE

TABLE 3.5. Demographic and behavioral predictors of weight-for age z (WAZ) score after 10 weeks of program participation [1]

Demographic, behavioral factor	Variable type	Coef.	SE	p> |t|	95% CI
RUF consumption level[2]	4 category	-0.034	0.069	0.625	-0.17, 0.10
Age of targeted child	continuous	-0.006	0.007	0.347	-0.02, 0.01
Maternal Education	4 category	0.163	0.121	0.181	-0.08, 0.40
Number of children in household	continuous	-0.056	0.092	0.541	0.21, 1.27

[1] Weight-for-age z score determined from 2006 WHO Reference Median, and coded as a 4 category variable (<-3, <-2, <-1, ≥ -1)

[2] RUF consumption level coded as 0 g, 1-<25 g, 25 to <50g, and ≥ 50g

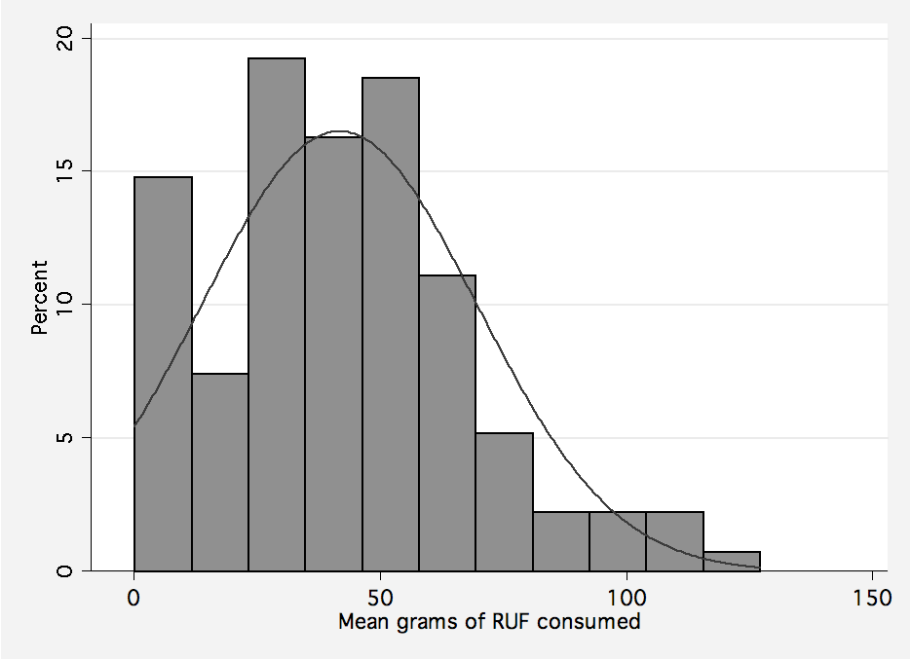
TABLE 3.6 Results of logistic regression analysis of factors associated with feeding any RUF to targeted child[1,]

Demographic, behavioral factor	Variable type	OR	95% CI	SE	z	P > |z|
Number of biological children	number, continuous	0.66	0.52, 0.91	0.10	-2.73	0.006[2]
Number of weeks attended program	weeks, continuous	1.40	1.03, 1.89	0.22	2.13	0.034[2]
Targeted child age	months, continuous	1.01	0.95, 1.08	0.04	0.46	0.648
Targeted child gender	binary	0.93	0.26, 2.87	0.58	-0.11	0.909
Weight-for-age Z score	coded, 4 category	0.97	0.50, 2.07	0.35	-0.08	0.937
Presence of father in home	binary	1.98	0.66, 7.04	1.22	1.11	0.269
Maternal education	years, continuous	1.03	0.86, 1.28	0.11	0.27	0.789
Primary means of food acquisition	coded, 3 category	1.58	0.86, 1.28	0.98	0.74	0.458

[1] Feeding any RUF coded as "0" for no RUF fed to child, or "1" if any RUF was fed to child over two days of diet recall

[2] Variable was significantly associated with whether RUF was fed to child, $p < 0.05$

FIGURE 3.1 Mean grams of Ready-to-use-food consumed by targeted children. Caregivers of targeted children were given 128g/d of RUF (n=135). Values are mean portion sizes offered to children over two days of recall



CHAPTER 4

Participation in a nutrition education program for underweight children in western Uganda is associated with more diverse household food purchasing, home agricultural production, and improved dietary adequacy.

Abstract

Cost-effective population-based approaches to improve feeding practices are needed in low-income countries to improve child-feeding practices and to reduce under nutrition. Strategies such as nutritional counseling, food supplements, and conditional cash transfers, delivered separately or in combination, can substantially reduce stunting and the related burden of disease among food-insecure populations. Ready-to-use-foods are a popular strategy to treat and prevent undernutrition; however, it is unknown whether the dietary benefits gained by supplemental feeding program beneficiaries who receive ready-to-use food (RUF) persist after the free food rations are discontinued. The post-program effects of participation in a supplemental feeding program in combination with nutrition education on child feeding practices, food purchasing, and home agricultural production practices are also not well-understood. We recruited 61 Post-Program (PP) children who had participated in a supplemental feeding program and nutrition education in western Uganda and a Comparison group (CG) of 61 children to conduct a quantitative dietary analysis which examined caregiver feeding practices and dietary adequacy, by collecting two 24 h recalls per child on non-consecutive days. We also conducted a caregiver survey among this same group to assess caregiver knowledge of healthy complementary feeding practices, and food procurement patterns within households. Caregivers of PP children demonstrated superior knowledge of child nutrition and feeding and PP children had more adequate diets compared to CG children; however a substantial proportion of underweight children in both groups failed to meet their Dietary Reference Intake for protein required for catch-up growth. Over 90% of the total study population failed to meet their Adequate Intake for calcium. PP caregivers were more likely than CG caregivers to report growing vitamin A rich foods for their children's consumption. Nutrition education can be an effective means of improving

caregiver feeding practices, and children's dietary adequacy, and can address underlying issues of food security through education focused on household food procurement. Serious dietary adequacies exist among children in rural Uganda that underscore the need for multi-level interventions to promote dietary adequacy and prevent growth faltering in a region of the world where nearly 50% of children are stunted.

Introduction

Major reductions in undernutrition can be made though programmatic health and nutrition interventions (Black et al. 2008). Strategies such as nutritional counseling, food supplements, and conditional cash transfers, delivered separately or in combination, can substantially reduce stunting and related burden of disease among food-insecure populations. (Bhutta et al, 2008; Dewey & Adu-Afarwuah 2008). Being moderately underweight (weight-for-age Z-score (WAZ) <-1) doubles the risk of all-cause child mortality (Caulfied et al, 2004). Stunting (height-for-age Z-score (HAZ) <-2) has been shown to impair cognitive development and educational attainment among children (Grantham-McGregor et al, 2007; Victora et al, 2008). Ready-to-use-food (RUF) supplements can be an effective strategy for improving children's dietary adequacy and growth (Adu-Afarwuah et al, 2007; Phuka et al, 2008); however the effect of RUF supplementation in combination with nutrition education on caregiver feeding practices and children's dietary adequacy is unknown. The long-term impact of complementary feeding interventions on children's nutritional status depends largely on long-term changes in the underlying household determinants of child feeding patterns, including caregiver nutrition knowledge and the procurement of diverse diets for children, through household purchasing or home production (Dewey & Adu-Afarwuah, 2008). As rising food and fuel prices threaten the food security in marginalized regions of the world, interventions to affect sustainable household changes that support child nutrition and health are increasingly important.

Since 1995, World Harvest Mission and other humanitarian organizations have been operating child nutrition programs in western Uganda to address the high prevalence of under nutrition and stunting. The goals of these programs are to: 1) provide nutritional support for malnourished children and those at risk for malnutrition; 2) educate caregivers about healthy complementary feeding practices; 3) build the local capacity to produce high protein foods; and 4) encourage food crop cultivation (Jilcott et al, 2008).

The ongoing *Byokulia Bisemeye mu Bantu* (BBB) Supplemental Feeding Program provides nutrition education and a 650 kcal/d peanut and soy-based RUF supplement to moderately malnourished children, aged 6 to 59 mo.

The purpose of this study is to assess the impact of the BBB program on 1) caregiver nutrition knowledge, 2) child feeding patterns, and 3) household food purchasing and homestead agricultural production. As most nutrition interventions contain multiple program components, it becomes difficult to distinguish the separate effects of these components on children's dietary adequacy and feeding practices (Penny et al, 2005). Therefore, this study also compares the dietary adequacy of children after they are discharged from the BBB program to assess the degree that nutrition education and behavioral modeling may affect long-term dietary adequacy of children after RUF supplemental rations are discontinued.

Participants and Methods

Setting. Bundibugyo is one of four districts in Uganda's western region and the only district in the west with no paved roads or electricity. The district is bordered by the Democratic Republic of Congo to the west and the Rwenzori mountains to the east, which adds to the geographic isolation of the district. The majority of families rely on subsistence farming; some cultivate cocoa and coffee as cash crops. Cooking is done over open fire, from wood gathered by women and children, or with charcoal in metal grills.

The Bakonjo and Babwisi are the two predominant people groups in the 290,000-person district, which includes 52,500 (18%) children less than 5 years. The prevalence of stunting (Height-for-age Z score (HAZ) < - 2) is 45%, compared to the national prevalence of 38% (Jilcott et al. 2007). Maternal education is associated with stunting prevalence. In western Uganda, over 95% of women do not complete primary school, and 25% have never received any formal education at all. (UBOS and Macro International Inc., 2007). Fertility and cultural marriage patterns also play a role in child nutrition. Women in western Uganda also are the most likely to be in a polygamous marriage with two or more co-wives (11%). With a mean number of 7.3 total births per woman, western Uganda has one of the highest birth rates worldwide, and the median age of a woman's first marriage (17 years) is the lowest in the county (UBOS and Macro International Inc., 2007).

Purpose and Study Tools. The purpose of this study was to assess the impact of supplemental feeding program participation on caregiver feeding practices and children's diet quality. We compared dietary recall data collected during and after participation in the BBB program (n=61 for CG; n=61 for PP), and used a post-program caregiver survey [n=61 Comparison Group (CG), n=50 Post-Program (PP) participants] to examine child feeding practices and food procurement practices. As dietary recall data collection began before survey data collection, the caregiver survey was not administered among 11 PP participants, from whom dietary recall data was already.

Study Population. All PP caregivers who participated in the 10 wk BBB Supplemental Feeding Program between October 2007 and June 2009 were eligible for recruitment. CG caregivers were eligible if they resided in or near Bundibugyo, had at least one child between the age of 6 and 59 mo, and never participated in the BBB program. Recruitment of all participants took place at caregiver homes. Of all subjects in both groups who were located, found to be eligible, and recruited, none refused to participate. A convenience sample was obtained for both study groups and CG participants were recruited within the major sub-counties represented by the BBB program participants: Ndugutu, Bubandi, and Busaru. All surveys and dietary recalls were conducted in either Lubwisi or Lukonjo, the two primary local languages, depending on the language preference of the caregiver. Program records were used to obtain village locations for PP participants. CG caregivers were randomly sampled in the sub-counties targeted by the BBB program, with an emphasis on recruiting CG participants from the major villages that are represented in the BBB program. Verbal informed consent was obtained after explaining the study purpose. One 24 h dietary recall was obtained for each participating child immediately following the caregiver survey. A second 24 h dietary recall was obtained on a non-consecutive day, within 10 d of the original recall to account for within person variation (Willet, 1998). Human subjects' approval was obtained from the University of North Carolina at Chapel Hill Public Health Institutional Review Board (Study # 08-1100), and from the Bundibugyo District Health Office.

Program components of the BBB Supplemental Feeding Program. Operated by World Harvest Mission in Bundibugyo District of Uganda, the BBB program delivers 650 kcal/d of a peanut and soy-based RUF to

supplement the diets of moderately malnourished children, aged 6 to 59 mo. The program operates in two health centers and enrolls 50 underweight (WAZ < -2) children per 10 wk cycle. At each weekly visit caregivers receive child growth monitoring, a weekly dose of children's multivitamin with iron, and nutrition education. Education is delivered by community health workers and health center staff and covers: 1) the impact of early nutrition on school performance later in life, 2) antenatal nutrition, 3) growth monitoring, 4) the importance of breastfeeding, 5) healthy complementary feeding practices, 6) using an attentive, responsive child feeding style, 7) feeding children during and after illness, and 8) hygiene practices (Jilcott et al, 2009). A key component of the nutrition education curriculum is to encourage caregivers to consider their home gardens and household food purchasing as critical methods for meeting the nutritional needs of their children. In support of these messages, World Harvest Mission and the health centers that deliver the BBB program maintain demonstration gardens to model homestead gardens.

Caregiver survey. Qualitative caregiver interviews from a previous study (Ickes et al, 2009) and additional interviews conducted in February 2009 were used to inform the development of a structured caregiver survey. The surveys addressed five main dimensions: 1) child care practices, 2) nutrition education, 3) community awareness of the BBB program, 4) willingness to purchase RUF, and 5) food purchasing and home production practices.

Assessment of Dietary Diversity Score (DDS) and Infant and Young Child Feeding (IYCF) Practices. World Health Organization IYCF guidelines were used to assess whether a child was fed a "minimally adequate diet" for children ages 6 to 24 mo. Breastfed children were considered to have a minimally adequate diet if they were fed three or more food groups and were fed the age-specific minimum number of times per day (≥ 2 for children 6-8 mo, ≥ 3 for children ages 9-23 mo). To be considered having a "minimally adequate diet," non-breastfed children were required to consume a minimum of four food groups, consume milk or milk-based products, and be fed a minimum of four times (Dewey et al, 2008). A food group was counted if a child consumed at least 1 g of a food item from any of the following eight groups: 1) infant formula, milk other than breast milk, cheese or yogurt, or other milk products; 2) matoke and foods made from grains, roots, and tubers, including porridge, fortified baby food from grains; 3)

vitamin A-rich fruits and vegetables; 4) other fruits; 5) other vegetables; 6) eggs; 7) meat, poultry, fish, and shellfish (and organ meats); 8) legumes and nuts; and 9) foods made with oil, fat, or butter. A DDS was calculated by summing the nine food groups (Kennedy & Nantel, 2006). In order to assess the relationship between DDS and micronutrient adequacy, red palm oil was considered a vitamin-A rich fruit/vegetable.

Nutrient densities per 100 kcal were computed for each child, as 100 times the ratio of the mean nutrient intake over two d of recall divided by mean caloric intake over the two d of recall. Dietary nutrient density is independent of energy intake, and therefore provides additional information about the quality of children's diets. Energy density requirements are a function of energy needs, gastric capacity, and number of meals per day.

Assessment of Dietary Adequacy. Nutrient values were represented as the mean from the two 24 h recalls, obtained on non-consecutive days. Food items were coded and assigned nutrient values compiled from the Tanzania Food Consumption Table (FCT), Malawi FCT, and USDA Nutrient Database (Lukmanji et al, 2008; USDA, 2009; Gibson, 2004). Portion weights were estimated by multiplying the estimated portion size (obtained with standard local utensils) by the unit weight in grams (obtained from field measurements taken in February 2009, or from the USDA or Tanzania FCT, when available). Total daily nutrient intakes were calculated for nutrients of particular interest to child growth: energy, protein, vitamin C, vitamin A, vitamin B6, zinc, iron, and folate. For a sub sample of 41of the PP participants, dietary information was collected for two observations taken during program participation. Mean nutrient values from the two 24 h recalls obtained during program participation were used to compare dietary adequacy during and after program participation, using separate age-specific requirements based on the age at the day of recall.

The achieved adequate intake for each selected nutrient was calculated using the cut-point method, which compared each child's nutrient consumption with his or her age-specific Dietary Reference Intake (DRI), or Adequate Intake (AI), in the case of calcium (Murphy et al, 2006). DRI and AI values were obtained from the Food and Nutrition Board and Institute of Medicine guidelines (FNB, IOM, 1997, 1998a, 1998b, 2000a, 2000b, 2002, and 2005). Values for absorbed calcium were adjusted by multiplying the total grams of calcium consumed by an absorption factor of 0.32 for all food groups. Iron absorption was calculated using absorption factors of 0.06 and 0.11 from plant and animal sources, respectively (Arimond

et al, 2005).

Statistical Analysis. Between-group comparisons for dietary adequacy, child feeding practices, and home food production purchasing behaviors were made using T-tests for proportions and simple logistic regression analysis using Stata 9.0 (Stata Corp. College Station, TX). A predictive model selection process was used to assess the need to include potential confounders. Regression models were specified according to significant demographic differences between PP and CG **(Table 4.1)** that were believed to relate to the outcome of interest. Potential confounders included child age, gender, presence of mother in the household, presence of father in the household, paternal and maternal education, parity, birth order, parental marital status, primary method of food acquisition, maternal occupation, paternal occupation, number of total children at the compound, distance to drinking water source, distance to health center, and socioeconomic status (estimated by the production of cash crops, participation in a small business, and the quality of building materials of the home).

It was hypothesized that for all comparisons, the PP group would have higher dietary adequacy, a greater likelihood of achieving a "minimally acceptable diet," according to WHO-recommend IYCF standards, and exhibit more diverse home food production and purchasing behaviors. Therefore, a 1-tailed T-test was used, with $p<0.05$ considered statistically significant for these analyses. A 2-tailed test was used to assess between group differences in demographic indicators, and energy and nutrient density of child diets as no differences were hypothesized *a priori*.

Results

A total of 122 children were recruited for the study, with 61 children in each of the comparison and PP groups. Demographic characteristics (**Table 4.1**) and dietary recall information was obtained for all study participants. All participants in the CG, and 50 participants in the PP group completed the survey, for a total of 111 survey respondents. The PP children were more likely be underweight (72% vs. 39%, $p=0.000$), to be second in the family birth order (28% vs. 16%, $p=0.006$), and to live in households with no father present (58% vs. 20%, $p=0.000$). Caregivers of PP children were more likely to grow cash crops (100% vs. 64%, $p=0.000$) and were less likely to rely only on their garden for household food procurement

(0% vs. 18%, p=0.001).

CG caregivers were more likely to live >500 m from a water source, and >3000 m from a health center (82% versus 43% p=0.000, and 64% versus 23% p=0.000, respectively). Fathers in the CG were more likely to have received no education (23% versus 8%, p = 0.023).

Recall of nutrition and childcare education. Caregivers were asked to recall any messages or topics covered in the standard BBB program curriculum. The mean ± SE number of program sessions attended was 7.0 ± 0.2 out of 10, with a range of 3 to 10. All PP caregivers were able to recall at least one key message from the BBB program curriculum. CG caregivers were asked to recall any nutritional education message they had received about child nutrition or feeding. In the CG group, 14 of 61 caregivers (23%) reported ever receiving any education about how to feed their child. CG caregivers received nutrition education from local health centers (19%) or on child immunization days (4%). Overall, caregivers in the PP group were more likely than CG caregivers to recall specific child feeding messages. The most common unprompted responses included: hygiene (82%), feeding “different kinds of foods” (70%), not adding too much water to children's meals (54%), how often to feed a child (54%), and “feeding a small amount of food that a child can finish” (46%). Caregivers also noted lessons related to responsive feeding, including "monitoring the child when s/he eats” (16%) (**Table 4.2**).

Most PP caregivers (45 of 50, 90%) reported sharing the education lessons they learned with others, including other caregivers within their community (46%), compounds (36%), or families (16%). The content of messages shared closely resembled the recalled messages, including feeding different kinds of foods (60%), washing/hygiene (46%), not adding too much water to children's meals (42%), and feeding a small amount of food that children can finish (32%)

Comparison of Infant and Young Child Feeding (IYCF) Practices (Table 4.3). Among children aged 6 to 24 months (n=68), members of the PP group were more likely to achieve a minimally acceptable diet, according to WHO standards for IYCF, when compared to CG [61% versus 44%, adjusted OR=4.07 (1.17, 1.10), p=0.027]. Caregivers in the PP group reported a greater number of mean feeding occasions than the CG (2.9 versus 2.6), which was significant after controlling for child age, gender, and maternal education

(p=0.029). Among children ages 6 to 12 mo, the CG had a greater proportion of children who were no longer breastfeeding, compared to PP children. Of the non-breastfed children, no participants in either group were fed milk or milk products.

Comparison of Dietary Diversity (Table 4.4). A mean comparison test indicated that children in the PP group had a significantly greater Dietary Diversity Score (DDS) compared to CG children (4.9 versus 3.8, p=0.000) (**Figure 4.2**). This difference remained significant after controlling for child age, underweight status, number of birth children, maternal education, possession of cash crops, distance to water source, distance to health center, and presence of the father in the home (p=0.000). Controls were less likely to consume meat, poultry, or fish [66% versus 49%, Adjusted OR (95% CI)=3.07 (0.86, 10.87), p=0.041)], Vitamin A-rich fruits and vegetables [98% versus 87%, Adjusted OR (95% CI)=12.89 (0.91, 182.41, p=0.029)], and legumes, pulses, and nuts [95% versus 69%, Adjusted OR=16.94 (1.22, 234.93), p=0.018].

Comparison of Dietary Adequacy (Table 4.5). Compared to CG children, a greater proportion of children in the PP group consumed their age-specific DRI for all of the macro and micronutrients examined in this study, except for calcium. After controlling for potential confounders, the PP group had a significantly greater proportion of children who met their DRI for total energy, protein, vitamin A, vitamin C, iron, and zinc. Fewer than 10% of children in both groups met their adequate intake for calcium. Less than three-quarters of the CG group met their requirements for iron, zinc, vitamin C, vitamin A. Fewer than 60% of children in the CG group met their requirements for total energy and folate.

Dietary adequacy and dietary diversity following RUF supplementation. Dietary diversity, and dietary adequacy were examined during and after program participation among the 41 children who had dietary recall data. The overall diet diversity score (DDS) (mean ± SE) did not change significantly after RUF supplements were no longer available to children (4.45 ± 0.13 during the program versus 4.71 ± 0.12 post program, p=0.1324). Comparisons of the proportion of children consuming complementary foods within specific foods group indicated that there was a 20% increase in the percentage of children consuming vegetables after the RUF supplements were discontinued compared to either of the 2 days of recall

(80.95% during the program, 100.0% post program, p=0.0029) **(Table 4.6).** There were no other significant differences in the consumption of foods from any other food group examined between the two time periods **(Table 4.7).** Dietary adequacy was similar during and after program participation. Children were less likely to meet their DRI for zinc after the program than during the program (78% versus 95%, p=0.023). There were no other significant differences in nutrient adequacy probabilities during and after program participation.

Comparison of nutrient density. Because energy density needs vary with age, group comparisons (**Table 4.8**) were stratified by age. As group medians are more stable to outliers, median energy density between groups was compared. Adjusted quantile regression analysis indicated no significant differences in energy density between groups. Children in the PP group had a higher number of daily meals compared to CG children within the 12-23 month age strata (2.86 versus 2.25, p=0.040). Although non-significant after adjusting for potential confounders, the PP children in the in the 9-11 month age strata also had a higher mean number of meals per day compared to CG children (3.0 versus 2.3, p=0.230).

Comparison of Food Purchasing and Home Food Production Behaviors. Caregivers were asked to list whether they purchased certain foods for the child to consume. PP caregivers also were asked if they began buying this food since the BBB program, or if they bought the food item more often since enrolling in the program. Logistic regression models were child age, presence of the father in the household, and primary means of food acquisition. A significantly greater proportion of caregivers in the PP group reported purchasing kidney beans [OR=5.50 (1.97, 15.36)], cassava tubers [OR=2.30 (0.92, 5.75)], plantains [OR=12.71 (2.22, 48.48)], palm oil [OR= 4.50 (1.58, 12.79)], and meat [OR= (,)]. A trend towards significantly higher purchasing of groundnuts, pumpkin and palm oil by the PP group also was observed.

PP caregivers were less likely to report purchasing small (sweet) bananas [OR=0.34 (0.13, 0.86) and oranges [OR=0.34 (0.14, 0.85)] than CG caregivers. Self-reported *changes* in food purchasing among PP caregivers indicated that a substantial proportion of caregivers *began purchasing* eggs (6 of 50, 12%) and large bananas (bogoyas (7 of 50, 14%). Avocados (32%), groundnuts (64%), eggs (28%), and cabbage (20%) were foods that PP caregivers reported *buying more often* since they participated in the BBB

program.

Home food production practices also differed between groups. A substantial number of vitamin A-rich foods were more commonly grown by PP caregivers, including pumpkin leaves [OR (95% CI) =5.3, (1.44, 19.88)], dodo (amaranth) [OR (95% CI) =16.74 (3.47, 80.71)], greens [OR (95% CI) =59.10 (11.78, 296)], and pumpkins [OR (95% CI) =1.41(0.62, 3.52)]. In addition, a greater proportion of PP caregivers reported growing avocados [OR (95% CI) =2.59 (1.05, 6.42)] and plantains/matoke [OR (95%) =9.62 (2.49, 37.13))], both foods that were advocated for healthy child nutrition during the BBB program curriculum. Several foods were commonly noted as new crops to the homestead gardens, for consumption by young children. These included soy beans (20%), amaranth (48%), greens (18%), pumpkin leaves (24%), and pumpkin (16%), the latter four foods being rich sources of vitamin A.

Logic model of improvements in children's dietary adequacy. The combined results from the above study topics were assimilated into a simplified logic model (**Figure 3**) which suggests that elaborated home garden diversity, improved nutrition knowledge, and increased purchasing of fruits, vegetables, and animal sources foods for children can individually and collectively lead to improvements in children's dietary adequacy.

Discussion

This study used multiple methods to assess Infant and Young Child Feeding practices measured by self-reported child feeding behaviors. Across a series of measures to assess children's dietary adequacy and supportive household factors, children who participated in a 10 wk nutrition education and supplemental feeding program outperformed children who received no such education and supplemental feeding. In general, caregivers who participated in a 10 wk nutrition education-based supplemental feeding program reported higher levels of knowledge about child feeding and fed their children's diets that were more nutritionally adequate. PP children had greater dietary diversity and mean number of daily feeding occasions compared to CG children, and were more likely to meet their energy, macro and micronutrient requirements. Both PP and CG children had a high probability of achieving adequate nutrient and energy density intake, according to reference values established by Dewey and Brown (2003). This finding

suggests that the nutrient density of complementary foods is not likely to be a major barrier to adequate child feeding in this region of Uganda. Instead, the frequency of child feeding and dietary diversity seems to drive the differences in adequacy between groups. In each of the age groups examined, PP children had significantly greater number of daily feeding occasions and significantly greater dietary diversity.

Several findings highlight important information about critical dietary inadequacies among children in rural Uganda. First, over 95% of the study sample in both groups failed to meet dietary recommendations for calcium. This finding provides insight into the high stunting prevalence of 45-50% (Jilcott et al, 2007), as attained height is affected by insufficient energy, protein, micronutrients and frequent infections in the early years of life (Black et al. 2008). Second, fewer than 60% of children in the CG met their total daily energy requirements. Third, among underweight children in the CG, only 10% consumed enough dietary protein required for catch-up growth (data not presented).

It is worth noting that while children in the PP group achieved, on the whole, more adequate diets compared to CG children; there were still a significantly higher proportion of PP children who were classified as underweight. This difference is not surprising as the PP sample is expected to be more underweight given that being underweight is a key criterion for program eligibility. However, this finding does point out that, despite feeding generally adequate diets, a large majority of children remain underweight. This poor outcome may be result of chronically insufficient protein and calcium intakes. Findings from our previous study indates that among a sample of 135 children receiving RUF supplementation, onlt 61.5% consumed adequate protein required for catch-up –growth and fewer than 20% consumed their Adequate Intake for calcium. In the present study, it remains that children have a probability of adequacy for the necessary protein and calcium. Moreover, there is a considerable biologic challenge to reversing the effects of malnutrition after 2 years of age.

Comparison with other studies. The Uganda DHS report also makes use of a summary indicator that describes the quality of IYCF practices. The IYCF indicator is designed for children ages 6-23 months and includes three key practices: 1) initiation of feeding solid/semisolid foods from age 6 months, 2) increasing the amount and variety of foods, and 3) increasing the frequency of feeding as the child gets older, while maintaining frequent breastfeeding (World Health Organization, 2008).

In the present study, among children ages 6 to 24 months, both the PP (64%) and CG (43%) reported IYCF practices that were greater than the national average and western region estimates from 2006. In 2006, only 23% of Ugandan children ages 6 to 23 months met all three IYCF guidelines. This figure was higher in the western region, where 31% met these guidelines (Uganda Bureau of Statistics & Macro International Inc., 2007).

The superior recall of key nutrition messages such as not to dilute complementary foods, and feeding "different kinds of foods" to young children, were corroborated by higher proportions of children achieving actual IYCF practices, and by greater reported household production (in homestead gardens) of nutrient dense foods. These findings are important as feeding frequency, the energy density of complementary foods, and dietary diversity are all independently associated with children's energy and micronutrient intakes. In a recent study of healthy Bangladeshi children ages 8-11 months, energy intakes from complementary foods were significantly predicted by both energy density of the food and feeding frequency (Islam et al, 2008). Among children ages 6 to 23 months in Madagascar, dietary diversity was been demonstrated to accurately predict the micronutrient density of children's diets (Moursi et al, 2008).

Limitations. To our knowledge, this is the first study to examine the impact of a RUF-supported supplemental feeding program on IYCF practices and children's dietary adequacy. We were not able to obtain baseline dietary measures prior to program participation. Comparison of PP children with a group of non-program children attempted to approximate this comparison. The interpretation of statistical significance of the study results is limited by a relatively small sample size and multiple comparisons. Consequently, adjustment for potential confounders in regression models results in small sample sizes within comparison cells and wide confidence intervals. This study was not a randomized trial, and therefore demographic differences did vary between study groups. Group comparisons controlled for these differences.

Conclusions. The study findings suggest that participation in a combined nutrition education and supplemental feeding program in rural Uganda appears to have lasting benefits to IYCF practices and the corresponding dietary adequacy of children, after free supplemental food rations are discontinued.

Caregivers of these children have greater knowledge of healthy childcare and feeding practices. In addition, education on food purchasing and homestead agricultural practices to meet the nutritional needs of young children appears to improve the report diversity of food options grown and procured by caregivers. The potential long-term impacts of supplemental nutrition interventions can be strengthened through program components that address child-feeding practices, along with household food purchasing and homestead food production.

Chapter 4 References

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TABLE 4.1 Demographic information of study participants, according to study group[1]

	Post-Program N=61	Comparison N=61	Difference (95% CI)	P-value (2-tail)
Child age in months (mean ± SE)	26.8 ±1.6	23.4 ±1.9	-3.4 (-8.4, 1.6)	0.184
Percent underweight, Weight-for-age Z-score <-2 [2]	44 (72%)	24 (39%)	-33 (-49, 16)	0.000[3]
Percent male	34 (56%)	33 (55%)	1.6 (-1.6, 1.9)	0.856
Percent with living father	58 (95%)	54 (86%)	8.1 (-1.0, 17)	0.088
Percent with father present in the home	26 (42%)	49 (80%)	37 (22, 53)	0.000[3]
Highest Paternal Education	6.9 (0.4)	6.0 (0.6)	-0.8 (-2.0, 0.6)	0.236
None	5 (8%)	14 (23%)	15 (2, 27)	0.025[3]
Some primary	33 (54%)	23 (38%)	-16 (-33, 1)	0.069
Some secondary	12(20%)	11 (18%)	-2 (-15, 12)	0.817
Completed O-Level	11 (18%)	13 (21%)	3 (-11, 17)	0.649
Percent with living mother	59 (97%)	59 (97%)	0.0	1.000
Percent with mother or grandmother present in the home	58 (95%)	55 (90%)	-5% (-4, 14)	0.299
Highest Maternal Education (mean ± SE)	3.0 ±0.4	3.6 ±0.4	0.6 (-0.5, 1.7)	0.290
None	23 (38%)	24 (39%)	2 (-16, 19)	0.852
Some primary	34 (56%)	32 (52%)	-3 (-20, 14)	0.716
Some secondary	4 (6%)	4 (7%)	0 (0,0)	1.000
Completed O-Level	0 (0%)	1 (2%)	2 (-2, 5)	0.315
Birth order of child of interest in survey				
First	4 (7%)	15 (25%)	18% (6, 30)	0.006[3]
Second	17 (28%)	10 (16%)	18% (-6, 30)	0.006[3]
Third or greater	40 (65%)	36 (59%)	-6% (-23, 11)	0.455
Building Materials				
Percent with tin roof	9 (15%)	10 (16%)	-1% (-11, 15)	0.803
Percent with mud walls, no cement or bricks	54 (89%)	55 (90%)	-1% (-9, 14)	0.769
Number of birth children (mean ± SE)	4.2 ±0.2	3.8 ±0.3	-0.5 (X,X)	0.257
One	4 (7%)	14 (23)	16% (4, 29)	0.011
2 to 4	32 (52%)	28 (46%)	-6 (-24, 11)	0.469
5 or more	25 (42%)	19 (31%)	-11 (-27, 4)	0.154
Number of children at compound (mean ± SE)	8.2 ±0.6	4.0 ±0.3	-4.1 (-5.5, -2.7)	0.000[3]
Percent > 500 m from water source	26 (43%)	50 (82%)	39% (23, 55)	0.000[3]
Percent > 3000 m from health facility	14 (23%)	39 (64%)	40% (27, 58)	0.000[3]
Caregiver marital status				
Married, monogamous	25 (41%)	35 (57%)	16% (-1, 33)	0.070
Married, polygamous	29 (48%)	12 (20%)	-28% (-43, -12)	0.001[3]
Separated/Divorced/Widowed	7 (11%)	14 (23%)	12% (-2, 24)	0.093
Primary Means of food acquisition				
Garden only	0 (0%)	11 (18%)	18 (8, 27)	0.001[3]
Garden and some market purchase	19 (31%)	40 (66%)	35 (18, 51)	0.000[3]
Garden and market transfers	42 (69%)	10 (16%)	-53 (-67, -37)	0.000[3]
Percent growing cash crops	61 (100%)	39 (64%)	-36.1 (-48, -24)	0.000[3]

[1] Unless otherwise noted, reported values are Number (%).
[2] Anthropometric indices were calculated using the new WHO growth standards (WHO Multicentre Growth Reference Study Group, 2005).
[3] Differences were significant, $p < 0.05$.

TABLE 4.2 Comparison of recall of nutrition education topics and messages by post-program caregivers and CG groups[1]

	PP n=50	CG n=61	Diff.	Adj. OR[2]	95% CI	P-value (1-tail)
How often to feed my child	27 (0.54)	10 (0.16)	0.38	16.38	3.01, 89.10	0.000[3]
Washing/Hygiene	41 (0.82)	0 (0.00)	0.82	1.66	0.22, 12.39	0.310
Feeding different kinds of foods	35 (0.70)	12 (0.20)	0.50	28.59	5.63, 145.1	0.000[3]
Feeding soft foods	11 (0.22)	9 (0.15)	0.07	4.54	0.77, 26.80	0.045[3]
Feeding during and after my child gets sick	5 (0.10)	7 (0.11)	-0.01	1.51	0.22, 10.45	0.386
Breastfeeding	18 (0.36)	7 (0.11)	0.25	10.37	1.94, 55.47	0.003[3]
Growing foods in my garden that my child can eat	13 (0.26)	1 (0.16)	0.24	16.75	1.38, 202	0.014[3]
Feeding a small amount of food that my child can finish	23 (0.46)	0 (0.00)	0.46	0.50	0.09, 2.76	0.215
Not adding too much water to the child's meals	27 (0.54)	0 (0.00)	0.54	0.32	0.047, 2.21	0.125
Monitoring/being attentive to my child when she eats	8 (0.16)	0 (0.00)	0.16	NA[4]	NA[4]	NA[4]
Feeding more sauce than food	14 (0.28)	1 (0.02)	0.26	116.82	5.09, 2676	0.002[3]

[1]Values shown are number (proportion).

[2]Logistic regression adjusted for underweight status, typical means of household food acquisition, number of birth children, household size, distance to water source, and birth order of the child.

[3]Differences were significant, $p < 0.05$.

[4]NA because group membership predicted success perfectly and was dropped from the model.

TABLE 4.3 Comparison of Infant and Young Child Feeding Practices between study groups

Feeding Practice	Post Program n=61	Comparison n=61	Difference (95% CI)	P-value (1 tail)	Adjusted OR[1] (95% CI)	P-value (1-tail)
Percent of children breastfed, ages 6 to 12 mo (n=25)	4 (80%)	4 (80%)	-0.5 (-0.90, -0.09)	0.0206	12.21 (0.62, 241.56)	0.100
Percent of children breastfed, ages 6 to 12 mo (n=25)	21 (63.6%)	12 (33.3%)	-0.30 (09.53, -0.08)	0.0059	3.08 (1.02, 9.26)	0.041
Mean number of feeding occasions ± SE	2.9 ± 0.05	2.6 ±0.1	-.3 (-0.5, -0.05)	0.009	0.26 (0.03, 0.50)	0.029[3]
Fed minimum number of times on at least one observation[2]	15 (48.45)	12 (35.3%)	-0.13 (-0.37, 0.11)	0.1423	6.21 (1.41, 27.23)	0.015
Fed minimum number of times on both observations[2]	15 (48.45)	12 (35.3%)	-0.13 (-0.37, 0.11)	0.1423	6.21 (1.41, 27.23)	0.015
Achieved all 3 IYCF practices on at least one observation[2]	19 (61.3%)	15 (44.1%)	-.17 (-0.241, 0.067	0.027	4.07 (1.17, 14.10)	0.027
Achieved all 3 IYCF practices on both observations[2]	12 (38.7%)	8 (23.5%)	-.15 (-0.37, 0.07)	0.0927	3.28 (0.83, 12.88)	0.089

[1]Linear regression used to test group differences in mean number of feeding occasions, adjusted for age, gender, and maternal education.

[2]World Health Organization Infant and Young Child Feedings standards used to assess minimally appropriate feeding practices for children 6-24 mo (n=65). Assessment includes n=68, with n=35 in PP, n=33 in Comparison (CG) groups, respectively.

[3]Differences were significant, $p < 0.05$.

TABLE 4.4 Comparison of dietary diversity between Post-Program and Comparison groups based on 2 d of recall[1]

	PP (N=61)	CG (N=61)	Diff.	P-value (1 tail)	Adjusted OR (95%CI)[2]	Adj. P-value (1 tail)
Cereals, roots, tubers, and matoke	61 (100%)	58 (95%)	0.049	0.0397	1.80 (0.36, 9.05)	0.237
Vitamin A-Rich fruits and vegetables	60 (98%)	53 (87%)	0.11	0.0077	12.89 (0.91, 182.41)	0.029[4]
Other fruits	11 (18%)	10 (16%)	0.02	0.2398	4.16 (0.62, 27.88)	0.071
Other vegetables	61 (100%)	48 (79%)	0.21	0.0001	NA[3]	NA[3]
Legumes, pulses, nuts	58 (95%)	42 (69%)	0.26	0.0001	16.94 (1.22, 234.93)	0.018[4]
Meat, poultry fish	40 (66%)	30 (49%)	16.3	0.0336	3.07 (0.86, 10.87)	0.041[4]
Fats, oils	1 (0%)	0 (0%)	0.0	NA	NA[3]	NA[3]
Dairy	1 (1.6%)	2 (3%)	-0.02	0.7206	0.23 (0.01, 6.34)	0.195
Eggs	4 (7%)	0 (0%)	0.07	0.0210	NA[3]	NA[3]

[1]Value shown are number (percentage). Individuals were considered to consume a food group if a minimum of 1 g was consumed on either day of the 2 recalls.

[2]Logistic regression model adjusted for child age, underweight status, number of birth children, maternal education, possession of cash crops, distance to water source, distance to health center, and presence of father in the home.

[3]Independent variable of study group was dropped from logistic regression model because group membership predicted consumption or lack or consumption of a food item perfectly, and was therefore dropped from the model.

[4]Differences were significant, $p < 0.05$.

TABLE 4.5 Comparison of proportion of children achieving age-specific DRI between Post-Program and Comparison Groups[1,2]

Nutrient	Post-Program (n=61)	Comparison (n=61)	Difference (95% CI)	P-value (1 tail)	Adjusted OR[3] (95% CI)	P-value (1-tail)
Total Energy[2]	58 (0.95)	36 (0.59)	-0.36 (-0.5, -0.30)	0.000	27.9 (3.6, 215.6)	0.000[4]
Protein	61 (1.00)	48 (0.79)	-0.21 (-0.3, -0.10)	0.000	2.32 (0.96, 5.6)	0.031[4]
Protein required for catch-up growth	33 (0.54)	23 (0.38)	-0.16 (-0.3, 0.01)	0.035	1.28 (0.37, 4.4)	0.348
Folate	47 (0.77)	34 (0.55)	-0.21 (-0.4, -0.05)	0.006	1.62 (0.44, 6.0)	0.232
Vitamin B6	61 (1.00)	53 (0.87)	-0.13 (-0.2, -0.05)	0.002	2.23 (0.65, 8.1)	0.099
Vitamin A	60 (0.98)	46 (0.75)	-0.20 (-0.2, -0.1)	0.000	21.09 (1.4, 316.5)	0.014[4]
Vitamin C	57 (0.93)	45 (0.74)	-0.20 (-0.3, -0.08)	0.002	9.7 (0.7, 135.3)	0.045[4]
Iron	58 (0.95)	46 (0.75)	-0.20 (-0.3, -0.08)	0.001	15.4 (1.2, 204.1)	0.019[4]
Zinc	57 (0.93)	50 (0.82)	-0.10 (-0.3, 0.0)	0.027	12.5 (0.97, 160.8)	0.027[4]
Calcium	06 (0.10)	05 (0.08)	-0.02 (-0.1, 0.09)	0.376	1.63 (0.19, 19.9)	0.333

[1] Mean nutrient intakes calculated by average of two 24 h dietary recalls. DRI obtained from the Food and Nutrition Board and Institute of Medicine Dietary Reference Intake Reports published in 1997, 1998a, 1998b, 2000a, 2000b, 2002, and 2005.

[2] Values listed are number (proportion).

[3] Logistic regression model adjusted for child age, underweight status, number of birth children, maternal education, possession of cash crops, distance to water source, distance to health center, and presence of father in the home.

[4] Differences were significant, $p < 0.05$.

TABLE 4.6 Percent of children consuming complementary foods within food groups[1]

	During Program n=42	Post Program n=42	P value
Grains	100.00%	100.00%	1.0000
Milk Products	2.38%	0.00%	0.3144
Vitamin A FVs	97.62%	97.62%	1.0000
Other Vegetables	80.95%	100.00%	0.0029[2]
Other Fruits	9.52%	11.90%	0.7243
Eggs	2.38%	7.14%	0.3055
Meat, Fish, Poultry	54.76%	61.90%	0.5067
Legumes	97.62%	92.86%	0.3055
Oil or Fats	0.00%	0.00%	NA

[1] Consumption of a food group was credited if a child consumed at least 1gram of a food from the respective group of either day of dietary recall.

[2] Difference was significant, $p < 0.05$

TABLE 4.7 Comparison of proportion of children achieving age-specific DRI during and after program participation[1,2]

Nutrient	During Program (n=41)	After Program (n=41)	Difference (95% CI)	P-value (2 tail)
Total Energy	40 (0.98)	39 (0.95)	-0.02 (-0.11, 0.06)	0.556
Protein	41 (1.00)	41 (1.00)	NA	NA
Folate	38 (0.93)	36 (0.88)	-0.15 (-0.08, .18)	0.457
Vitamin B6	41 (1.00)	40 (0.98)	-0.02 (-0.02, 0.07)	0.314
Vitamin A	36 (0.88)	38 (0.93)	0.02 (-0.18, 0.08)	0.457
Vitamin C	34 (0.83)	32 (0.78)	-0.02 (-0.12, 0.22)	0.577
Iron	33 (0.80)	31 (0.76)	-0.02 (-0.13, 0.23)	0.594
Zinc	39 (0.95)	32 (0.78)	-0.07 (0.04, 0.31)	0.023
Calcium	09 (0.22)	06 (0.15)	-0.07 (-0.09, 0.24)	0.392

[1]DRI obtained from the Food and Nutrition Board and Institute of Medicine Dietary Reference Intake Reports published in 1997, 1998a, 1998b, 2000a, 2000b, 2002, and 2005.

[2]Value shown are number (proportion).

[3]Mean nutrient intakes calculated by average of two 24 h dietary recalls during each period (4 recalls per child total).

TABLE 4.8 Comparison of micronutrient density by study group[1]

Nutrient	PP (n=61)	CG (n=61)	P-value (2 tail)[2]
Protein density	2.04 (1.90, 2.45)	1.89 (1.65, 2.17)	0.391
Folate density	16.26 (14.93, 17.92)	12.96 (11.86, 13.62)	0.006[3]
Vitamin B6 density	0.11 (0.010, 0.11)	0.12 (0.10, 0.12)	0.226
Vitamin B12 density	0.028 (0.011, 0.062)	0.003 (0.00, 0.061)	0.076
Vitamin A density	153.24 (119.71, 179.19)	120.07 (106.31, 148.36)	0.280
Vitamin C density	4.79 (4.01, 6.09)	4.87 (4.34, 5.61)	0.669
Iron density	0.07 (0.066, 0.078)	0.059 (0.049, 0.072)	0.183
Zinc density	0.67 (0.63, 0.80)	0.70 (0.63, 0.77)	0.857
Calcium density	6.09 (5.46, 7.58)	5.18 (4.01, 6.17)	0.889

[1] Mean nutrient intakes calculated by average of two 24 h dietary recalls. Nutrient density was calculated by dividing the mean total amount of each specific nutrient by the mean total calories from complementary food consumed over two days of recall, multiplied by 100.

[2] Mean nutrient densities were compared between groups using quantile regression. Models were adjusted for underweight status, number of birth children, being second in birth order, maternal education, paternal education, building materials of house, and caregiver marital status.

[3] Differences were significant, $p < 0.05$.

TABLE 4.9 Comparison of energy density and meals per day, according to child age[1]

	6-8 mo (n=11)		9-11 mo (n=10)			12-23 mo (n=44)			24-36 mo (n=35)			36-59 mo (n=22)		
	PP	CG	PP	CG	Adj. P-value	PP	CG	Adj. P-value	PP	CG	Adj. P-value	PP	CG	Adj. P-value
Median (SD) Energy density (kcal/d)	NA	1.10 (0.37)	1.22 (0.52)	1.30 (0.32)	0.755	1.20 (0.05)	1.32 (0.91)	0.906	1.22 (0.24)	1.30 (0.11)	0.951	1.30 (0.13)	1.23 (0.24)	0.926
Mean (SE) (meals/d)	NA	2.36 ±0.29	3.00 ±0.00	2.28 ±0.32	0.230	2.86 ±0.09	2.25 ±0.21	0.040[2]	2.9 ±0.077	3.03 ±0.16	0.204	2.91 ±0.17	2.90 ±0.15	0.948

[1]Group differences in mean meals per day were compared using multiple linear regression. Median energy densities were compared between groups using quantile regression. Models were adjusted for underweight status, number of birth children, being second in birth order, maternal education, paternal education, buildng materials of house, and caregiver marital status.

[2]Difference is significant, $p<0.05$ (2-tailed).

TABLE 4.10 Comparison of home food purchasing for child consumption among caregivers who participated in a nutrition education program (Post program) and a Comparison group.[1]

Food	Post-Program (n=50)	Comparison (n=61)	Adj. OR[2]	95% CI	P-value (1 sided)[3]	Began buying since start of BBB program	Buy more often since start of BBB program
Avocado	24 (0.47)	33 (0.54)	0.59	0.25, 1.43	0.121	4 (0.08)	16 (0.32)
Bananas (large)	24 (0.47)	36 (0.59)	0.58	0.24, 1.37	0.108	7 (0.14)	10 (0.20)
Bananas (small)	**15 (0.29)**	**30 (0.49)**	**0.34**	**0.13, 0.86**	**0.011**	**1 (0.02)**	**7 (0.14)**
Beans, red	**39 (0.76)**	**27 (0.44)**	**5.50**	**1.97, 15.36**	**0.001**	**0 (0.00)**	**2 (0.04)**
Beans, soy (fresh)	20 (0.39)	17 (0.28)	1.60	0.64, 3.96	0.156	0 (0.00)	7 (0.14)
Beans, soy (flour)	4 (0.08)	6 (0.1)	0.78	0.17, 3.44	0.370	1 (0.02)	3 (0.6)
Cabbage	45 (0.88)	55 (0.9)	0.90	0.22, 3.67	0.441	2 (0.04)	10 (0.20)
Cassava tubers	**26 (0.51)**	**16 (0.26)**	**2.30**	**0.92, 5.75**	**0.038**	**0 (0.00)**	**2 (0.04)**
Cassava leaves	**0 (0.00)**	**8 (0.13)**	**NA**	**NA**	**NA**	**0 (0.00)**	**0 (0.00)**
Dodo (amaranth)	3 (0.06)	8 (0.13)	0.28	0.06, 1.28	0.050	1 (0.02)	1 (0.02)
Eggs	26 (0.51)	29 (0.48)	1.12	0.47, 2.67	0.401	6 (0.12)	14 (0.28)
Eggplants	28 (0.56)	33 (0.54)	1.00	0.42, 2.34	0.496	1 (0.02)	0 (0.00)
Field peas	2 (0.04)	3 (0.05)	0.41	0.06, 3.03	0.193	0 (0.00)	0 (0.00)
Guava	0 (0.00)	2 (0.03)	NA	NA	NA	0 (0.00)	0 (0.00)
Green pepper	**1 (0.02)**	**5 (0.08)**	**0.11**	**0.01, 1.28**	**0.040**	**0 (0.00)**	**0 (0.00)**
Greens	5 (0.10)	2 (0.03)	1.58	0.25, 10.08	0.315	0 (0.00)	4 (0.08)
Ground nuts	41 (0.8)	43 (0.7)	2.35	0.84, 6.58	0.052	1 (0.02)	32 (0.64)
Jack fruit	**12 (0.24)**	**21 (0.34)**	**0.42**	**0.16, 1.11**	**0.041**	**0 (0.00)**	**1 (0.02)**
Maize, flour	32 (0.63)	36 (0.59)	1.03	0.42, 2.48	0.474	1 (0.02)	4 (0.08)
Maize grains	30 (0.59)	24 (0.39)	1.89	0.79, 4.50	0.076	0 (0.00)	0 (0.00)
Moringa	0 (0.00)	6 (0.10)	NA	NA	NA	0 (0.00)	0 (0.00)
Mushrooms	5 (0.1)	15 (0.25)	0.36	0.11, 1.22	0.051	0 (0.00)	0 (0.00)
Onions	48 (0.94)	54 (0.89)	2.90	0.48, 17.60	0.124	1 (0.02)	2 (0.04)
Oranges	**19 (0.37)**	**33 (0.54)**	**0.34**	**0.14, 0.85**	**0.011**	**0 (0.00)**	**1 (0.02)**
Palm oil	**42 (0.82)**	**37 (0.61)**	**4.50**	**1.58, 12.79**	**0.003**	**1 (0.02)**	**3 (0.06)**
Papaya	0 (0.00)	4 (0.07)	3.06	0.62, 15.21	0.086	0 (0.00)	0 (0.00)
Passion fruit	19 (0.37)	31 (0.51)	0.49	0.19, 1.19	0.058	3 (0.06)	6 (0.12)
Pineapples	13 (0.25)	20 (0.33)	0.68	0.27, 1.74	0.213	0 (0.00)	1 (0.02)
Plantains, matoke	**31 (0.61)**	**17 (0.28)**	**6.46**	**2.37, 17.59**	**0.000**	**1 (0.02)**	**3 (0.06)**
Potatoes, Irish	13 (0.25)	21 (0.34)	0.49	0.19, 1.30	0.077	1 (0.02)	1 (0.02)
Potatoes, sweet	22 (0.43)	24 (0.39)	0.98	0.41, 2.31	0.480	0 (0.00)	2 (0.04)
Pumpkin	6 (0.12)	2 (0.03)	2.96	0.45, 19.48	0.130	0 (0.00)	0 (0.00)
Pumpkin leaves	0 (0.00)	0 (0.00)	NA	NA	NA	0 (0.00)	0 (0.00)
Sugar cane	21 (0.41)	32 (0.52)	0.54	0.22, 1.29	0.083	0 (0.00)	0 (0.00)
Soy flour	4 (0.08)	4 (0.07)	0.91	0.18, 4.52	0.456	2 (0.04)	2 (0.04)
Sweet potato	**22 (0.43)**	**15 (0.25)**	**2.22**	**0.90, 5.50**	**0.042**	**0 (0.00)**	**1 (0.02)**
Tomato	46 (0.90)	56 (0.92)	1.21	0.26, 5.65	0.403	1 (0.02)	2 (0.04)
Rice	39 (0.76)	52 (0.85)	0.68	0.23, 2.01	0.241	0 (0.00)	1 (0.02)
Yams	9 (0.18)	9 (0.15)	1.41	0.43, 4.63	0.288	0 (0.00)	0 (0.00)
Meat	**43 (0.84)**	**2 (0.03)**	**1.43**	**0.13, 1.44**	**0.087**	**0 (0.00)**	**4 (0.08)**
Fish	**41 (0.80)**	**2 (0.03)**	**NA**	**NA**	**NA**	**0 (0.00)**	**6 (0.12)**

[1] Value shown are number (proportion)

[2] Potential confounders used in the final model included: age, presence of father in the household, and primary means of household food acquisition.

[3] Differences were significant, $p < 0.05$. Significant differences highlighted in bold.

TABLE 4.11 Comparison of home food production for child consumption among caregivers who participated in a nutrition education program (Post program) and a Comparison group.[1]

Food	Post-Program (n=50)	Comparison (n=61)	Diff.	Adj. OR [2]	(95% CI)	P-value (1 tail)	Began growing after start of BBB program
Avocado	**24 (0.48)**	**14 (0.23)**	**0.25**	**2.59**	**1.05, 6.42**	**0.020**	**2 (0.04)**
Bananas (large)	13 (0.26)	11 (0.18)	0.08	1.86	0.67, 5.16	0.118	1 (0.02)
Bananas (small)	**22 (0.44)**	**13 (0.21)**	**0.23**	**2.56**	**0.10, 6.60**	**0.026**	**1 (0.02)**
Beans, red	16 (0.32)	31 0.51)	-0.19	0.48	0.19, 1.17	0.052	2 (0.04)
Beans, soy (fresh)	27 (0.54)	29 (0.48)	0.06	1.57	0.66, 3.74	0.154	10 (0.20)
Beans, soy (flour)	5 (0.10)	8 (0.13)	-0.03	1.11	0.28, 4.45	0.442	0 (0.00)
Cabbage	1 (0.02)	0 (0.00)	0.02	NA	NA	NA	0 (0.00)
Cassava tubers	38 (0.76)	47 (0.77)	-0.01	0.81	0.30, 2.22	0.345	3 (0.06)
Cassava leaves	49 (0.98)	54 (0.89)	0.09	6.44	0.66, 62.52	0.054	0 (0.00)
Dodo (amaranth)	**48 (0.96)**	**34 (0.56)**	**0.40**	**16.74**	**3.47, 80.71**	**0.000**	**24 (0.48)**
Eggs	**12 (0.24)**	**5 (0.08)**	**0.16**	**3.59**	**1.95, 13.54**	**0.030**	**0 (0.00)**
Eggplant	**17 (0.34)**	**8 (0.13)**	**0.21**	**2.74**	**1.02, 8.13**	**0.035**	**6 (0.12)**
Field peas	4 (0.08)	1 (0.02)	0.06	2.34	0.22, 24.59	0.239	0 (0.00)
Guava	32 (0.64)	33 (0.54)	0.10	1.54	0.64, 3.71	0.168	1 (0.02)
Green pepper	**10 (0.20)**	**3 (0.05)**	**0.15**	**4.44**	**1.05, 18.72**	**0.021**	**1 (0.02)**
Greens	**48 (0.96)**	**15 (0.25)**	**0.71**	**59.10**	**11.78, 296**	**0.000**	**9 (0.18)**
Ground nuts	7 (0.14)	9 (0.15)	-0.01	0.87	0.25, 2.99	0.412	3 (0.06)
Jack fruit	36 (0.36)	39 (0.64)	0.08	1.55	0.60, 3.98	0.181	0 (0.00)
Maize, flour	1 (0.02)	1 (0.02)	0.00	0.81	0.04, 17.08	0.445	0 (0.00)
Maize grains	16 (0.32)	18 (0.30)	0.02	0.94	0.38, 2.31	0.444	1 (0.02)
Moringa	19 (0.38)	18 (0.30)	0.08	1.11	0.44, 2.79	0.415	1 (0.02)
Mushrooms	27 (0.54)	26 (0.43)	0.11	1.78	0.76, 4.19	0.094	0 (0.00)
Onions	1 (0.02)	4 (0.07)	-0.05	0.29	0.03, 3.17	0.157	0 (0.00)
Oranges	**27 (0.54)**	**13 (0.13)**	**0.33**	**5.61**	**2.01, 15.64**	**0.001**	**0 (0.00)**
Palm oil	19 (0.38)	23 (0.23)	0.00	0.92	0.39, 2.20	0.430	0 (0.00)
Papaya	38 (0.76)	45 (0.74)	0.02	1.59	0.60, 4.19	0.174	2 (0.04)
Passion fruit	1 (0.02)	1 (0.02)	0.00	2.17	0.12, 38.51	0.299	0 (0.00)
Pineapples	10 (0.20)	0 (0.00)	0.20	0.65	0.24, 1.75	0.198	2 (0.04)
Plantains	**47 (0.94)**	**39 (0.64)**	**0.30**	**9.62**	**2.49, 37.13**	**0.001**	**1 (0.02)**
Potatoes, Irish	0 (0.00)	0 (0.00)	0.00	NA	NA	NA	0 (0.00)
Potatoes, sweet	31 (0.62)	36 (0.59)	0.03	1.48	0.62, 3.52	0.187	3 (0.06)
Pumpkin	25 (0.50)	33 (0.33)	-0.04	1.41	0.58, 3.40	0.222	8 (0.16)
Pumpkin leaves	**46 (0.92)**	**46 (0.75)**	**0.17**	**5.34**	**1.44, 19.83**	**0.006**	**12 (0.24)**
Sugar cane	**26 (0.26)**	**18 (0.30)**	**0.22**	**2.41**	**0.99, 5.90**	**0.027**	**0 (0.00)**
Soy flour	4 (0.08)	6 (0.10)	-0.02	1.78	0.28, 11.23	0.271	1 (0.02)
Sweet potato	**31 (0.62)**	**31 (0.51)**	**0.11**	**1.95**	**0.82, 4.62**	**0.065**	**2 (0.04)**
Tomato	17 (0.34)	0 (0.00)	0.34	1.32	0.56, 3.12	0.261	1 (0.02)
Rice	0 (0.00)	2 (0.03)	-0.03	NA	NA	NA	0 (0.00)
Yams	37 (0.74)	49 (0.80)	-0.06	0.56	0.20, 1.57	0.134	1 (0.02)
Meat	5 (0.10)	5 (0.08)	0.02	NA	NA	NA	0 (0.00)
Fish	0 (0.00)	1 (0.02)	-0.02	0.94	0.10, 8.82	0.479	0 (0.00)

[1] Value shown are number (proportion)

[2] Potential confounders used in the final model included: age, presence of father in the household, and primary means of household food acquisition.

[3] Differences were significant, $p < 0.05$. Significant differences highlighted in bold.

FIGURE 4.1 Study Profile

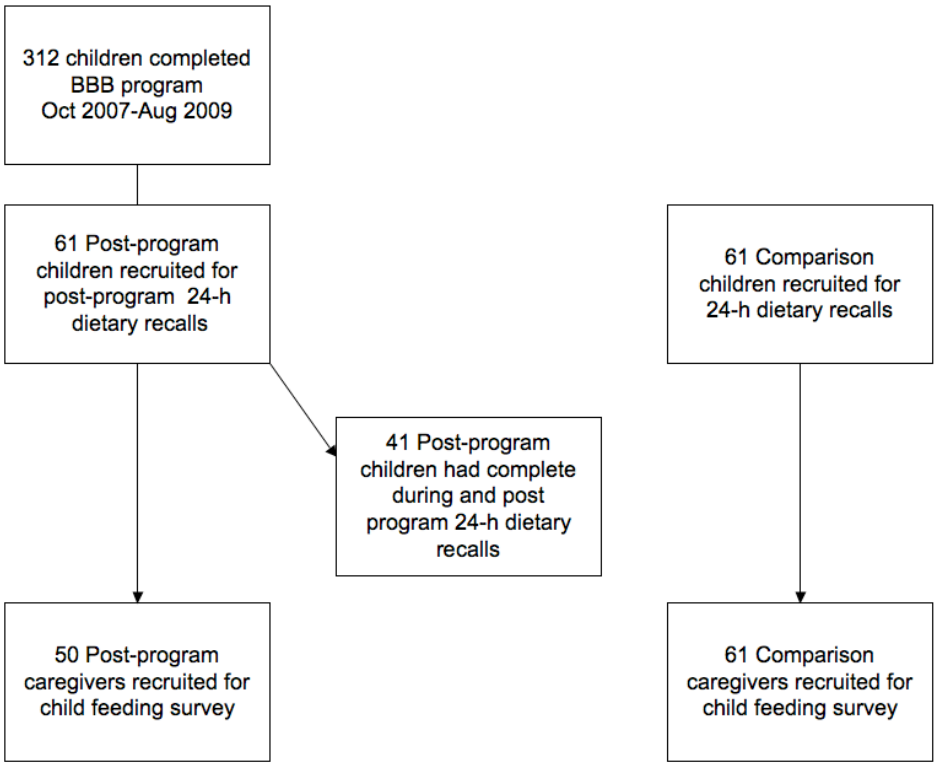


FIGURE 4.2 Dietary Diversity Score according to study group. (N=61 per group)

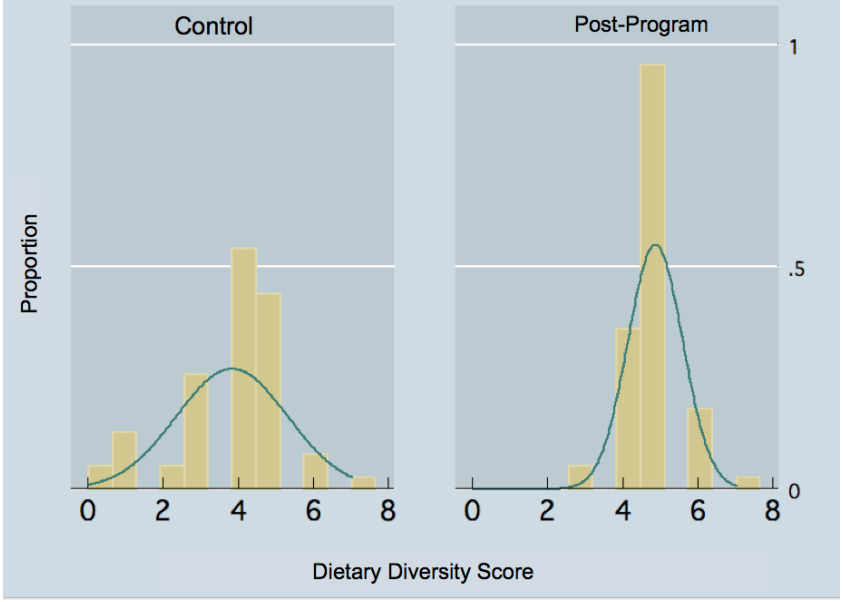
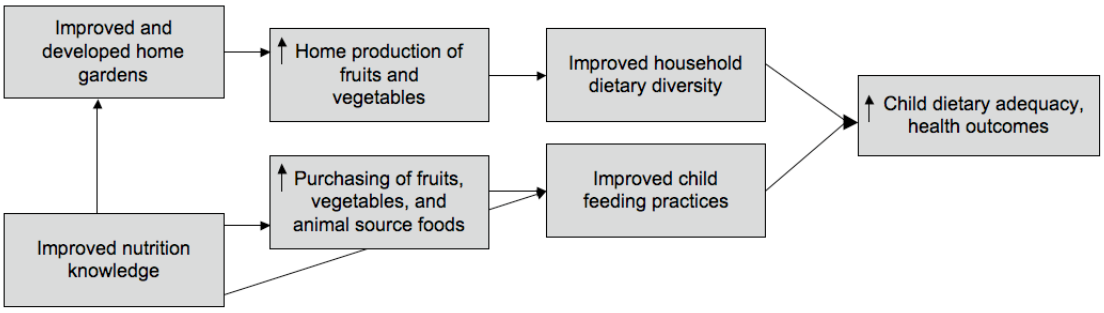


FIGURE 4.3 Logic model of improved diet adequacy and health outcomes resulting from a comprehensive nutrition education program



CHAPTER 5

Synthesis and Conclusions

This series of studies examined the impact of a community-based program to improve child nutrition in an under resourced setting where a high proportion of children suffer from chronic under nutrition. The UNICEF framework of the causes of malnutrition was adapted to describe the various factors that affect under nutrition in this region of the world. The intervention that was assessed attempted to modify and address the immediate and underlying causes of chronic malnutrition in a rural East African setting, where nearly 50% of children under 5 years are stunted.

This study addressed three overarching objectives: First, we identified the cultural factors that affect in-home consumption of ready-to-use food by underweight children. Second, we examined the contribution of the RUF ration to the overall child diets and examined the socio-demographic factors associated with RUF consumption patterns. Finally, we tested the impact of nutrition education on children's dietary patterns, diet adequacy, and household food production and purchasing. The results of these study objectives are summarized below.

Key findings

1. What are the most important factors the affect RUF utilization with households? How is RUF perceived and used by caregivers?

Ready-to-use foods that resemble locally available foods are well accepted by caregivers and children in western Uganda. The majority of caregivers prepared the RUF as thick porridges, or as a dish with small amounts of staple foods. Caregivers noted that RUF supplements allowed them to provide more protein-rich "sauce" for their children's diets. Sharing of RUF rations was an important study finding. In a

relatively food insecure households and in populations with large household sizes, caregivers are likely to share RUF rations, even if supporting education messages instruct otherwise.

The issue of household sharing was investigated using both direct and indirect methods of inquiry. First caregivers were asked whether they were challenged to feed the RUF to only one child. After receiving a number of positive responses to this question, we designed a follow up survey to further investigate the specific reasons that targeting RUF to one child was a challenge. Key reasons notes for this challenge included caregiver sensitivity to the cultural value of sharing, household food insecurity, or preparing of RUF in a way that generated leftovers, which were given to other children. Next, we used 24 hour dietary recalls to investigate the amount of the distributed ration that was given to children and found that, while the majority of targeted children (87%) were offered the RUF, a large proportion (65%) of the RUF was not offered to the targeted child. Caregivers with a greater number of natural born children (i.e. larger families) were less likely to feed RUF to the targeted child.

These findings suggest that food insecurity and the challenging decision-making around the allocation of scarce resources influences how RUF is used within households.

2. Do children who received RUF as a supplemental food achieve their recommended amounts of macro and micronutrients?

While a large proportion of children met their DRI for total energy, folate, Vitamin B6, vitamin A, vitamin C, iron, zinc, substantial deficiencies were indicated for calcium and protein required for catch-up growth. These deficiencies are likely to play a key role in growth faltering and impaired cognitive development. Furthermore, estimations of adequacy stratified by age indicated that children ages 6 to < 12 months were less likely to meet their DRI for vitamin A, vitamin C, iron, zinc, and protein required for catch-up growth. This finding underscores the importance of providing nutrition education that emphasizes the changing dietary needs of children as they grow and age, including the type of foods and nutrients needed.

The ready-to-use that was distributed in the assessed program was locally-sources and produced. The peanut, soy, and moringa-based product was not fortified with micronutrients, as is the case with most commercial RUF products. The results of the dietary analysis of children supplemented with this locally

produced RUF highlights the importance of providing multivitamins with iron in combination with non-fortified RUF products, as was done in the BBB program.

3. What effect does nutrition education have on long-term child feeding practices and children's dietary adequacy?

We aimed to understand the impact of a 10-week complementary feeding education program on caregiver feeding practices and children's diet adequacy. In general, caregivers exhibited strong recall of topics and messages that they received during the BBB program. Because we were unable to capture pre-program feeding behaviors and dietary measurements, we recruited a group of non-program children to approximate this comparison. In general, caregivers in the Post-Program (PP) group had more adequate complementary feeding practices, better household food procurement practices to benefit child nutrition, and children with more adequate diets. However, the 10-week complementary feeding education program did not solve the dietary adequacies of underweight children, as several key deficiencies remained.

Moreover, complementary feeding education and 10 weeks of RUF supplementation was not sufficient to promote sustained reductions in the prevalence of underweight, as 72% of children in the PP group had weight-for-age Z (WAZ) score < -2.

4. How does this education appear to influence children's diets?

Nutrition education seemed to influence diets by affecting child feeding practices. Caregivers who participated in a 10-week nutrition education program had children whose diets were, in general, more adequate than those who received no such formal education. The improved adequacy seemed to result from increased diversity of foods purchased, grown, and fed to children, and through more frequent child feeding occasions.

Improving the energy and nutrient density of children's meals did not seem to be affected by nutrition education. However, a large proportion of children in both the comparison and intervention groups achieved the minimum energy and nutrient density standards, though these standards are still recent and there is limited scientific literature on the topic of energy and nutrient density recommendations for young children.

The effect of education on actual behavior change is limited by the availability of resources needed to support changes. To date, only a small number of studies have prospectively tested the impact of education and supplemental food versus education alone among food insecure populations. Two important reviews about interventions to target undernutrition (Bhutta et al., 2008; Dewey & Adu-Afarwuah, 2008) have concluded that, in regions of food insecurity, food-based approaches may be necessary to promote positive growth outcomes among malnourished children.

5. What new insights does this study provide about challenges to child nutrition in rural Uganda?

The dietary analysis of the Post-Program group (n=61) and Comparison group of 61 children who had never participated in a nutrition education program revealed several important dietary inadequacies. Of these 122 children, only 3 children consumed dairy products during two days of dietary recall, and only 9% of children met their Adequate Intake level for calcium. Among this same group of children, 68 (55%) were underweight (WAZ < - 2). Underweight children require additional dietary protein to support catch-up growth, and only 46% of these children consumed enough protein to meet that requirement.

6. Is locally-produced RUF an effective strategy for treating underweight children at the community level?

In this study setting, a large majority of caregivers fed RUF to their children. Interviewed caregivers remarked that RUF has helpful qualities that encouraged children to consume the food easily. These include the soft texture, good taste, and similarity to locally available complementary foods. Moreover, caregivers found the RUF easier to prepare than other local foods, which are traditionally processed using a wooden mortar and pestle, or hulled by hand. However, as noted above, an RUF supplement that provided 35.1 grams per day of protein was not sufficient for 61% of targeted children to meet their requirement of protein for catch-up growth (26.5 grams), due to "leakage" of rations within households. This study was not primarily designed to assess the impact of RUF supplementation on child growth. At the time of program entry 78% of children were underweight (WAZ score < -2) and 87% were stunted (height-for-age Z (HAZ) score < -2). The proportion of children classified as underweight increased to 86.7% after 10 weeks of program participation (p=0.043). Height data at baseline and 10 weeks was

available for 68 of the 135 children assessed during the period of RUF supplementation. Of these children, 89.7% were stunted (HAZ < -2) during and after program participation (p=1.000); and 23.5% were moderately wasted (weight-for-length Z Score < -2) at baseline, compared to 29.4% at 10 weeks (p=0.437). These poor growth outcome findings should be interpreted in the light of the fact that reversing malnutrition among children over 2 years of age is very challenging, as the effects or poor diet quality during the first two years of life may be largely irreversible.

Study Limitations

Dietary assessment.

This study relied on self-reported measures of dietary intake to estimate children's food consumption. Self-reported dietary assessment may also misrepresent a child's dietary quality and RUF consumption as a result of social desirability bias or because of inaccuracy in estimating portion sizes and the amount of food consumed. Estimations of portion sizes were aided by using standard local utensils. Nevertheless, because many children eat from shared bowls, it may have been difficult for caregivers to provide accurate portion estimates for a single child of interest. In meals that are served from a family pot, the opportunity for error in estimation becomes greater.

Two dietary recalls collected on non-consecutive days improves the ability to account for within person variation in food consumption (24). However, we were limited by inherent nutrient variation within foods, and uncertainty about the actual shape of nutrient requirement distributions used to estimate the probability of adequacy. The error in reporting amounts of RUF in recipes may have varied according to the method of preparation in such a way that the ability to recall the amount of specific ingredients may decline for recipes with more ingredients.

Selection of a "true" control group.

Due to the ethical challenge of providing no service to children identified as malnourished, and because of budgetary restraints, we were unable to recruit a true control group to draw comparisons of dietary adequacy and caregiver feeding practices. To approximate a control group, we recruited a Comparison group of children living in the same villages and of the same age as post program children.

Nevertheless, the Comparison Group children differed in several characteristics that may be important to dietary intake. We attempted to control for these differences by including relevant demographic variables in statistical models; however underlying, unaccounted for differences may exist that biased our comparisons between study groups.

Demographic data collection.

We made use of a modified Demographic and Health Survey questionnaire to assess household characteristics of the study population. While this simplified survey was easier to use by field assistants, our survey may have over simplified household characteristics. For example, when inquiring about the presence of a mother we did not distinguish between actual mothers of children and grandmothers, who sometimes serve as maternal caregivers when biological mothers are deceased or absent. Demographic data was collected regarding whether the child's biological mother was living and present. However, information about the relationship of the primary maternal caregiver to the child of interest may have provided meaningful information about children's social environments that we did not assess in these studies.

Caregiver recruitment.

Due to time limitation for data collection and overall study budget, we were limited to collecting two dietary recalls per child to estimate actual food intake. Moreover, the logistical challenge of reaching caregiver homes led us to conduct the majority (65%) of recalls at health centers during the program day, when most of the enrolled caregivers were present at one location. The recalls conducted at the health centers assessed the child's food consumption on the day immediately prior to the program, and may represent a worst-case scenario of RUF consumption, given that the rations may have been depleted earlier in the week. Note was made on data forms if RUF rations had been exhausted earlier in the week, which occurred in only one instance.

To the extent that study resources allowed, we attempted to locate caregivers who were not in attendance at the BBB program, in order to capture the full experiences of all participations. Caregivers who did not participate as regularly in the program were, in some cases, less likely to be interviewed. If

these caregivers were different according to meaningful characteristics that were associated with our outcomes of interest, missing these caregivers may have biased study findings. If caregivers who did not attend the program as regularly were from more vulnerable households, or had sicker children, we may have missed part of the more vulnerable segment of program participants.

Public health and policy significance

Nutrition education can play an important role in improving child nutrition in resource-restricted settings. This study has demonstrated that a community-based, locally staffed program can promote positive influences in children's dietary adequacy through affecting household food procurement and caregiver feeding practices.

Ready-to-use food is likely to be shared among children, particularly in settings with large household sizes and food insecurity. It is likely that households with one malnourished child may have additional children who may also be malnourished, or at risk for malnutrition. Program planners and policy makers should consider household size and food security when determining rations sizes for supplemental feeding programs where distributed rations are consumed at home. In addition, programs should deliver supplemental food rations with culturally sensitive messages to encourage delivery of food supplements to targeted beneficiaries.

Due the strong connection between maternal and child health and nutrition, it is important for child nutrition programs to support caregivers, especially mothers, with food rations when program resources permit.

Family and household characteristics have an important influence on child nutrition and health. This study identified several important characteristics that were associated with the Post-Program group compared to the Comparison group. In general, the Post-Program group had poorer nutritional status. The Post-Program group was more likely to have larger household sizes (measured by the number of children living at the caregiver's compound), a higher absence of fathers, and a greater number of caregivers who were in polygamous unions. The role and impact of these household factors on household food environments and child nutrition is worthy of further investigation.

As up to 50% of child deaths worldwide can be attributed to under nutrition, evidence-based

programs and policies to address this issue remain an urgent priority to achieve the Millennium Development Goals. Reducing extreme poverty and child mortality will only be achieved through coordinated, multi-sectoral approaches. Ready-to-use food is one tool in development and public health toolkit, and nutrition education is another. Together, these tools can promote improvements in children's dietary intakes. Community-based nutrition programs that use these tools can be improved through culturally-relevant research that assesses program impact on the various underlying and immediate factors of malnutrition.

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APPENDICES

The following appendices (1-7) contain the data collection instruments for studies conducted.

Appendix Table of Contents

Appendix 1. Dietary Recall Questionnaire

BBB Evaluation
Children's 24 Hour Dietary Recall

Health Center Identification Number

Staff ID _____

Today's Date (DD/MM/YY) _____

Child Date of birth (DD/MM/YY)

Visit Code (01, 02, 03, 04) _____

Time Of Day	Name of Food/Dish or Beverage (including breast milk) Given	Cooking Method (If applicable)	Ingredients	Amount of Ingredients	Amount of Ingredients from RUF ration (All, some, none)	Amount of Food/Dish or Beverage given or length of time breastfed	Size of Portion consumed from the total prepared (e.g. ¼, ½, All)	How Given (e.g. cup, bottle, by hand, plate, bowl, spoon)

Excel Entry ID _____

Page _____ of _____

Source: Breastfeeding, Anti-retroviral and Nutrition Study Team. (2006). University of North Carolina at Chapel Hill and Kamuza Central Hospital in Lilongwe, Malawi.

Appendix 2. Semi-structured Interview Guides

Appendix 2a. Caregivers Interview Guide

Introduction: Good morning/afternoon. My name is Scott Ickes and this is Basiime Godfrey. We are doing a research project to understand the positive and negative aspects of the *Byokulia Bisemeye mu Bantu Project*—this is the project your child participates in that provides the g-nut, soybean mixture is small bhuvela each week. We would like to understand how well this project is working for you and your child, and we would like to learn some ways that the project might be improved. After our interview, we would also like to watch you feed your child with the product. Your participation in both the interview and the observation of feeding is completely voluntary, which means that we will only proceed if we have your permission. [*Refer to consent form, obtain consent.]* We appreciate your honest responses to our questions. We would like to emphasize that nothing that you share with us today will affect your involvement with the BBB project, and will be kept confidential, that is, no one will know what information you shared during this interview. If you wish to stop the interview at any time, just let us know. Please note that nothing that you share during this interview will affect your relationship with World Harvest Mission, or the services that you receive by being part of the BBB program, or at the local health center. May we begin the interview?

Okay, I'd like to know about your experiences with the BBB program, and the food you receive from that program. When I ask you about your child, I am just asking you about that child only, and not any other children.

1. First off, how did you hear about the BBB program?

2. What does being part of the BBB program mean to you? Tell me.

3. Tell me about all of the activities that are part of the BBB program.
   Repeat all of the activities back, see if they add anything.

4. Why do you think your child gets weighed each week?

5. What do you think about your child's weight?

6. Has anyone in your family talked about your child's weight? What do they say?

7. Has anyone at the health center talked about your child's weight? What do they say?

8. Has anyone else in the community talked about your child's weight? What do they say?

9. What do you think about your child's overall health? Why do you say that?

10. What are all of the ways that your child takes the soy flour?

11. How does your child like the soy flour?

Now I want to ask you some questions about the food that is called the Byokulia Bisemeye. That is the ground nut paste that is mixed with morgina powder. When I ask you about the groundnut paste, I mean the one given to you as part of the BBB program. Please answer the questions only about that food. I know you may buy a similar food in the market, but please answer these questions based only on the BB food. [May bring a sample bag of the BB product to show the caregiver the food.]

12. What does the name Byokulia Bisemeye mean to you? Tell me.

13. What are all of the ways that your child takes the groundnut paste? Tell me.

14. Tell me about the moringa added to the groundnut paste.

15. How does your child like the groundnut paste?
    Probes: Why do you think your child likes the paste in those ways?

16. What do you think about the moringa powder?
    Probes: Why is it included in the groundnut paste?
    How does the moringa powder taste to your child?

17. Do you do anything to prepare the food? Tell me about that.
    Probes: What makes you choose to prepare it those ways? *(Ask for each.)*

18. Does anyone else help you feed the paste to the child?
    If yes, "How do they help?"

19. How does your child like those ways that you prepare the food.

20. Does anyone else eat this food in your household? Tell me. If yes, "How do they like to take the groundnut paste?"

21. Does your child share the food with other siblings or children in the compound?

22. Is there anything that might help you to feed the groundnut paste to your child?

23. What do you think the purpose of the groundnut paste for your child?

24. Is there anything that you would like the BBB program to change about the groundnut paste.

25. How does the groundnut paste fit into the overall diet of your child?

26. Has using the groundnut paste with your child affected other foods that your child eats? Tell me.

27. Do you remember hearing any nutrition or health messages during your child's time in the BBB program?
    Probes: What were those messages?
    What did those messages mean to you?

28. If you could find the groundnut paste in the market, do you think you would buy it for your child? Why do you say that?
29. Does anyone else help you feel the paste to the child?
    → If yes, "How do they help?"

30. Has using the groundnut paste with your child affected other foods that your child eats? Tell me.

31. How would you feel if ground nut paste and soy flour were mixed together before you received them at the health center? Why do you say that?
32. Does your child share the food with other siblings or children in the compound?
33. Is there anything that might help you to feed the groundnut paste to your child?
34. Is there anything that you would like the BBB program to change about the food you receive? Tell me about that.
35. Is there anything else that you would like to tell me about the BBB program?

"Thank you for your time and for the insightful responses that you gave us. I would like to thank you for participating in the study by offering you small gift of rice and beans. I really appreciate your help. *Weebale mili mo* (Thank you very much.)"

Appendix 2b. Health Center Staff Interview Guide

Introduction: Good morning/afternoon. My name is Scott Ickes and this is Basiime Godfrey. We are doing a research project to understand the positive and negative aspects of the *Byokulia Bisemeye mu Bantu Project*. We would like to understand how well this project is working and how it might be improved. We will also ask you to show us how you prepare the Byokulia Bisemeye. Your participation in both of these parts is completely voluntary and we will only proceed if we have your permission. [*Refer to consent form, obtain consent.]* We appreciate your honest responses to our questions. We would like to emphasize that nothing that you share with us today will affect your involvement with the BBB project, employment at the Health Center, or relationship with World Harvest Mission. Everything you share will be kept confidential, that is, no one will know what information you shared during this interview. If you wish to stop the interview at any time, just let us know. May we begin?

1. What does being part of the BBB program mean to you?
 Probe: What are the things that made you want to participate in this program?

2. What is the purpose of the BBB program?
 Repeat purpose: Is there anything else that the BBB program is for?

I would like to understand all that it takes to operate this program at your health center.

3. Think about what happens on a typical distribution day in the BBB program. [Pause.] Tell me everything that happens, from preparing for the distribution until after the caregivers leave.
 Repeat steps back, see if participants add anything.

4. Is there anything that happens in between distribution days for this program at your health center? If yes, what are these?

5. Now, I would like to know about your specific responsibilities in the BBB program.
 Have these stayed the same since the beginning of the program or has it changed over time?
 If their responsibilities have changed: "Tell me about how your responsibilities have changed."
 Repeat responsibilities to the participant, ask if they would like to add anything?
 How do you feel about your responsibilities for the program?
 How do these responsibilities fit within your normal job at the health center?

6. How many health center staff help to administer this program at your health center?
 How many staff do you think are necessary to carry out the responsibilities of the program?

7. Do you receive any compensation for helping with the BBB program?
 If yes, "How do you feel about the compensation you receive?"

8. What do the caregivers think about the BBB program?
 What do you think about their opinions?

9. What do caregivers think about the foods they get in this program. Tell me about each food, the soybean flour and the groundnut paste.

"Now think about other people in the community besides the caregivers."

10. What do people in the community think about the BBB program?
 What do you think about their opinions?

What do people in the community think about the foods they get in this program. Tell me about each food, the soybean flour and the groundnut paste.

11. Tell me--What kinds of things do you interact with the caregivers about with regards to the BBB project?

12. Think about all of the ways that the caregivers feed the two foods to their children.
First, tell me about how the caregivers feed the soybean flour to their children.
Repeat all of the ways to the participant, ask if they would like to add anything.

Now, tell me about how the caregivers feed the groundnut paste to their children.
Repeat all of the ways to the participant, ask if they would like to add anything.

13. What do you think about the amount of food that the caregivers get each week? Why do you say that?

14. What do you think about the way the food is distributed each week? Why do you say that?
Probe: Is there anything that you would change about the program for distribution?

15. Think about how you determine a child's nutritional status. Tell me how you determine a child's nutritional status, including all of the steps, from beginning to end.
Repeat back steps to see if they add anything.

16. Tell me how you understand how well a child is growing as he or she continues through this program.

17. How do the parents understand their child's growth progress throughout the program. Tell me. Why do you say that?

18. Tell me about the education that you give to the caregivers about the two foods that you distribute. Tell me about the education for each food—the soybean flour and the groundnut paste.
Repeat back educational messages, then ask: "Are there any other messages that you give to the caregivers?"

19. How do you feel about the <u>number</u> of children served by this program at your health center. Why do you say that?

20. Tell me about some of the challenges of the BBB program.

21. Can you think of any changes that you would make to the BBB program to improve it? Tell me about these?
Repeat back changes. Are there any other changes that you would make to the program?

22. Is there anything that you would remove from the program?

23. Think about how this program has affected the way that your health center treats moderate malnutrition. Tell me about that.

24. Tell me about any effects that the BBB program has on the Health Center.

25. Is there anything else that you would like to tell me about the BB program?

"Thank you for your time and for the insightful responses that you gave us. I would like to thank you for participating in the study by offering you small gift of rice and beans. I really appreciate your help. *Weebale mili mo* (Thank you very much.)"

Appendix 2c. Agricultural Extension Officer Interview Guide

Introduction: Hi, my name is Scott Ickes. I am trying to learn more about the positive and negative aspects of the BBB Project and consider your insights into this program to be very valuable. I would like to ask you a series of questions to help me understand the barriers and facilitators to making this program more effective in achieving its goals. Please note that your responses to my questions will be kept confidential, that is, your responses will not be linked to your job title or name, so that no one will ever know what information you shared. I appreciate your honest responses. *[Refer to consent form, obtain consent. Proceed if consent is received.]* May I begin?

1. Okay, I would like to understand everything that goes into making the *Byokulia Bisemeye* (the groundnut paste with moringa) product. Tell me, from beginning to end, every step.

Ask questions along the way. Repeat all of the steps back to clarify and see if participants add more.

2. I would like to understand everything that goes into making the *roasted soybean flour*. Tell me, from beginning to end, every step.

Ask questions along the way. Repeat all of the steps back to clarify and see if participants add more.

3. Next I would like to know about the program for purchasing the BB products.
How do you drop off the moringa powder?
How do you know the quantity to drop off?
How do you place an order?
How do you decide which production team to purchase from?
How many teams do you purchase from each week?
How do you get the money to make the purchase?
How do you make the purchase?

4. Tell me about how you get the moringa to deliver to the production teams.
Do you have any difficulties in delivering the moringa to the teams?

5. Describe your programs for distributing the BBB products to the Health Centers.
When do you pick up the BBB products?
Do you always pick up the products at the same time?
Which production teams do you buy the products from?
Is this program always the same? Tell me.
Have their been any problems in picking up the product? Tell me about these.
Probe: Are you always able to get the amount of product that you need?

6. Think about any efforts made to control the quality of the products? Tell me.

7. Can you think of any other ways that might be useful to control the quality of the products.

8. Think about how the production teams react if World Harvest provided a document to the production businesses that outlines their standards for the production of the products? Tell me.

"For the next two questions, I am going to ask you about changing the recipe of the BB product. For these questions, assume that World Harvest Mission would be able to pay a higher price for the product."

9. How would the production teams manage if they were asked to alter the recipe of the BB to include ingredients such as oil, sugar, and vitamin and mineral powder? Why do you say that?

10. How would changing the recipe affect the production businesses?

11. As a project manager, who would changing the recipe affect you?

12. Recently, the BBB program has undergone a major shift from a voluntary production process to a small business. Can you tell me about that shift?

Probe: What contributed to the teams being able to make that transition? (Why did the teams shift to become businesses?)

13. Tell me about the outcomes of the transition of the production teams to small businesses?

14. Tell me—what do you think about the BBB program's ability to stay operation?

15. Do you have any ideas about making the program more sustainable? Tell me.

16. I want to know about how the two products that you distribute are supposed to be used.

a. How is the *groundnut paste* supposed to be used?

b. How are caregivers informed by the Health Centers to use the *groundnut paste*?

c. How is the soybean flour supposed to be used?

d. How are caregivers informed by the Health Centers to use the soybean flour?

16. Do you know how the caregivers feed the groundnut paste to their child? Tell me.

17. Are there any challenges that caregivers might face in trying to give all of the paste directly to the one child enrolled in the BBB program? Tell me.

18. Are there any challenges that caregivers might face in feeding the groundnut paste directly to their child without mixing it with other foods? Tell me.

19. What is your advice to us for how to get mothers to feed groundnut paste to their children directly, without cooking it into a sauce first?

20. Is there anything else that you would like to tell me about the BBB program?

"Thank you for your time and for the insightful responses that you gave us. I would like to thank you for participating in the study by offering you small gift of rice and beans. I really appreciate your help. *Weebale mili mo* (Thank you very much.)"

Appendix 2d. Ready-to-use-food Production Team Member Guide

Introduction: Good morning/afternoon. My name is Scott Ickes and this is Basiime Godfrey. We are doing a research project to understand the positive and negative aspects of the *Byokulia Bisemeye mu Bantu Project*. We would like to understand how well this project is working and how it might be improved. We will also ask you to show us how you prepare the Byokulia Bisemeye. Your participation in both of these parts is completely voluntary and we will only proceed if we have your permission. [*Refer to consent form, obtain consent.]* We appreciate your honest responses to our questions. We would like to emphasize that nothing that you share with us today will affect your involvement with the BBB project, and will be kept confidential, that is, no one will know what information you shared during this interview. If you wish to stop the interview at any time, just let us know. May we begin?

1. Ok, I would like to understand everything about what you do to make the BBB product. Tell me from the beginning to the end, every step.

    In between, may stop to ask questions. Repeat all of the steps back to clarify and see if participants add more.

2. Can you tell me what being part of the production process means to you?

3. On your team, how are the responsibilities divided?
    a) Who roasts the groundnuts?
    b) Who skins them?
    c) Who pounds the soybean?
    d) Who grinds the groundnuts?
    e) Who measures the ingredients?
    f) Who measures the product and puts it into individual *bhuvela*?
    g) Does any one try to make sure the work environment is clean?
    h) Does anyone try to make sure the BB product is the same each time you make it?
    i) Does anyone test for aflotoxin in the groundnuts? If so, how do you test for this?
    j) What other jobs are there? Who does these?

4. Tell me – is there anything you would change about how you are producing BBB?

5. What is the purpose of the BB product?

6. How much time do you spend each day on this business?
    When do you do your work?

7. How well does the grinder work for you?

8. Have you ever had to make any repairs to the grinder? If so, how did you make these?

9. When you make the product, is there any other way that you like to prepare the product besides the grinder?

10. How do you get your ingredients?
    Are there any problems with the program of getting your ingredients?

11. I know that recently the production process has changed from being a voluntary project to a small business. Tell me about the shift from being a volunteer production team to a business?

12. Are you interested in expanding your business?
    If yes, "Tell me some ways that you would like to expand your business?"

13. Besides selling the product for a higher price, can you think of ways to make more profit in your business? Tell me.

14. How many bhuvela of BB are you producing each week?

15. Besides producing the product for World Harvest Mission, is there anyone else that you produce the product for?

16. Is there anyone else that you sell the product to?

17. If you were able to sell more BB, could you business produce more?
If yes, "About how much do you think you could produce in one week."
If no, "What makes you say that?"

18. Can you think of ways to expand your business to sell to more people? Tell me.

19. The grinders loaned to the production teams are also available to be used by other people in the community for grinding. Does anyone from the community, not counting the members of the production team, bring their own nuts for grinding?
(If yes, "What do they use the grinder for?")

20. Tell me about how the community feels about the BB product.

21. How do you feel about the community's opinions about the product?

22. Tell me about the community feels about the production of the BB product (How does the community feel about your business?)

23. How do you feel about the community's opinions about the BB production? (How do you feel about the community's opinions about your business?)

24. How is the product picked up from you to deliver to the health centers?
Are there any problems with the pick-up program?

25. How do you receive payment for this product?
Are there any problems with the program of getting paid?

26. We are interested in understanding what happens when families use this product at home, which is meant for small children. Can you tell me about that?

(Then probe about all the things you think might be going on, such as mixing into sauce, sharing with other family members.)

27. Do you know how people are using the BB product in their homes?
(May use the following to probe based on responses.)
Why are women mixing the BB into soup?
Why are women mixing the BB into the family's pot?

28. What is your advice to us on how to educate mothers to feed the BB product directly (with no mixing) to their children?

29. I would like to know your thoughts about the product (Byokulia Bisemeye)?
Have you ever tasted the product?
(If yes, "Tell me-how does the product taste to you?")
Tell me about the product's nutritional qualities?)
Tell me about ease of producing the product compared to other sauces.

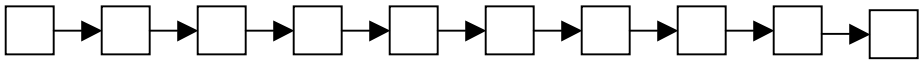
Tell me about the ease of using the product to help feed malnourished children.

30. What do you think about moringa powder?

31. What do others think about the moringa powder?

32. Is there anything else that you would like to tell me about the BB product?"

33. Would you mind if I watch you prepare some Byokulia Bisemeye? If yes, continue:

Order of production: 

Code for steps

1-Obtaining ingredients
2-shelling ground nuts
3-roasting ground nuts
4-grinding ground nuts
5-shelling soybeans
6-Pounding soybeans
7-Measuring groundnuts and soybeans
8-Mixing in moringa powder
9-Measuring amount of product to put in *bhuvela*
10-Placement of product into *bhuvela*

33. How is the final product measured?

34. Notes on production process:

"Thank you for your time and for the insightful responses that you gave us. I would like to thank you for participating in the study by offering you small gift of rice and beans. I really appreciate your help. *Weebale mili mo* (Thank you very much.)"

Appendix 3. Recruitment Scripts

*Caregivers will first be recruited for diet recalls, then observations, followed by a separate recruitment for an interview. Caregivers that do not wish to participate in a diet recall will not be asked if they would like to be observed or interviewed; their first refusal will preclude their recruitment for any other potential study contacts.

Caregiver, observation and diet recall
"Hi. My name is Scott Ickes. I am a student from the United States studying nutrition. I am here to learn about the Byokulia Bisemeye mu Bantu (or BBB) Project. We're trying to learn ways that World Harvest Mission can improve the BBB Project. I would like to observe you feeding the BBB foods to your child so that I can understand how children like to consume this food. I will also ask you questions about what your child ate yesterday so that I can understand the typical diets of young children in Bundibugyo. The observation and questions will take about one hour. I would like to do the observation and interview at your home, but we can arrange to do it at a different location if that would be more comfortable. The interview will be conducted in English and translated into Lubwisi. Are you interested in participating? If so, please write down your name and, if you have one, your phone number, as well as a day that would be good for you to be interviewed. We will schedule a time to meet with you and use this information to find you at the location we agree upon."

[Schedule interview. Once arrived at interview site, proceed with introduction and consent form. If caregiver refuses to participate in diet recall, no further recruitment will take place.]

Caregiver, interview
"Hi. My name is Scott Ickes. I am a student from the United States studying nutrition. I am here to learn about the Byokulia Bisemeye mu Bantu (or BBB) Project. We're trying to learn ways that World Harvest Mission can improve the BBB Project. I would like to interview you about your participation in the project. The interview will take about one hour, and will take place either at the health center, or—if you wish—at your home. The interview will be conducted in English and translated into Lubwisi. Are you interested in participating? If so, please write down your name and, if you have one, your phone number, and a day that would be good for you to be interviewed. We will schedule a time to meet with you and use this information to find you at the location we agree upon."

[Schedule interview. Once arrived at interview site, proceed with introduction and consent form.]

Agricultural Extension Worker
"Hi. My name is Scott Ickes. I am a student from the United States studying nutrition. I am here to learn about the Byokulia Bisemeye mu Bantu (or BBB) Project. We're trying to learn ways that World Harvest Mission can improve the BBB Project. I would like to interview you about your participation in the project. The interview will take about one hour, and will take place at my office, in the room at a Health Center, or—if you prefer—at your home. The interview will be conducted in English. Your employment with World Harvest Mission will not be affected by your choice to participate. Are you interested in participating? If so, please write down your name and your phone number, and a day that would be good for you to be interviewed. We will schedule a time to meet with you and use this information to find you at the location we agree upon."

[Schedule interview. Once arrived at interview site, proceed with introduction and consent form.]

Production Team member
"Hi. My name is Scott Ickes. I am a student from the United States studying nutrition. I am here to learn about the Byokulia Bisemeye mu Bantu (or BBB) Project. We're trying to learn ways that World Harvest Mission can improve the BBB Project. I would like to interview you about your production of the food for the BBB Project. I would also like to watch you produce some of the BBB food. The interview and observation will take about one hour, and will take place at your home, or—if you are more comfortable—at my office. The interview will be conducted in English and translated into Lubwisi. Are you interested in participating? If so, please write down your name and, if you have one, your phone number, and a day that

would be good for you to be interviewed. We will schedule a time to meet with you and use this information to find you at the location we agree upon."

[Schedule interview. Once arrived at interview site, proceed with introduction and consent form.]

Health Center Staff

"Hi. My name is Scott Ickes. I am a student from the United States studying nutrition. I am here to learn about the Byokulia Bisemeye mu Bantu (or BBB) Project. We're trying to learn ways that World Harvest Mission can improve the BBB Project. I would like to interview you about your participation in the project. The interview will take about one hour, and will take place either at the health center, or—if you wish—at your home. The interview will be conducted in English and translated into Lubwisi. Are you interested in participating? If so, please write down your name and, if you have one, your phone number, and a day that would be good for you to be interviewed. We will schedule a time to meet with you and use this information to find you at the location we agree upon."

[Schedule interview. Once arrived at interview site, proceed with introduction and consent form.]

Appendix 4 Comparison Group Caregiver Survey (Aim 3)

To be completed with caregivers of children 6 -59 months in Bundibugyo.

Hello. My name is _____. I am working with World Harvest Mission's nutrition program. We would like to learn about your experiences with caring for and feeding your child. Would you be willing to answer some questions? Go through consent information and obtain verbal consent.

Please answer the following questions about one child in your family under 5 years. If you have multiple children under 5, please select the one between 6 and 24 months and answer these questions about that child.

A. Child care practices

1. How are you feeling about your child's health in the past 3 months?
   - ○ **I feel like my child is excellent health**
   - ○ **I feel like my child is in fair health**
   - ○ **I feel like my child is in poor health**

2. How do you feel about your child's growth in the past 3 months?
   - ○ **I feel like my child's growth has been below normal**
   - ○ **I feel like my child's growth has been normal**
   - ○ **I feel like my child's growth has been better than normal**

3. Have you ever taken your child to be weighed at a health center or hospital?
   - ○ **Yes→ What were the reasons you took your child to be weighed**
     - ○ **My child was sick and they weighted him/her at the health center**
     - ○ **I wanted to see how well my child was growing**
     - ○ **I wanted to see if the food I have been feeding my child has help improve his/her weight**
     - ○ **Other. List_____**
   - ○ **No → What were the reasons you did not take your child to be weighed?**
     - ○ **The health center is too far away from my home**
     - ○ **I did not see any reason to bring my child to the health center/hospital**
     - ○ **Other. List_____**

4. Has your child ever been weighed by a health care worker?
   - ○ **Yes→ When and where was your child weighed?**
     - ○ **Immunization clinic**
     - ○ **Child health days**
     - ○ **Local health center**
     - ○ **OPD**
     - ○ **Other. List_____**

- ○ **No**

B. Education messages

1. Have you ever received any education about how to feed your child?
   - ○ **Yes**
   - ○ **No –>Skip to Section C.**

2. What are some of the lessons you learned?
   - ○ **How often to feed my child**
   - ○ **Washing/hygiene**
   - ○ **Feeding different kinds of foods**
   - ○ **Feeding soft foods**
   - ○ **Feeding during and after my child gets sick**
   - ○ **Breastfeeding**
   - ○ **Growing foods in my garden for my child to eat**
   - ○ **Feeding a small amount of food that my child can finish**
   - ○ **Not adding too much water to the child's meals**
   - ○ **Feeding more sauce than food**
   - ○ **Other:_____**

3. Where did you receive this education? Check all that apply.
   - ○ **Local Health Center**
   - ○ **A Family member**
   - ○ **A friend or neighbor**
   - ○ **A community group or church**
   - ○ **Child Health/Immunization Day**
   - ○ **From my child's school**
   - ○ **A nutrition program. List program_____**
   - ○ **Other. List_____**

C. Food purchasing and feeding practices

1. Do you currently breastfeed your child?

   Yes

   No → Skip to # C3

2. What are the reasons you continue to breastfeed your child?
   - ○ **I feel it is healthy for my child**
   - ○ **Breastfeeding is good for my child's nutrition**
   - ○ **Breast milk helps my child to rest well**
   - ○ **Breast milk is an easy way to feed my child**
   - ○ **Other list:_____**

   → **Then, Skip to Section D**

3. When did you stop breastfeeding?

- ○ **Before 6 months**
- ○ **Between 6 and 12 months**
- ○ **After 1 year**
- ○ **I never breastfed this child**

4. What are the reasons you no longer breast feeding your child?
   - ○ **I have another child that I breastfeed instead**
   - ○ **My child no longer wanted the breast milk**
   - ○ **I felt that my child' health could be improved by feeding other foods**
   - ○ **I felt that my health could be improved by feeding other foods instead of breast milk**

D. COMMUNITY AWARENESS OF BBB PROGRAM

1. Have you ever heard of the BBB program?
   - ○ **Yes→ Go to question # D2.**
   - ○ **No→ Skip to # D4**

2. Did you ever talk to anyone who was in the BBB program aout what they learned in the program
   - ○ **Yes→ Go to question # D3**
   - ○ **No→ Skip to # D4**

3. What, if anything, did you learn from people who were part of the BBB program:
   - ○ **I did not learn anything from the people I knew in the program**
   - ○ **How often to feed my child**
   - ○ **Washing/hygiene**
   - ○ **Feeding different kinds of foods**
   - ○ **Feeding soft foods**
   - ○ **Feeding during and after my child gets sick**
   - ○ **Breastfeeding**
   - ○ **Growing foods in my garden for my child to eat**
   - ○ **Feeding a small amount of food that my child can finish**
   - ○ **Not adding too much water to the child's meals**
   - ○ **Feeding more sauce than food**
   - ○ **Other:_____**

Show caregivers the BBB food, and explain that it is a food made of groundnuts, soy flour, and moringa powder made in Bundibugyo. Explain that this food has enough energy in it to make sauces for a young child for about 1 week. Then ask the following questions.

4. During the past four weeks, have you ever purchased the BBB food in the market? If so, what was the unit purchased (cup, bags, spoons), price per unit, and total number of units purchased?

Example: 3,000/- per Tampico cup 4 units total (1 per week)

4a. Groundnut paste:

- ○ **Yes → Price for ground nut paste _____Unit_____ Units**

purchased_____

- ○ **No**

4b. Soy flour:

- ○ **Yes → Price for soy flour _____ Unit_____ Units purchased_____**
- ○ **No**

4c. Groundnuts and soy flour mixed together:

- ○ **Yes → Price for mixed gnuts/soy _____ Unit_____ Units purchased_____**
- ○ **No**

5. What were the reasons you did/did not purchase the BBB food in the market? Check all that apply.

- ○ **I did not know that I could find this food in the market**
- ○ **Groundnuts were not available**
- ○ **Groundnut paste was too expensive**
- ○ **I grow my own ground nuts and do not need to purchase them in the market**
- ○ **My child does not like groundnut paste**
- ○ **Soy flour was not available**
- ○ **Soy flour was too expensive**
- ○ **I grow my own soy beans**
- ○ **My child does not like soy flour**
- ○ **Mixed ground nuts and soy flour was not available**
- ○ **Mixed groundnuts and soy flour was too expensive**
- ○ **I make mixed groundnuts and soy flour at home**
- ○ **My child does not like mixed groundnut paste and soy flour**
- ○ **Other.List_____**

6. How willing would you be to use the BBB RUF again for this child or another one of your children in a similar situation, if he or she was malnourished?

- ○ **Very willing**
- ○ **Somewhat willing**
- ○ **Somewhat unwilling**
- ○ **Very unwilling**

7. How willing would you be to use the BBB RUF again for this child or another one of your children if he or she was healthy (not malnourished)?

- ○ **Very willing**
- ○ **Somewhat willing**
- ○ **Somewhat unwilling**
- ○ **Very unwilling**

8. If the BBB RUF was a product you had to buy, how willing would you be to buy it for one of your

children if he or she was underweight?

- ○ **Very willing**
- ○ **Somewhat willing**
- ○ **Somewhat unwilling**
- ○ **Very unwilling**

9. How much would you be willing to pay for one bag of the BBB RUF, with the same amount of groundnuts, soy flour and moringa powder that you received during the program?

- ○ **Less than 1,000/-**
- ○ **1,000 to 2,000 /-**
- ○ **2,000 to 4,000/-**
- ○ **4,000 to 6,000/-**
- ○ **Over 6,000/-**

10. If you were to buy the BBB RUF for your child, where would you most like to buy it? Check one.

- ○ **From a Health Center near my home**
- ○ **From Nyahuka Health Center**
- ○ **From one of the BBB Production Teams**
- ○ **From a friend who produces it at home**
- ○ **From the market**

11. Did you ever bring any groundnuts to one of the BBB production teams for grinding? Check all that apply.

- ○ **Yes**
- ○ **No. If no, why not?**
  - ○ **The price for grinding was too expensive**
  - ○ **The grinders were too far away from my home**
  - ○ **I did not see any good reason to use the grinders for soy beans**
  - ○ **I didn't know that I could bring soy beans to the teams for grinding**
  - ○ **I didn't know about the production teams**
  - ○ **Other. Please list_____**

12. Did you ever bring any soy flour to one of the BBB production teams for grinding? Check all that apply.

- ○ **Yes**
- ○ **No. If no, why not?**
  - ○ **The price for grinding was too expensive**
  - ○ **The grinders were too far away from my home**
  - ○ **I did not see any good reason to use the grinders for soy beans**
  - ○ **I didn't know that I could bring soy beans to the teams for grinding**
  - ○ **I didn't know about the production teams**
  - ○ **Other. Please list_____**

13. *Now, I would like to ask you about the kinds of food you grow or buy for your household in the past three months. Please tell me if you purchase or grow any of these foods.*

After the list is finished, ask if there are any other foods that they grow and/or purchase for their child.

SAMPLE

Code	Food	Home-produce	Purchase
01	Avocado		X
17	Groundnuts	X	X

This person:
… Buys avocados for her household.
… Boys and grows avocados for her household.

After the list is finished, ask if there are any <u>other</u> foods that they purchase or grow for their child and list these.

Code	Food	Home-produce	Purchase
01	Avocado		
02	Bananas (large, bagoya)		
03	Bananas (small, busicali)		
04	Beans, red		
05	Beans, soy (fresh)		
06	Beans, soy (flour)		
07	Cabbage		
08	Cassava tubers		
09	Cassava leaves		
10	Do-do		
11	Eggs		
12	Eggplants		
13	Field peas		
14	Guava		
15	Green pepper		
16	Greens		
17	Ground nuts		
18	Jack fruit		
19	Maize, flour		
20	Maize grains		
21	Moringa		
22	Mushrooms		
23	Onions		
24	Oranges		
25	Palm oil		
26	Papaya		
27	Passion fruit		
28	Pineapples		
29	Plantains, matoke		
30	Potatoes, Irish		
31	Potatoes, sweet		

32	Pumpkin		
33	Pumpkin leaves		
34	Sugar cane		
35	Soy flour		
36	Sweet potato		
37	Tomato		
38	Rice		
39	Yams		
	Other: _____		
	Other:_____		
	Other:_____		
	Other:_____		

If groundnuts are listed:

14. What is the most common way you prepare the groundnut paste?

- ○ **I buy it in the market already ground as a flour**
- ○ **I buy it in the market as a paste**
- ○ **I buy it and pound it with a mortar**
- ○ **I buy it and have it ground**
- ○ **I grow my own and pound it with a mortar**
- ○ **I grow my own and have it ground**
- ○ **Other. List_____**

15. What is the most common way you feed your child groundnut paste?

- ○ **Directly (no cooking)**
- ○ **As porridge (alone)**
- ○ **As porridge, mixed with soy flour**
- ○ **Mingled with kahunga (cassava)**
- ○ **Mixed with matooke (alone)**
- ○ **Mixed with matooke and soy flour**
- ○ **Other. List_____**

If soybeans or soy flour are listed:

16. **What is the most common way you** prepare the soyflour

- ○ **Directly (no cooking)**
- ○ **As porridge (alone)**
- ○ **As porridge, mixed with ground nut paste**
- ○ **Mingled with kahunga (cassava)**
- ○ **Mixed with matooke (alone)**
- ○ **Mixed with matooke and ground nut sauce**
- ○ **Other. List_____**

17. What is the most common way you feed your child soy flour?

- ○ **I buy it in the market already ground as a flour**

- ○ **I buy soy beans and pound them with a mortar**
- ○ **I buy soy beans and have it ground**
- ○ **I grow my own and pound them with a mortar**
- ○ **I grow my own and have them ground**
- ○ **Other. List_____**

We appreciate your insights and the time you have shared with us to help improve this program. Thank you!

Appendix 5 Post Program Caregiver Survey (Aim 3)

A. CHILD CARE PRACTICES

1. How are you feeling about your child's health now that he/she has been discharged from the program?

- ○ **My child's health is not as good as it was during the program**
- ○ **My child's health is about the same as it was during the program**
- ○ **My child's health is better than it was during the program**
- ○ **Other. List**_____

2. How do you feel about your child's growth since the program ended?

- ○ **My child is not growing as well as s/he was during the program**
- ○ **My child is growing about the same as s/he was during the program**
- ○ **My child is growing better than s/he was during the program**
- ○ **Other. List**_____

3. Have you ever taken your child to be weighed at a health center or hospital?

- ○ **Yes→ What were the reasons you took your child to be weighed**
  - ○ **My child was sick and they weighted him/her at the health center**
  - ○ **I wanted to see how well my child was growing**
  - ○ **I wanted to see if the food I have been feeding my child has help improve his/her weight**
  - ○ **Other. List**_____

- ○ **No → What were the reasons you did not take your child to be weighed?**
  - ○ **The health center is too far away from my home**
  - ○ **I did not see any reason to bring my child to the health center/hospital**
  - ○ **Other. List**_____

B. RECALL/APPLICATION OF FEEDING EDUCATION

1. What did the Health Center staff tell you about feeding and caring for your child?
Check all responses listed without prompting:

- ○ **How often to feed my child**
- ○ **Washing/hygiene**
- ○ **Feeding different kinds of foods**
- ○ **Feeding soft foods**
- ○ **Feeding during and after my child gets sick**
- ○ **Breastfeeding**
- ○ **Growing foods in my garden for my child to eat**
- ○ **Feeding a small amount of food that my child can finish**
- ○ **Not adding too much water to the child's meals**
- ○ **Feeding more sauce than food**
- ○ **Other:**_____

2a. Have you ever shared any this information with others?

- ○ **Yes**
- ○ **No**

2b. Who did you share these messages with? Check all that apply.

- ○ **Another caregiver on my compound**
- ○ **A family member**
- ○ **Other caregivers in my community**
- ○ **Other. List**_____

2c**.** What information did you share? Check all that apply.

- ○ **How often to feed my child**
- ○ **Washing/hygiene**
- ○ **Feeding different kinds of foods**
- ○ **Feeding soft foods**
- ○ **Feeding during and after my child gets sick**
- ○ **Breastfeeding**
- ○ **Growing foods in my garden for my child to eat**
- ○ **Feeding a small amount of food that my child can finish**
- ○ **To not add too much water to the child's meals**
- ○ **Feeding more sauce than food**
- ○ **Other:**_____

3. Have you changed any of the ways you feed your child since you joined the BBB program? Check all that apply.

- ○ **I feed my child more kinds of foods**
- ○ **I feel my child more often**
- ○ **I feed my child g-nuts more often than before the program**
- ○ **I feed my child soy-flour more often than before the program**
- ○ **I feed my child moringa more often than before the program**
- ○ **I wash my child before feeding**
- ○ **I feed my child more types of foods**
- ○ **I feed my child smaller portions that s/he can finish**
- ○ **I feed my child more sauce than food**
- ○ **I add less water to the sauces I make for my child**
- ○ **Other:** _____

C. PROGRAM PARTICIPATION

1. Was it ever a challenge for you to attend the BBB program every week?

- ○ **Yes→** What were the reasons it was a challenge to attend the program each week?
  - ○ **Transportation to the clinic was difficult**
  - ○ **I did not see a good reason to come to the program every week**

- ○ **The food we received each week was not enough to make it worth my time**
- ○ **I was not able to do everything the health center staff told me to do**
- ○ **I did no think my child gained any weight that week**
- ○ **I could not leave my other children at home**
- ○ **My child was sick and I could not bring him/her to the clinic**
- ○ **Other.**
  List_____

○ **No**

D. FOOD PURCHASING/FEEDING PRACTICES

1. Was it ever a challenge to feed the BBB food to only to the one child enrolled in the program?

- ○ **Yes → If "Yes" go to #2**
- ○ **No → If "No" skip to #3**

2. What were the reasons it was a challenge to feed the BBB food to only the one child enrolled in the program?

Check all that apply.

- ○ **It is part of our culture. I cannot feed the food only to one child**
- ○ **The child in the program did not eat the food**
- ○ **After the one child finished eating, I gave the food to other children**
- ○ **There was not enough other food around to feed the other children**
- ○ **Other. List**_____

Write direct quote:

3. How willing would you be to use the BBB RUF again for this child or another one of your children in a similar situation, if he or she was malnourished?

- ○ **Very willing**
- ○ **Somewhat willing**
- ○ **Somewhat unwilling**
- ○ **Very unwilling**

4. How willing would you be to use the BBB RUF again for this child or another one of your children if he or she was healthy (not malnourished)?

- ○ **Very willing**
- ○ **Somewhat willing**
- ○ **Somewhat unwilling**

- ○ **Very unwilling**

5. If the BBB RUF was a product you had to buy, how willing would you be to buy it for one of your children if he or she was underweight?

- ○ **Very willing**
- ○ **Somewhat willing**
- ○ **Somewhat unwilling**
- ○ **Very unwilling**

6. How much would you be willing to pay for one bag of the BBB RUF, with the same amount of groundnuts, soyflour and moringa powder that you received during the program?

- ○ **Less than 1,000/-**
- ○ **1,000 to 2,000 /-**
- ○ **2,000 to 4,000/-**
- ○ **4,000 to 6,000/-**
- ○ **Over 6,000/-**

7. During the past four weeks, have you ever purchased the BBB food in the market since no longer receiving it from the program? If so, what was the unit purchased (cup, bags, spoons), price per unit, and total number of units purchased?

Example: 3,000/- per Tampico cup 4 units total (1 per week)

7a. Groundnut paste:

- ○ **Yes → Price for ground nut paste _____Unit_____ Units purchased_____**
- ○ **No**

7b. Soy flour:

- ○ **Yes → Price for soy flour _____ Unit_____ Units purchased_____**
- ○ **No**

7c. Groundnuts and soy flour mixed together:

- ○ **Yes → Price for mixed gnuts/soy _____ Unit_____ Units purchased_____**
- ○ **No**

8. What were the reasons you did/did not purchase the BBB food in the market? Check all that apply.

- ○ **Groundnuts were not available**
- ○ **Groundnut paste was too expensive**
- ○ **I grow my own ground nuts and do not need to purchase them in the market**
- ○ **My child does not like groundnut paste**
- ○ **Soy flour was not available**
- ○ **Soy flour was too expensive**

- **I grow my own soy beans**
- **My child does not like soy flour**

- **Mixed ground nuts and soy flour was not available**
- **Mixed groundnuts and soy flour was too expensive**
- **I make mixed groundnuts and soy flour at home**
- **My child does not like mixed groundnut paste and soy flour**
- **Other.**
  List_____
  ____

9. If you were to buy the BBB RUF for your child, where would you most like to buy it?

- **From the Health Center I went to the program for?**
- **From Nyahuka Health Center**
- **From one of the BBB Production Teams**
- **From a friend who produces it at home**
- **From the market**

10. Did you ever bring any groundnuts to one of the production teams for grinding? Check all that apply.

- **Yes**
- **No. If no, why not?**
  - **The price for grinding was too expensive**
  - **The grinders were too far away from my home**
  - **I did not see any good reason to use the grinders for ground nuts**
  - **I didn't know that I could bring soy beans to the teams for grinding**
  - **Other. Please list**_____

11. Did you ever bring any soy flour to one of the production teams for grinding? Check all that apply.

- **Yes**
- **No. If no, why not?**
  - **The price for grinding was too expensive**
  - **The grinders were too far away from my home**
  - **I did not see any good reason to use the grinders for soy beans**
  - **I didn't know that I could bring soy beans to the teams for grinding**
  - **Other. Please list**_____

Now, I would like to ask you about the kinds of food you grow or buy for your household in the past three months.

12. Please tell me if you purchased or home produced (grow) any of the following foods in the past three months, and if you started growing or buying these foods since the BBB program started. If you bought these foods before the program, you can also let me know if you buy these foods more often since you started going to the BBB program.

Only check one column about buying—if you began buying since the start of the program, check "began buying". If you were already buying, but now buy more often, check "Buy more often"

SAMPLE

Code	Food	Home-produce	Purchase	Began growing after start of BBB program	Began buying start of BBB program	Buy more often since start of BBB program
01	Avocado		X			X
17	Groundnuts	X	X	X	X	

This person:

… Buys avocados more often for her household since the start of the BBB program.
… Began both growing and buying groundnuts for her household since the start of the BBB program.

After the list is finished, ask if there are any other foods that they purchase or grow for their child and list these.

Code	Food	Home-produce	Purchase	Began growing after start of BBB program	Began buying start of BBB program	Buy more often since start of BBB program
01	Avocado					
02	Bananas (large, bagoya)					
03	Bananas (small, busicali)					
04	Beans, red					
05	Beans, soy (fresh)					
06	Beans, soy (flour)					
07	Cabbage					
08	Cassava tubers					
09	Cassava leaves					
10	Do-do					
11	Eggs					
12	Eggplants					
13	Field peas					
14	Guava					
15	Green pepper					
16	Greens					
17	Ground nuts					
18	Jack fruit					
19	Maize, flour					
20	Maize grains					
21	Moringa					
22	Mushrooms					
23	Onions					

24	Oranges					
25	Palm oil					
26	Papaya					
27	Passion fruit					
28	Pineapples					
29	Plantains, matoke					
30	Potatoes, Irish					
31	Potatoes, sweet					
32	Pumpkin					
33	Pumpkin leaves					
34	Sugar cane					
35	Soy flour					
36	Sweet potato					
37	Tomato					
38	Rice					
39	Yams					
	Other: _____					
	Other:_____					
	Other:_____					
	Other:_____					

If groundnuts are listed:

13 What is the most common way you prepare the groundnut paste?

- ○ **I buy it in the market already ground as a <u>flour</u>**
- ○ **I buy it in the market as a <u>paste</u>**
- ○ **I buy it and pound it with a mortar**
- ○ **I buy it and have it ground**
- ○ **I grow my own and pound it with a mortar**
- ○ **I grow my own and have it ground**
- ○ **Other. List_____**

14. What is the most common way you feed your child groundnut paste?

- ○ **Directly (no cooking)**
- ○ **As porridge (alone)**
- ○ **As porridge, mixed with soy flour**
- ○ **Mingled with kahunga (cassava)**
- ○ **Mixed with matooke (alone)**
- ○ **Mixed with matooke and soy flour**
- ○ **Other. List_____**

If soybeans or soy flour are listed:

15. **What is the most common way you** prepare the soyflour

- ○ **Directly (no cooking)**
- ○ **As porridge (alone)**

- ○ **As porridge, mixed with ground nut paste**
- ○ **Mingled with kahunga (cassava)**
- ○ **Mixed with matooke (alone)**
- ○ **Mixed with matooke and ground nut sauce**
- ○ **Other. List_____**

16. What is the most common way you feed your child soy flour?

- ○ **I buy it in the market already ground as a flour**
- ○ **I buy soy beans and pound them with a mortar**
- ○ **I buy soy beans and have it ground**
- ○ **I grow my own and pound them with a mortar**
- ○ **I grow my own and have them ground**
- ○ **Other. List_____**

E. COMMUNITY AWARENESS OF BBB PROGRAM

1. Did anyone else in your community know that you were in the BBB program?

- ○ **Yes→ Go to question D2.**
- ○ **No→ END OF SURVEY.**

2. What did others think about the BBB program? Check all that apply.

- ○ **No one said anything to me about being involved in the program.**
- ○ **They wanted to know how they could become involved in the program.**
- ○ **They asked me for advice on feeding children.**
- ○ **They wanted to know where they could buy the BBB food.**

We appreciate your insights and the time you have shared with us to help improve this program. Thank you!

Appendix 6. Institutional Review Board Application Approval

To: Scott Ickes, Ctr Health Prom Disease Prev CB: 7426
From: Public Health-Nursing IRB
Approval Date: 7/10/2008 **Expiration Date of Approval:** 7/09/2009

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Initial
Expedited Category: 7. Surveys/interviews/focus groups, 6. Voice/image research recordings
Study #: 08-1100

Study Title: Evaluation of the Byokulia Bisemeye mu Bantu ("Good Food for People") Project in Bundibugyo, Uganda.
Sponsors: University of North Carolina at Chapel Hill, Glaxo SmithKline Foundation
Duke Global Health Project Student Research Award

This submission has been approved by the above IRB for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Study Description:
Purpose: The purpose of this study is to evaluate the Byokulia Bismeye mu Bantu Project, a community – based feeding program in Bundibugyo, Uganda. This study aims to understand the components of successful and sustainable production, distribution and use of local ready-to-use supplemental food (RUSF) and to determine the contribution of a local RUSF to the overall diet of children enrolled in the BBB program. Participants: (A) Agricultural Extension workers with world harvest missions, (B) Bundibugyo Health Center Staff, (C) Caregivers of children who receive RUSF from World Harvest Mission nutrition program, (D) RUSF production team members. Procedures: In-person interviews, structured observations of feeding practices (spoon feeding, not breast feeding).

Study Specific Details:
Please be sure to submit translated documents, prior to their use, as an amendment.

Regulatory and other findings:
This research meets criteria for a waiver of written (signed) consent according to 45 CFR 46.117(c)(2) for the caregiver aspects of this study.

Investigator's Responsibilities:
Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

When applicable, enclosed are stamped copies of approved consent documents and other recruitment materials. You must copy the stamped consent forms for use with subjects unless you have approval to do otherwise.