GROWING THE EVIDENCE FOR NUTRITION PROGRAMMING: PERCEPTIONS, IMPLEMENTATION, AND UPTAKE OF A PACKAGE OF LIPID-BASED SUPPLEMENTATION AND BEHAVIOR CHANGE COMMUNICATION INTERVENTIONS IN MALAWI

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Abstract

Background: Childhood undernutrition continues to be a problem of public health significance in low and middle-income countries (LMIC), holding consequences for children's physical and cognitive development that contributes to lower economic earnings and increased morbidity in adulthood. Efficacious interventions to improve child growth during the critical window of opportunity, from conception to 2 years of age, include nutrition education to promote optimal infant and young child feeding (IYCF) practices, and supplementation with fortified foods, such as lipid-based nutrient supplements, among others. The delivery of these interventions in a programmatic context so that they yield improvements in child nutritional status, however, proves to be difficult given the logistical and sociocultural challenges associated with the delivery and uptake of interventions. Understanding how programs work to improve child nutrition and feeding behaviors is critical for scaling up nutrition interventions globally.

Objective: To study how a nutrition program in rural Malawi was perceived, accepted, implemented, and taken up, and whether high adherence to program interventions resulted in improved child growth and feeding behaviors after 1 year of implementation.

Methods: The nutrition program in Malawi includes: (1) the monthly distribution of a daily, small-quantity (20g) lipid-based nutrient supplement, Nutributter (Nutriset, Malaunay, France) to all children 6-23 months; and (2) a social behavior change communication (SBCC) campaign to promote optimal IYCF and water, sanitation, and hygiene (WASH) practices. The program is monitored by monthly attendance tracking of target beneficiaries, and quarterly post-distribution monitoring (PDM) surveys to assess product utilization and IYCF and WASH knowledge. An independent impact evaluation

was led by the Johns Hopkins University's Center for Human Nutrition (JHU CHN) to measure IYCF and WASH practices, and child nutrition outcomes after 1 and 3 years of implementation in the program (Ntchisi) and a comparison (Dowa) district.

A qualitative study employed in-depth interviews (IDI) with mothers (n=34) and household members (fathers, n=11; and grandmothers, n=4), focus group discussions (FGD) with village leaders (1 with n=11) and program staff (3 FGD with n=12, n=10, and n=11), and direct observations of mothers and their children (n=12), to elicit beneficiary and community perceptions of the program's intervention components. Recorded interviews and FGDs were simultaneously transcribed and translated verbatim, and inductive line-by-line coding was conducted. Results were presented using a hybrid of the Socio Ecological Model and Transactional Theory.

A process evaluation study measured the program's conformity to its original design using various data sources to measure: program recruitment (n=21,456 children tracked through attendance records from the first year of implementation), program fidelity (n=28 direct observations of program activities; n=84 knowledge questionnaires with program staff; 8 PDM surveys with pooled n=2,901 and 2 annual performance review documents); and program reach (n=41,617 children's attendance records for years 0-3 of implementation). Process indicators were categorized as "working well" (>75%), "needing improvement" (25%-75%), and "not working" (<25%).

Impact evaluation data collected at 1 year post-program implementation (midline) (n=2,047) was linked with individual-level program attendance data (n=846) to generate high and low participation for Nutributter distributions (>71.4% and ≤71.4%, respectively) and SBCC messaging (SBCC score≥2 and SBCC score=1, respectively);

those who were not exposed served as the referent category for each program component n=1,208 and n=204, respectively). Household, individual, and maternal characteristics were analyzed to examine their association with program exposure, using multinomial logistic regression. Varying levels of program participation were analyzed to examine the association with anthropometric (length-for-age (LAZ), weight-for-age (WAZ), weight-for-length z-scores (WLZ) and stunting, underweight, and wasting, defined as LAZ, WAZ, and WLZ <-2, respectively), IYCF, and WASH outcomes, using multivariable linear and logistic regression for continuous and binary outcomes, respectively. All linear and logistic models adjusted for household, maternal, and individual characteristics.

Results: Results from the qualitative study demonstrated that Nutributter was viewed positively by all members of the household and community. Mothers and community members reported perceiving changes in child health and growth, ascribing them to Nutributter. Barriers to the monthly collection of Nutributter were competing household tasks and obligations, such as caring for ill family members or attending funerals. When asked to discuss program messages, a majority of mothers demonstrated limited and superficial knowledge of the IYCF and WASH messages. This, in combination with the described lack of financial and physical access to nutritious foods promoted by those messages were perceived as significant barriers to enacting desired behavioral changes among mothers.

The process evaluation indicated that only 20.7% of children were registered into the program at or by 6 months of age. Direct observations of Nutributter distributions demonstrated that most procedures were functioning at 85% or higher, with some areas needing improvement, such as the conduct of multiple counseling sessions throughout

distributions to account for latecomers. Despite the relatively high implementation of training activities as planned (73.3%) for frontline staff, the completion of training modules for breastfeeding (22.9%) and complementary feeding (18.6%) was low. Nevertheless, knowledge of key IYCF, WASH, and Nutributter messages among those who were trained on those messages was high, with the exception of being able to list the 6 food groups (22.9%). Over 3 years of implementation, the program reached a mean (SD, range) of 81.0% (8.5, 65.6%-93.5%) of eligible beneficiaries during monthly Nutributter distributions and 92.1% of mothers with group counseling activities, but only 32.9% (8.0, 18.8%-42.0%) of mothers with individual-level SBCC.

Using multivariable models, socioeconomic characteristics (land and livestock ownership) and child morbidity (7-day diarrhea and malaria) were positively associated with high vs. no participation in Nutributter distributions (all $p<0.05$). Maternal age, working in agriculture as a primary occupation, and childhood acute respiratory infection were positively associated with exposure to SBCC (all $p<0.05$), while food insecurity was associated with lower risk of high exposure to SBCC. The dose-response analysis showed that high and low participation in Nutributter distributions was associated with higher WLZ of 0.21 (95% CI 0.01, 0.31) and 0.17 (95% CI 0.06, 0.36), respectively among children, (both $p<0.05$) relative to the control children. However, the confidence intervals for each were overlapping, suggesting the lack of a true dose response relationship. Program exposure was not associated with any of the other measures of nutritional status, including LAZ and WAZ, or stunting, wasting and underweight. Low and high exposure to SBCC were associated with increases ($p<0.05$) in dietary diversity score of 0.22 (95% CI 0.03,0.41) and 0.21 (95% CI 0.01, 0.42), respectively, and higher

likelihood of achieving minimum meal frequency (OR=1.62, 95% CI) compared to no exposure.

Conclusions: This study demonstrated that the large-scale nutrition program in Ntchisi was well implemented and accepted, and that higher doses of exposure yielded improvements in some anthropometric and IYCF outcomes. The detailed documentation of the perceptions, facilitators and barriers to, implementation, characteristics associated with exposure to program components, and intermediate impact of the large-scale nutrition program generates important lessons for current and future policy, programming, and scale-up of nutrition interventions in this, and other similar contexts in sub-Saharan Africa.

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Table of Contents

List of Tables

Chapter 6

List of Figures

Chapter 5

Supplementary Tables and Figures

Chapter 3

Chapter 5

Acronyms and Abbreviations

AGA	Appropriate for Gestational Age
ANC	Ante-Natal Care
APR	Annual Performance Review
ARI	Acute Respiratory Illness
A&T	Alive & Thrive Initiative
BMI	Body Mass Index
CBCC	Community-Based Child Care Center
CCP	Center for Communication Programs
CGV	Care Group Volunteer
CI	Confidence Interval
CIFF	Children's Investment Fund Foundation
CSB	Corn-Soya Blend
DDS	Dietary Diversity Score
DHS	Demographic and Health Survey
DOHAD	Developmental Origins of Health and Disease
EBF	Exclusive Breastfeeding
EED	Environmental Enteric Dysfunction
EDP	Extended Distribution Point
FGD	Focus Group Discussion
FGR	Fetal Growth Restriction
FS	Fortified Spread
GDP	Gross Domestic Product
GMP	Growth Monitoring and Promotion
GNI	Gross National Income
HANCI	Hunger and Nutrition Commitment Index
HAZ	Height-for-Age z-score
HFIAS	Household Food Insecurity Access Scale
HIV	Human Immunodeficiency Virus
HSA	Health Surveillance Assistant
IDI	In-Depth Interview
IFA	Iron Folic Acid
IP	Implementing Partner
IRR	Inter-Rater Reliability
IYCF	Infant and Young Child Feeding
JHU	Johns Hopkins University
LAZ	Length-for-Age z-score
LMIC	Low and Middle-Income Countries
LNS	Lipid-Based Nutrient Supplement
LP	Likuni Phala (traditional porridge in Malawi)
MAD	Minimum Acceptable Diet
MDD	Minimum Dietary Diversity
MMF	Minimum Meal Frequency
MMS	Multiple Micronutrient Supplements
MNP	Micronutrient Powders

MQ-LNS	Medium-Quantity Lipid-Based Nutrient Supplement
MUAC	Middle Upper Arm Circumference
NECS	National Nutrition Education and Communication Strategy
NNC	National Nutrition Committee
NNPSP	National Nutrition Policy and Strategic Plan
OR	Odds Ratio
PI	Principal Investigator
PDM	Post-Distribution Monitoring
PIP	Program Impact Pathways
PR	Prevalence Ratio
RO	Research Objective
RR	Relative Risk
SEM	Socio Ecological Model
SCOpe	System for Cash Operations
SBCC	Social and Behavior Change Communication
SGA	Small for Gestational Age
SUN	Scaling Up Nutrition
SQ-LNS	Small-Quantity Lipid-Based Nutrient Supplement
TA	Traditional Authority
UNICEF	United Nations Children's Fund
US	Unfortified Spread
WASH	Water, Sanitation, and Hygiene
WAZ	Weight-for-age z-score
WHO	World Health Organization
WFP	The World Food Programme of the United Nations
WLZ	Weight-for-length z-score
WSB	Wheat-Soya Blend
WV	World Vision

Chapter 1: Introduction

1.1 Problem statement

The global burden of undernutrition, manifested in part as stunting and micronutrient deficiencies, is significant and responsible for 45% of all deaths among children under five years of age.[1] In addition to its contribution to child mortality, a high and sustained prevalence of stunting has far reaching consequences affecting future development and health with implications for the country's economic and social development.[2] Early insults to nutrition lead to poor physical and cognitive development in children, predisposing them to health and economic consequences that continue throughout the life course.[1] Furthermore, conditions of restriction in utero "program" an increased risk of chronic diseases later in life.[3]

Pregnant women and children, whose nutritional demands are increased to support rapid growth and development, are disproportionately affected by undernutrition and consequently suffer the greatest burden. Undernutrition begins in pregnancy: maternal nutrition at conception and in early pregnancy is known to influence fetal growth, and children who are born small and under conditions of growth restriction are at increased risk of experiencing growth faltering in the first two years of life, including stunting,[1] defined as a length-for-age z-score (LAZ) less than -2 standard deviations below the reference median.[4] Basic and underlying factors, such as adequate infant and young child feeding (IYCF) practices, access to and utilization of social safety nets, agricultural technologies, high quality health care, clean water consumption and improved sanitation

and hygiene, and political environment all influence nutritional status indirectly via pathways of food security, infection, and more distally, conflict and displacement.[5]

Cost-effective, efficacious interventions to address child undernutrition exist.[6] To *break* the intergenerational cycle of undernutrition, interventions begin as early as adolescence and continue through the reproductive period and pregnancy, infancy, and childhood.[6] In their systematic review, Bhutta and colleagues reported that interventions that showed an impact on LAZ or stunting, specifically, included: (1) complementary feeding promotion for children 6-23 months of age; (2) supplementation with multiple micronutrients; and (3) zinc supplementation.[6] In an older review of nutrition interventions by Allen and Gillespie, processed complementary foods such as fortified blended cereals and legumes or those containing dry skimmed milk, also demonstrated potential for improving linear growth in African settings (Sudan, D.R. Congo, Ghana).[7]

More recently, different variations of lipid-based nutrient supplements (LNS) that contain protein, lipids, carbohydrates, and an array of micronutrients, have demonstrated improvements in child growth in some settings, including Bangladesh, Burkina Faso, Haiti, and Algeria.[8–11] In Malawi, the demonstrated impact of LNS on child growth has been mixed: out of nine studies that measured this association, only two reported reductions in severe stunting.[12,13] Though non-significant, the remaining seven studies' results in Malawi suggested a trend of improved growth with LNS supplementation.[14–20] Combined nutrition education to promote optimal IYCF with the provision of complementary foods can amplify the effects on linear growth, and especially so in food insecure contexts.[6,21]

Despite the demonstrated efficacy of nutrition interventions on child growth, global progress towards the reduction of undernutrition and stunting, specifically, has been slow.[1] This is in part due to the implementation of interventions in a manner that is "untested, unsuitable, or incomplete",[22] and thus fails to achieve adequate coverage and quality.[23] Insufficient attention to studying program effectiveness, or "the extent to which a specific intervention, when deployed in the field, does what it is intended to do for a defined population",[24,25] is partly to blame. Consequently, our understanding of how to design and implement nutrition interventions at scale, at the community level, and in a programmatic context, where logistical challenges and inefficiencies arise and where individual behaviors and environments are at play, is lacking.

Documenting and measuring *how* programs and interventions are implemented and *why* they do or do not achieve impact, is therefore an essential component of program implementation and evaluation.[26] For instance, how a program balances facilitators and barriers to program adherence to obtain high participation and positive nutritional and behavioral outcomes, can generate important lessons for researchers and program planners alike. Similarly, understanding the logistics and mechanisms used to establish community-based distribution networks and implementation modalities that ensure the timely and continuous delivery of the chosen intervention(s) to target beneficiaries, and why they did or did not work well, is critical for scale-up.

Malawi is a small, landlocked country in south-eastern sub-Saharan Africa that has exhibited a near-complete stagnation in child stunting prevalence over more than one decade, when it went from 49% in 2000, to 47.8% in 2004, and 47.1% in 2010.[27–29] The prevalence of child stunting was even higher in the country's central region for those

same years, affecting 55.5%, 52.7%, and 47.2% of children in 2000, 2005, and 2010, respectively.[27–29] In 2014 and to respond to such high levels of stunting, the Government of Malawi, with the financial and technical support of the Children's Investment Fund Foundation (CIFF), UK and the World Food Programme (WFP), respectively, began the implementation of a large-scale nutrition program whose primary goal is to prevent stunting in the first 1,000 days of a child's life in the district of Ntchisi in Malawi's central region. The program involves the monthly, blanket distribution of a small-quantity LNS (20g), Nutributter (Nutriset, Malaunay, France), for all children aged 6-23 months, and a social and behavior change communication (SBCC) strategy to promote optimal IYCF and proper water, sanitation, and hygiene (WASH) practices at the household and community levels. SBCC activities are designed to start as early as pregnancy, and continue through the child's 24-month birthday. For the receipt of the Nutributter supplement, children are enrolled at 6 months of age, and eligible to receive Nutributter every month for 18 months, until they turn 24 months of age, at which point they "age out" of the program.

To assess the impact of the nutrition program in Ntchisi on nutritional outcomes such as child stunting, wasting, underweight, and anemia, an independent evaluation led by the Johns Hopkins University Bloomberg School of Public Health's Center for Human Nutrition (JHU CHN) was undertaken. The impact evaluation used three cross-sectional panel surveys at base-, mid-, and endline (at 0, 1, and 3 years of implementation, respectively), to measure the difference in stunting and anemia outcomes among children 6-23 months in the program district of Ntchisi, and a neighboring comparison (non-program) district of Dowa. Cross-sectional surveys assessed children's length, weight,

middle-upper arm circumference (MUAC), head circumference, feeding patterns, morbidity, and program utilization in both districts. The impact evaluation also included additional, parallel and complementary research activities, involving a qualitative study, a cost-effectiveness analysis, and a process evaluation.

Nutrition education and supplementation with LNS are efficacious in promoting linear growth in children.[6–10] However, and as described above, their delivery and implementation at the country level and in the program context, which is characterized by physical and sociocultural challenges and real-world complexities, often hampers the achievement of nutrition impact.[30] In addition, the multi-causal and multi-level nature of undernutrition and stunting, specifically, further complicates the achievement of results. Consequently, our understanding and documentation of *how* to deliver nutrition interventions effectively in the program context requires further experimentation and documentation.

This dissertation research aimed to fill this programmatic and research gap by complementing the nutrition program's impact evaluation to measure the program's implementation, an activity deemed to be essential for policy and program considerations, as well as for attributability of impact to the program.[31] All research activities were grounded in principles of implementation science, defined as "the study of methods to improve the uptake, implementation, and translation of research findings into routine and common practices."[32] Three research activities were conducted to better understand program implementation and processes including a qualitative study, a process evaluation study, and an assessment of the characteristics associated with participation in the program's two main components.

The use of qualitative methods, including in-depth-interviews and focus group discussions that supported the collection of deep and rich data,[33] elucidated the physical and sociocultural facilitators and barriers to utilization and participation in the Ntchisi nutrition program. Gathering this information from the perspective of targeted beneficiaries and communities enabled examination of which program aspects may have influenced participation in, and uptake of program activities, and to what extent.

Complementary to the qualitative study and based on concepts of implementation theory, a process evaluation was conducted to further clarify, understand, and measure (quantitatively) how the Ntchisi nutrition program was delivered and to what extent each of its two primary intervention components reached program beneficiaries as intended (i.e. "conformity to its original design"). Implementation theory involves outlining the inputs, process, and delivery of the program's main components that "intend to bring about the desired interactions with the target population and provide the planned services".[34] As such, the testing of implementation theory describes whether and how programs can lead to expected outcomes and impact,[35] comprising a necessary complement to impact evaluation and program effectiveness studies.

Lastly, and to complement findings from the process evaluation and midline impact evaluation of the program, an assessment of the characteristics associated with varying levels of program exposure, as well as what mid-term child nutrition and IYCF outcomes were influenced by exposure, was conducted. This analysis holds important programmatic implications not only for improving the understanding of 'participant profiles', but also regarding the magnitude of impact that could be achieved with so-called "realistic" doses of program implementation and exposure. Furthermore, clarifying

and understanding what the optimal dose of exposure to the program is represents an important contribution to future efforts to scale up LNS and nutrition education interventions in this and similar contexts. Secondary data from the cross-sectional midline survey on child anthropometry, diet, maternal IYCF practices, and sociodemographic characteristics, was used for this last objective.

With this context, the research objectives of this study were to:

RESEARCH OBJECTIVE 1: Using qualitative methods, assess and document physical and sociocultural facilitators and barriers to program utilization by mothers of children 6-23 months in the program district of Ntchisi.

RESEARCH OBJECTIVE 2: Conduct a process evaluation for the Malawi nutrition program to test the nutrition program's implementation theory using process indicators of recruitment, reach, and fidelity.

Sub-objective 2.1: Describe the nutrition program's implementation theory to guide the selection of indicators and measures for the process evaluation.

Sub-objective 2.2: Measure the recruitment, reach, and fidelity of the Ntchisi nutrition program.

RESEARCH OBJECTIVE 3: To measure the association between household, maternal, and individual characteristics and varying levels of program participation in Nutributter distributions and exposure to SBCC channels. A secondary objective was to assess how such levels of participation were associated with anthropometric and IYCF outcomes.

As discussed, findings from this study can be used first to strengthen the delivery and implementation model of the Ntchisi nutrition program by generating lessons for both

course-correction, as well as potential scale-up in Malawi. Second, these study results complement impact evaluation findings by bringing to light the programmatic aspects that could have led to observed program impacts. Moreover, this study enriches the evidence base for program effectiveness of a small-quantity LNS (SQ-LNS) on child growth during the critical window of opportunity for nutrition in a poor, Sub-Saharan African context with a high prevalence of stunting.

1.2 Summary of dissertation chapters

There are seven chapters in this dissertation. The second chapter presents a comprehensive literature review on trends, causes, and consequences of undernutrition, and the efficacy of interventions to address stunting. With regards to nutrition interventions, the focus is on those that are implemented in the nutrition program, namely lipid-based interventions, and SBCC for optimal IYCF and WASH practices. Evidence of "effective" programming for nutrition, process evaluation and theory-based evaluation, and uses of these research methods, are also included in Chapter 2.

The third chapter in this dissertation presents the methods that were used to conduct this research. These are presented by research objective and include a description of the study setting and population; data collection and measurements; sampling strategies and sample sizes; training, supervision and quality assurance; analytic approaches; and ethical considerations, including the process for ethical review.

Chapter four (Paper 1) presents findings from a qualitative study on the physical and sociocultural facilitators and barriers to access and utilization of the nutrition program. This study found that in this highly food insecure setting, the program and food supplement achieved widespread acceptance in the community. However, increasing the

flexibility of distribution arrangements and using locally available, seasonally specific foods in program messaging for improved IYCF practices was seen as necessary for boosting participation and driving desired changes in behavior among the target population.

Chapter five (Paper 2) presents findings of the process evaluation of the nutrition program in Ntchisi. Results from the process evaluation indicated that while certain aspects of the program required continued improvement, such as the completion of training by front-line staff delivering SBCC, the program was effective in implementing and obtaining high participation in Nutributter distributions.

Chapter 6 (Paper 3) presents findings on the factors associated with high participation in Nutributter distributions and SBCC exposure, which included household characteristics such as land and livestock ownership, and child morbidity from diarrhea, malaria, and respiratory infections. The association between various doses of program exposure and anthropometric and IYCF outcomes is also presented. Results for this secondary analysis demonstrated that participation in the program's Nutributter distributions was associated with improved WLZ, but no other anthropometric outcomes. Higher doses of program exposure to SBCC improved dietary diversity score and the achievement of minimum meal frequency, but no other IYCF or anthropometric outcomes.

The last chapter of this dissertation (Chapter 7) summarizes the main findings from each of the papers and synthesizes the results and their complementarity to discuss program, policy, and research implications. This chapter also includes a description of the study's strengths and limitations, and future directions for research.

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Chapter 2: Literature review

2.1 Childhood undernutrition: trends and determinants

Childhood undernutrition is characterized by indicators of stunting, underweight, wasting, and micronutrient deficiencies, each of which represent different types of dietary restrictions and deprivation that may be occurring over the short and/or longer term. In this literature review, the focus is on stunting, which is measured by a length-for-age z-score (LAZ) that is less than -2 standard deviations below the reference median established by the World Health Organization's Growth Standards.[1] Stunting is representative of a chronic deficiency in energy, protein, or nutrients,[2] which is further indicative of exposure to long-term poverty and inequalities in human development.[3]

2.1.1 Global and national (Malawi) trends in undernutrition

Despite a growing and alarming global burden of overweight and obesity, undernutrition in its various forms continues to affect significant proportions of women and children globally, representing an unfinished agenda item for nutrition. Women and children suffer the greatest burden of undernutrition given their increased nutritional demands during these periods of rapid growth and development. Child undernutrition often begins in utero and continues to deteriorate during childhood, adolescence, and pregnancy, contributing to an inter-generational cycle of undernutrition (Figure 2.1).[5] Low maternal body mass index (BMI≤18.5) or short stature (<145cm) increases the risk of fetal growth restriction (FGR), resulting in term and pre-term small-for-gestational age (SGA), which in turn increases the risk of neonatal (RR 3.06 95% CI 2.21-4.23 and RR 15.42 95% CI 9.11-26.12, respectively) and post-neonatal mortality (RR 1.98 95% CI 1.39-2.81 and RR 5.22 95% CI 2.83-9.64, respectively) relative to appropriate for

gestational age (AGA) infants, and stunting in childhood (OR 4.51 95% CI 3.42-5.93 among children who are SGA and preterm).[6] In the latter case, the cycle of undernutrition perpetuates itself as stunted children become stunted adolescents and mothers, who continue to give birth to small children.[1]

Stunting among children under the age of five represents the largest burden of undernutrition, estimated to affect 162 million children globally.[4] South Asia continues to have the largest share of the world's stunted children (92 million), but Africa has the highest prevalence of stunting (36%).[4] The African trend for child stunting prevalence is particularly alarming as it represents an almost near-stagnation since 1990 when it was just over 40%.[5] This is largely the result of an unchanged or deteriorating rather than improving nutrition situation in many Sub-Saharan African countries, which was the only region to experience an increase in the number of stunted children since 1990.[5,6] Malawi undoubtedly contributes to the observed stagnation of nutrition indicators in sub-Saharan Africa: the national prevalence of childhood stunting hovered around 50% from 2000 to 2010,[7–9] and only recently began to decline (37.1% in 2015-16).[10] In the districts of Ntchisi and Dowa, however, the prevalence of stunting in 2013 was even higher (53%, 2014 baseline report, unpublished) than the national and regional averages reported in the 2010 Demographic and Health Survey (DHS) for the Central region (47.2%).[9]

2.2.2 Determinants of Undernutrition

A conceptual framework that hierarchically lays out the determinants of child nutritional status was developed as early as 1990 by UNICEF, in their strategy for improved maternal and child nutrition.[11] Although it has been adapted and reformulated since then, it continues to present the determinants of undernutrition in various layers,

beginning with the most proximal and immediate causes, and moving on to more distal, yet influential, underlying and basic causes. Most importantly, it represents the long process of interlinked events that eventually lead to a poor nutritional state.[11] In its most recent iteration (Figure 2.2),[12] the two most proximal determinants of undernutrition include dietary intake and disease, which act synergistically to deteriorate nutritional status.[11,13,14] The process by which this occurs is a through cyclical interaction whereby inadequate dietary intake leads to weight loss and/or growth faltering, which is associated with lowered immunity and greater susceptibility to disease. Similarly, many childhood diseases are characterized by loss of appetite, and loss and/or malabsorption of nutrients, contributing to inadequate dietary intake and fueling this undernutrition-disease cycle.[13]

Underlying causes of undernutrition are those that influence dietary intake and disease, such as household food insecurity, inadequate care, household environment and access to health services. These underlying causes can be quite broad, are often interrelated, and are largely driven by poverty; essentially, they represent an inability to fulfill the specific, yet basic needs of women and children.[11] Within the realm of food insecurity, which refers to the lack of "physical and economic access to sufficient, safe, nutritious, and culturally acceptable food to meet their dietary needs",[15,16] issues of household distribution of food also arise and influence nutrition both at the individual and household levels, more so in some contexts than others. Inadequate care, on the other hand, encompasses care practices as they relate to behavioral aspects of infant and young child feeding. These include early initiation and exclusive breastfeeding in the first 6 months of life and continued breastfeeding until 2 years of age, parenting and caregiving, and stimulation. Household environment has to do with access to safe water and both

environmental and personal hygiene and sanitation practices, which are being increasingly understood to play a role in nutrient absorption and nutritional status through pathways of Environmental Enteric Dysfunction (EED), even in the absence of clinical symptoms and/or illness.[3]

Even more distal are basic causes of undernutrition, which encompass the broader socio-political environment, policies and access to or availability of social programs that support economic, human, and physical growth and development.[12] These include the way in which political structures, ideologies, and legal systems – in the way of formal and informal institutions – converge and permeate throughout a society to influence the more proximal and underlying determinants of undernutrition referred to above.

In Malawi, each of these direct, underlying, and basic causes of undernutrition contribute to children's poor nutritional status. Overall, the diets of children are inadequate in terms of both quality and frequency: although more than three quarters of children are exclusively breastfed from 0-1 months (81.0%), this is down to only 34.3% by 4 to 5 months of age.[10] In addition, only 8% of children consume a minimum acceptable diet (MAD) thereafter (6-23 months).[10] Both indicators used to construct the MAD are problematic: in 2015-16, less than $^{1}/_{3}$ (29.2%) of children achieved the meal frequency requirement for their specific age, while only ¼ (25.1%) of them were able to meet the minimum dietary diversity of 4 food groups.[10]

The lack of dietary diversity is a consequence of many more distal factors, namely food insecurity and maternal knowledge that influences child feeding practices. Although the average available calories per capita in Malawi are sufficient to meet the population's daily needs (2,318kcal/person/day),[17] 71% of calories come from staple foods and only

6% from animal source protein.[18] In this context of subsistence farmers (84% of women in the study area are employed in agriculture) (baseline report 2014, unpublished), seasonality may also play a role in food insecurity, and subsequently influence dietary intakes of nutrient-rich foods among children. Regarding maternal knowledge and care seeking, which influence nutrition through pathways of infection, ¾ or less of all mothers sought care when their child was ill with diarrhea, acute respiratory illness (ARI) symptoms, and malaria/fever (65.8%, 77.6%, and 66.8%, respectively).[10] This represents both a threat to optimal child health, as well as a missed opportunity for health staff to deliver essential and timely nutrition messages. Moreover, the high prevalence of common childhood illnesses (21.7% had diarrhea, 5.4% had ARI, and 28.8% had fever in the 2 weeks preceding the survey)[10] compromises children's immune systems and can have devastating consequences for their nutritional status, and vice versa, given the above-referenced infection-nutrition cycle.[13]

At the level of basic determinants of undernutrition, the socioeconomic context of Malawi is important to consider. Malawi is among the poorest countries in the world, ranking 173 out of 188 countries on the Human Development Index[19] and with a gross national income (GNI) per capita of $340 in 2015.[20] Pervasive and chronic poverty, along with a complex and wide range of other socioeconomic factors, are associated with a high prevalence of undernutrition,[21] such as that seen in Malawi. In recent years, however, the Government has increasingly paid attention to nutrition, in particular childhood stunting and micronutrient deficiencies in children <5yrs, as laid out in their National Nutrition Policy and Strategic Plan (NNPSP) 2007-2015 (currently under revision).[22] In 2011, the country reinforced their commitment to nutrition by formally joining the Scaling Up

Nutrition (SUN) Movement, as well as developing a National Nutrition Education and Communications Strategy (NECS) for Preventing Child Stunting in Malawi 2012-2017, and a National Micronutrient Strategy 2012-2017. Other key nutrition-related sectors such as agriculture, education, and social protection have also demonstrated interest in addressing nutrition. This is evidenced in their development of nutrition policies and engagement in the multi-sectoral and multi-stakeholder platforms, the National Nutrition Committee (NNC) and the SUN Task Force Committee that coordinates nutrition plans and actions at the national level.[23] Policies in these sectors address the underlying causes of undernutrition, namely food security, feeding programs within the school system, and programs to reduce vulnerability during times of crisis or instability.

In light of Malawi's renewed political commitment to nutrition, as reflected both in the resolutions and declarations described above, the country had an impressive performance in the Hunger and Nutrition Commitment Index (HANCI 2012), where it ranked 3rd of 45 countries in commitment to nutrition.[24] Within this index, Malawi received this high ranking based on (among others): (1) substantial investments in its health sector, as well as a separate budget line for nutrition; (2) high performance on some maternal and child health and nutrition indicators, such as prenatal visits attended by a skilled provider, twice-yearly distribution of vitamin A supplements, and promotion of complementary feeding; and (3) the implementation and integration of nutrition policies and plans that include time-bound nutrition targets. Despite the critical nature of such political investments to the improvement of nutrition, the translation of such commitment into impact has been slow in Malawi, as exemplified by the data presented above, given the distal nature of such activities to the direct causes of undernutrition.

Each of the determinants discussed here are fundamental to nutrition and are especially relevant for children's linear growth since it represents a prolonged and chronic form of undernutrition that results from exposure to and interplay between combinations of these many factors over time. In addition, many of these are relevant in the context of this research, as they represent collective actions being taken at multiple levels in Malawi and in the program district, specifically, to improve the nutrition of young children in this country.

2.2 Consequences of stunting

The short-term consequences of stunting are manifested through an increased risk of morbidity and infections from common childhood illnesses such as diarrhea, pneumonia, and malaria, that result from a chronically inadequate dietary intake.[3,5] As such, the child is also at an increased risk for mortality given the fragility of their immune systems in such a nutritional state.[25] The relationship between stunting and all-cause and cause-specific mortality appears to be present even in mild cases of stunting (defined as height-for-age z-score (HAZ) -1 to -2 standard deviations below the reference median), which is associated with an increased risk of mortality of 1.56 (95% CI 0.98, 2.46) as compared to children who have a HAZ ≥-1.[25] This risk continues to increase significantly with stunting severity, with a hazard ratio (HR) of 2.12 (95% CI 1.33, 3.38) among children with a HAZ between -3 and <-2, and HR of 5.50 (95% CI 3.04, 9.98) among those with a HAZ <-3, as compared to a reference HAZ of ≥-1.[25] This important finding signals that even children who are not yet categorized as stunted but who may be on their way to becoming so, are affected by the consequences of lowered immunity and subsequently, more susceptible to infection and mortality.

Stunting and micronutrient deficiencies have also been associated with poor physical and cognitive development in children. This association is not surprising given the tremendous brain growth and development that coincides with a child's first 1,000 days,[26] a period also recognized as being critical for nutrition. The cognitive, educational, and behavioral components associated with stunting and other nutritional risk factors such as iodine deficiency and iron-deficiency anemia include "impaired behavioral development in early life", lower likelihood of, and/or later school enrollment, lower grade achievement, and poorer cognitive ability (as measured by various cognitive tests) as compared to non-stunted children.[3,27] Studies have found that even growth restriction that begins in utero (FGR), as measured by low birthweight, is associated with lower cognitive scores, problem solving abilities, and young children being less "active, vocal, happy, or cooperative";[27] the evidence regarding whether the cognitive effects of FGR persist into adolescence and possibly adulthood continues to be mixed.[28] Conversely, the association between stunting at 5 years of age and long term-outcomes of educational attainment, increased formal employment, and psychological functioning continue to be quite strong and consistent.[28,29] These results are aligned with the thinking that the greatest improvements in cognition may be seen in those who receive interventions during the period in which the effects of stunting may still be reversible.[3]

The longer-term effects of stunting may be viewed under the broader framework provided by the Developmental Origins of Health and Disease (DOHAD),[30] previously known as Barker's hypothesis. This hypothesis is founded on the basis that the early-life environment in which an individual's brain and organs develop triggers permanent psychophysiological changes that influence the risk of later chronic, non-communicable

diseases.[30] Other consequences of stunting in early childhood are those that reflect the lasting effect of losses in cognition and schooling discussed above, as well as in physical growth, and which translate into lower physical capacity and productivity levels, and subsequently, lower wages and lost economic output both at the individual and societal levels.[31,32] It has been estimated that stunting alone may contribute to country-level economic losses that add up to as much as 3% of a country's GDP.[15]

2.3 Interventions to address stunting

The cyclical and intergenerational links between undernutrition at birth, adolescence, and pregnancy signal an urgency to improve nutritional status not only among pregnant women, but also to limit the extent of growth faltering and its consequences that are largely irreversible after two years of age. Interventions to address undernutrition and stunting, specifically, should therefore begin as early as conception and continue into infancy and childhood. Many of these interventions, especially those related to micronutrients and energy supplementation (be it during pregnancy or early childhood), are increasingly being delivered through a variety of channels, including micronutrient powders and lipid-based nutrient supplements (LNS), which are discussed in more detail below.

Given the primary objective of the Malawi nutrition program to prevent linear growth faltering, the interventions discussed in this chapter focus on those targeting the 6-23 month age group, being implemented by the program, and the demonstrated evidence of their effectiveness on stunting. Specifically, the Ntchisi nutrition program is based on the following three components, the latter two of which are the focus of this dissertation:

1. The promotion of antenatal care (ANC) service utilization among pregnant women, and the daily consumption of iron folic acid (IFA) supplementation received during ANC.
2. The monthly provision of Nutributter to all children aged 6-23 months of age
3. Support for the implementation of the national social and behavior change communication (SBCC) strategy (NECS) that promotes improved infant and young child feeding (IYCF) practices from birth to 23 months, as well as proper water, sanitation and hygiene (WASH) practices. Specifically, the SBCC messaging focuses on:
    a. Exclusive breastfeeding (EBF) from 0 to 6 months of age
    b. Dietary diversification, meal frequency, quantity, and composition during the complementary feeding period, with continued breastfeeding to 24 months and beyond
    c. Appropriate utilization of Nutributter for the target child
    d. Improved WASH, with a specific focus on handwashing and ownership and use of a handwashing station (tippy tap)

2.3.1 Interventions During Infancy and Childhood

During infancy and childhood, improved child feeding practices, such as timely and EBF from 0 to 6 months, optimal childcare and complementary feeding behaviors from 6-23 months of age, are critical. Micronutrient supplementation (vitamin A, zinc, iron, and/or multiple micronutrient powders) and disease prevention and management are also imperative, given the cyclical and bi-directional interactions between infection and undernutrition.[33] These interventions are thus centered on ensuring a nutritious diet that

meets the high nutrient requirements needed for proper growth during early childhood (0 to 23 months), as based on the best available scientific and epidemiological evidence. Moreover, such recommendations have been used to generate the World Health Organization's Global Strategy for Infant and Young Child Feeding,[34] and the Guiding Principles for Complementary Feeding of the Breastfed Child[35] that drive the implementation of these interventions in countries around the world.

Although neither early initiation of breastfeeding nor exclusive breastfeeding from 0-6 months are directly associated with improvements in linear growth or reductions in stunting, their role in reducing infection and improving gastrointestinal health are especially relevant for nutrition and growth. Exclusive breastfeeding is recommended beginning within the first hour birth, to continue on demand until 6 months of age, when breastmilk is no longer sufficient to meet the dietary requirements of the growing infant, yet after which it can continue, combined with the introduction of complementary foods, until 24 months of age and beyond.[35] Initiation of breastfeeding that occurs within the first day of birth has been associated with a reduced risk of all-cause neonatal mortality (RR 0.56, 95% CI 0.40-0.79).[36] The continuation of breastfeeding for 6 months demonstrates significant benefits to the infant in terms of gastrointestinal health[37] and marked reductions in infection, illness, neurological outcomes, child mortality, and cardiovascular and metabolic disease risk.[38] The most widely used intervention to increase EBF from 0 to 6 months is to promote the practice among mothers and communities through counseling and educational activities, which have been associated with increases in EBF of 43% (95% CI 9-87) at day 1, of 30% (19-42) by 1 month, and of 90% (15-134) from 1-6 months of age.[33] Such interventions also translated into

significant reductions in the rates of no breastfeeding ranging from 32% to 30% and 18% at day 1, month 1, and from 1-6 months, respectively.[33] Innovative approaches including mass media messaging through television spots, have also been successful in significantly increasing EBF in some settings, such as in Vietnam where EBF went from 18.9% to 57.8%.[39]

Interventions targeting the introduction of safe and nutritious complementary foods from 6-23 months also fall under the umbrella of individual and/or group counseling and education, though they are often complemented by micronutrient and/or energy supplementation in contexts that experience high levels of poverty and food insecurity. The impact of educational activities alone on complementary feeding practices has been recently shown in the Alive & Thrive (A&T) Initiative that was implemented in Bangladesh and Ethiopia, which demonstrated significant improvements in almost all complementary feeding indicators measured, including timely introduction of complementary foods, dietary diversity, and meal frequency.[40,41] Despite cited improvements in breastfeeding and complementary feeding practices, it is worth mentioning that those impacts were not accompanied by significant improvements in child growth.[40–42]

In food insecure settings, such as Malawi, nutrition education interventions have yielded greater gains in height, whereas greater gains in weight are seen in food secure settings.[33] For instance, in food insecure settings, complementary feeding promotion in children 6-23 months was associated with an increase in LAZ of 0.25 (95% CI 0.09-0.42) and weight-for-age z-score (WAZ) of 0.26 (95% CI 0.12-0.41), as well as a reduction in the risk of stunting of 0.68 (95% CI 0.60-0.76).[33] Such effects, with the exception of

stunting, were amplified when they were combined with complementary food provision (with or without education), yielding increases in LAZ and WAZ of 0.39 (95% CI 0.05-0.73) and 0.26 (95% CI 0.12-0.41), respectively.[33] Similarly, in a process evaluation of a randomized controlled trial providing complementary foods and child feeding education to mothers across four countries in Africa, Central America and South Asia, Newman and colleagues[43] documented an increase in growth velocity with improved message recall/recognition by mothers (main effect estimate 0.048 cm/month ± 0.019, p=0.0304).

Furthermore, increasing "doses" of nutrition education activities appear to be important for improving IYCF outcomes. In India, the promotion of improved IYCF practices, including exclusive breastfeeding and optimal complementary feeding, was integrated into existing child health programs, such as antenatal care, routine child well-visits, and home-visits by Aanganwadi (community) workers.[44] The result of this study highlighted the importance of repeated counseling achieved by multiple channels, which was positively associated with improved breastfeeding and complementary feeding practices.[45] Similarly, in Bangladesh, Menon and colleagues demonstrated that exposure to more than one messaging platform (inter-personal counseling, mass media, and community mobilization) was associated with large and significant gains in the proportion of children achieving minimum dietary diversity, minimum meal frequency, minimum acceptable diet, and consumption of iron-rich foods.[40]

The study of the influence of varying doses of SBCC on caregiver behaviors is especially relevant in the context of this program, given its inclusion of LNS, which raises concerns around the potential displacement of breastmilk and traditional complementary foods. It also contributes to our understanding of whether greater

exposure to SBCC and subsequent changes in behaviors (if any) yield improvements in child nutrition outcomes in this setting.

Micronutrient supplementation comprises an additional strategy to education and counseling that has been used widely to fill the nutrient gaps that can often not be met by diet alone in resource-poor settings. This includes supplementation with vitamin A, iron, zinc, and/or multiple micronutrient supplementation. Although vitamin A and iron status influence child morbidity and mortality, given their lack of an explicit and direct effect on growth, they will not be discussed in detail here. Zinc supplementation interventions, however, do represent a preventive intervention that is often combined with diarrhea management and prevention to reduce the severity and duration of the current diarrheal episode, and to prevent future episodes.[46] Zinc deficiency has also been linked with linear growth impairment and childhood stunting.[5,46] The provision of zinc supplements has been shown to contribute to reductions in diarrhea morbidity, including the incidence of all-cause diarrhea (RR 0.87, 95% CI 0.85-0.89), and small improvements in height (standardized mean difference of -0.09, 95% CI -0.13-0.06).[46]

Supplementation with multiple micronutrients has become increasingly used in low and middle-income contexts and for young children, especially as new products to deliver them have become available, such as micronutrient powders (MNP) and fortified LNS. The impact of multiple micronutrients or fortified foods (with 3 or more micronutrients) on child growth has been demonstrated (length/height effect size=0.13, 95% CI 0.055-0.21 and weight effect size of 0.14, 95% CI 0.029-0.25);[47] however, these effects did not hold in a review on MNP only.[48] In both reviews, however, multiple micronutrients/MNP had an impact on hemoglobin (and anemia and iron-deficiency anemia), serum retinol,[48]

and serum zinc.[47] The efficacy and effectiveness of lipid-based interventions, which often serve as vehicles for the delivery of micronutrients, will be discussed in a separate section (below) given the emphasis of the program on Nutributter to improve growth and micronutrient status.

Since the nutrition program's SBCC is also addressing WASH practices, their efficacy as an intervention to improve nutrition deserves mention here. The link from WASH to child growth is indirect, passing through the pathway of diarrheal disease and, as more recently discovered, environmental enteropathy. As such, the majority of reviews on the effect of WASH (handwashing with soap, specifically) focus on its impact on diarrheal disease reduction, which is significant and results in a reduced risk of 48%.[49] The direct effect of WASH on anthropometric measures (WAZ, WHZ), however, has not been shown, although a small and marginally significant effect on HAZ was found (mean difference 0.08, 95% CI 0.00-0.16) in a meta analysis of fourteen studies in 10 low and middle-income countries.[50]

2.3.2 Lipid-Based Interventions

Given the difficulty of meeting the high nutrient requirements of young children in resource-poor and food-insecure settings, lipid-based interventions represent promising avenues for delivering essential micronutrients, fatty acids, amino acids, and energy to growing children.[51] In addition, the increasing variety of products available today (in terms of quantity and content) offers program planners many options that can be implemented based on the specific nutritional needs and challenges of a particular target population. In fact, some countries – Bangladesh, Mali, Malawi, Zimbabwe, and Kenya – have even experimented with locally produced ready-to-use foods (RUTF) that use

traditional, culturally accepted and known ingredients.[52–56] Moreover, concerns around the displacement of nutrient rich foods among supplemented children, particularly breastmilk, and the acceptability and adherence to the food supplement have been studied and do not represent significant risks to implementation. For instance, studies in Honduras, Malawi, DRC, and Haiti, have found that although the consumption of LNS increased the overall macronutrient and micronutrient content of children's diets, it did not displace breastmilk or other nutrient-rich foods any more than complementary feeding did.[57–61] Although adherence was documented as a potential impediment to program impact in some contexts (Uganda,[62] Burkina Faso,[63] and Malawi[64]), LNS product acceptability has been found to be extremely high by mothers and infants (as perceived by the mother).[55,64–73]

To date, no systematic review or meta analysis of the effects of LNS on growth have been done, but observed effects of its impact on preventing stunting in controlled settings (i.e. efficacy trials) have been mixed. This may have been influenced by the different quantities, compositions, and durations of supplementation that were provided to children in each study, and to study design issues, such as sample sizes that were not powered to detect differences in linear growth or short intervention durations. Overall, there is evidence of an impact of LNS on linear growth; however, when such impact is seen, changes in length gain or length/height-for-age-scores have generally been minimal.

Perhaps the most promising results came from Bangladesh and Burkina Faso. In Bangladesh, a 5-arm trial comparing consumption of two locally produced LNS (chickpea and rice-lentil-based), one commercially produced medium-quantity (MQ) LNS (Plumpy'doz), and a fortified blended flour (WSB++) for one year (from 6 to 18

months) against a control group, demonstrated a significant reduction in the rate of decline of LAZ in the lipid based groups as compared to control (0.02-0.04/month in the Plumpy'doz, chickpea, and rice-lentil groups, respectively).[52] These results also translated into significant absolute reductions in the risk of stunting of 5%, 6.2%, and 3.9% in the MQ-LNS, chickpea, and WSB++ groups as compared to control.[52] In Burkina Faso, supplementation with a SQ-LNS for 9 months (from 9-18 months of age) with varying zinc content led to significant increases in length gain regardless of zinc content, as compared to a non-intervention group.[74] The observed changes in length gain in this study translated into a reduction of stunting of 10 percentage points (29.3% versus 39.3% in intervention and non-intervention, respectively).[74] It should be noted, however, that morbidity surveillance (diarrhea and malaria) and treatment was offered to the intervention groups but not the non-intervention group in the Burkina Faso study, which may have contributed to the favorable results of this study. In Ghana, a shorter intervention period (6 months) also yielded improvements in length gain as compared to other supplements (Nutritabs with 16 micronutrients, 8.3cm versus 7.8cm in Nutributter versus Nutritabs groups, respectively), but these effects were not extended to a comparison against the group receiving Sprinkles, nor did they translate to differences in LAZ between the four supplementation groups.[75] In a Haitian study that supplemented young children (6-11 months) with a SQ-LNS for either 3 or 6 months, children who received the intervention for the longer period (6 months) had significantly improved LAZ (β=0.12±0.05, p=0.02), the impact of which was sustained at 6 months post-intervention (β=0.10±0.05, p=0.04).[76] A 5-arm study in Algeria that provided highly dense nutrient spreads with or without antiparasitic treatments daily for 6 months to

stunted children (HAZ<-2SD) aged 3-6 years also found significant impacts on attained height in the groups receiving a fortified spread (FS) versus those receiving an unfortified spread (US) at the end of the intervention period (95.1±6.4cm in FS, 94.5±6.0cm in US, and 92.7±6.7cm in control).[77] Similarly, HAZ increased in the FS groups (0.15z±0.22, p<0.001) as compared to the US and control groups, where it remained unchanged.[77] Lastly, supplementation with MQ-LNS (46g/day) in Chad for 4 months among children 6-36 months receiving food distributions yielded improvements (or lack of deterioration) of LAZ/HAZ (-1.79z±1.46 in LNS group vs. -2.06z±1.39 in control group, p<0.001) and growth velocity in the supplemented group (0.03 LAZ/HAZ/month, 95% CI 0.01-0.04, p<0.001).[78] Differences in LAZ/HAZ and length gain, however, did not translate into significant differences in stunting, despite the trend being in the right direction (OR=0.69, 95% CI 0.45-1.07, p=0.099) when comparing supplemented children versus control.[78]

Despite the positive impact on growth in the above-referenced studies, in Malawi, where many of the LNS trials have been carried out, results have been disappointing. Out of a total of 9 studies,[53,79–86] only 3 showed a positive and significant impact on linear growth,[81–83] and 2 of these 3 reported a reduction only in severe stunting (LAZ<-3SD) but not moderate-to-severe stunting (-3SD<LAZ<-2SD) or stunting (LAZ<-2SD).[82,83] Nevertheless, most results trended in favor of LNS. Among the trials that demonstrated impact, composition and quantity of the LNS appeared to be important. Regarding composition, in Mangani et al's study,[81] a milk-based LNS (as compared to a corn-soya blend (CSB) and soy-based LNS providing the same number of daily calories) yielded the greatest length gain (in cm and z-scores) among the 4 groups, especially from 9-12 months when those children in the milk-based LNS group's z-scores remained stable

while those in the other 3 groups (control being the 4th group) saw a significant deterioration in z-scores (-0.02z in milk-based LNS; -0.12z in soy-based LNS; -0.18z in corn-soya blend (CSB); -0.15 in control, p=0.045). Quantity of LNS, on the other hand, was shown by Phuka and colleagues[82,83] to be most impactful in the 50g (256kcal) range than in the 25g (127 kcal) on the incidence of severe stunting. In addition, both formulations of LNS, be it 25g or 50g, were more efficacious in reducing the incidence of severe stunting than a higher calorie dose of a fortified locally milled flour, Likuni Phala (LP) (71g, 282kcal) (0% in FS50g, 3.5% in FS25g, and 12.5% in LP group, p=0.008).[82] Furthermore, these differences in severe stunting were sustained after 12 months post-intervention, with incidence of severe stunting in these same three groups of 3.6%, 10.3%, and 19.6% (p=0.03), respectively.[83] Studies that did not reach significance but confirmed the quantity and content argument included an 8-arm trial that tested 5g, 25g, 50g, and 75g of milk and soy-based FS,[79] as well as a number of LNS versus CSB or LP trials.[84–86]

Overall, and whether the impact of LNS-based interventions was found to be significant or not, a few noteworthy, though not universal, patterns emerged in specific contexts. Children who were younger,[77] more undernourished (all forms, i.e. stunted, wasted, underweight),[74] and were supplemented for longer periods of time,[76] demonstrated improved growth from these types of interventions. This is not to say that if all of these conditions are met, impact will be achieved, but the few studies that achieved improvements in linear growth exhibited these basic characteristics.

In the Malawian context and despite some of the results presented above, the design of the nutrition program and its interventions are well positioned to yield improvements

in linear growth given the age group it targets (children 6-23 months), the long duration of implementation (18 months), the vulnerability of the targeted population, and the high prevalence of stunting. Nevertheless, adherence to the intervention by children under these programmatic and "realistic" conditions (as opposed to those presented in clinical trials), where mothers are required to sustain participation each month over a period of 18 months (from when the child is 6 to 23 months of age) amidst their long list of household responsibilities, remains a critical element of the program's success in preventing stunting. Thus, assessing which characteristics (household, caregiver, child) are associated with varying levels of participation in monthly food supplement distributions, can support improved targeting mechanisms relevant to program design staff and policy makers. Furthermore, clarifying what dose eligible beneficiaries are receiving, and how that dose is associated with nutrition outcomes, comprises an important contribution to program implementation efforts and implementation research more broadly.

2.4 Evidence of "Effective" Programming for Nutrition

Despite what is known about the efficacy of nutrition interventions, a gap remains to be filled on how to deliver them in a programmatic context, where physical and sociocultural challenges and real-world complexities arise and often hamper the achievement of nutrition impact.[87] The various interventions described above were shown to be efficacious in improving the nutritional status of vulnerable populations, such as pregnant women and young children. The majority of these interventions were evaluated under controlled conditions, be it in a clinical trial or a program efficacy trial, and thus likely do not represent the effect that would be seen in a programmatic context. Evidence of "effective" programming for nutrition, that is, the evidence that interventions have an

impact when delivered under "real" or programmatic conditions, are much harder to come by. There are a number of reasons for this, the most important being that there are few published studies of well-designed evaluations that explore the effectiveness of community-based nutrition interventions being delivered at scale.[88] In addition, large-scale programs often implement a "package" of integrated interventions, rendering it difficult to isolate the effects of each individual program component on the nutritional outcome of interest, especially when interventions are implemented globally.[88] Nevertheless, and although efficacy trials are a necessary pre-requisite to programmatic research for determining biological pathways and plausibility of impact of an intervention, Habitcht and Pelto argue that *program effectiveness* trials, "which assess the efficacy of an intervention implemented within a public health program, are much more useful for policy and program considerations."[89]

Though limited, evaluations of large-scale nutrition programs in Senegal,[90] Uganda,[91] Bangladesh,[92] Peru,[93] Haiti,[94] and China,[95] among others, exemplify how different models and platforms can be used to deliver nutrition services and effectively produce impact on child nutrition outcomes. In Senegal, the evaluation of their large-scale community growth monitoring and promotion (GMP) program, *the Senegal Nutrition Enhancement Project,* found reductions in the prevalence of underweight (WAZ <-2SD) and a higher likelihood of having received vitamin A supplementation in the previous 6 months in intervention areas as compared to non-intervention areas.[90] The evaluation attributed this program's success to the provision not only of growth monitoring services, but to the use of this platform as an entry point for providing individualized counseling to participating mothers of young children, as well as essential health services such as

vaccinations and micronutrient supplementation.[90] In Peru, an intervention that implemented an accreditation system of health facilities to enhance nutrition education on IYCF for children under two in a poor periurban area, demonstrated increased receipt of nutrition advice in intervention areas, which translated into children in those same areas receiving more nutrient-dense meals and exhibiting lower prevalence of stunting as compared to areas without the intervention.[93] A similar intervention in rural China also found improvements in food diversity, meal frequency, and hygiene practices in intervention groups, as well as greater weight and height gains as compared to children who did not reside in intervention areas.[95]

A review of the effectiveness of large-scale interventions finds that nutrition education, supplementation, and GMP interventions can be effective in achieving nutrition outcomes so long as they consider several design and implementation issues.[88] For SBCC interventions, key activities should occur prior to and during the implementation process. For instance, establishing a comprehensive understanding of behaviors and available resources among the target population (attitudes, perceptions, and practices) and developing messages using known strategies to enact behavior change, such as addressing all known obstacles convincingly and creating the right motivations to enact desired changes without contradicting prevailing beliefs.[88] Supplementary feeding interventions, which are more costly but more effective in reducing the nutrient gap between consumption and requirements, face additional challenges in their implementation, ranging from storage and leakage concerns, to cultural acceptability, digestibility, and palatability of the foods.[88] Supplementation activities should therefore

be balanced with adequate supply, timing, and frequency of distribution in a way that minimally disrupts daily routines.[88]

Both issues were relevant in Malawi, given the program's two pillars of community-based nutrition education for improved IYCF and WASH practices, combined with supplementary food distribution to improve linear growth. Thus, and in preparation for the design and implementation of the Ntchisi nutrition program, a formative research study was conducted to understand the sociocultural facilitators and barriers to implementing nutrition-related behavior change, as well as the patterns and determinants of Nutributter utilization in this program context.[64,96] Specific to the behavior change component, the study found that nutrition-related illnesses, and stunting especially, were not perceived by the community as a strong threat, as were other common childhood illnesses like malaria and diarrhea.[96] Recommendations for the development of SBCC materials to promote optimal nutrition behaviors were therefore focused on applying local, cultural metaphors related to other illnesses, to nutrition concepts.

Formative research on LNS utilization and consumption patterns highlighted product misuse in Ntchisi district, which included both over- and under-use.[97] Over-use was the most commonly identified form of misuse, and involved caregiver consumption of the Nutributter, or sharing with other children older than two years.[97] Sharing of LNS in particular, be it with other children or community members, has been identified as being problematic in other similar settings in sub-Saharan Africa (Burkina Faso and Uganda), and can constitute an important barrier to program impact if children are not receiving the intended supplement dose.[63,66] Additional barriers to LNS use documented in Uganda

included structural factors, such as long commutes to the distribution point, combined with competing demands for completing household responsibilities.[66]

The conduct of the formative research activities to better understand the context in which the Ntchisi nutrition program would be implemented was an important step towards identifying and addressing identified facilitators and barriers to the uptake of the program's chosen nutrition interventions. The extent to which the program achieved this once implemented at scale, however, constituted an important research gap that this study aimed to fill. In addition, a re-exploration of perceptions, facilitators, and barriers in a programmatic context, as opposed to within a small-scale pilot, could reveal important, unforeseen issues that could be useful for program improvement purposes.

2.5 Implementation science and the study of program implementation

Implementation/delivery science/research is "the study of methods to improve the uptake, implementation, and translation of research findings into routine and common practices".[98] It is a broad term that encompasses an entire science devoted to understanding the what, why, and how of programs and interventions delivered to achieve desired effects, or how they should and can be modified to do so more efficiently and effectively.[99] Despite the various terminologies used to describe implementation science (i.e. program delivery science, implementation research, delivery science, and improvement science, among others), they all include the systematic attention to various aspects of an intervention's effectiveness in a programmatic or field-based implementation context, in order to improve the quality of service delivery.[100]

An underwhelming emphasis has been placed on implementation science, which accounts for less than 3% of health research funding within the research and donor

communities.[101] This limited attention has been blamed for the lack of results in public health improvements in low and middle-income countries (LMIC), largely because the implementation of interventions fails to achieve adequate coverage and quality of implementation,[102] and is being delivered in a manner that is "untested, unsuitable, or incomplete".[103] In fact, some even argue that investing time and resources into implementation science is an ethical commitment in health care.[104] And although implementation science itself is not a newly identified area of research, it has only recently received increasing attention within the field of nutrition,[101,102,105–107] most recently culminating in a Society for Implementation Science for Nutrition.[108] This renewed attention comes under the philosophy that without providing an intervention to "the right people at the right time for the right duration and with the right quality, the intervention will not be effective," no matter how efficacious it is.[109] Disruptions in supply chains, low human resource capacity and/or difficulty in training and maintaining high staff motivation while reducing turnover, are often associated with increased implementation costs, and render interventions and programs to be ineffective.[109] Otherwise stated, implementation research sheds a much-needed light on the "bumpy interface" between what can theoretically be achieved and what actually happens on the ground.[110]

2.5.1 Implementation theory and process evaluation

Implementation theory is defined as the details of how a program is implemented, which includes the inputs, process, and delivery of the program's main components that "intend to bring about the desired interactions with the target population and provide the planned services".[111] It is different than program theory, which explicitly describes *links*

between program activities, outcomes, and impacts, clarifying not only how interventions are implemented and utilized, but also how they could have led to intended impacts.[112] Implementation and program theories thus complement each other, in that if the program is implemented perfectly (according to its implementation theory), the program would lead to expected outcomes and impact as laid out in the program theory. Process evaluation is a common tool used to test implementation theory, as it allows for the systematic study and understanding of program delivery and constraints, why they arise, how to address them, and how they might have influenced program outcomes.[113]

Process evaluation has been deemed as a necessary component of impact evaluation since the 1960s.[113] In 1985, Basch and colleagues coined the term "Type III error", which refers to the type of error that results from "evaluating a program that has not been adequately implemented".[114] Basch and colleagues maintain that measuring program implementation is critical to avoiding making such types of error, and consequently, to drawing false conclusions about the effectiveness of an intervention.[113,114] Process evaluation also strengthens the internal and external validity of the impact evaluation's results: internal validity refers to the extent that the impact seen is truly a result of the program, and external validity refers to the extent to which such a program is generalizable to other populations,[115] such that the processes that lead to impact are thoroughly documented, including the successes, failures, and inefficiencies that may arise in similar or other environments, and how they were or can be addressed.[116]

Despite its stated and critical role in unpacking the *why* and *how* interventions achieve their impact in programmatic contexts, the use and documentation of process evaluation is generally scarce and represents an important research gap in nutrition,

especially in light of current efforts to scale up nutrition interventions globally. A few examples of process evaluation include those used in the A&T Initiative in Bangladesh, Ethiopia, and Vietnam, which are briefly described here. Despite different implementation models in each country, the (A&T) process evaluations were based on the following principles: (1) the development of detailed program impact pathway (PIP) models; (2) the linking of data collection to the PIPs, using mixed methods and multiple data sources; (3) the linking of evaluation activities to program implementation timelines; and (4) engaging with program implementation and management teams.[87,117] Early process evaluation results in pilot areas of Bangladesh highlighted, for example, that despite a high quality implementation of activities to improve IYCF, household-level constraints were inhibiting the adoption of recommended practices.[117] Early findings like these are instrumental in that they can be used to shape and adjust the program such that it better addresses identified constraints when implementation moves to a larger scale.

Another example of the use of process evaluation was in Cambodia, under the impact evaluation of a homestead food production program that aimed to increase the production and consumption of diverse and nutritious foods year-round as a means of improving maternal and child nutrition outcomes.[118] The results of the impact evaluation indicated that although production of nutritious foods and dietary diversity among target beneficiaries increased, there was no improvement in their anthropometric or anemia indicators.[118] To better understand why the program failed to improve child growth and anemia despite increases in production and dietary diversity, the process evaluation assessed whether program components along three pathways of impact were being implemented and utilized as planned.[119] The comprehensive data collection, gathering,

and analysis along each of these pathways revealed challenges in relation to the knowledge, motivation, and compensation of village health volunteers who assisted in the delivery of the educational intervention, as well as explicit gaps between the production and consumption of certain nutrient-rich foods (eggs).[119] Most importantly, this work highlighted that despite identified necessary tweaks to the implementation process, it was unlikely that without additional program components and inputs (for example, access to water, distribution or sale of micronutrient supplements, or the addition of animal-source food production), the program could not have realized its expected impacts on child nutrition outcomes.[119]

In Malawi, a process evaluation nested in a clinical trial assessed fidelity to the study protocol and dose-delivered by measuring nurses' adherence to an infant-feeding protocol for infants of HIV-infected mothers.[120] The process evaluation revealed that although the nurse's average implementation adherence was very high (>90%), key counseling elements during early and late postpartum visits were inconsistent.[120] They also found that nurses wanted additional training and guidance on the preparation of and counseling around infant formula feeding, which was an element that had not previously been addressed in the study's nurse training protocol.[120]

In rural Peru, Robert and colleagues unpacked a randomized trial's implementation, to identify the main pathways (health center implementation, caregiver exposure, and caregiver message recall) through which feeding behaviors of caregivers and infant nutritional status was achieved.[121]

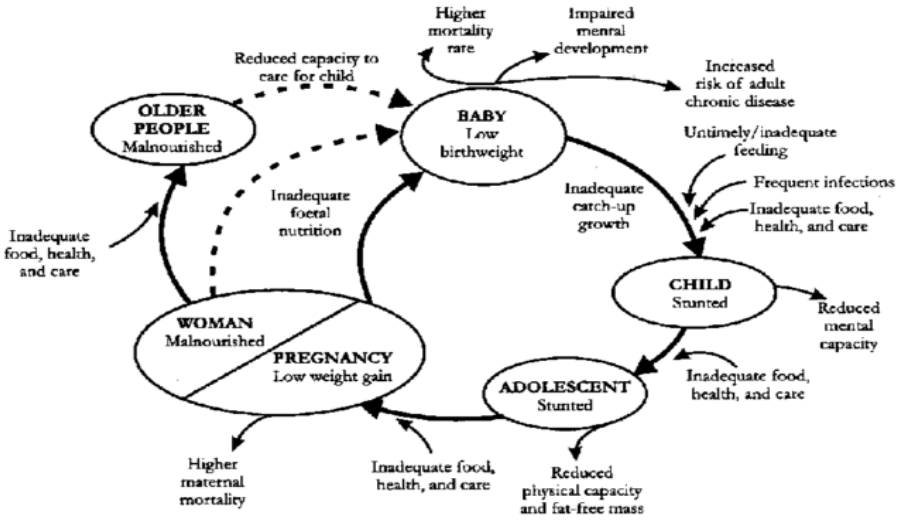
2.6 Summary

Given the various and multi-layered determinants contributing to poor child nutrition in Malawi, the complexity of intervening to improve the nutritional status of this population is not to be underestimated. Efficacious interventions to address undernutrition and to prevent linear growth faltering were presented here; designing and implementing these, and seeing an impact on nutritional status in a programmatic context, where logistical challenges and inefficiencies arise, and where individual behaviors and environments are part of the equation, is much more difficult, and thus requires further attention and understanding.

In the context of the large-scale, community-based nutrition program and impact evaluation in Ntchisi district in Malawi, the design and implementation of the research activities presented in this dissertation represented unique opportunities to examine the program in profound depth, to systematically measure its implementation, to better understand the contextual factors that drive behavioral and nutritional changes in this population, and whether varying doses of implementation are associated with improved outcomes. Filling these research gaps is especially critical in light of the global nutrition community's efforts to scale-up nutrition and achieve the World Health Assembly's ambitious nutrition targets[122] and Sustainable Development Goals.[123]

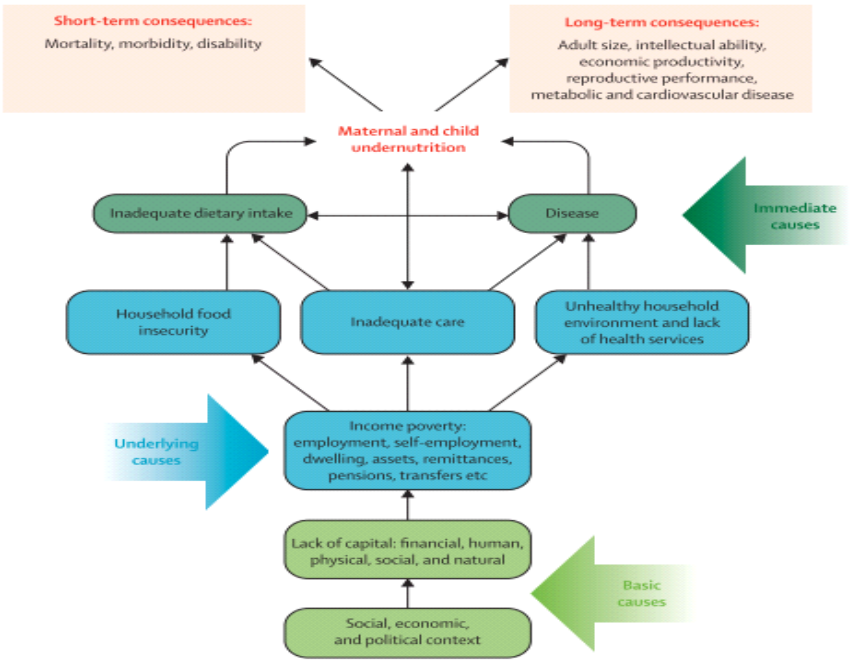
Tables and Figures

Figure 2.1: Nutrition throughout the life cycle



Source: United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition, 2000.

Figure 2.2: Conceptual framework for maternal and child undernutrition



Source: Black, R., Allen, L., Bhutta, Z. et al, 2008.

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Chapter 3: Study design and methods

3.1 Introduction

This thesis work was undertaken under the auspices of an impact evaluation of a nutrition program in Malawi, being conducted by investigators (PIs: Christian, Hurley) at the Johns Hopkins Bloomberg School of Public Health's Center for Human Nutrition (JHU CHN)(IRB No.00005237 and clinicaltrials.gov #NCT 02985359). The overarching objective of the present study was to understand and document various aspects of program implementation, drivers of participation, and examine the characteristics associated with program exposure, as well as how program adherence was associated with impact on outcomes of nutritional status and infant and young child feeding (IYCF) practices. The methods used in the study are summarized in Table 3.1; both primary and secondary data were used to address the research questions.

First, a qualitative study, conducted after 1.5 years of program implementation, elucidated perceived representations of the program with program staff, community and household members, and participating mothers in the program district. This included an exploration of perceived facilitators and barriers to access, participation, uptake and utilization of the program's monthly Nutributter distribution sessions, and of IYCF and water, sanitation and hygiene (WASH) messages included in the program's social behavior change communication (SBCC) campaign. Influential household members were included to broaden our understanding of the context in which decisions, as they related to program participation and their child's nutrition and care, are made by mothers or caregivers, and how they are influenced by household members.

The second research objective was to conduct a process evaluation to test the program's implementation theory, and to identify strengths and weaknesses in program implementation. Both qualitative and quantitative data from various sources were used to measure the program's "operations, activities, functions, performance, component parts, and resources"[1] to determine whether the program achieved said components. Routine program monitoring data (attendance records from a system called SCOpe, post-distribution monitoring surveys (PDM), and annual performance review (APR) documents) provided by the program implementers (WFP), qualitative data from the impact evaluation study, and newly collected data (direct observations and quantitative knowledge assessments with program staff) were used to measure program recruitment, fidelity, and reach, based on Linnan and Steckler's definitions.[2] Findings from the process evaluation were then categorized and integrated into the program's logical framework to illustrate successes and potential bottlenecks in implementation.

The third and final research objective of this study was to explore which household, maternal, and child characteristics were associated with varying levels of program participation in Nutributter distributions and/or exposure to SBCC activities, and the extent to which these were then associated with child anthropometric outcomes and IYCF and hygiene practices. Data on program participation in Nutributter distributions were obtained from the program's monitoring and evaluation system called SCOpe, which measured attendance at monthly distribution sessions. Cross-sectional survey data from the impact evaluation's midline survey, conducted 1 year into program implementation, was used to construct variables of exposure to SBCC, household and individual

characteristics, and nutrition and IYCF outcomes including anthropometry and dietary intake.

The methods used for these three research activities, including an overview of the nutrition program and the impact evaluation, study design, data collection, data management, and data analysis, are described in detail in this chapter.

3.2 Overview of the Malawi Nutrition Program

In January 2014, and as part of a national effort to reduce childhood stunting, the Government of Malawi, with technical, logistical, and financial support from the WFP, World Vision, and the Children's Investment Fund Foundation (CIFF), UK, respectively, launched a large-scale nutrition program in the central Malawian district of Ntchisi. The program has two primary components: (1) the blanket distribution of a small-quantity (20g) lipid-based nutrient supplement (SQ-LNS), Nutributter (Nutriset, Malaunay, France), to children 6-23 months of age; and (2) an SBCC campaign to promote optimal IYCF and WASH behaviors at the household and community levels.

The LNS used in this program, Nutributter, is a peanut-based product that contains protein, lipid, carbohydrate, kilocaries (108kcal per sachet), and an array of micronutrients such as essential amino acids, vitamins, and minerals needed to fill the identified nutrient gap during this critical period of child development (Supplemental figure 3.1). The monthly distribution of Nutributter rations (35 individually packaged sachets) occurs through 80 distribution points across the district that are run by World Vision staff; distribution points include health centers and extended distribution points (EDP)(health posts, churches, community-based child-care centers (CBCC), schools, and other community structures). The location of distributions is selected to maximize

convenience and minimize travel distances for participating mothers; most mothers spend approximately 1 hour traveling to distribution points, but those living in very remote areas may require 3 to 4 hours to get there. Ideally, and to receive the full 18 months of Nutributter rations (from 6 to 23 months of age), mothers of children 4-6 months of age are instructed by health surveillance assistants (HSA), nutrition Promoters, or Care Group Volunteers (CGV) who maintain a "community roster", to enroll their children. Enrolment of new mothers involves the collection of basic personal information of the mother and child (village name, name, sex, age or date of birth), and taking a photograph for the identification (ID) card, which is printed and given to the mother in the next month's distribution. Distributions occur in the first two weeks of each month, typically on a similar day in each location, beginning sometime mid-morning and concluding by noon. Distribution sessions begin generally involving group songs and/or a counseling session covering a variety of often seasonally specific IYCF, WASH, and Nutributter messages.

The program's second component falls under the country's national-level roll-out of an SBCC campaign delivered by a core network of nutrition Promoters and CGV under the larger Scaling Up Nutrition (SUN) initiative in Malawi.[3] Messages included in the SBCC campaign were developed based on the National Nutrition Education and Communication Strategy (NECS),[4] formative research,[5,6] and scientific theory using the Socio-Ecological Model (SEM)[7] to target health workers, the community, and caregivers around appropriate health care and diet during pregnancy, optimal breastfeeding and IYCF and WASH practices. Using IYCF and WASH messages as their focal area, the SBCC component includes advocacy and media activities at the district and community

levels, such as Open Nutrition Days for the community, radio clubs, and billboards, and a care-group model at the interpersonal and individual levels.

The Care Group Model was originally designed and implemented by World Relief in 1995,[8] and is centered on cost-effective, sustainable, community-based mobilization of local volunteers to deliver behavior change communication messages at the household level. In Malawi, the Care Group model (see figure 3.1) was adapted to use nutrition Promoters who were chosen by their own community members to champion nutrition issues in their villages. Each Promoter is responsible for a maximum of three care groups of 10-12 CGV, who in turn act as community-based health and nutrition educators. The CGV meet regularly (typically once every two weeks) with their Promoters for interactive training, support, and reporting, and are responsible for visiting a group of 10 households in their community each month to deliver health, nutrition, and WASH messages. Promoters, on the other hand, are managed and supervised by Government-paid and supervised HSAs, who have a catchment area of 10-15 villages, and who report directly to district-level health officials, with copy of summary reports to World Vision. Each HSA is responsible for managing 3 to 6 Promoters, and all HSAs in one district (range of 5-16 HSAs per health center) report to the District Health Officer, who reports to the District Medical Officer (Figure 3.1).

The logistical aspects associated with the roll-out of the SBCC, such as the identification, training, and supervision of nutrition Promoters and CGV, is done in partnership with World Vision, who handles day-to-day field logistics and synthesis and report-back of monitoring data to WFP and the Government. World Vision is also responsible for identifying, hiring, and managing staff who conduct monthly Nutributter

distributions and who support Promoters in their catchment areas to plan and implement community mobilization events and radio clubs. Thus, the collaboration between the WFP and World Vision is close and active, with staff from both organizations working together daily to organize logistics and to troubleshoot.

In addition to the implementation of the described program components, two monitoring and evaluation systems accompany the program to collect monthly and quarterly data on program operations and utilization. The System for Cash Operations (SCOpe), collects monthly output-level data using a card scanning technology, which allows tracking of individual attendance at Nutributter distributions each month in quasi real-time. This system allows for timely adjustments to improve program implementation, such as the addition and placement of a new distribution points in geographic areas that exhibit low coverage. Performance of the program as it relates to product usage, understanding of key messages by participating mothers, and participation experiences such as reasons for missing a distribution, wait times at and travel distances to the distribution center is monitored through quarterly post-distribution monitoring (PDM) surveys. These are implemented in a newly selected stratified, clustered random sample of participating beneficiaries after every three-month cycle of distributions. Data from both monitoring systems was used in this study.

3.3 Impact evaluation of the Malawi Nutrition Program

The impact evaluation of the Malawi nutrition program used a comparative design that included three cross-sectional surveys (base-, mid-, and endline), two longitudinal cohorts, a qualitative study, a process evaluation study, and a cost-effectiveness study. The study's timeline for each of these activities is outlined in Figure 3.2.

Cross-sectional base-, mid-, and endline surveys were conducted in January-March 2014, 2015, and 2017, respectively, in 216 sampled villages among children 6 to 23 months of age in the program district of Ntchisi, and the neighboring comparison district of Dowa (n=1,200 per district per survey, total n=7,200). Data collected under the impact evaluation's cross-sectional surveys included household-level socioeconomic characteristics such as asset, land, and livestock ownership, household size, tribe and religion, employment, water, sanitation and hygiene variables, and food insecurity. Child and maternal characteristics were also collected, and included individual dietary diversity, caring and feeding behaviors, morbidity and care-seeking behaviors, program participation and adherence characteristics, anthropometry, and hemoglobin (in a subset of both population groups and at baseline and endline only). Additional data collection details and methodology are presented below.

The qualitative study was conducted from November-December 2015, with the objective of understanding maternal and community members' perceptions of the program, the food commodity (Nutributter), and the SBCC package, and how these influenced the uptake of program activities. Additional data collected for the process evaluation study in December 2016 included direct observations of program procedures and knowledge questionnaires with front-line program staff (nutrition Promoters and CGV). This data was used to complement the process evaluation's measures of program fidelity to original design. The cost effectiveness study used available program costs of implementation to calculate basic costs per child covered by the nutrition program, as well as an incremental cost-effectiveness ratio to report on cost per case of stunting averted and cost per 0.1 unit change in mean length-for-age z-score (LAZ).

3.4 Study setting and population

Young children aged 6-23 months, mothers, households, and community members living in Ntchisi district Malawi were targeted by the nutrition program. Ntchisi district is located in the central region of Malawi, covering an area of 1,655km^2 with a population of almost 200,000 people. Ntchisi is bordered by Dowa district in the South, Kasungu on the West, Nkhotakota to the North and East, and Salima on the South-East (Figure 3.3). Ntchisi district is broken down in to seven traditional authorities (TA) or geographic sub-divisions, which are served by twelve health centers (some TAs have more than 1 health center). The population in Ntchisi is largely rural, and includes approximately 47,500 households spread out over 1,500 villages ranging from small (<100 people) to moderate (150-600 people) in size. Of these households, an estimated 15,000 children are eligible to receive program benefits each month. Based on the baseline survey conducted in 2014 (baseline report, 2014, unpublished), a majority of families (97%) in Ntchisi belong to the Chewa tribe, and housing characteristics indicate that the population is generally poor. Most households in the district do not have electricity and have minimal asset ownership. Access to an improved drinking water source and latrine ownership, however, is relatively high (>80%). The majority (>75%) of households depend on agriculture as their main livelihood, and educational attainment is relatively low (7y among men and 5y among women), especially among women.

Dowa district was selected as the comparison district in the impact evaluation study, and neighbors Ntchisi to the North, is larger than Ntchisi, covering an area of 3,041km^2 and with an estimated population of 557,000 people. It is also in the central region of Malawi, and borders Lilongwe district on the South, Salima on the East, and Kasungu on

the West (Figure 3.3). Like Ntchisi, Dowa has seven TAs, but more health centers (23 in total) given its larger size. The socioeconomic conditions of Dowa are similar to those observed in Ntchisi, with Dowa exhibiting more urban-like characteristics than Ntchisi. For example, minor differences observed at baseline between the two districts included household ownership and use of land to grow and produce food (higher in Ntchisi), household construction materials, with Dowa having higher use of cement and brick than Ntchisi, and maize storage being higher in Ntchisi, among others.

3.5 Selection, training, supervision, and quality assurance of field staff

All research assistants who participated in this study were selected and hired from a pool of staff who had participated in data collection activities with Wadonda Consult, Inc., the Malawian firm responsible for coordinating and implementing the impact evaluation's data collection activities in the field. Research assistants from this pool have been vetted by Wadonda Consult, Inc., and preference for research assistants in all study activities was given to those who: (1) had experience working on the impact evaluation, i.e. had collected baseline, midline, and/or longitudinal data; (2) had experience using qualitative methods, especially IDIs and FGDs (for the qualitative and process evaluation studies in particular); and (3) were fluent in the local language, Chichewa.

3.5.1 Qualitative Study

Six research assistants (1 of whom would be a supervisor) were recruited and trained, with the intention of keeping 4 to 6 interviewers for field activities. All 6 were retained for data collection. Training on qualitative methods and data collection was conducted over a period of one week (November 2-6, 2015). The training was led by two senior members of the Center for Communications Programs (CCP) (KK, NKK) and attended

by the study Principal Investigator (PC) and two JHU CHN students (RO, JRB). Training covered the following topics: background of the JHU CHN impact evaluation study, research ethics, data integrity, interviewer characteristics and active listening for the collection of rich data, qualitative data collection techniques [in-depth interviews (IDIs) and focus group discussions (FGDs)], review and modification of data collection tools, and simultaneous and word-for-word translation and transcription.

Supervision and quality control during data collection was maintained by the field supervisor, a local CCP staff member (DC), and two JHU CHN students (RO, JRB). The field supervisor was responsible for managing the field team, organizing field logistics, and scheduling interviews with mothers and household members. A local CCP staff member (DC) intermittently supported supervision and quality control activities; his fluency in the local language was of particular importance in terms of ensuring word-for-word (verbatim) simultaneous translation and transcription quality. The two JHU CHN students (RO, JRB) supervised all data collection activities, and performed random quality control checks using a pre-determined checklist (Appendix A). Detailed debriefings were conducted at end of each day of data collection, allowing for the documentation of main findings and integration of these into future data collection activities.

3.5.2 Process evaluation study

Two research assistants conducted direct observations and administered knowledge questionnaires for the process evaluation (December 5-17, 2016). Training for process evaluation-related data collection was conducted over a period of two days (December 2-3, 2016), with one additional day for piloting and refining of questionnaires and direct

observation guides. I (JRB) was responsible for leading the process evaluation training, and was supported by a JHU CHN scientist (AB). Training covered the following topics: background of the JHU CHN impact evaluation study, research ethics, detailed description of field activities, qualitative data collection techniques (direct observation) and standardization across observers, and review and modification of knowledge questionnaires based on training documents. Piloting of the direct observation tool involved conducting a direct observation and comparing results as a group of four to illustrate how people view, record, and interpret things differently, and the importance of using rich descriptions in observations.

Supervision, quality control, and the organization of logistics during data collection were maintained by two JHU CHN scientists (AB, JRB) and the field supervisor. The majority (75%) of data collection activities were conducted in pairs, with the research assistant being accompanied and/or supervised by a JHU CHN scientist or student (AB, JRB). In addition, detailed debriefings and note-taking were conducted as a team at the end of each day of data collection, which allowed for a group discussion of what was observed at the data collection sites, whether there were any variations observed in implementation, and any issues associated with the administration of knowledge questionnaires or recruitment of participating staff.

3.5.3 Midline impact evaluation survey

A team of 16 research assistants were trained and recruited to conduct household interviews for the midline impact evaluation survey. Five teams were formed, which consisted of 2 to 4 research assistants, 1 supervisor, and 1 driver.

In preparation for the midline survey, research assistants participated in a 1-week [refresher] interactive training, where each module was reviewed question by question. During this time, research assistants were encouraged to discuss the wording/translation of the Chichewa questions, what they were asking, and how to extract the required information in a standardized way and in difficult situations. An anthropometric standardization exercise was also conducted following the week of training, which involved conducting repeated measurements on a select number of children and comparing measurements to a gold standard measurer (Malawian co-principal investigator with extensive experience in child measurement, JP). The top five performing anthropometrists were then selected as "measurers", and performed all anthropometric measurements in the field and throughout the data collection period.

Quality control was maintained by a local project supervisor, as well as the project coordinator. The project supervisor (PH at baseline and PM at midline and endline) was responsible for quality-checking critical variables in questionnaires for erroneous values (such as date of birth and identification variables) before submitting all questionnaires to the project coordinator (ABM at baseline and midline, AB at endline). The project coordinator (ABM or AB) was in turn responsible for quality-checking a minimum of 10% of incoming questionnaires. Questionnaires that were identified as problematic were discussed one-on-one with supervisors and/or field workers, and returns to the household to verify responses were implemented as needed. Problems that arose in greater frequency were discussed with the data collection team during weekly meetings, and flagged to supervisors who were instructed to pay close attention to the problem while in the field.

3.6 Qualitative assessment of facilitators and barriers to program use in Ntchisi district

The qualitative study was conducted under the umbrella of the impact evaluation of the Ntchisi nutrition program. The goal of this qualitative study was to assess and document physical and sociocultural facilitators and barriers to program utilization by mothers of children 6-23 months. This research complemented program evaluation activities in describing the culture, perceptions, and value of the interventions being delivered, from the perspective of the community and the primary beneficiaries.

This section describes the study's data collection and measurements, sampling and sample sizes, and analysis that were used to respond to this research question.

3.6.1 Data collection

The qualitative research study was conducted 1.5 years after program implementation, from November to December 2015. The timing of this study allowed participants to have had the required duration of exposure and experience with the program to respond to questions about the program and their experience with it in an informed and meaningful way. Qualitative research strategies and methodologies included IDI, direct observations, and FGD. Data collection followed an iterative process, beginning with IDI and direct observations, using emergent themes to guide and inform future IDI and FGD.

3.6.1.1 Semi-structured in-depth interviews

Semi-structured IDIs are scheduled, open-ended conversations that are based on a clear plan and set of questions that the interviewee seeks to answer.[9] Structured interviews were selected as a preferred method of interviewing for this study given their flexibility in gathering deep and rich data, all the while using a field guide that covered a

list of questions and topics that responded to specific research questions, and that could be used by various interviewers to gather similar types of information.[9]

In this study, semi-structured IDIs were used to explore facilitators and barriers that influenced mothers' participation in the program, both as they related to the use of the Nutributter, as well as to the behavior change components of the program. Specific aspects of the Nutributter and of the SBCC that were valued and/or not valued, and how these increased or decreased the use and acceptability of the program's interventions, were elicited. These included taste, ease of use, and knowledge of Nutributter benefits, and self-efficacy to implement improved child feeding behaviors, as these could affect a mother's desire and ability to properly feed her child. The IDIs also focused on specific components of the nutrition program's SBCC component, and their perceptions and feasibility of incorporating SBCC messages and behaviors into their daily child care and feeding practices. Mothers were asked to elaborate on specific behaviors (for instance, washing their hands, seeking care for their children during illness, breastfeeding practices, meal frequency, and feeding of nutritious foods) that they practiced, as well as those that they were not able to adhere to, and why.

Interviews were conducted at the household, with mothers of children 6-23 months, as well as other important household members such as fathers and grandmothers (in a subsample of households only). IDIs with influential members of the household, such as the child's father, or a grandmother were performed to broaden understanding of the context in which mothers made decisions as they related to program participation and their child's nutrition and care, and how much these were influenced by household members. Interview field guides for family members were the same as those used with

mothers of children 6-23 months.

Each respondent participating in an IDI was asked a similar set of questions based on a pre-established semi-structured theme-oriented field guide (Appendix B). The development of field guides was a multi-stage and iterative process, which began with a set of questions that were deemed adequate in eliciting information that responded to the research questions of interest. Field guides were then translated into Chichewa, the local language in which IDIs were conducted, and reviewed with data collectors for accuracy and comprehensibility during their training, at which point clarifying edits were made. Field guides were then piloted in the field, after which further clarifications and additions were made. Lastly, data collectors were instructed to add probes and questions to the guides throughout the data collection process, as un-planned and newly discovered themes arose. One participant was interviewed more than once to obtain further clarification or exploration of key themes.

3.6.1.2 Direct observations

Direct observation is a technique that involves continuous monitoring, that is, watching a person or a household, to know and see what people *actually* do,[9] as compared to what they *tell you* they do in IDIs or through other survey methods. In this setting, direct observations were structured, which involved giving observers a pre-determined set of behaviors to focus on and record, for example handwashing, child feeding, and mother-child interactions. As with other study tools used in this research, the direct observation guide was developed using an iterative approach, which first involved conducting a set of unstructured direct observations (n=6) by the study supervisors (JRB, RO). These sessions were used to broaden our understanding of the setting, and pinpoint

the specific behaviors that the guides should bring special attention to. Once developed, the direct observation guide was piloted and discussed to improve and refine the guides, and to standardize the observation procedure across the multiple research assistants.

Data from direct observations was used to complement and triangulate information collected by the IDIs regarding a range of maternal behaviors around IYCF. Special attention was paid to breastfeeding, complementary feeding, food preparation, water, sanitation, and hygiene practices, child stimulation, and mother-child interactions (Appendix C). Direct observations were conducted after an IDI in a subsample of households, and were scheduled to ideally capture a feeding episode, to allow for the extensive documentation of: the types/amounts of foods served and consumed, number of times the child self-fed, vessel(s) used for feeding, physical actions used to help the child consume the food, verbal and non-verbal interaction between the caregiver and the child, handwashing before, during or after feeding, and responsive and nonresponsive caregiver behaviors applied during feeding episode. Whenever feeding of Nutributter was observed, special attention was paid to assessing how consumption of the Nutributter influenced consumption of other foods (substitution), and sharing of the Nutributter with other household members. Additional activities that the mother and/or other family members were engaging in before or after the feeding episode, their timing, duration, and location/setting, as well as descriptions of the physical and environmental setting, were also documented using the direct observation guide. Direct observations provided a rich supplement to the data collected by the IDIs and to the behaviors mothers employed to feed and care for their children in this setting.

3.6.1.3 Focus group discussions

FGDs involve the recruitment of a group of people to discuss a particular topic.[9] In this study, FGDs were conducted with village leaders, nutrition Promoters, and CGVs, to enable a better understanding of their perceptions of the purpose and rationale of the nutrition program, how these modified the acceptability of the program in their communities, ways in which these perceptions changed over time, and, where applicable, details about their responsibilities in program delivery and implementation. The types of participants were the same in each FGD, that is, "types" of community members were not mixed. One FGD was conducted with village leaders only, another with nutrition Promoters only, and two with CGVs only. The objective of separating "types" of community members into specific FGDs was to elicit and categorize common themes that arose based on their common status and responsibilities in the community and in their households. In the case of the nutrition Promoters and CGVs, these themes were centered on their involvement in the program's delivery, their experience in interacting with mothers and level of influence they perceived on mothers' program uptake and utilization, and the common challenges they faced in relaying health and nutrition messages to members in their community.

FGD field guides were used (Appendix D). The development of field guides for the FGDs was similar to that used and described for the IDI guides, where a set of questions that responded to the research questions of interest were elaborated for each type of FGD and translated into Chichewa. Translated field guides were then reviewed with data collectors for accuracy and comprehensibility during training. The timing of FGDs was scheduled to occur in the latter part of data collection to allow emergent themes from IDIs and direct observations to be integrated into the FGD guides and to verify or

triangulate information that was received in IDIs with a broader group of community members participating in the FGDs. The two best interviewers were selected to lead the FGDs, and each FGD had a note-taker to facilitate recording, logistics, and transcription. As with the IDIs, FGD leaders were trained and encouraged to explore additional themes that were not pre-specified in the guide but that arose during the discussion.

3.6.2 Sampling and sample sizes

A multi-step sampling process was used to identify participants for the IDIs with mothers and household members. First, program monitoring data (SCOpe) was used to assess village size, based on the number of eligible children living in each village across the district. Second, villages were selected using purposive, clustered criterion sampling, which involved searching for clusters of individuals who met a certain criterion. Criterion under which clusters (in this case villages) were selected were: (i) representative of at least half (4 out of 7) of the Traditional Authorities (TA) in Ntchisi district; (ii) village size with a median number of eligible children (6) or larger; and (iii) high and low village-level participation. The calculation of village-level participation was done by obtaining de-identified individual-level data gathered by the WFP's monitoring system that generates monthly attendance records through the use of card scanning technology at each distribution session (SCOpe). The use of "clusters of participation" was selected to protect the privacy of program participants and the data that was collected for them under program operations. For sampling purposes and once village-level participation was calculated, villages were categorized as being of high or low participation, using the following criteria: high participating clusters were those who had 50% participation or greater in the last 3 months; low participating clusters were those who had 49% participation or less in the last 3 months. Once villages were stratified by these three

criteria (representativeness, participation, and village size), a random number generator was used to randomly select 5 villages with each type of participation and from the 5 health centers that surrounded the District Health Office (Mkhuzi, Chinthembwe, Khuwi, Chinguluwe, Kangolwa), to meet the criterion of representativeness at the sub-district (TA) level.

In the 5 villages selected for sampling, qualitative data collectors were dispatched into the villages and used snowball sampling, with the support of the village head, to identify mothers of children 6-23 months (n=3 mothers per village, n=15 mothers per participation level, total n=30 IDI with mothers). Mothers who were present and met the criteria for inclusion (had a child of the desired age range) were asked to participate in IDI until the desired number of interviews was performed.

Influential household members, such as fathers or grandparents, were sampled for interviews in a sub-sample of households where mother's IDIs were being conducted (n=1-2 per village, n=7-8 per participation level, total n=15 IDIs with household members). Also in a sub-sample of households, direct observations were performed either preceding or following the interview (n=5 per participation level, total n=10 direct observations). The purpose of selecting mothers and family members in this way was to obtain a diverse set of perspectives from families living in different settings and contexts, and with varying levels of program participation.

Sampling for focus group discussions with village leaders, nutrition Promoters, and CGV was done at the sub-district (TA) level using convenience sampling. Similar to the sampling for the IDIs, participation data was analyzed at the TA-level to identify high and low-participating TA. For logistical purposes, one TA was selected for the FGD with

village heads and nutrition Promoters, while for FGDs with the CGV, one high and one low participation TA was selected to increase the variation in responses regarding the implementation of the SBCC strategy. Upon selection of the TA in which the FGD would take place, traditional authorities were visited and requested to convene 8-10 village heads, nutrition Promoters, and CGVs, depending on the type of planned FGD in that TA. FGDs were held at an accessible and well-known location (nearest health center, TA offices) and on a specified date and time. Figure 3.4 summarizes the sampling schematic and corresponding sample sizes used for this qualitative study; sample sizes in this figure represent actual numbers of IDIs and FGDs conducted and are thus slightly greater than planned samples sizes discussed here.

3.6.5 Analytic approach

Textual data from IDIs and FGDs was simultaneously transcribed and translated, verbatim, from Chichewa to English by the research assistant who conducted the interview. Key themes from IDIs and FGDs were used to create a formal codebook with definitions for each code, for which subsequent line-by-line coding was done by a team of four JHU researchers (KH, RO, NKK, JRB), all of whom were present during all or some of the training and data collection, and who also participated in debriefings in the field. All coders were very familiar with the context, the study, and its objectives. Analysis of textual data followed a Grounded Theory approach,[10] wherein themes that emerged from or, were "grounded" in the data were incorporated into continuing data analysis, coding (see Appendix E for a sample list of codes used), and interpretation. Common with the Grounded Theory approach, this involved, specifically, close supervision of field interviews and procedures, regular debriefing with data collectors,

and review and discussion of incoming transcripts to identify key themes and to continue exploring those in further data collection and analysis. In addition, a hybrid of the SEM[7] and the Transactional Model[11] were used to analyze the data and report on individual and community behaviors (Figure 3.5). The SEM emphasizes the multiple levels of society that can influence health behaviors and outcomes,[7,12] starting with the organizational, then community, followed by household, and finally, the individual. The incorporation of the transactional model was done at the individual level of the SEM, given its focus on the dynamic interaction (give-and-take) between individuals (in this case, a mother and her child) (Figure 3.5).[11,13] Analyzing the data at each of these levels improved our understanding of the multiple factors that influence behaviors, and how they interact or are related in this study setting.

To ensure consistency across the four coders, an inter-rater reliability (IRR) test was performed on multiple segments of text from IDIs prior to commencing coding activities (5-17 segments per IDI on 10% of IDIs). Cohen's Kappa statistic, which measures agreement in coding of text as compared to a gold standard coder (JRB), was measured and was within acceptable ranges (Cohen's Kappa statistic=0.72-0.79). Results of the IRR test were reviewed and discussed among all coders to maximize future alignment of coding activities. Each IDI was coded by one of the four standardized coders.

All qualitative (textual) data analysis, including data management, coding of transcripts, and classification of excerpts, was done using Dedoose Version 6.1.18, a web application for managing, analyzing, and presenting qualitative and mixed method research data (SocioCultural Research Consultants 2015). Findings were organized and presented in a conceptual framework that was based on a methodology used in a similar

study by Ickes and colleagues (2012). The conceptual framework visibly diagrams the program's two main components studied, and the associated facilitators and barriers identified and for each of the levels of the SEM.

3.7 Process evaluation of the Malawi nutrition program

The process evaluation study combined data from various sources, including the nutrition program's monitoring and evaluation systems, the impact evaluation's qualitative study, and additional data collected on program functioning and knowledge of front-line staff. The goal of the process evaluation study was to assess the program's implementation using indicators of recruitment, fidelity, and reach, based on Linnan and Steckler's definitions.[2] A slight modification to their definitions was made by nesting indicators of program quality, dose delivered, and dose received under the broader indicator of program fidelity, as presented in Table 3.2. This section describes the study's data sources, collection, measurements and analysis, and sampling and sample sizes that were used to respond to this research question.

3.7.1 Sources of data for the process evaluation of the Ntchisi nutrition program

3.7.1.1 Program design and implementation documents

The indicators used to conduct the process evaluation were borne out of the program's implementation theory, which was developed based on a review of programmatic documents. These included program design documents, such as the program concept note and logical framework. Documents generated throughout the course of program implementation, such as qualitative study reports, monitoring and evaluation reports (PDM, specifically), and peer reviewed publications,[3,14,15] were also used to inform the development of the program's implementation theory. In addition,

informal discussions with program staff at all levels and throughout the duration of the program's implementation, as well as participation in WFP's APRs, were instrumental in understanding intricacies of program implementation and data-informed course-corrections.

3.7.1.2 In-depth interviews

In-depth interviews conducted under the qualitative study (described above) that elicited information about the program's functioning and the caregiver's experience as a beneficiary, were used in this process evaluation. Details of registration procedures, child's age at enrolment, community-level notification procedures to enroll children at the designated age, and reasons for non-participation, were all used to clarify procedures and methods used to recruit participants and identify reasons for non-participation, both of which were considered under the 'program recruitment' indicator.

3.7.1.3 Focus group discussions

Data on program staff's work responsibilities, work-related activities in the community, training received, and adequacy and understanding of program messages that was collected under the qualitative study (see above) was also used for this process evaluation. FGD with program staff were critical in clarifying program functioning and to respond to process indicators of fidelity.

3.7.1.4 Program monitoring data

The program's monthly attendance monitoring system, SCOpe, collected and reported individual- and district-level program coverage data for all program beneficiaries using an electronic card-scanning technology and real-time reporting to a system dashboard. Monthly attendance records from all program beneficiaries who had

ever participated in the program in the first (year 0-1) and first three (years 0-3) of the program January 2014-December 2014 and 2016, respectively), were provided by WFP and used to report on the program's recruitment and reach (coverage) for the Nutributter distribution component.

Post-distribution monitoring surveys, also conducted by WFP, were conducted quarterly and were based on interviews with beneficiary households using self-reported receipt of Nutributter, SBCC messaging, and Nutributter use behaviors. Eight PDM surveys were conducted in the program's first three years of implementation (see the program's timeline of activities in Figure 3.2 for details); these were used in the process evaluation for the indicators of program recruitment, program fidelity, and program reach of the SBCC component.

In addition to SCOpe and PDM, data specific to SBCC activities, which was supervised by the implementing partner, World Vision, was obtained from APR documents, which presented a summary of staff trained and staff activities more broadly. Although data regarding the functioning and delivery of SBCC activities was collected and reported on by World Vision on a monthly and quarterly basis, a summary of such activities was deemed sufficient and appropriate for this process evaluation. APR data was used for process indicators of program fidelity's components of dose delivered and received.

3.7.1.5 Direct Observations

Structured direct observations of Nutributter distributions and one-on-one counseling sessions between CGVs and mothers were conducted to add depth and understanding of specific programmatic procedures, and to assess the quality component of fidelity to

program design. Direct observations of the program's Nutributter distribution activities (Appendix F) demonstrated how the program was delivered in practice, which supported the triangulation of what was observed with maternal and staff reports of how the program functioned. These were also useful in deepening our understanding of the beneficiary's experience as a participant in the program. Direct observations of one-on-one counseling sessions between CGV and beneficiary mothers (Appendix G) were done with the objective of gathering data on knowledge and communication of product use, and health, nutrition, and sanitation messages, and mother's understanding of these messages.

3.7.1.6 Knowledge questionnaires with program staff

Nutrition, sanitation, and Nutributter knowledge of Promoters and CGVs was assessed using structured knowledge questionnaires. Knowledge questionnaires were designed to test the nutrition and sanitation knowledge of nutrition Promoters and CGV (Appendix H) based on the four modules they reported having been trained on, which included: (1) breastfeeding; (2) complementary feeding; (3) WASH; and (4) Nutributter use. All questions within each module were based on the messages as they appeared in the flipbooks staff received to conduct CGV training and/or household-level counseling. Completion of training, also as reported by program staff, was used to measure dose received under the program fidelity indicator.

3.7.2 Measurements and analysis of process evaluation data

Much of the data used for this process evaluation was provided by WFP. Additional data that was collected included direct observations of program procedures and

interviews with program staff to assess their knowledge. Structured guides were used to conduct both types of direct observations.

The process under which the implementation theory was used as a basis for the process evaluation is similar to that which was described by Kim et al[16] and Olney et al.[17] Using this methodology, the implementation theory was integrated into the program's logic model, which enabled the identification of the variables that were already, or still needed to be collected and/or compiled as part of the process evaluation to best measure the what, why, and how of the program's interventions along each of the program's main components. The development of the program's implementation theory was heavily based on data collected by IDIs and FGDs, which was analyzed using an inductive thematic approach[18] to develop codes that are grounded in the data.[10,19,20] Codes then supported the identification, analysis, and reporting of patterns and themes within the data, which could be used to describe and draw the program's implementation theory (Figure 3.6). Process indicators included measures of recruitment, fidelity, and reach. Each of these are described in detail in this section, with their corresponding indicators, which are summarized in Table 3.3.

3.7.2.1 Program recruitment

Program recruitment refers to the procedures used to approach and attract participants. A review of program documents, discussions with program field staff and HSAs (who play a significant role in recruitment), and qualitative data collected during FGDs was used to clarify the methodology used for the recruitment of beneficiaries. The extent to which the recruitment protocol was followed was verified using program monitoring data (both SCOpe and PDM). Specifically, program recruitment was

measured using the following indicators, with their source of data specified in parentheses:

- % eligible beneficiaries registered by 6 months of age (SCOpe)
- % mothers who did not receive Nutributter at the last distribution (PDM)
- Reasons (%) for not receiving Nutributter, among mothers who did not receive Nutributter in the last distribution (PDM)

The proportion of eligible beneficiaries registered by 6 months of age was calculated for the first year of program implementation only (January-December 2014), as data from subsequent years was unavailable. This indicator was assessed by calculating how many children had been enrolled at or by the age of six months beginning in March 2014, or 2 months after the initiation of the program. This was done to provide a grace period given the calendar, rather than age-based initiation of the program, which counted all children between the ages of 6-23 months enrolled in January and February 2014 (during mass enrolment activities) as being enrolled on time. The number of children enrolled at 6 months was divided over the total number of children who had ever attended a distribution session in the program's first year of implementation to assess timely enrolment. The two subsequent indicators of non-participation came from PDM survey data, provided by WFP. PDM data was pooled, and mean proportions were calculated for each indicator presented.

3.7.2.2 Program fidelity

Program fidelity was adapted from Linnan and Steckler's definitions[2] to include elements of quality of implementation, as well as dose delivered and dose received. To get at quality of implementation, direct observations of program operations, and

structured interviews (knowledge questionnaires) with front line staff, were used. Direct observations focused on the two primary components of the program: (1) Nutributter distributions (Appendix F); and (2) one-on-one counseling by CGVs (Appendix G). Direct observations of distributions were done at health centers (n=6) and EDP (schools, churches, or other community structure) (n=8), with the dual purpose of seeing how the program was delivered in practice, and to understand broadly the beneficiary's experience as a participant in the program. Observations focused on logistical aspects of distribution, such as whether the card scanning technology was functioning, waiting time of mothers at the distribution point, and availability, quantity, and correct distribution of the food commodity. To understand the mother's experience as a beneficiary, observations also captured the dynamics and interactions between mothers and program (distributing) staff.

Observations of one-on-one counseling sessions between CGVs and beneficiary mothers (n=14), gathered data on knowledge and communication of Nutributter use, and health, nutrition and sanitation messages. These attempted to capture elements of understanding on the part of the mother, as well as the style of counseling used, for example, whether the CGV used their flipbook to explain the concepts or not, and to what extent they engaged the mother in the counseling session.

Knowledge of front line workers was assessed using structured interviews with both CGVs (n=70) and nutrition Promoters (n=14). These tested their completion of training as well as knowledge of IYCF, WASH, and Nutributter messages based on modules on which they reported having been trained on. Program fidelity was measured using the following indicators, with their source of data specified in parentheses:

- % distributions with functioning card scanning technology (direct observation)
- Duration of distribution sessions (direct observation)
- % distributions with adequate stock of Nutributter (direct observation)
- % distributions where correct number of packets was distributed to all/some/no mothers (direct observation)
- % distributions where all/some/no mothers were treated courteously (direct observation)
- % distributions where Nutributter, IYCF, and/or WASH messages were delivered to all/some/no mothers (direct observation)
- % mothers who received group counseling at distributions (direct observation)
- % mothers who received counseling on IYCF, WASH, and/or Nutributter messages during one-on-one counseling (direct observation)
- % Promoters/CGVs who completed training modules (each module and all 4 modules) (knowledge questionnaires)
- Promoter and CGV knowledge of Nutributter, IYCF, and WASH messages (knowledge questionnaires)
- Waiting time at the distribution point (PDM)

Dose delivered (sometimes measured as "utilization")[21] and dose received were nested under the program fidelity indicator, and were measured as the "proportion of the intended intervention that was actually delivered to, and received by the intended audience".[2] The two indicators are closely related, where dose received represented a measure of program utilization by the target beneficiary, which in this case represented

either mothers of eligible children or program staff, who were the recipients of training activities. Program monitoring data from annual performance reviews were used to assess dose delivered using the following indicators:

- % care groups formed (APR)
- % health staff trained in program delivery (APR)
- % SBCC cadres trained (APR)
- % Open Nutrition Days Conducted (APR)
- % billboards erected (APR)
- % promotional campaigns on IYCF conducted (APR)

As with dose delivered, program monitoring data from PDM captured much of the indicators that measure dose received. The indicators used to measure dose received, with their data source in parentheses, were the following:

- Mean number of households visited per month by CGVs (knowledge questionnaires)
- % target beneficiaries who attended a community event (PDM)
- % target beneficiaries who heard a radio message (PDM)
- % mothers who could recognize at least 3 nutrition messages (PDM)
- % mothers who reported that their child consumed 1 sachet of Nutributter in the last 24 hours (PDM)
- % mothers who reported that Nutributter was shared (PDM)
- % households who experienced a gap in Nutributter supply (PDM)
- Mean number of gap days among households who experienced a gap in Nutributter supply (PDM)

Analysis for program fidelity indicators was descriptive. The number of times specific activities (specified above) were observed as being done correctly, based on total number of observations, was used to calculate proportions used to represent program functioning. Similarly, the proportion of CGVs and nutrition Promoters who provided a "correct" answer to each question was calculated based on total staff who had answered that question, for three key questions per module. Mean knowledge scores were also calculated for each module among program staff who had completed each module. One point was assigned for each correct answer, and the total number of points was summed to create a score. Highest possible scores for the modules were 27 for breastfeeding, 34 for complementary feeding, 5 for WASH, and 9 for Nutributter. A "global" knowledge score was not calculated due to a very low proportion of staff (5.7% of CGVs and 21.4% of nutrition Promoters) having completed all four training modules.

3.7.2.3 Program reach

Program reach, or "the proportion of the target audience that participated in the intervention",[2] sometimes also referred to as "coverage" [21] was measured for the two primary program components. The proportion of beneficiaries attending monthly distribution sessions used individual-level attendance data (SCOpe) from all program beneficiaries who had ever participated in the program from January 2014-December 2016. Measurement of reach of the SBCC activities was based on PDM data of maternal report of receipt of individual and group counseling. Specifically, indicators to measure program reach, with their source in parentheses, included:

- % target/eligible beneficiaries attending monthly Nutributter distribution sessions (SCOpe)

- % target/eligible beneficiaries who received a home visit by a CGV (PDM)
- % target/eligible beneficiaries who received group counseling (PDM)

Both domains of program reach were measured using program monitoring and evaluation data provided by WFP.

To facilitate understanding and synthesis of all process indicators collected and presented, Olney and colleague's (2013) categorization method was used.[17] This method involved categorizing crude proportions for each process indicator into one of the following categories: "working well" (>75%), "needs improvement" (25-75%), and "not working" (<25%). Data from qualitative activities such as opinions by program staff on how certain components were working were also considered in this categorization, and concerns raised by more than a few respondents were classified as "needing improvement" or "not working". Once classified, each of the indicators captured in the process evaluation were integrated into the program's logical framework and linked with the program theory to highlight downstream outcomes or impacts that may be affected by the program's implementation.

All analyses of quantitative data were performed using Stata v13.1 (StataCorp, College Station, TX); all analyses of qualitative data were performed using Dedoose Version 6.1.18, a web application for managing, analyzing, and presenting qualitative and mixed method research data.[22]

3.7.3 Sampling and sample sizes

3.7.3.1 Program monitoring data

Data from the program's SCOpe system, which tracks monthly attendance at distribution sessions using a card scanning technology, was used to assess indicators of

program recruitment (at 1 year of implementation) and program reach (at 3 years of program implementation). In the first year of program implementation (January to December 2014), n=22,556 children had ever been registered into the program; those who were enrolled at or by 6 months of age were considered to have been enrolled on time. After 3 years of program implementation (January 2014 to December 2016), n=41,617 children had ever been registered into the program; their participation data was provided by WFP and used to measure reach of the program Nutributter component.

Data from eight PDM surveys (January 2014-December 2016) were pooled and used to calculate the above-specified indicators used in this process evaluation. The sampling strategy for each PDM survey was the same: a two-stage stratified sampling method based on district population data and program registration lists was used. In the first stage, clusters (group village heads (GVH), a traditional aggregation of villages in Malawi) were randomly selected from district population data using probability proportional to size sampling. In the second stage, mothers with children aged 6-23 months were randomly selected for inclusion in the survey. PDM sample sizes were calculated based on a 65% estimated prevalence of participation and a 0.065 level of precision for the prevalence estimate requiring a sample size of n=330. Sample sizes for each PDM survey are as follows: PDM 1, n=368; PDM 2, n=386; PDM 3, n=390; PDM 4, n=369; PDM 5, n=358; PDM 6, n=344; PDM 7, n=340; PDM 8, n=346. The total number of children pooled from these eight PDM surveys is n=2,901, and data from all PDMs was shared by WFP and used for this process evaluation study.

3.7.3.2 Direct observations and knowledge questionnaires

Stratified purposive sampling was used to select direct observation sites for Nutributter distributions; sampling for knowledge questionnaires and direct observations of one-on-one counseling stemmed from this initial sampling of Nutributter distributions. First, 1 health center and 1 EDP in each of the district's seven TA was randomly selected using a random number generator in Microsoft Excel (2011), for n=14 observations of monthly distributions. In TAs with only one health center (n=3), no random selection was performed.

Sampling of Promoters and CGV for knowledge questionnaires was based on the sampling scheme used for the direct observations of Nutributter distributions described above. Using a district-wide roster of field-level program staff, Promoters were identified at each health center and EDP at which an observation of Nutributter distribution was conducted. In cases where more than one Promoter was present, one Promoter was randomly selected to participate in the knowledge questionnaire (total Promoter n=14). Subsequently, one of every two CGVs who fell under the selected Promoter's catchment area was randomly selected from the staff roster and asked to participate in knowledge questionnaires (CGVs per Promoter=5, total CGVs n=70). One of every five CGVs who participated in knowledge assessment interviews was randomly selected for observations of one-on-one counseling sessions.

3.8 Measuring the association of varying levels of program exposure and nutrition and IYCF outcomes

The third research objective of this study was to measure the association between household, maternal, and individual characteristics and varying levels of program exposure. The secondary objective was then to measure how those varying levels of

program exposure were associated with anthropometric and IYCF outcomes. To achieve this objective, two data sources were used. Individual-level data from the program's monitoring system (SCOpe) on attendance at monthly Nutributter distribution sessions in the first year of implementation was used to calculate a program participation score for the LNS component in the program district. Data from the impact evaluation's midline survey was used to create a variable to measure exposure to the SBCC, as well as to create outcome variables of household, maternal, and individual characteristics, child anthropometry and IYCF practices. This section describes the study sample and sample sizes, enrolment criteria, data collection and measurements, and the analytic plan to address the research question.

3.8.1 Sampling and sample sizes

The sampling frame for the impact evaluation's cross-sectional surveys included all small-to medium-sized villages, defined as having a total population of 150-600 people, in all 12 health catchment areas of Ntchisi district and 14 of 23 health catchment areas in Dowa. Villages with less than 150 people or more than 600 people were excluded for purposes of maximizing data collection efficiency and potentially different characteristics of unusually large villages. The 9 health catchment areas excluded in Dowa were purposively excluded due to either their proximity to Ntchisi or Lilongwe, or topographical differences that could affect the comparability of the villages between the two districts. In addition, one health center catchment area in Dowa was excluded because it houses a large refugee population. The required number of villages to achieve the sample size of children aged 6-23 months for the cross-sectional baseline, midline, and endline surveys was calculated as 108 per district, and these were randomly sampled

using probability-proportional-to-size sampling, using the sampling frame described above. Door-to-door household listing of all household members in all sampled villages was performed at each survey to identify eligible household members (children 6-23 months and pregnant and lactating women).

The sample size for the impact evaluation's cross-sectional surveys were determined based on published prevalence rates of stunting of 50% in this population, and an absolute reduction in the prevalence of stunting of 6%, that is, 2% reduction per year over the course of three years of program implementation between intervention and comparison groups. Assuming an alpha (Type I error) and beta (Type II error) of 0.05 and 0.20, respectively, and a 10% loss to follow up rate, the calculated sample size was estimated at 1200 children 6-23 months per district, or 2400 children total, per survey (base-, mid-, and endline), for a total of n=7,200.

3.8.2 Measurements

A program participation variable for exposure to Nutributter distributions was created by linking individual-level data from the impact evaluation's midline survey to the program's monitoring system, SCOpe. As has been described, SCOpe uses a card scanning technology at monthly Nutributter distributions to capture attendance data among program beneficiaries in the district. Participant card numbers, which were collected under the impact evaluation's midline survey, were used to link participants from the survey to their program participation data as collected by SCOpe.

All other measures used to respond to this research objective were obtained from the impact evaluation's midline survey, which was conducted from January 2015-March 2015 (Figure 3.2), exactly 12 months after the program's launch. Midline survey data was

collected over three months, beginning with the district of Ntchisi (January-February), followed by the district of Dowa (February-March).

Midline impact evaluation data specific to exposure to SBCC, child anthropometry, IYCF and hygiene practices, and sociodemographic characteristics was used to create the remaining variables used in this analysis. Anthropometric measurements were conducted on all children included in the midline impact evaluation survey, and included recumbent length, and weight, which were measured using a Seca 417 length board and Seca 374 infant scale, respectively. Dietary intake was measured by the administration of a 24-hour food frequency questionnaire, which asked mothers about specific foods that were consumed by the child in the 24-hour period preceding the survey. For each of the foods that the mother reported the child to have consumed, the mother was then asked to report the number of times those foods were consumed over the 24 hour period. Hygiene behaviors (handwashing practices, water treatment, and provision of treated water to the child) and sociodemographic characteristics were based on maternal self-report. Child age was recorded from the child's health passport or maternal self-report if the health passport was not available, or had been lost or damaged.

3.8.3 Variable creation

Individual-level program participation in Nutributter distributions was measured as the number of months the child received Nutributter as compared to the total months that child was eligible to receive Nutributter, and expressed as a %, ranging from 0 to 100. Months of eligibility were calculated based on the age at which the child should have been enrolled (6 months), rather than the age at which the child was actually enrolled, as the latter would potentially over-estimate program participation. Program exposure was

dichotomized into high and low program participation in the program district based on the distribution of the participation (median program participation, 71.4%). Children who participated in the midline survey and who did not have a recorded participant ID card and/or number were excluded from the analysis. Children in the comparison district of Dowa were used as the referent category of "no" participation.

SBCC is delivered through various channels and platforms in both the program and comparison districts. Channels include: (1) one-on-one counseling at the household level; (2) group counseling at under-five well-visits and Nutributter distributions in the program district; and (3) mass media messaging through billboards, radio clubs, and Open Nutrition Days. SBCC exposure was measured by first creating a score, where 1 point for exposure to each channel was assigned. In the program district, to account for the group counseling component of Nutributter distributions and to eliminate the risk of "double counting" exposure to group counseling, 1 and 2 points were awarded for low and high participants, respectively. The range of the SBCC score was therefore 0-3 in the comparison district and 1-4 in the program district. The SBCC exposure score was further categorized into no, low, and high exposure based on the SBCC score's median (SBCC score of ≤1). An SBCC score of zero was categorized as no exposure (comparison district only), an SBCC score of one was categorized as low exposure, and an SBCC score of 2-4 was categorized as high exposure.

Sociodemographic data, such as child sex and age, maternal education and occupation, and household-level characteristics, including ownership of basic assets and household construction materials, and food insecurity, were also used, either to create a wealth index or to be included in models as potential confounders. Wealth quintiles were

created using the methodology used for Demographic and Health Surveys (DHS) and published by ICF Macro,[23] which involved the use of socioeconomic variables such as the ownership of basic consumer items, household dwelling characteristics, and access to sanitation and hygiene. Following a removal of items with low variability (<5%) and stepwise reduction of assets with <0.3 factor loading, assets that were included in the wealth index included: household ownership, sand as a flooring material, mud and brick as a wall material, a thatch or galvanized sheet roof, ownership of a latrine, radio, bicycle, mobile phone, tape or CD player, bed, mattress, sofa, and table with chairs. A principal components analysis was generated to create a factor score with these assets, which was then used to create wealth quintiles.

Child age was calculated in months using the child's recorded date of birth. Household food insecurity was calculated based on the Household Food Insecurity Access Scale (HFIAS) methodology,[24] which uses indicators of the food insecurity experience to categorize households on a spectrum of food insecurity status that ranges from food secure to severely food insecure. The HFIAS methodology focuses on three domains of food insecurity, including anxiety and uncertainty about the household food supply (1 question), insufficient quality of food (3 questions), and insufficient food intake and its physical consequences (5 questions). For each of the questions, participants who report having experienced any of the conditions are then asked to state the frequency with which they experienced it (rarely, sometimes, or often), with which they are categorized as food secure, and mildly, moderately, and severely food insecure. Households are categorized as increasingly food insecure as they respond affirmatively to more severe conditions and the frequency with which they experience them, as illustrated in

Supplementary table 3.1. Maternal education was dichotomized by those having completed primary school (8 years) or not.

Children's anthropometric data on length and weight were used to generate length-for-age (LAZ), weight-for-age (WAZ), and weight-for-length z-scores (WLZ), as well as proportions of stunted, underweight, and wasted children. Children's length and weight measurements were converted to z-scores (LAZ, WAZ, and WLZ) using the WHO's Growth Reference Standards.[25] Stunting, underweight, and wasting were defined as LAZ, WAZ, and WLZ, respectively, that was less than -2 standard deviations below the reference median for that child's age and sex.

Infant and young child feeding outcome variables of dietary diversity score (DDS), minimum meal frequency (MMF), minimum dietary diversity (MDD), and minimum acceptable diet (MAD) were constructed from child's 24-hour food frequency data collected in the midline cross-sectional survey. World Health Organization definitions and guidelines[26] were used to construct these composite indicators, each of which is described in Table 3.4. IYCF knowledge was measured by creating a score (range 0-8) where 1 point was assigned to correct answers about how to feed a young child, including breastfeeding practices, types of foods that should be fed, feeding frequency by age (6, 9, and 23 months), and feeding during illness. DDS was measured continuously, based on the number of food groups consumed in the last 24 hours. MDD refers to the proportion of children who consumed ≥4 food groups; MMF is measured as a minimum frequency of meals based on child age and breastfeeding status; and MAD combines MMF and MDD to report the proportion of children who achieved both the MDD and MMF.

A handwashing score (range 0-4) was created based on handwashing at four critical time points (after using the toilet, after cleaning the child's nappy, before feeding the child, and before cooking food); one point was awarded for each mother's mention of handwashing *with soap* at these times. Water treatment methods reported by mothers were analyzed as a binary variable of correctly treating water or not, based on WHO/UNICEF's Joint Monitoring Program for Water Supply and Sanitation definitions (Table 3.4).[27]

3.8.4 Analytic approach

Cross-tabulations of program exposure and basic socioeconomic, IYCF and WASH, variables were conducted to assess for and understand differences between mothers and children with various levels of participation and exposure. Chi-square tests for categorical variables, and Kruskal-Wallis H tests for continuous outcomes were used to test for significant differences in basic characteristics across categories of participation. The cltest option in Stata, which provides optional support for group stratified outcomes, was used to adjust for village-level clustering when measuring for differences in continuous and binary outcomes across levels of program exposure. To understand the association between household, maternal, and child characteristics and program exposure, multinomial logistic regression was used. Models were adjusted for household, maternal and child characteristics of interest, and estimated prevalence ratios (PR) and 95% confidence intervals (CI) for each level of participation (high and low) compared to the reference category of 0 or no participation. Although the outcome of program participation was arguably an ordinal (no, low, and high exposure) outcome, some of the predictor variables used in ordered logistic regression analyses (using the ologit

command in Stata) violated the parallel regression assumption. The parallel regression assumption states that the relationship between all pairs of groups is equal, thus providing only one set of coefficients.[28] The parallel regression assumption was tested using the Brant test.[28]

The dose-response analysis measured the association between participation in the program's Nutributter component or exposure to SBCC channels and anthropometric outcomes and IYCF practices that were posited to be influenced by participation in the program. Multiple linear and logistic regression for continuous and binary outcomes was used to obtain adjusted beta coefficients and odds ratios and their standard error or 95% confidence intervals, respectively. The cluster command (vce in Stata) was used to account for study design effect (village-level clustering) in all models to produce robust standard errors and 95% confidence intervals. Using this option, the calculation of standard errors allowed for intragroup correlation by relaxing the usual requirement that observations be independent within groups (villages). All models were adjusted for potential confounders of household wealth, maternal education, child sex, and age. Models that included hygiene outcomes were also adjusted for distance to a water source, and models that measured the association between infant and young child feeding knowledge and IYCF practices (DDS, MDD, MMF, MAD) were adjusted for household food insecurity. Confounders included in the models were selected based on proven or hypothesized evidence of associations between the selected confounder, the exposure, and the outcome, while not being on the causal pathway. Dose-response trends were assessed by comparing the overlap of confidence intervals between categories of interest (i.e. high vs. low).

Significance of all outcomes of interest was tested at $P < 0.05$. All statistical analyses were performed using Stata version 13.0 (Stata Corporation, College Station, TX, USA).

3.9 Quality control and data management

All IDI and FGD (textual) data collected under the qualitative study was recorded. At the end of each day of data collection, audio files were transferred to a password-protected study computer that was in the possession of the field supervisor; all files were saved using a standard naming convention. Audio files also remained on interviewer's individual recording devices to facilitate transcription and translation. All IDIs and FGDs were simultaneously translated and transcribed into their own notebooks. IDIs and FGDs that required more than one notebook were stapled together to keep the IDI or FGD as one unit. Hand-written transcriptions and direct observation data were typed into Microsoft Word.

Paper-based data from the midline impact evaluation survey was double entered in country at Wadonda Consult, Inc.'s central office, using a custom data entry program developed specifically for this survey. Personal identifiers were included in the database, but access to identifiers was restricted and stored on a secure, password-protected server that is accessible by authorized study personnel.

Data for all study activities was kept in the possession of the field supervisor under lock and key, with the exception of when it was reviewed by the study lead (JRB) and/or other study staff (RO, KH, AB, ABM). Upon the completion of all field activities, data (paper and digital) was transferred to the Wadonda Consult, Inc. central office in Zomba, Malawi. Final datasets were transferred to the JHU study team using a password-protected data management system, and only de-identified data was used in the analysis

phase for security purposes. Access to analytic datasets was restricted to authorized study personnel.

Agreement and permission to use data generated by the SCOpe system was granted to JHU CHN research staff under the contract with the program and impact evaluation donor agency, the Children's Investment Fund Foundation (CIFF). All SCOpe-generated data was de-identified and linked with de-identified midline data by use of the program participant ID.

3.10 Ethical considerations and approvals

The JHU-led impact evaluation of the Malawi nutrition program, including questionnaire forms, research plan, and consent forms, was approved by the Institutional Review Boards (IRB) at the Johns Hopkins University Bloomberg School of Public Health (IRB No.5237), and the College of Medicine Research and Ethics Committee (COMREC) in Malawi. Julie Ruel-Bergeron was listed as a student investigator in the impact evaluation study. Amendments to the research protocol were submitted to, and approved by both IRBs prior to the initiation of qualitative and process evaluation data collection activities conducted in late 2015 and 2016, respectively.

Informed consent was obtained from all mothers, community members, and program staff who participated in structured and unstructured interviews or focus group discussions under the various study components described above. Illiterate respondents were consented by stamping their fingerprint (rather than signing their names) on the consent form. All consent forms were translated and administered in the local language, Chichewa, and included an explanation of the study objectives, study procedures, potential risks and benefits to participation, and participation on a voluntary basis, with

option to withdraw at any point and for any reason. All study participants received a copy of the consent form, with a local contact name (JP), address, and phone number, which they could reach out to for questions or reporting of adverse events.

All interviews and discussions were completed in less than 2 hours, which was considered to be moderately disruptive to participant's daily schedules and responsibilities. Nevertheless, the potential harm in participation was minimal given the lack of sensitivity of issues discussed. An exception to this were study activities that involved program staff, who could have felt threatened by questions related to their impressions of the work responsibilities, the program, and their knowledge of program messages on which they were trained. Nevertheless, and as with all other study data, all data was collected and managed by research assistants who were trained in ethical matters and who maintained confidentiality by keeping completed questionnaires stored away during field work, and submitting completed questionnaires to the team supervisors at the end of each day. All data was kept under lock and key at all times, and once entered, all data at the analysis and reporting stage was de-identified.

The impact evaluation study was registered at ClinicalTrials.gov with number NCT02985359.

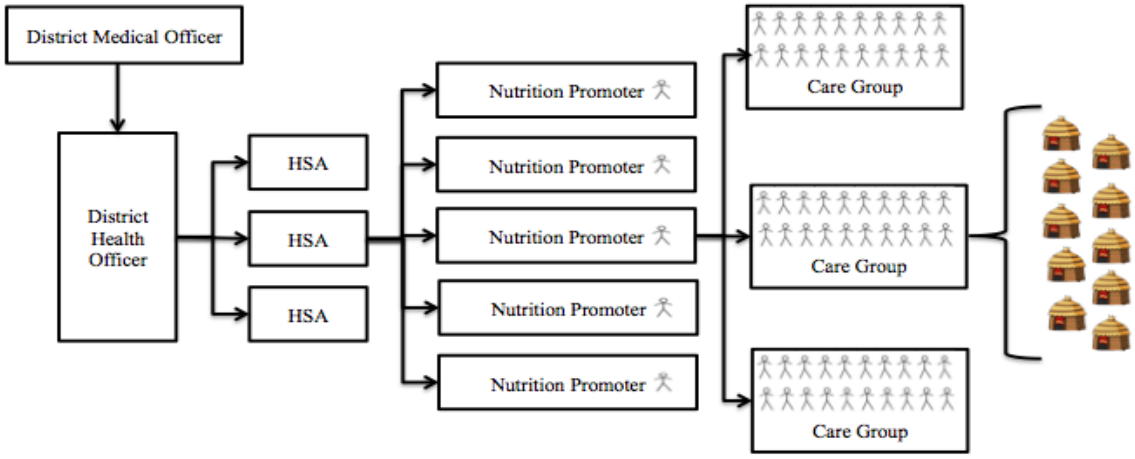
Tables and Figures

Table 3.1 Summary of research objectives, methods and sample sizes, data source, and data analysis used in this study

Research objective	Methods and sample size	Data source	Data analysis
1. To assess and document facilitators and barriers to program utilization by mothers of children 6-23 months in the program district of Ntchisi	49 IDI with families of children 6-23 months • 34 mothers • 4 grandmothers • 11 fathers 4 FGD with community members • 1 with village leaders (n=11) • 1 with nutrition Promoters (n=12) • 2 with CGV (n=10 and n=11)	Qualitative study in the program district of Ntchisi under the program impact evaluation (Nov-Dec 2015)	Grounded theory, using theoretical constructs from the Socio-Ecological Model and Transactional Theory.
2. To test the Malawi nutrition program's implementation theory using process evaluation indicators of recruitment, fidelity, and reach.	Program design and implementation documents (logical framework, program concept note, qualitative study reports)	Provided by program implementers (WFP and WV)	Review and illustration of implementation theory
	49 IDI with families of children 6-23 months (see RO1) FGD with community members (see RO1)	Qualitative study (see RO1)	Inductive thematic analysis
	Routine monthly program monitoring data (n=22,556 year 0-1; and n= 41,617 year 0-3)	SCOpe (Jan 2014-Dec 2016)	• Proportions that describe program recruitment, reach, and fidelity • Categorization of proportions for each indicator into "working well" (>75%), "needs improvement" (25%-75%), and "not working" (<25%)
	Routine quarterly program monitoring data (n=2,901)	8 PDM surveys (Jan 2014-Dec 2016)	
	Direct observations • Nutributter distributions (n=14) • One-on-one counseling by CGV (n=14)	Process evaluation study conducted in Ntchisi district (Dec 2016)	
	Knowledge questionnaires with program staff • Nutrition Promoters (n=14) • CGV (n=70)		
3. To measure the characteristics associated with varying levels of program	Surveys with mothers of children 6-23 months • Program district of Ntchisi (n=1,179) • Comparison district of Dowa (n=1,208)	Cross-sectional midline survey of the impact evaluation, conducted in Ntchisi and Dowa districts (Jan-Mar 2015)	• Unadjusted multinomial logistic regression • Multivariable linear and logistic regression for continuous and

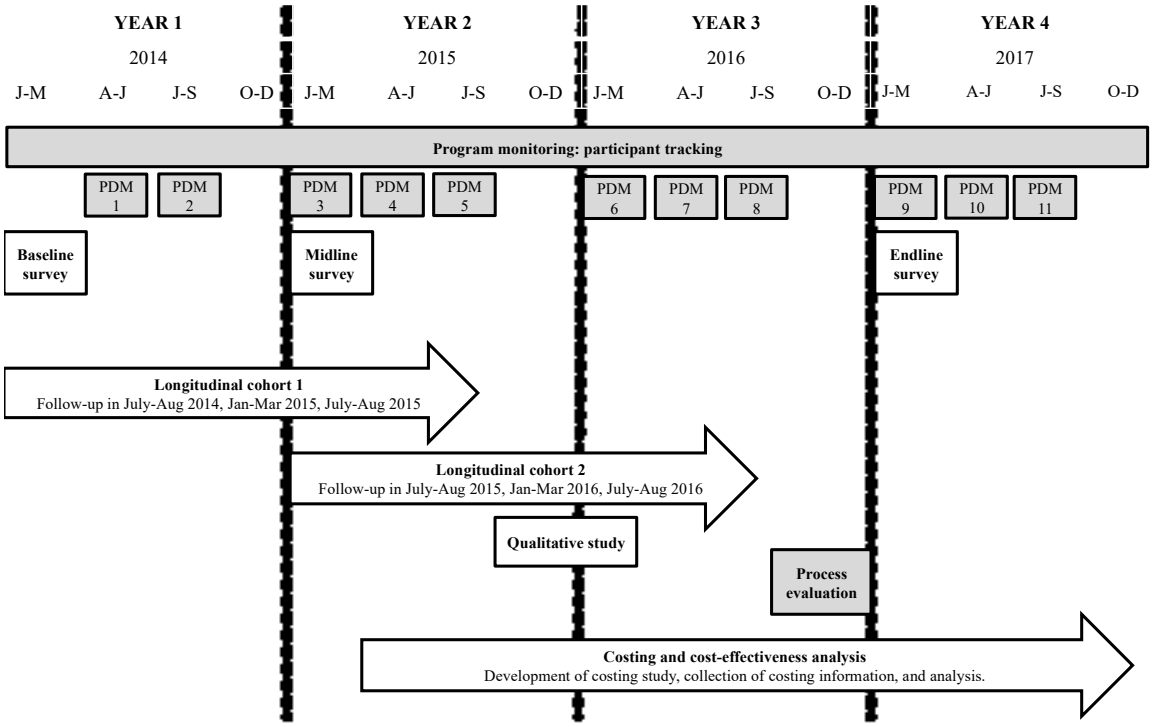
Research objective	Methods and sample size	Data source	Data analysis
participation.	Monthly attendance records for mothers of eligible children in Ntchisi district (n=22,556)	SCOpe data from year 1 of program implementation (Jan-Dec 2014)	binary outcomes, respectively, adjusted for potential confounders and study design

Figure 3.1. The Promoter-led Care Group Model in Malawi



HSA: Health surveillance assistant

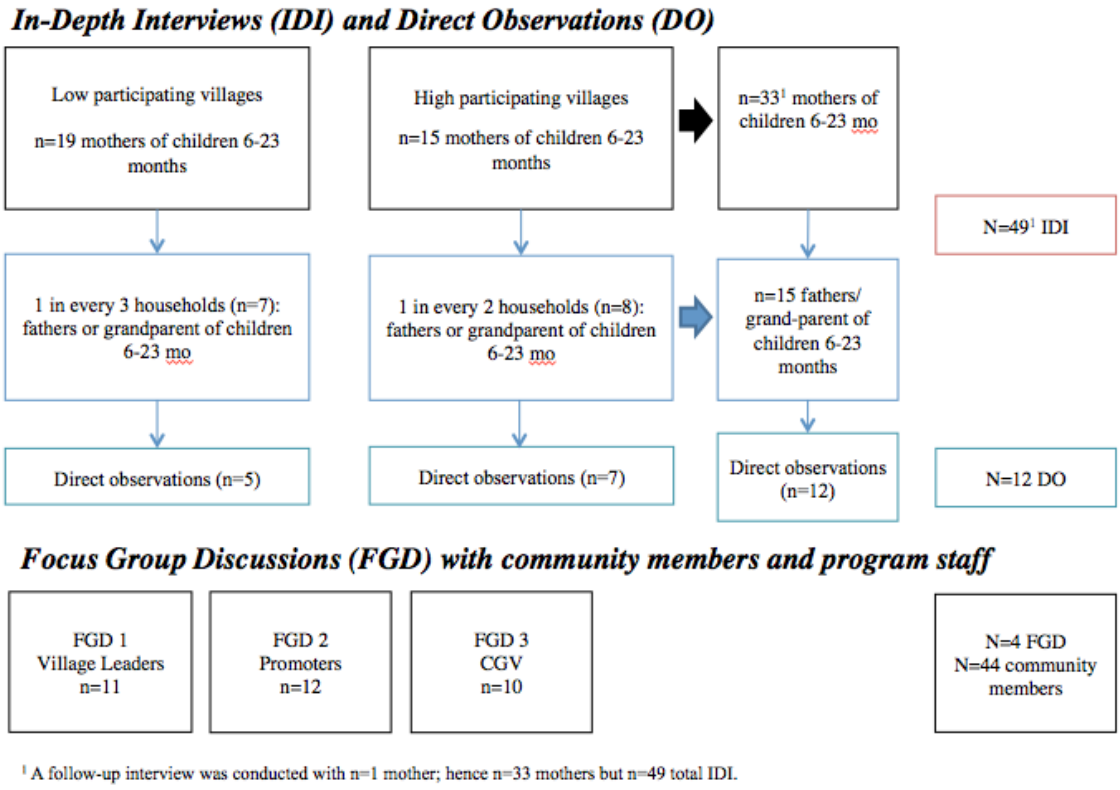
Figure 3.2 Timeline and activities included under the Malawi nutrition program's independent impact evaluation



J-M: January to March; A-J: April to June; J-S: July to September; O-D: October to December.
Boxes shaded in grey are those that relate to assessments of program implementation and monitoring; white boxes and arrows include research activities that assess program impact.

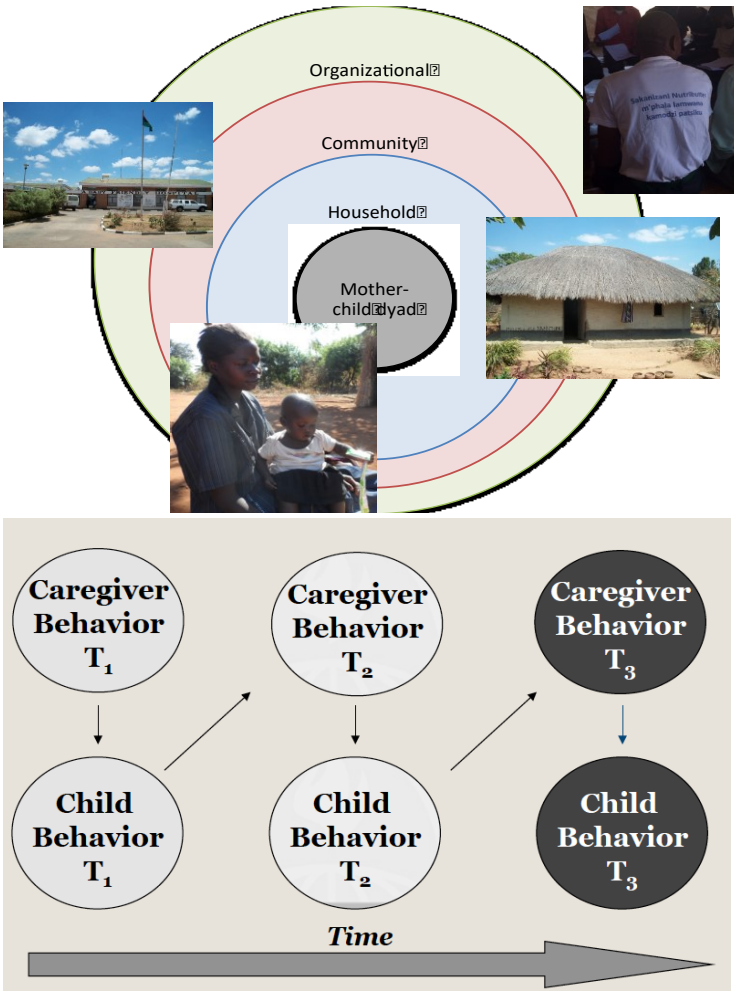
Figure 3.3 District-level map of Malawi and study sites

Figure 3.4: Sampling schematic and sample sizes for the qualitative research study



[1] A follow-up interview was conducted with n=1 mother; hence n=33 mothers but n=49 total IDI.

Figure 3.5 Hybrid of the Socio Ecological Model and Transactional Theories used for the design, data collection, analysis, and presentation of results of the qualitative study

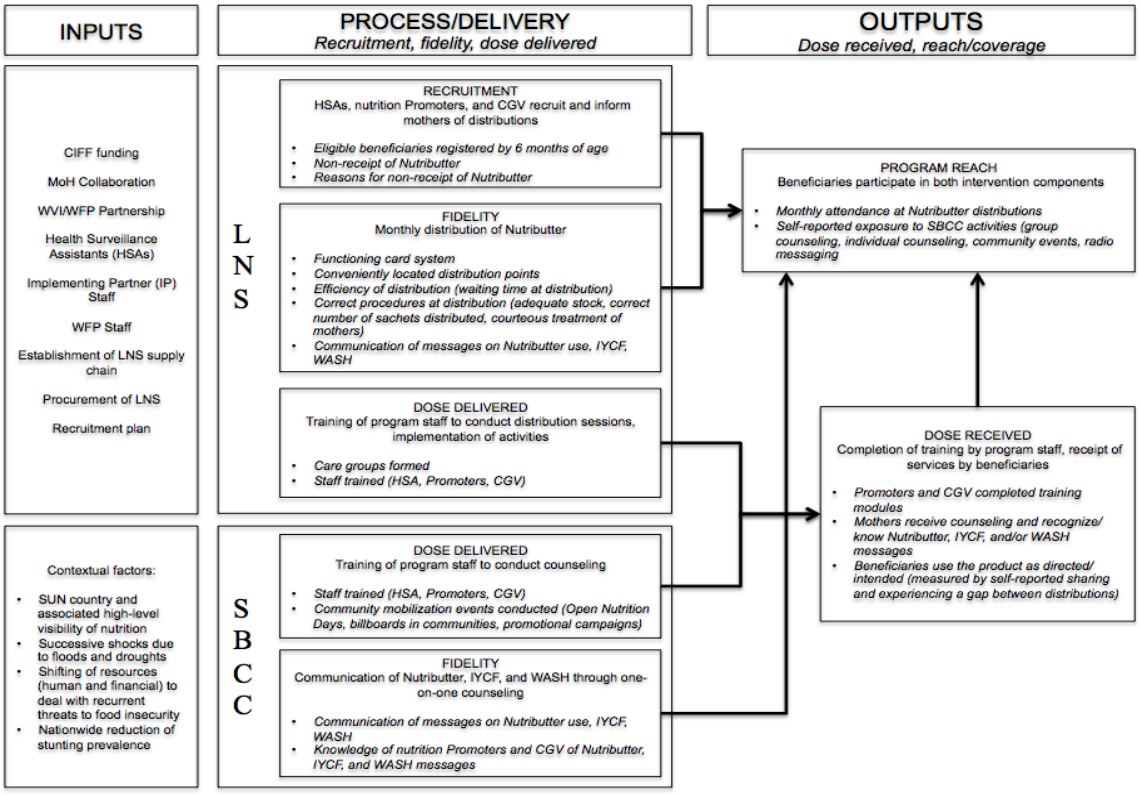


Adapted from McLeroy et al.'s[7] Socio-Ecological Model and Sameroff's Transactional Theory.[13]

Table 3.2 Definition of key process evaluation components included in this study, based on Linnan and Steckler (2002)

Process evaluation component	**Definition**
Recruitment	Procedures used to approach and attract participants. Recruitment often occurs at the individual and organizational/community levels.
Fidelity	The extent to which the intervention was delivered as planned. It includes three critical elements of quality, dose delivered, and dose received.
Quality	The quality and integrity of the intervention as conceived by the developers.
Dose delivered	The number of intended units of each intervention or each component that are delivered
Dose received	The extent to which the target audience (of the dose delivered indicator) actively engages with, interacts with, is receptive to, and/or uses materials or recommended resources.
Reach	The proportion of intended target audience that participates in an intervention, often measured by attendance. Reach is a characteristic of the target audience.

Figure 3.6. Implementation theory for the nutrition program implemented in the district of Ntchisi, Malawi



LNS: Lipid-based nutrient supplement; SBCC: Social and behavioral change communication; CGV: Care Group Volunteer; HSA: Health Surveillance Assistant; IYCF: Infant and Young Child Feeding; WASH: Water, Sanitation, and Hygiene

Table 3.3 Summary of data collection methods, sample, and indicators used for the process evaluation of the nutrition program in Ntchisi district, Malawi

Type of process variable	Objective	Data source	Sample size	Measurement/ Indicators
Program recruitment	To clarify procedures and methods used to recruit participants, and identify reasons for non-participation.	Review of available program design and implementation documents Informal discussions with program design and implementing staff	N/A	• Description of procedures used to attract and recruit participants • Reasons for non-participation
		IDI with mothers	n=34	
		IDI with household members	n=15	
		FGD with: • Promoters • CGV	 n=11 n=22	
		Program M&E systems: SCOpe	n=22,556	• Eligible beneficiaries registered by 6 months of age, %
		Program M&E systems: PDM surveys	n=2,901	• Mothers who did not receive Nutributter at last distribution, % • Reasons for not receiving Nutributter, among mothers who did not receive it in previous distribution, %
Program fidelity: Quality of implementation	To evaluate the extent to which the program is being delivered as it was intended, including an assessment of the *quality* and	Direct observations of Nutributter distributions	n=14[1]	• Functioning of card scanning technology, % • Duration of the distribution session, mean hours • Adequate stock of Nutributter at the distribution, % • Correct distribution of Nutributter, % • Courteous treatment of mothers at distribution, % • Communication of Nutributter usage messages, % • Communication of IYCF and WASH messages, % • Receipt of group counseling at distribution, %

Type of process variable	Objective	Data source	Sample size	Measurement/ Indicators
	integrity of its delivery.	Direct observations of CGV delivering SBCC	n=14	• Communication of IYCF and/or WASH messages, % • Communication of Nutributter usage messages, %
		Knowledge assessments with Promoters Knowledge assessments with CGV	n=14 n=70	• Training completed by Promoters and CGV, % • Promoter and CGV knowledge of Nutributter messages • Promoter and CGV knowledge of IYCF messages • Promoter and CGV knowledge of WASH messages
		Program M&E systems: PDM surveys	n=2,901	• Waiting time at distribution point, median hours
Program fidelity: Dose delivered	To measure how much of the program's intended activities were delivered to the target beneficiaries.	Program M&E systems: APR	N/A	• Care groups formed, % • Health staff trained in program delivery, % • Training of SBCC cadres, % • Open Nutrition Days conducted, % • Billboards erected, % • Promotional campaigns on IYCF, %
Program fidelity: Dose received	To measure the extent to which all program components are received and utilized by target beneficiaries	Knowledge assessments with CGV	n=70	• Households visited per month by CGV, mean
		Program M&E systems: PDM surveys	n=2,901	• Target beneficiaries who attended a community event, % • Target beneficiaries who heard a radio message, % • Mothers who recognized at least 3 nutrition messages, % • Consumed 1 sachet of Nutributter in last 24 hours, % • Nutributter shared, % • Households experiencing a gap in Nutributter supply, % • Gap days among households experiencing a gap in supply, mean
Program reach	To measure the % of eligible beneficiaries who are reached by the program.	Program M&E systems: SCOpe	n=41,617	• Target beneficiaries attending monthly Nutributter distribution sessions, %
		Program M&E systems: PDM surveys	n=2,901	• Target beneficiaries who received a CGV home visit, % • Target beneficiaries who received a group counseling, %

APR: Annual performance review; CGV: Care Group Volunteers; EDP: Extended Distribution Point; FGD: Focus group discussions; IDI: In-depth interviews; M&E: Monitoring and Evaluation; PDM: Post-distribution monitoring; SCOpe: System for Cash Operations.

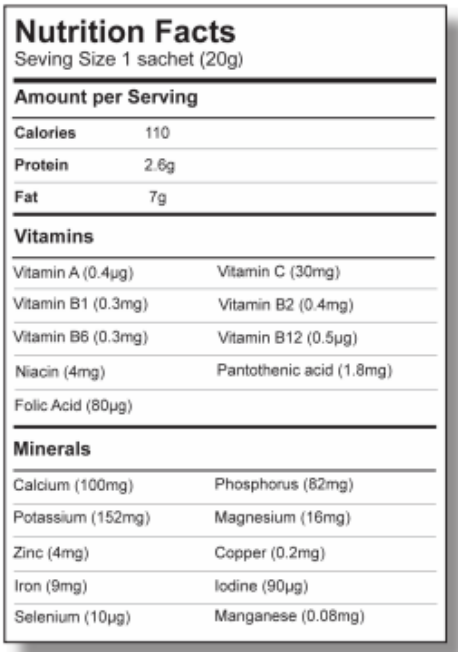
1 An imbalance in observations of Nutributter distributions at the health center and EDP resulted from a misunderstanding of distribution dates, which yielded one more EDP-based observation than planned, and one less health center-based observation than planned. Nevertheless, the total number of observations of Nutributter distributions (n=14) remained as planned.

Table 3.4 Definitions and construction of infant and young child feeding, water, sanitation and hygiene, Nutributter use, and anthropometric outcomes

Indicator	Definition	Type of variable
Nutrition outcomes		
LAZ, WAZ, WLZ	Length and weight measurements were converted to z-scores using the WHO Growth Reference Standards.	Continuous
Stunting	% of children who are stunted. Stunting is measured as less than -2 standard deviations below the length-for-age of the reference population (children of the same age and sex)	Binary
Underweight	% of children who are underweight. Underweight is measured as less than -2 standard deviations below the weight-for-age of the reference population (children of the same age and sex)	Binary
Wasted	% of children who are wasted. Wasting is measured as less than -2 standard deviations below the weight-for-length of the reference population (children of the same age and sex)	Binary
Infant and young child feeding, and hygiene variables		
Infant and young child feeding knowledge score	Calculation of a score that assigns one point for each correct answer to the following eight questions: (1) how soon after birth a child should start breastfeeding; (2) other than breastmilk, should any foods be given to a 0-6 month old child; (3) feeding frequency for a 6 to 8 month child; (4) feeding frequency for a 9 to 11 month old child; (5) feeding frequency for a 12 to 23 month old child; (6) types of nutritious foods that should be part of a young child's diet; (7) whether a sick child should be fed less, more, or same as normal; (8) whether a child recovering from illness should be fed less, more, or same as normal.	Continuous
Dietary Diversity Score	Calculation of a food group score (range 0-7) based on the consumption of foods falling into the following food groups in the previous day: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, fish, poultry and liver/organ meats); (5) eggs; (6) vitamin A-rich fruits/vegetables; (7) other fruits and vegetables. For each of the food groups included in the score, a score of 0 is assigned when none of the foods in that group are consumed, and a score of 1 indicates that at least 1 food from that group was consumed.	Continuous
Minimum dietary diversity	% of children 6-23 months who receive foods from 4 or more food groups (out of the 7 food groups listed above)	Binary
Minimum meal frequency	% of children (breastfed and not breastfed) 6-23 months who receive solid, semi-solid, or soft foods the minimum number of times or more. The minimum number of times is 2 for breastfed children 6-9 months, 3 for breastfed children 9-23 months, and 4 for non-breastfed children 6-23 months.	Binary
Minimum acceptable diet	% of children 6-23 months who receive a minimum acceptable diet. Minimum acceptable diet is a composite of the minimum dietary diversity and meal frequency indicators.	Binary
Handwashing score	% of mothers who reported handwashing with soap at critical times. Critical times included: after defecation, after contact with the child's stool, after going to the toilet, before preparing food, before eating, before feeding a child.	Continuous
Treated water	Water treatment that was considered adequate included: boiled, boiled and filtered, filtered, solar disinfection, covering the container, adding bleach/chlorine.	Binary

Source: WHO, 2008[29] for IYCF variables; WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation, 2016[30] for facility variables; Ram, P., 2010,[31] for handwashing variables; WHO Growth Reference Standards[25] for nutrition outcomes.

Supplementary figure 3.1 Nutritional composition and contents of Nutributter supplement



Nutrition Facts

Seving Size 1 sachet (20g)

Amount per Serving	
Calories	110
Protein	2.6g
Fat	7g

Vitamins	
Vitamin A (0.4µg)	Vitamin C (30mg)
Vitamin B1 (0.3mg)	Vitamin B2 (0.4mg)
Vitamin B6 (0.3mg)	Vitamin B12 (0.5µg)
Niacin (4mg)	Pantothenic acid (1.8mg)
Folic Acid (80µg)	

Minerals	
Calcium (100mg)	Phosphorus (82mg)
Potassium (152mg)	Magnesium (16mg)
Zinc (4mg)	Copper (0.2mg)
Iron (9mg)	Iodine (90µg)
Selenium (10µg)	Manganese (0.08mg)

Supplementary table 3.1. Categories of food insecurity in the Household Food Insecurity Access Scale (HFIAS)

Question	Frequency		
	Rarely	Sometimes	Often
1. In the past four weeks, how often did you worry that your household would not have enough food?			
2. In the past four weeks, how often were you or any member of your household not able to eat the kinds of foods you preferred because of a lack of resources?			
3. In the past four weeks, how often did you or any household member have to eat a limited variety of foods due to a lack of resources?			
4. In the past four weeks, how often did you or any household member have to eat foods that you really did not want to eat because of a lack of resources to obtain other types of foods?			
5. In the past four weeks, how often did you or any household member have to eat a similar meal than you felt you needed because there was not enough food?			
6. In the past four weeks, how often did you or any household member have to eat fewer meals in a day because there was not enough food?			
7. In the past four weeks, how often was there ever no food to eat of any kind in your household because of lack of resources to get food?			
8. In the past four weeks, how often did you or any household member go to sleep hungry because there was not enough food?			
9. In the past four weeks, how often did you or any household member go a whole day without eating anything because there was not enough food?			

Food secure

Mildly food insecure

Moderately food insecure

Severely food insecure

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Chapter 4: Physical and sociocultural facilitators and barriers to access and utilization of a nutrition program in rural Malawi: A qualitative study

4.1 Abstract

Objective: To understand the facilitators and barriers to participation in a district-wide nutrition program aiming to reduce stunting among children 6-23 months of age in rural Malawi.

Methods: A nutrition program being implemented in Ntchisi District of Malawi since 2014 distributes a monthly ration of daily fortified, lipid based nutrient supplements (called Nutributter) to mothers of eligible children, and a social behavior change communications (SBCC) package of infant and young child feeding (IYCF) and water, sanitation and hygiene (WASH) messages to improve growth. A qualitative study was conducted to elicit participant household and community perceptions of and experiences related to the program. Semi-structured in-depth interviews with mothers (n=34), fathers (n=11), and grandmothers (n=4) of children aged 6-23 months; focus group discussions (FGD) with village leaders (1 FGD of n=11) and program staff (3 FGD of n=12, n=10, and n=11, respectively); and direct observations of mothers and their children (n=12 pairs) were conducted. Grounded theory guided all study processes. Dedoose v.6.1.18 was used for data management, coding, and analysis. Theoretical constructs from the Socio-Ecological Model and the Transactional Model were used to summarize and present results.

Results: Nutributter was viewed positively by all members of the household and community. Visible changes in child health and growth described and ascribed to the

introduction of Nutributter was an important determinant of program participation and adherence. Benefits to participation far outweighed perceived barriers to utilization of Nutributter. Barriers that affected participation were related to monthly collection of Nutributter and included competing tasks or obligations that prevented travel to the distribution site. Household-level misuse of Nutributter, despite widespread knowledge that the product was not for sharing, was also noted as a potential barrier to the program achieving its intended impact. Limited and superficial knowledge of the SBCC IYCF and hygiene messages, and lack of financial and physical access to nutritious foods promoted by those messages constituted significant barriers to enacting desired behavioral changes among mothers. Respondents also had difficulty recalling certain IYCF messages, such as "the six food groups", suggesting that such constructs were alien to the socio-cultural landscape of the target communities and therefore hard to understand and apply.

Conclusions: In this setting of high food insecurity, a program that provides a food supplement achieved widespread acceptance in the community and perceived benefits to child health and nutrition. Increasing the flexibility of distribution arrangements and using locally available, seasonally specific foods in program messaging for improved infant and young child feeding practices may be needed to further boost participation and drive desired changes in behavior.

4.2 Introduction

The global burden of undernutrition, manifested mostly as stunting and micronutrient deficiencies, is significant and contributes to 45% of deaths among children under five years of age.[1] The dire consequences of stunting, not only for the health and development of children, but also for future economic and social development of nations[1] and the need to intervene as early as possible, have been increasingly recognized in global movements such as Scaling Up Nutrition,[2] the World Health Assembly's Global Targets 2025,[3] and the 2030 Sustainable Development Goals.[4] Nevertheless, progress towards the reduction of stunting has been extremely slow, especially in countries like Malawi, which represents a case of near-complete stagnation in stunting prevalence over more than one decade, going from 49% in 2000, to 47.8% in 2004, and 47.1% in 2010.[5–7] Inadequate complementary feeding, high child morbidity, among other factors, have been associated with stunting in rural Malawian infant (≤12 mo) populations.[8] Other underlying factors such as widespread poverty and household food insecurity, may further contribute to the observed high prevalence of child stunting in this context.

Since January of 2013, the Government of Malawi has been working towards reducing child stunting in one district, Ntchisi, through a large-scale nutrition intervention that includes a social behavior change communication campaign (SBCC) that promotes optimal infant and young child feeding (IYCF) and water, sanitation and hygiene (WASH) practices, and the monthly provision of a daily small-quantity lipid-based nutrient supplement (SQ-LNS), Nutributter (Nutriset, Malaunay, France), to all children 6-23 months of age.

Nutrition education that promotes optimal infant and young child feeding practices for children aged 6-23 months has been shown to be effective in improving breastfeeding and complementary feeding practices in a variety of contexts, such as in Bangladesh, Ethiopia, and Vietnam under the Alive & Thrive initiative.[9–13] In Ethiopia, a large-scale SBCC intervention that promoted improved breastfeeding and complementary feeding practices led to improvements in all but one (continued breastfeeding at 12 months of age) of the WHO-recommended IYCF practices.[13,14] In a review of evidence for nutrition interventions, complementary feeding further demonstrated impact on child growth, and in food insecure settings, yielded gains in height (height-for-age z-score (HAZ) of 0.25, 95% CI 0.09-0.42) and a reduction in the risk of stunting (RR: 0.68, 95% CI 0.60-0.76).[15] Effects on linear growth were amplified when combined with complementary food provision (with or without education) (HAZ of 0.39, 95% CI 0.05-0.73).[15]

The evidence for the benefits of lipid-based nutrient (LNS) supplements, however, has been mixed, especially in Malawi where many LNS efficacy trials have been carried out.[16–24] Though most results trended in favor of LNS, Mangani et al (2013) showed appositive and significant impact on linear growth, while Phuka and colleagues (2008 and 2009) reported a reduction only in severe stunting (HAZ<-3SD).

Despite the evidence that exists around the efficacy of the program's selected interventions, their delivery and implementation at scale and in a programmatic context presents a new set of challenges such as physical and sociocultural characteristics and real-world complexities that can hamper the achievement of nutrition impact.[25] In Malawi, for example, a major barrier to the uptake of complementary feeding messages by mothers could be related to the lack of access, both financial and physical, to foods

due to widespread food insecurity[26] and poverty. With respect to the program's Nutributter component, a new set of challenges arise, ranging from storage and leakage concerns, to cultural acceptability, digestibility, and palatability of the food.[27] In addition, and irrespective of uptake of the supplement, household level utilization, such as sharing, has been documented as being problematic in this and other similar settings.[28–30]

Thus, in a programmatic context in rural Malawi, we sought to identify and understand the facilitators and barriers, and the extent to which such factors influenced, either by enabling or challenging, program beneficiaries' access to, participation in, and utilization of a nutrition program after almost 2 years of implementation.

4.3 Methods

4.3.1 Setting and programmatic context

This qualitative study was conducted from November to December 2015 under the umbrella of the broader impact evaluation of a Government of Malawi-implemented nutrition program in the district of Ntchisi. Ntchisi district is located in the central region of Malawi, with a population of almost 200,000 people, or 47,500 households, with an estimated 15,000 children between the ages of 6-23 months. A majority of families in Ntchisi belong to the Chewa tribe (97%), and housing characteristics indicate that the population is generally poor and rural (Johns Hopkins University baseline report, 2014, unpublished). Most households in the district do not have electricity and have minimal asset ownership (Johns Hopkins University baseline report, 2014, unpublished). Access to an improved drinking water source and latrine ownership, however, is relatively high (>80%)(Johns Hopkins University baseline report, 2014, unpublished). The majority (>75%) of households depend on agriculture as their main livelihood, and educational

attainment is relatively low (7y among men and 5y among women), especially among women (Johns Hopkins University baseline report, 2014, unpublished).

The Ntchisi nutrition program was launched in January 2014, with the technical and financial support from the World Food Programme (WFP) and the Children's Investment Fund Foundation (CIFF), respectively, with the aim of reducing the prevalence of stunting during the critical window of opportunity of a child's life. Program components include: 1) blanket distribution of a ready-to-use, daily packaged SQ-LNS (20g, 108 kcal), Nutributter (Nutriset, France), to all children 6-23 months, and 2) an SBCC package that promotes improved IYCF and WASH practices. The SBCC is built on a community-based "care group model",[31] which uses a nutrition Promoter who is chosen by his or her own community members, and supervised by government-paid extension health workers (HSA), to champion nutrition issues in his/her village. Each Promoter is responsible for 1 to 3 groups of 10 to 12 Care Group Volunteers (CGV), who act as community-based health and nutrition educators that disseminate key program messages at the household level. CGV interact regularly with their assigned Promoters for additional training and support.

Studying and understanding the way in which the described program components were perceived and used by target beneficiaries, was done through in-depth interviews (IDIs), direct observations, and focus group discussions (FGDs). These methods, described in detail below, allowed for an exploration of the facilitators and barriers to program use, and the extent to which these influenced participation in the program.

4.3.2 In-depth interviews

Semi-structured IDIs were used to elicit maternal and other influential caretaker's

perceptions of the program, and the extent to which these influence their program participation. IDIs with household members were performed to broaden our understanding of the context in which mothers make decisions as they relate to program participation and their child's nutrition and care. Interviews were conducted at the household, with mothers of children 6-23 months, as well as with other household members (fathers and grandparents) of these same children.

4.3.3 Focus group discussions

Focus Group Discussions were conducted with village leaders and program staff (nutrition Promoters and CGVs, separately) to enable a better understanding of their perceptions of the purpose and rationale of the nutrition program, how these have impacted the acceptability of the program in their communities, ways in which these perceptions have changed over time, and, where applicable, details about their responsibilities in program delivery and implementation. The purpose of separating "types" of community members into specific FGDs was meant to elicit and categorize common themes that might arise based on their common status and responsibilities in the community, and in the case of the Promoters and CGV, for whom FGDs were separately conducted, on their involvement in the program's delivery and the facilitators and barriers they face as program staff.

4.3.4 Direct observations

Structured direct observations were used to complement and triangulate information collected in the IDIs regarding a range of maternal behaviors around infant and young child feeding (including Nutributter use), food preparation, water, sanitation, and hygiene practices, child stimulation, and mother-child interactions. Feeding observations

extensively documented whatever activity the mother was engaging in for a period of approximately two hours preceding or following the IDI.

4.3.5 Sampling

IDI participants in this study were purposively selected from the program district only (Ntchisi). A multi-step sampling process that relied on de-identified program monitoring data was used to identify villages that fit a certain criteria, and from which mothers and household members were selected for IDI; figure 4.1 diagrams the sampling schematic and sample sizes used in this study and described below. Criterion under which clusters (villages) were selected included: (i) representing at least 4 out of 7 of the Traditional Authorities (TA) in Ntchisi District; (ii) village size containing the median number of eligible children (6) or larger; (iii) high (≥50%) and low (<50%) village-level participation among eligible program beneficiaries. The calculation of participation levels was done using de-identified individual-level data from the program's monitoring and evaluation system that uses a card-scanning technology at each distribution session to provide real-time participation data. Snowball sampling was used to identify mothers of children 6-23 months in selected villages with the assistance of the village chief. Influential household members, such as fathers and grandmothers of those same children, were also sampled for interviews in a sub-sample of households where mother's IDI were being conducted, using convenience sampling (Figure 4.1).

Village leaders and front-line program staff (Promoters and CGV) were sampled at the sub-district (TA) level for FGDs using convenience sampling. Upon selection of the TAs in which FGDs were to be conducted, TA were visited and asked to convene 8-10

village leaders, Promoters, or CGV. FGDs were conducted in accessible and well-known locations to maximize convenience and participation.

4.3.6 Data collection and tools

Grounded theory[32] guided all major study processes, including design of field tools, data collection, and analysis. The development of field guides was a multi-stage and iterative process, wherein field guides were developed based on our research questions, translated to the local language (Chichewa), reviewed and edited with data collectors for comprehensibility, and further refined after piloting activities in the field and throughout data collection. Participants were interviewed more than once if further clarification or exploration of key themes was deemed necessary.

The data collection team comprised five data collectors and one supervisor, who was responsible for field logistics and staff supervision. All data collection staff participated in a one-week training, were native to Malawi and fluent in the local language, Chichewa. Mother, father, and grandmother interviews lasted 60-90 minutes and were conducted at the home of the respondent. One to two interviews per day were conducted and recorded by each data collector, with multiple days between interviews to allow for immediate and simultaneous verbatim translation (from Chichewa to English) and transcription of interview recordings. Data collectors were trained to retain local words and phrases in transcripts, and to probe of their meaning during interviews. Comprehensive debriefings were conducted at the end of each data collection day, as well as following the review of interview transcripts. This allowed for the identification of emerging themes that could be integrated into future data collection and FGDs in

particular. At the analysis stage, identified themes were incorporated into coding activities and interpretation of results.

4.3.7 Theoretical underpinnings

Theories around which data collection and analysis could best answer the research questions included the Socio-Ecological Model (SEM)[33] and the Transactional Model.[34] SEM is applied to many global health interventions as it emphasizes the multiple levels of society that can influence health behaviors and outcomes,[33,35] while the transactional theory focuses on the dynamic interaction (or give-and-take) between individuals (in this case the mother and child) that drive both of their behaviors and health.[34,36] This study used a hybrid of these models, presented in Figure 4.2, by including the transactional model at the individual level of the SEM for the "mother-child dyad"; the other SEM levels included other members of the household (fathers and grandmothers), community (village leaders), and program staff (Promoter and CGV).

4.3.8 Data analysis

Key themes from IDI and FGD were used to inductively create a formal codebook with definitions for each code. Line-by-line coding was conducted by a team of four standardized researchers who were present during all or some of the data collection, who participated in debriefings in the field, and who were familiar with the study and its objectives. An inter-rater reliability (IRR) test was performed prior to commencing coding activities, to ensure consistency across coders, as measured by agreement in coding of multiple segments (5-17 per IDI) from selected IDIs as compared to a gold standard coder (JRB)(Cohen's Kappa statistic=0.72-0.79). Disagreements in coding were

discussed as a team, and decisions about how such segments should be coded were agreed upon.

All textual data analysis, including data management, coding of transcripts, and classification of excerpts, was done using Dedoose Version 6.1.18, a web application for managing, analyzing, and presenting qualitative and mixed method research data.[37] Findings were organized and presented in a conceptual framework based on a methodology used by Ickes and colleagues (2012) to answer a similar research question about facilitators and barriers to a home-based supplementation program for underweight children in Western Uganda.[29] The conceptual framework visibly diagrams the program's two main components, and the associated facilitators and barriers identified by this study and for each of the levels of the SEM.

4.3.9 Ethical approval

This study was approved by institutional review boards at Johns Hopkins Bloomberg School of Public Health and the College of Medicine Research and Ethics Committee in Malawi. Oral informed consent was sought from all study participants.

4.4 Results

4.4.1 Sample characteristics and study setting

In-depth interviews were conducted with mothers (n=34), fathers (n=11), and grandmothers (n=4) of children aged 6-23 months; FGD1 included n=11 village chiefs, FGD2 included n=12 nutrition Promoters, and FGDs 3 and 4 included n=10 and n=11 CGV, respectively. Table 4.1 describes the basic sociodemographic characteristics of study participants, both for IDIs and FGDs. The mean age of IDI participants was 29.5 (mothers, fathers, and grandmothers mean age was 26.1, 31.5, and 53.0 y, respectively);

mean years of education was 4.1 years (women and their husbands had 4.2 and 4.3 y of education, respectively, with grandmothers being the least educated with 2.3 y). A large majority (>90%) of the women interviewed (both mothers and grandmothers) were farmers (91.2%). Occupation was more diversified for men, some of whom were involved in small business work like shop-keeping or tea room ownership (18.2%), and the remainder working in agriculture (81.8%).

When asked about the daily concerns in the community, low rainfall and drought-like conditions, and the devastating effect these had on harvests and, consequently, on food availability and food prices, were commonly cited by all household and community members alike as a serious problem. Hunger, food insecurity, and lack of water thus provide the backdrop to the environment in which our study participants lived in at the time this study was conducted and when asked about the program, the Nutributter, and the challenges associated with feeding children less than 23 months of age. Describing, and taking into account these constraints when synthesizing the study results enabled a better understanding of the factors that underlie and influence the decisions that mothers, caregivers, community members, and program staff make with regards to their behaviors as they relate to child feeding and WASH, many of which are articulated in this paper.

4.4.2 Conceptual framework of factors influencing program participation

The facilitators and barriers influencing program participation are summarized in a conceptual framework (Figure 4.3). The results are organized by the program's two main components, and represent perspectives from all levels of the SEM used to frame the study and corresponding analysis.

Briefly, facilitators to program use included the widespread acceptance of Nutributter among children, mothers, household members, and the wider community members, and acceptance of program messages related to breastfeeding given the well-established social norm of breastfeeding in this context. Other IYCF messages were also well received, and there was demonstrated understanding of the links between food consumption, diversity, and frequency. Though not significantly affecting program participation but receiving mention during interviews and FGDs and considered as potential barriers to program participation for some respondents, were distribution logistics, side effects of Nutributter, traditional practices, limited message recall of IYCF messages specifically, and variability in the implementation of SBCC activities. The barriers identified as most importantly influencing participation were competing priorities that interfered with Nutributter pick up, product misuse at the household level, and lack of resources to implement SBCC messages. Detail on each of these identified facilitators and barriers are expanded upon below.

4.4.3 Perceptions of Nutributter and facilitators and barriers to its use

Nutributter was viewed positively at all levels of the community and organization, beginning from the mother to the village chiefs and program staff. The product itself was widely accepted by children and mothers especially. Acceptance was also driven by perceived and reported changes in child health and nutrition, such as reductions in the frequency and severity of illness, and monthly weight gain observed in under-five clinics. Both were seen as strong drivers and facilitators of enrolment and continued participation throughout the child's period of eligibility (Figure 4.3). Some village leaders even attributed perceived reductions in child deaths in their villages to the Nutributter. The

desire to be part of the program, to give children the same opportunity that others in their community were getting, and to improve child health and nutrition, was described in many ways by mothers and household members. Some described it as wanting their child to be healthy and to grow well, while others specifically cited having children who were sick less frequently, suffered from less infections, didn't suffer from undernutrition, were "stronger", and had *smooth* bodies, as stated by a mother below.

> *"When the children are eating the Nutributter they become healthy...a healthy child looks smooth…the child does not get sick."*
>
> – Mother, age 42, of a 15-month old male child

Among fathers, and given their culturally implied role of providing for their families, Nutributter was further perceived as filling a gap in being able to ensure an adequate diet for their children:

> "*I thought of enrolling them because I know that I was lacking resources to feed them the way I need to. So then I decided to enroll them so that they should have what I fail to give them*."
>
> – Father, age 48, of 18-month old male twins

A few mothers also attributed positive changes in their child's health to improving their own productivity: because children are perceived as happier and "pacified" by the Nutributter, mothers could spend less time attending to the child, and more time on their chores, thus completing them more efficiently and quickly. Lastly, the positive reaction of the child to the Nutributter, and the perceived content of the product, appeared to

encourage the mother to continue offering it to the child. For instance, approximately half of the respondents referred to the Nutributter as containing a variety of foods from "the 6 food groups" (n=10), "vitamins" or "nutrients" (n=7), "medicine" (n=5), and resembling breastmilk (n=2). The transaction between the mother and the child was in some cases so strong that it encouraged product misuse by the mother, where she reported providing more than one packet per day (n=3).

Distributions of Nutributter were done monthly, typically in the first two weeks of the month and 30-35 days after the last distribution. With very few exceptions study participants responded positively to distribution and program arrangements and the above-cited benefits of participating in the program and receiving the Nutributter supplement appeared to be far outweighed by inconveniences of traveling to, or attending distributions. Although they were mentioned by a minimal number of mothers and household members as program aspects that could be improved, they did not constitute strong barriers to participation in this program component (Figure 4.3). Competing and unanticipated events or obligations in the community or in the household, however, were overwhelmingly cited as being the primary interference with Nutributter pick-up (Figure 4.3). Specifically, child, maternal, or other family member illness and funerals were the most frequently cited reasons for missing Nutributter pick-up. Nevertheless, mothers who missed distributions due to illness were sometimes able to send someone, like a friend or neighbor, to pick up the Nutributter on their behalf.

Aside from missing Nutributter distributions, other reasons for which target children did not to consume their daily ration of Nutributter resulted from situations that included improper use at the household level, and/or theft by older siblings, despite high

knowledge of Nutributter messages (Figure 4.4). For example, 28 of the 34 mothers interviewed stated that the child should receive only one packet per day, and 17 of them mentioned the importance of not sharing the Nutributter. Nevertheless, some mothers (n=3) reported giving their children more than one packet per day because the child asked or cried for it, while others reported sharing the Nutributter with older siblings, neighbors, or household members (n=12), some of whom were those who used to be enrolled in the program previously (n=3). Consumption by older children without the mother's consent was reported by some mothers (n=4), but this issue was resolved once mothers started storing Nutributter in a safe place that was unreachable to them.

4.4.4 Facilitators and barriers to improved IYCF and WASH behaviors

All but two mothers (6%) in this sample were still breastfeeding their children (whose ages were 20 and 23 months), with the remaining 94% reporting breastfeeding more than 8 times per day. In addition to the widespread practice of continued breastfeeding during the period of complementary feeding (from 6 to 23 months), the importance of breastfeeding, either exclusive, frequent, or continued during complementary feeding, to promote child health and growth was a message that was known and mentioned by 22 out of the 34 mothers interviewed (Figure 4.4).

In addition to a thorough understanding of the benefits of breastfeeding for child health, growth, and development, respondents often made the link between food consumption, diversity, and frequency and child growth or undernutrition. One mother, with probing, said:

> *"It is required that we should give her frequently a lot of food… **we** should give her porridge, nsima, fruits…So that the baby can be well*

and grow well, they should not also be malnourished, the baby should look fat and should also be strong."

– Mother, age 26, of a 23-month old male child

Despite study participant's excellent recall of Nutributter-specific messages, knowledge and recall of other program messages specific to IYCF and WASH were less common among all types of community members and program staff (CGV specifically), but especially among mothers (Figure 4.4). This may be in part due to the repetitious exposure to Nutributter messages at each distribution session. Among those who could recall IYCF and WASH messages, knowledge of the behaviors associated with each message was often superficial and lacking specificity when reported back to the interviewer, which was understood as a barrier to executing such messages at the household level. This was especially true for messages about diet diversification (feeding from "the six food groups"), which was mentioned by 26 mothers, and handwashing *with soap*, which was mentioned by only one mother despite frequent mention of handwashing at one or more key events (n=10) or washing hands before feeding Nutributter (n=13) (Figure 4.4). Of the mothers who mentioned food groups, for example, only one of them (out of 34) was able to name the 6 correctly (carbohydrates, animal fleshed foods, vegetables, fruits, nuts and seeds, oils and fats), with the large remainder being able to name 3 or less groups (4 mothers could name 4 groups).

Fathers, on the other hand, were better able to articulate SBCC messages, despite their limited involvement in program activities and exposure to messages through common avenues such as the under-five clinics, distribution sessions, and interaction with CGVs. Still, they commonly cited hearing messages from the radio, billboards, and

the health center, the majority of which were well retained and articulated by men in general (fathers and village chiefs), suggesting that message recall may have differed by household and community members.

Regardless of specificity of message recall, receptivity to program messages was very high: in most instances, mothers perceived the messages they received as being important for improving their child's health and growth. One mother specified that the work of CGV should continue, as follows:

> *"The volunteers of Nutributter who are visiting us, should not stop visiting us because we are people too and we tend to forget some of the things that they teach us."*
>
> – Mother, age 22, of a 12-month old female child

In addition to limited recall and superficial knowledge of IYCF and WASH-specific messages and behaviors, the physical and financial constraints faced by mothers and households to access nutritious foods were cited as important limitations to their implementation in this context. Mothers described widespread poverty and hunger, as well as seasonality of foods (fruits in particular), and dependence on maize as the primary food crop in this setting limiting their access and ability to practice behaviors promoted by the program (Figure 4.3). For example, one mother explained that she could not fortify her child's porridge with groundnut flour because "groundnut farming is no longer common here". She also described the combination of financial and physical constraints to diet diversification:

> "*... we cannot manage all the food groups in a day, no. Finding the resources is a challenge; like here in the village, it*

is difficult to find cooking oil and meat. Poverty, this can also make it difficult, because if one has money you would easily go and buy the resources."

– Mother, age 36, of a 15-month female child

Thus, although mothers may have generally understood the link between food diversity and child health and "strength", they described facing constraints in feeding their children a variety of foods related to lack of resources (Figure 4.3). Similarly, despite their ability to recall WASH messages, as well as the importance of practicing improved WASH behaviors, a small number of households (n=4) referenced environmental challenges that prohibited their successful implementation at the household level. One mother, for example, explained that termites were always destroying her handwashing station, while another described her livestock knocking it down.

Though not mentioned explicitly by mothers, household members, nor village chiefs, program staff pointed to traditional practices and beliefs related to the prioritization of the man, rather than the child, in the household, and how this holds negative consequences for the child in terms of household food allocation and thus child nutritional status. One CGV describes it as such:

"*For example, in families, issues of pleasing husbands are making the children to be malnourished. We like caring for the husband, forgetting the children...You feel that you are showing love to the husband whilst you are killing the child.*

You keep food for the husband, when a child is trying to touch it, 'stop it, it's for your dad'."

- CGV, age 30, female, from Vuso Jere TA

At the organizational level, CGVs cited the knowledge they gained in this position as having taught them to better care for their households and children:

"*What I have learnt from being a CGV is that previously, when a child was born I used to just care for the child anyhow. Giving the child water before the child was six months old. But since I became a volunteer, after being taught, now I am able to care for my child the way it is supposed to be done*."

- CGV, age 26, female, from Vuso Jere TA

Most Promoters described that they received 1-2 formal trainings; however, some shared that they had never attended training. Some had recently received educational materials that they used to teach themselves, but others continued to rely on information obtained from a previous, similar program and training. In addition, some CGVs discussed the difficulty associated with balancing household and work responsibilities, especially during times when other livelihood activities, such as farming, may be yielding higher returns to their own households.

4.5 Discussion

This qualitative study sought to understand the facilitators and barriers to participation in a nutrition program providing a nutritional supplement combined with counseling for behavior change around infant and young child feeding and water,

sanitation and hygiene being implemented in the district of Ntchisi, Malawi. The program, especially the food supplement, Nutributter, was well accepted by all levels of the community, from caregivers to program staff and village chiefs, which likely contributed to observed high participation among target children and families. Other program messages related to infant and young child feeding and water, sanitation, and hygiene, were also well accepted but less well articulated by mothers. Illness in the family, conflicting community events (funerals), and lack of resources at the household level constituted the biggest barriers to participation in the Nutributter distributions, and implementation of messages at the household level, respectively. Other potential, yet less influential, barriers to participation in the program's Nutributter component included: (1) distribution logistics such as waiting times and distance to the distribution point; (2) side effects of the Nutributter; and (3) lack of alternatives to pick-up. Specific to the SBCC component, perceived barriers to receipt, understanding, and implementation of messages at the household level included: (1) limited and superficial knowledge of infant and young child feeding and water, sanitation, and hygiene messages; (2) traditional practices that negatively influenced household food allocation; and (3) variability in training and program implementation by front-line workers (nutrition Promoters and care group volunteers).

Lipid-based nutrient supplements have been demonstrated to be highly acceptable in Ghana,[38,39] Burkina Faso,[40] Niger,[41,42] and Malawi.[30,43,44] In most of these studies, however, the supplement was often delivered to study participants in their home or at study enrolment, for much shorter supplementation periods (2 weeks to 6 months) than those seen in this program. Thus, the high acceptability, knowledge of, and stated

participation in the program's Nutributter component could indicate that participation in this setting can be sustained for as long as 18 months, and in a context in which traveling to, and attending a monthly distribution for this time period is required. The mother's perceived acceptance of the food product by the child, and mother's report of improved health and general appearance, and reduced frequency of illness, appeared to influence the acceptability and use of the Nutributter. The transaction between the mother and her child, where the child's acceptability of the product and the mother's perceived benefits of it both worked in tandem to drive continued participation and use. This has been documented in Niger,[42] and is aligned with Sameroff's transactional theory of development, which describes the interaction between a caregiver and his/her child as both simultaneously influencing each other's behaviors.[34]

Although some barriers, such as waiting time at, and distance to the distribution point, and initially unpleasant side effects of the Nutributter (diarrhea, vomiting), were mentioned and may have impacted program participation for a small number of study participants, the real barriers to picking up supplements were competing priorities or obligations, such as illness or funeral ceremonies. In addition, improper use of the Nutributter at the household level, such as the provision of more than one packet per day and sharing with other siblings or neighbors, represented a common and important barrier to program *adherence*. Despite the cited widespread knowledge of messages on how to use and feed Nutributter, consumption by the non-target child was common in this context. Sharing of LNS has been documented in Malawi and other similar contexts,[28,29,45] and during the period of the year during which this study was conducted, was predicted to be moderate at the household and community levels.[30] Though

infrequent, situations in which there was an older sibling who previously participated in the program and received the program ration appeared to be particularly difficult, given the older child's familiarity with the product. Other forms of Nutributter misuse at the household level, such as providing the child with more than one packet per day, were also explicitly stated by mothers and have been documented in this setting previously.[30]

Findings relating to the SBCC component of the nutrition program highlighted limited and superficial knowledge of IYCF and WASH messaging, especially among mothers of eligible children. Other respondents, such as fathers, program staff, and village chiefs (all male), on the other hand, had slightly better knowledge on these topics, and were better able to articulate some of the IYCF and WASH messages. It is unclear whether the seemingly improved recall among fathers in particular was a reflection of better knowledge, more confidence and comfort with the interview process than their spouses, and/or different sources from which they received the messages (i.e. radio versus distribution sessions). In addition, program staff's demonstrated variability in training, geographic saturation, and knowledge of program messages may have contributed to the limited recall of IYCF and WASH messaging in the community. Similarly, the volunteer nature of the CGV position in particular, further contributes to variable implementation of the program's SBCC component at the village level, especially during times where other livelihood activities may be more beneficial to their families.

Specific to the message about the six food groups, which was found to be particularly problematic, the images of foods used in billboards and messaging materials, as well as the categorization of food groups were understood to be foreign to the sociocultural

landscape in Malawi. For instance, images of certain foods were not representative of the way foods were prepared or processed in this setting. Similarly, the grouping of foods (carbohydrates, animal fleshed foods, vegetables, fruits, nuts and seeds, oils and fats) often did not correspond with the way in which mothers would group foods.

Despite the evidence that messages are reaching mothers and communities in this setting, it is difficult to say whether improved IYCF and WASH knowledge will translate to improved practices and nutrition. In a four-country study (Guatemala, Pakistan, Zambia, and the Democratic Republic of the Congo), improved message recall was associated with increased growth velocity.[46] In the Alive & Thrive studies in Bangladesh[10] and Ethiopia,[13] however, community-level SBCC yielded large and significant improvements in infant and young child feeding practices, but not in measures of child anthropometry. Nevertheless, results from the Alive & Thrive initiative, as well as from a review of interventions to improve child growth[27] emphasized the importance of providing community-based messages that are comprehensible and implementable. Given the difficulty of respondents to recall certain IYCF messages, for example those relating to the six food groups, one might conclude that these are alien to the socio-cultural landscape of the people in Ntchisi, making them even more difficult to be understood and applied.

This qualitative study had several strengths. First, it was conducted by a team of native Malawian researchers who were rigorously trained in qualitative methods, and some of whom had participated in other data collection activities of the broader impact evaluation study. Thus, they had familiarity with the nutrition program, the study area, and other complementary study components. This experiential and contextual knowledge

facilitated study processes, including identification of villages, and interactions with community and household members who participated in our study. Second, the inclusion of multiple qualitative methods and types of study participants contributed to a deep and holistic view of the Ntchisi nutrition program and challenges associated with its implementation, uptake, and utilization.

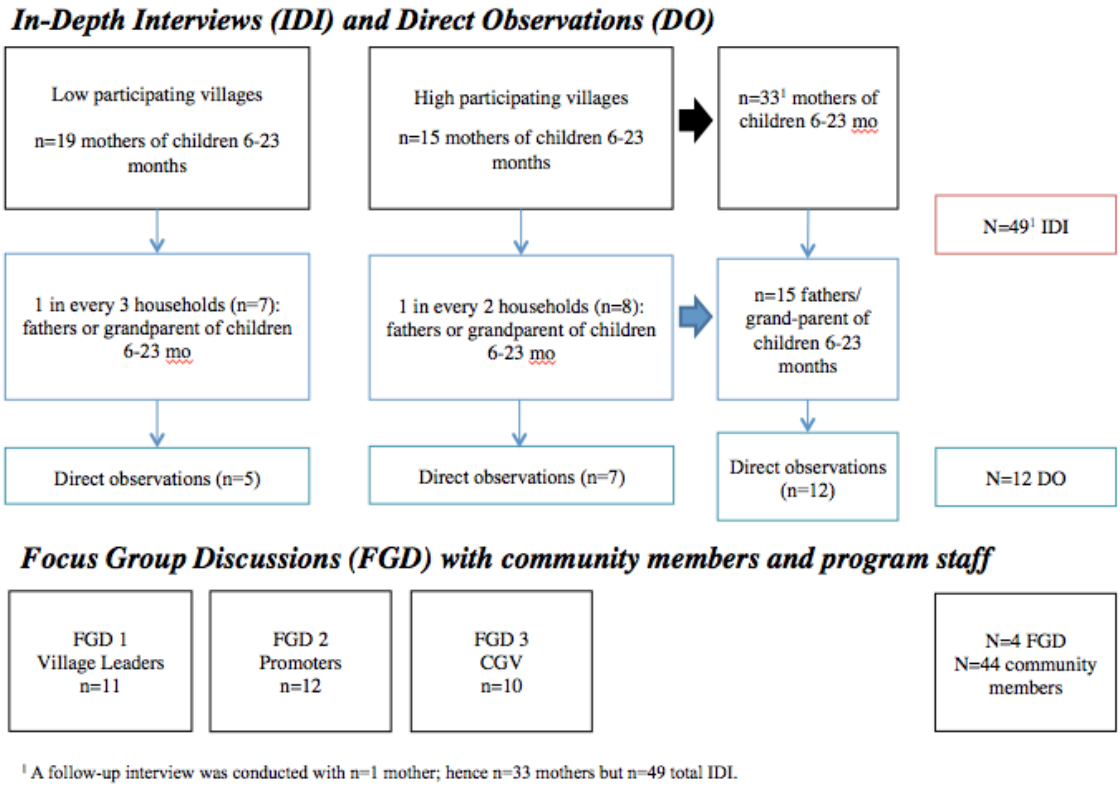
Some limitations of the study were: (1) the potential loss of meaning of local words or phrases in the simultaneous translation and transcription process; and (2) the limited transferability of our findings given that the program district in which interviews were conducted was selected based on a pre-defined set of characteristics (i.e. poverty, food insecurity, undernutrition). Although translations were word-for-word, were performed by those who conducted the interviews, and translators were trained to maintain emic terminology, certain phrases or words did not have an English equivalent and were thus more difficult to translate, understand, and interpret. Daily debriefings on interview days with the study team, combined with careful review of transcripts upon completion, were instrumental in identifying such "untranslatable" terms early in the interviewing process and applying standardized solutions, such as probing, to minimize misunderstandings. The transferability of this study is limited to areas similar to that in which the study was conducted, that is, rural, poor, facing high levels of seasonal food insecurity, and with similar sociocultural norms and traditions. The stratified purposive sampling strategy used in this study, however, supported our attempt to glean varying perspectives of the program by providing a broader set of experiences to draw our conclusions from.

Since 2011, the Government of Malawi has been actively working towards scaling up nutrition, and this program represents one such effort to move the needle on the stagnant

and high stunting prevalence in the country. This program is among the first to attempt the blanket distribution of LNS at scale and throughout the entirety of the complementary feeding period in the child's first thousand days. Understanding the facilitators and barriers of such an endeavor, from the perspective of various community actors and beneficiaries, is therefore essential to improving program implementation and delivery, and to potentially continued scale up in other districts of Malawi. Recommendations for future program implementation would be largely centered on strengthening the program's social behavior change communication component, especially as it relates to infant and young child feeding and water, sanitation, and hygiene messaging. Building the capacity of program staff to deliver individualized and situation- and age-specific infant and young child feeding messages is critical to effectively and sustainably drive desired changes in behaviors that are needed to improve child nutrition over the long term in this context.

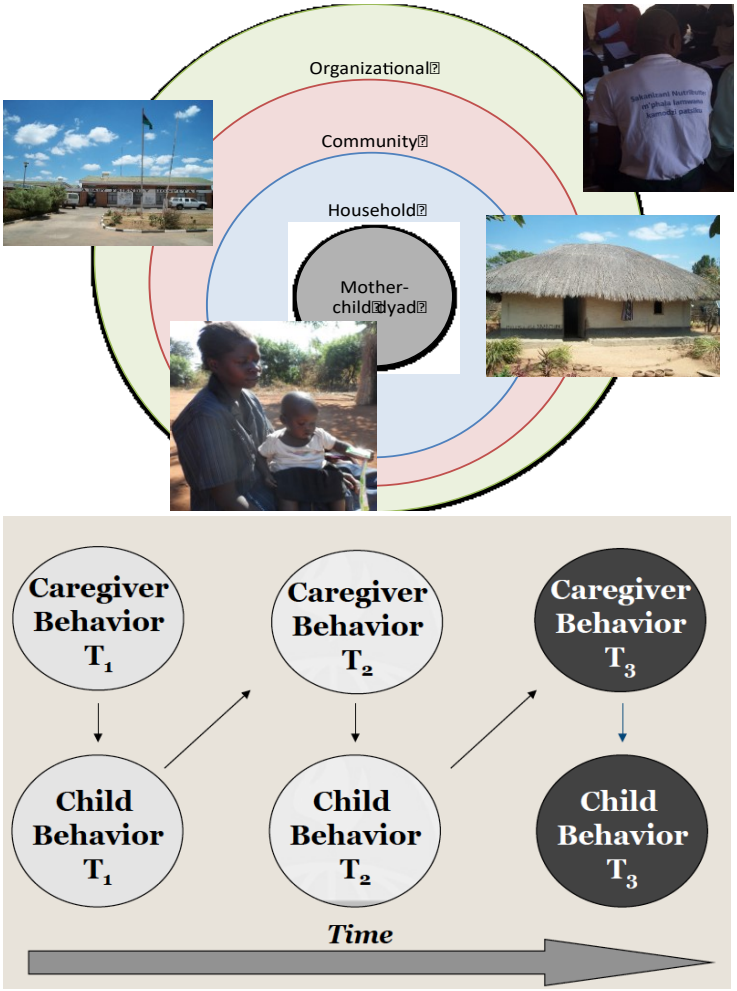
Tables and Figures

Figure 4.1. Sampling schematic and target sample sizes for this qualitative study



[1] A follow-up interview was conducted with n=1 mother; hence n=33 mothers but n=49 total IDI.

Figure 4.2 Hybrid of the Socio Ecological Model and Transactional Theories used for the design, data collection, analysis, and presentation of results of the qualitative study



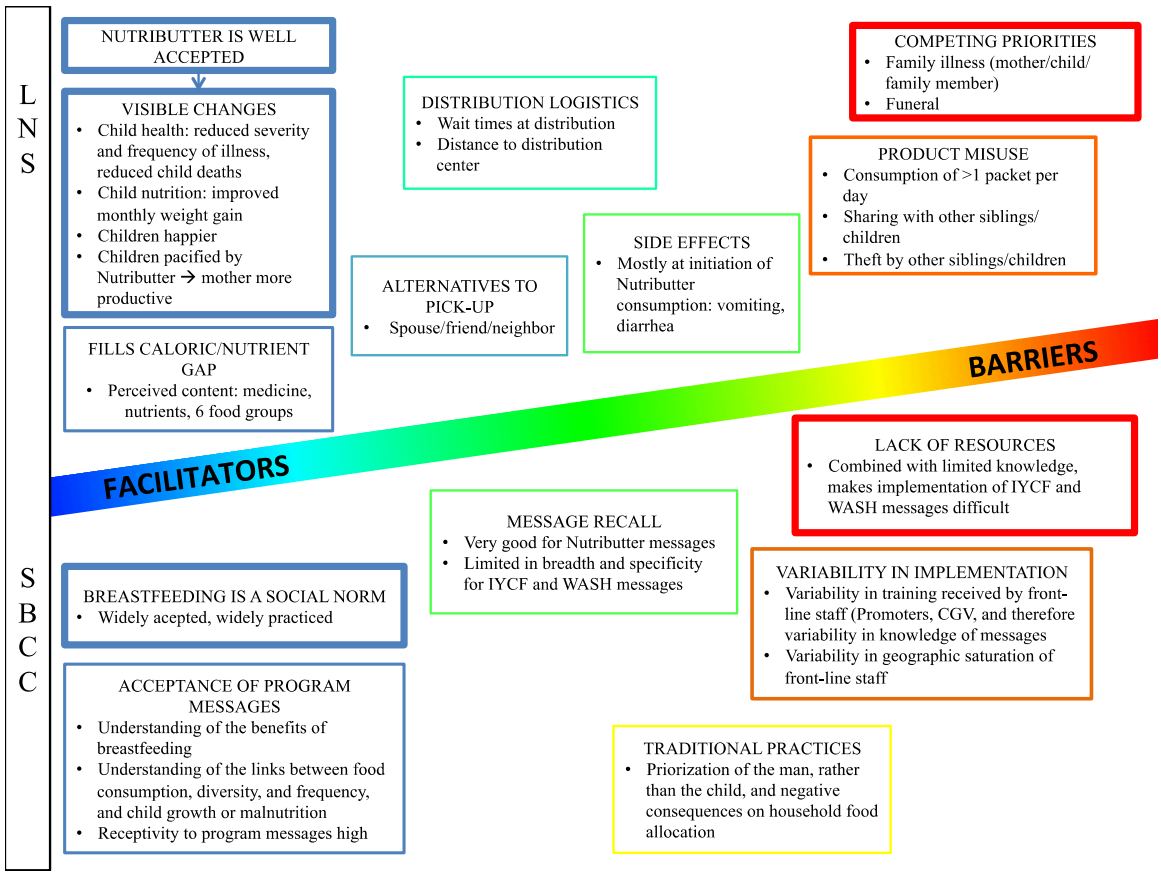
Adapted from McLeroy et al.'s[33] Socio-Ecological Model and Sameroff's Transactional Theory.[36]

Table 4.1. Sociodemographic characteristics of the study sample participating in in-depth interviews (IDIs), and in focus group discussions (FGDs)

	IDI		FGD	
	n	Mean (SD) or %	n	Mean (SD) or %
Respondent type, %				
Mother	34	69.4		N/A
Father	11	22.5		N/A
Grandmother	4	8.2		N/A
Village head		N/A	11	25.0
Nutrition Promoter		N/A	12	27.3
Care Group Volunteer		N/A	21	47.7
Sex, %				
Male	11	22.4	22	50.0
Female	38	77.6	22	50.0
Age, mean (SD) years	49	29.5 (11.1)	44	34.1 (11.5)
Marital status				
Married	47	95.9	39	88.6
Other[1]	2	4.1	5	11.4
Education, mean (SD) years	48	4.1 (2.9)	23	8.6 (3.2)
None, %	5	10.4	1	4.4
Completed primary, %	41	85.4	17	73.9
Secondary or higher, %	2	4.2	5	21.7
Occupation				ND
Farming	44	91.2		
Piecework/Ganyu?	2	5.9		
Other[2]	3	2.9		

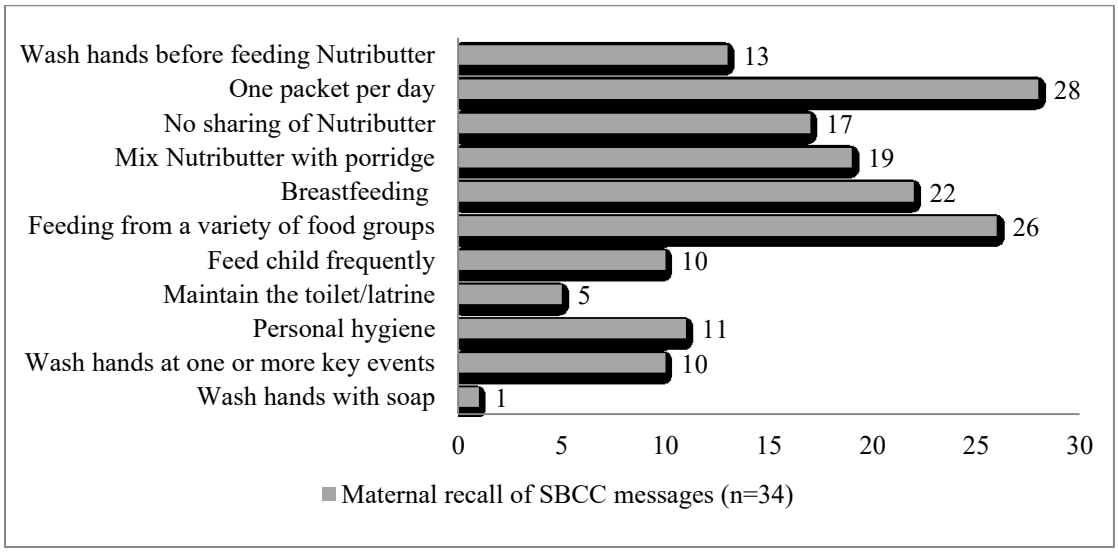
1 Includes divorced (n=1), widowed (n=1), or single (n=5)
2 Includes owning a business (n=2) or salaried work (n=1)
ND: No data; N/A: Not applicable; IDI: In-depth interview; FGD: focus group discussion

Figure 4.3: Conceptual framework of the facilitators and barriers that likely affect program participation, by component



IYCF: Infant and young child feeding; WASH: Water, sanitation, and hygiene; CGV: Care Group Volunteer.
Box color, placement, and thickness of the lines are meant to reflect the level of influence on program participation and use and frequency of mention by study participants. Boxes to the furthest left and right of the framework are deemed to be the strongest facilitators and barriers to program use, while those in the middle were mentioned with lower frequency and/or described as being less influential.to program participation.

Figure 4.4: Number of mothers recalling IYCF and WASH messages



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Chapter 5: Process evaluation of a large-scale nutrition program in Ntchisi district, Malawi

5.1 Abstract

Background: Until recently, global attention to the study of nutrition program implementation has been inadequate. The assessment and documentation of the delivery of community-based nutrition programs, and challenges faced in their implementation, are critical for generating lessons on effective delivery and impact of nutrition interventions at scale.

Objective: Within the context of a large-scale, community-based nutrition program, this study aimed to test its implementation theory using process evaluation. Implementation was measured by program recruitment, conformity of the program to its original design using measures of fidelity, which include dose delivered and received, and program reach, defined as the proportion of the target audience that participated in each intervention component.

Methods: Since January 2014, a large-scale nutrition program operating in Ntchisi district of Malawi has been delivering a monthly ration of a daily lipid-based nutrient supplement (LNS), Nutributter (Nutriset, Malaunay, France) and a community-level social-behavior change communication campaign (SBCC) to improve infant and young child feeding (IYCF) and water-sanitation and hygiene (WASH) practices targeted to households with children aged 6-23 months. In-depth-interviews (IDI) with mothers of beneficiary children and influential household members (n=49) and focus group discussions (FGD) with village leaders (1 FGD with n=11) and program staff [nutrition Promoters (1 FGD with n=12) and Care Group Volunteers (CGV) (2 FGD with n=10 and

n=11)] were used to understand perceptions of the program and recruitment procedures. Routine monthly (n=41,617) and quarterly (n=2,901) program monitoring and evaluation data collected by program implementers (World Vision with technical assistance by the World Food Programme) were used to measure program reach and fidelity, which encompassed indicators of dose delivered and received. Direct observations of program activities (n=28), and knowledge questionnaires with Promoters (n=14) and CGV (n=70) contributed to measurements of program fidelity, getting at aspects of program *quality*, as well as measurements of dose delivered and dose received that fall under this indicator. An inductive thematic analytical approach was used to analyze textual data. The number of times specific activities, as observed or reported, were done correctly was used to calculate proportions representative of program functioning (recruitment, fidelity, and reach); denominators for each calculation were total sample sizes from each data source. Proportions for each process indicator were then categorized as "working well" (>75%), "needing improvement" (25%-75%), and "not working" (<25%) and presented within the program's logical framework to visualize program functioning and implementation.

Results: IDI and FGD clarified that program recruitment was conducted in collaboration between CGV, nutrition Promoters, and health surveillance assistants, who maintained a roster of community members in their catchment areas and encouraged them to register their children between 4 and 6 months of age. Using the program monitoring system, SCOpe, only 20.7% of children had been registered into the program by 6 months of age during the first year of program implementation (January-December 2014). Direct observations of Nutributter distributions indicated high fidelity to program design, with most observed procedures, including card scanning, stocking of Nutributter, number of

sachets distributed, and conduct of group counseling functioning at 85% or higher. Multiple counseling sessions throughout distributions, the most effective way to ensure that all mothers received counseling messages, was done only in 28.6% of observed distributions. Direct observations of household-level counseling sessions revealed that although the CGVs tailored messages to the households they visited, none of them discussed complementary feeding messages during their counseling sessions. Despite the relatively high implementation of training activities as planned (73.3%), the completion of training modules was very low for some modules: completion of breastfeeding and complementary feeding were 50.0% and 35.7%, respectively, among Promoters, and 22.9% and 18.6%, respectively among CGV. Knowledge of key IYCF, WASH, and Nutributter messages on which they were trained was high: >85% correctly answered breastfeeding, WASH, and Nutributter use questions, with the exception of how to overcome breastfeeding problems (answered correctly by 47.8% CGV and 69.2% Promoters). Complementary feeding knowledge was lower for both groups, especially being able to list the 6 food groups, which only 22.9% and 35.7% of CGV and Promoters, respectively, could do. Among program recipients and despite a low dose of SBCC activities delivered, such as the conduct of open nutrition days (57.1%) and billboards erected (50.0%), dose received, which was measured by maternal knowledge of program messages, was very high, with almost all mothers (98.9%) being able to recognize at least 3 of the program's nutrition messages. High maternal knowledge may also be due in part to the 100.0% delivery of promotional IYCF campaigns. Program reach, which was assessed using attendance records from the program's first three years of implementation showed mean (SD, range) participation in monthly distribution sessions of 81.0% (8.5,

65.6%-93.5%). Exposure to the SBCC component, which was measured by self-report, demonstrated that 32.9% (8.0, 18.8%-42.0%) of mothers reported having received a CGV home visit in the past month over 3 years of program duration. Maternal self-report of exposure to other SBCC activities such as group counseling, however, was higher, with a mean (SD, range) of 92.1% (5.4, 80.0%-96.7%).

Conclusion: This assessment highlighted certain aspects of the program that require continued improvement, such as completion of certain training modules by front-line workers, and conduct of counseling activities by care group volunteers at the household level, as originally planned. It also finds that some aspects of the program were implemented very well: for example, that the program was effective in establishing a vast and well-functioning Nutributter distribution system that reached a large proportion of the target population every month, and high recognition of key messages by participating mothers.

5.2 Introduction

Child stunting affects 165 million children globally and is representative of a chronic deficiency of essential nutrients during critical periods of growth and development.[1] Pregnant women and children, whose nutritional demands are increased, are disproportionately affected and consequently suffer the greatest burden. Early insults to nutrition, especially those that occur in the first thousand days of a child's life (from conception to two years of age), contribute to poor physical and cognitive development in children, predisposing them to health and economic consequences that are manifested throughout the life course.[2–6] Stunting in turn holds severe implications not only for the individuals affected, but also for the broader social and economic development of nations.[7]

Global progress towards the reduction of child undernutrition has been extremely slow, and especially so in sub-Saharan African countries like Malawi, where, until 2015, stunting prevalence hovered around 50% for more than two decades.[8–10] Immediate and underlying determinants of undernutrition, such as high morbidity and suboptimal infant and young child feeding (IYCF) practices that contribute to inadequate food intakes, combined with low access to and utilization of high quality health care services and unhealthy household environments (sanitation), all contribute to child stunting in this context.[11]

Efficacious interventions that have been shown to improve child linear growth include complementary feeding promotion for children 6-23 months of age, supplementation with multiple micronutrients, and zinc supplementation.[12] Though not included in Bhutta's 2013 systematic review, the provision of lipid-based nutrient

supplements (LNS) that contain protein, fat, and essential micronutrients, has demonstrated improvements in linear growth among young children in Bangladesh, Burkina Faso, Haiti, and Algeria.[13–16] Studies to understand the impact of LNS on growth in Malawi have demonstrated mixed results, but two studies reported reductions in severe stunting,[17,18] with the remaining, though failing to reach significance, trending in favor of LNS.[18–24] The combination of SBCC activities with the provision of complementary foods can amplify the effects of complementary feeding promotion on linear growth, and especially so in food insecure contexts.[12,26]

In January 2014, the Government of Malawi launched a large-scale nutrition program that included: (1) the blanket distribution of a daily ration of a small-quantity (20g, 110kcal) lipid-based nutrient supplement (SQ-LNS), Nutributter (Nutriset, Malaunay, France), to all children 6-23 months in the program district; and (2) the delivery of social behavior change communication (SBCC) messages to educate mothers and the community on optimal infant and young child feeding (IYCF) and water, sanitation, and hygiene (WASH) practices. The impact of the program on child nutrition outcomes was measured by an independent impact evaluation that used a comparative design, carried out by the Center for Human Nutrition at the Johns Hopkins University.

Critical in any impact evaluation, is to unpack the *why* and *how* interventions did or did not achieve their impact, which can be done with the thorough study of the what, why, and how programs and interventions were delivered.[27] Process evaluation, which measures the extent to which planned program components are actually implemented,[28] is especially important and relevant in programmatic research given the complexity of social and behavioral interventions and the need to know and understand how they can,

do, or have led to impact. This is especially true for nutrition, where complexity lies not only in the interventions being delivered, but also in the determinants of nutrition,[1] which render nutrition impact variable and difficult, and especially so under programmatic conditions.[29,30]

The process evaluations of the Alive & Thrive Initiative that was piloted in Bangladesh, Ethiopia, and Vietnam, for example, documented implementation models in each country while identifying implementation bottlenecks and challenges throughout the life of the respective programs.[30,31] In Cambodia, the process evaluation of a homestead food production program revealed challenges in the knowledge, motivation, and compensation of front-line volunteer workers, as well as explicit gaps between the production and consumption of nutrient-rich foods being promoted by the program.[32] In Malawi, process evaluation demonstrated high adherence to a clinical trial's intervention protocol by program staff, but revealed inconsistencies in the delivery of key counseling elements, as well as a desire by program staff for additional training and guidance on certain counseling skills that were previously not addressed in training protocols.[33] Though limited, these examples magnify the role process evaluation in making program adjustments, in understanding which program components were implemented with fidelity to the planned protocol (or not), and how they were received by program staff and beneficiaries alike. In the context of an impact evaluation, process evaluation goes one step further in clarifying whether measured impact was truly a result of the program's implementation.[34]

The objective of this study was to use the principles of implementation science, "the study of methods to improve the uptake, implementation, and translation of research

findings into routine and common practices",[35] to measure the program's conformity to its original design using process measures of program recruitment, fidelity, which includes measures of dose delivered and received, and reach.

5.3 Methods

5.3.1 The Ntchisi nutrition program

The Ntchisi nutrition program was launched in January 2014 by the Government of Malawi, with the technical and financial support of the World Food Programme (WFP) and the Children's Investment Fund Foundation (CIFF), respectively. The program is implemented by World Vision, who has been sub-contracted by WFP to handle day-to-day implementation and logistics. The monthly, blanket distribution of Nutributter, is done through 80 distribution points across the district, which are either health centers or "extended distribution points" (EDP), which range from health posts, churches, schools, community-based child-care centers (CBCC), or other community structures. The location of distribution points and EDP were selected to maximize convenience and participation while minimizing travel distances for program beneficiaries.

The program's SBCC campaign falls under the larger, country-wide Scaling Up Nutrition (SUN)[36] initiative, which uses nationally vetted and standard communication materials and messages. The SBCC campaign is modeled under the Socio-Ecological Model (SEM) for behavior change,[37] which targets the various levels of society that influence behaviors (individual, interpersonal, organizational, and community). Provision of nutrition education is done at the individual, household, group, and community levels using a variety of dissemination channels. These include one-on-one counseling conducted by a core network of Care Group Volunteers (CGV) at the household level,

group counseling by World Vision staff members and Health Surveillance Assistants (HSA) at monthly Nutributter distributions and growth promotion and monitoring at monthly under-five clinics, respectively, and mass media messaging (billboards, radio clubs) to reach the wider community. Continuous training and supervision of care groups, composed of 10-12 CGV each, is maintained by nutrition Promoters (see supplementary figures 5.1 and 5.2).

To address the objectives of this study and analysis, we used a mixed method design to define and test the implementation theory of the Ntchisi nutrition program using process evaluation indicators of recruitment, fidelity, and reach.[28] We defined implementation theory as the details of how a program is implemented: the inputs, process, and delivery of the program's main components that "intend to bring about the desired interactions with the target population and provide the planned services".[38] The implementation theory states that, if implemented perfectly, the program would lead to expected outcomes and impact as laid out in the program theory. The Ntchisi nutrition program's implementation theory is provided in Figure 5.1.

5.3.2 Data sources used for the process evaluation

Various sources of data were used to examine the quality of program implementation and conformity to its original design (Table 5.1). Program design and implementation documents, as well as information-gathering meetings with key program personnel were used to understand and clarify program procedures needed for the development of the program's implementation theory. In-depth interviews (IDI) with mothers of children aged 6-23 months and influential household members (fathers and grandmothers) and focus group discussions (FGD) with village leaders and program staff (nutrition

Promoters and CGV) provided details of recruitment procedures used to attract and enroll participants, and reasons for non-participation. Monthly and quarterly program monitoring and evaluation data from the World Food Programme's System for Cash Operations (SCOpe) and Post-Distribution Monitoring (PDM) surveys were used to measure the program's reach (coverage) and process indicators of fidelity, which also included measures of dose delivered and received. Direct observations of Nutributter distributions and one-on-one household counseling sessions provided additional details of the program's implementation for the development of the implementation theory, as well as measures used to capture elements of quality within the realm of program fidelity. Knowledge questionnaires with front-line program staff (nutrition Promoters and CGV) also measured program quality, which was measured by completion of training modules (among other indicators) and knowledge of messages on which they were trained, as reported by respondents.

5.3.2.1 Program design and implementation documents

Available program design and implementation documents, including the program concept note, logical framework, qualitative study reports, monitoring and evaluation reports, and peer-reviewed publications[36,39,40] were reviewed and used to learn about the program's implementation theory. Additional and ongoing informal discussions with program staff at all levels and throughout the duration of program, were instrumental in understanding intricacies of program implementation as well as data-informed modifications of program operations that were used to expand the reach and coverage of interventions.

5.3.2.2 In-depth interviews

In-depth interviews with mothers (n=34) and influential household members (n=11) were conducted under a broader qualitative research study on facilitators and barriers to program access and utilization from November-December 2015, and whose methodological details are described elsewhere (chapters 3 and 4). Briefly, semi-structured interview guides were used to understand maternal and other caregivers' perceptions of the program, and how these influenced their participation in the program. These interviews also elicited information about the program's functioning and the caregiver's experience as a beneficiary, including registration procedures, child's age at enrollment and community-level notification procedures to enroll children at the designated age, and reasons for non-participation. Program recruitment data from these interviews was used in this process evaluation to clarify procedures and methods used to recruit participants and identify reasons for non-participation, both of which were considered under the 'program recruitment' indicator.

5.3.2.3 Focus group discussions

Also under the umbrella of the qualitative study and to better understand other community member's and program staff's perceptions of the purpose and rationale of the program, focus group discussion data conducted with nutrition Promoters and CGV (1 FGD with n=12 nutrition Promoters and 2 FGD of n=10 and n=11 with CGV) were used in this analysis. Data from these FGDs that was specific to program staff's work responsibilities, work-related activities in the community, training received, and adequacy and understanding of program messages were used to clarify program functioning and respond to process indicators of fidelity.

5.3.2.4 Program monitoring data

The program's SCOpe system collected and reported program coverage data for monthly Nutributter distributions using an electronic card-scanning technology and real-time reporting to a system dashboard. Data collected and provided by WFP included individual-level attendance data from all program beneficiaries who had ever participated in the program from January 2014-December 2016 in the district (n=41,617). Attendance data was used in this study to measure program reach of the Nutributter distributions component. SCOpe data was also used to assess program recruitment during the first year of program implementation (n=22,456).

Post-distribution monitoring surveys (n=8) were conducted quarterly by the WFP and were based on interviews with beneficiary households using self-reported receipt of Nutributter, SBCC messaging, and Nutributter use behaviors. Each PDM survey used a two-stage stratified sampling method based on district population data and program registration lists. In the first stage, clusters (group village heads (GVH), a traditional aggregation of villages in Malawi) were randomly selected from district population data using probability proportional to size sampling. In the second stage, mothers with children aged 6-23 months were randomly selected for inclusion in the survey. PDM sample sizes were calculated based on a 65% estimated prevalence of participation and a 0.065 level of precision for the prevalence estimate requiring a sample size of n=330, with actual sample sizes ranging from n=340 (PDM 7) to n=390 (PDM 3). WFP provided their data from 8 PDM surveys for this analysis, each with the following sample sizes: PDM1 (n=368); PDM2 (n=386); PDM3 (n=390); PDM4 (n=369); PDM5 (n=358); PDM6 (n=344); PDM7 (n=340); PDM8 (n=346). The total, pooled sample size used as the denominator of process measures pulled from PDM surveys was n=2,901.

In addition to SCOpe and PDM, data specific to SBCC activities, which was supervised by the implementing partner, World Vision, was obtained from annual performance review (APR) documents prepared by WFP, which presented a summary of staff trained and SBCC activities more broadly. Although data regarding the functioning and delivery of SBCC activities was collected and reported on by World Vision on a monthly and quarterly basis, a summary of such activities as provided in the APR documents was deemed sufficient and appropriate for the measurement of dose delivered that falls under the umbrella of program fidelity.

5.3.2.5 Direct Observations

Structured direct observations were conducted to add depth and understanding of specific programmatic procedures, and to assess the quality component of fidelity to program design. Observations were conducted from December 5-17, 2016 in 6 health centers and 8 extended distribution points (EDP) in each of the district's seven TAs by two trained research assistants who spoke the local language, Chichewa, fluently and who were familiar with the district, the nutrition program, and the impact evaluation. Structured guides were used to conduct both types of direct observations to capture dimensions of program fidelity, such as having an adequate stock of Nutributter at distributions, and tailoring individual counseling sessions according to household characteristics.

Direct observations of the program's Nutributter distribution activities were conducted to see how the program was delivered in practice, to triangulate what was observed with maternal and staff reports of how the program functioned, and to understand broadly the beneficiary's experience as a participant in the program. Direct

observations of the SBCC component, on the other hand, were of one-on-one counseling sessions between CGV and beneficiary mothers, with the objective of gathering data on knowledge and communication of product use, and health, nutrition, and sanitation messages, and mother's understanding of these messages. Standardization of direct observations for the two research assistants was obtained by conducting paired observations (research assistant and supervisor) prior to and during the first half of data collection, followed by debriefing as pairs and as a team to discuss what was observed and how certain features of the observation were interpreted and why.

Stratified purposive sampling was used to select direct observation sites, wherein 1 health center and 1 EDP in each of the district's seven traditional authorities (TA) was randomly selected using a random number generator in Microsoft Excel (2011), for a total of n=14 observations of monthly distributions. Sampling of CGV on whom observations of one-on-one counseling were done were selected randomly from the CGV with whom knowledge questionnaires were conducted (see below).

5.3.2.6 Knowledge questionnaires with program staff

Knowledge related to infant and young child nutrition, sanitation, and Nutributter provision and use among Promoters and CGV was elicited to assess program quality, an element of program fidelity. Questionnaires were designed to test the knowledge of workers as presented in the four training modules and lessons used in the program, which include: (1) breastfeeding; (2) complementary feeding; (3) water, sanitation, and hygiene; (4) and Nutributter use.

Sampling of Promoters and CGV was based on the sampling scheme used for the direct observations of Nutributter distributions described above. Using a district-wide

roster of field-level program staff, Promoters were identified at each health center and EDP at which an observation of Nutributter distribution was conducted. When more than one Promoter was present, one Promoter was randomly selected to participate in the knowledge questionnaire (total Promoter n=14). Subsequently, one out of every two CGV who fell under the selected Promoter's catchment area was randomly selected from the staff roster and asked to participate in knowledge questionnaires (CGV per Promoter=5, total CGV n=70). One of every five CGV per Nutributter distribution area and who participated in knowledge assessment interviews were randomly selected for observations of one-on-one counseling sessions. Questionnaires were administered during the same data collection period as the direct observations, from December 5-17, 2017.

5.3.3 Measurement and analysis of program implementation variables

The program's conformity to design was assessed using process measures of recruitment, fidelity, and reach, largely based on Linnan and Steckler's (2002) definition, with slight modifications, as presented in Table 5.2 and described below. Specifically, indicators of program quality, dose delivered, and dose received, were all grouped under the program fidelity indicator, which broadly represents the program's "conformity to its original design". Each of the indicators used to measure implementation and delivery were selected based on the program's implementation theory (Figure 5.1), which graphically displays the set of activities implemented by the program (described above), by component, and the outcomes expected. The development of the program's implementation theory was heavily based on data collected by IDI and FGD, which was analyzed using an inductive thematic analytical approach[42] driven by concepts of

grounded theory,[43] but without the building of theoretical models. Thematic analysis was conducted using inductive, or "open" coding, wherein codes (often *in vivo*) emerged from, or were "grounded" in the data.[44,45] From there, codes supported the identification, analysis, and reporting of patterns or themes within the data.[42] Four study staff coded study transcripts using line-by-line coding; details of standardization across coders is described elsewhere (chapters 3 and 4). All qualitative data analysis was done using Dedoose Version 6.1.18, a web application for managing, analyzing, and presenting qualitative and mixed method research data.[46]

5.3.3.1 Program recruitment

Program recruitment refers to the procedures used to attract, recruit, and retain participants. Program recruitment was measured as the proportion of eligible beneficiaries who were registered by the targeted 6 months of age, as well as the proportion of, and reasons for not receiving Nutributter at the last distribution. Timely registration data came from the program's monthly monitoring system (SCOpe) and includes attendance data from the first year of program implementation only (n=22,456). Remaining program recruitment indicators were informed by the program's eight PDM surveys conducted over three years of program implementation. PDM data was pooled (n=2,901) and mean proportions were calculated for each indicator presented.

5.3.3.2 Program fidelity

Program fidelity encompasses the extent to which the program was delivered as it was intended, including elements of quality and integrity of delivery, as well as dose delivered and received by the target population(s) for each activity. The quality component of program fidelity was measured by observations of Nutributter distributions

and one-on-one counseling sessions (n=14 each, for total n=28), from which the number of times specific activities were done correctly was used to calculate proportions used to represent program functioning. Activities included: functioning of the card scanning technology, adequate stock of Nutributter at the distribution site, correct distribution of Nutributter to mothers (35 sachets), courteous treatment of mothers, communication of IYCF, WASH, and Nutributter messages, and receipt of group counseling during distributions. Duration of the distribution session was recorded for all distributions, and presented as mean and standard deviation.

The assessment of staff (Promoters and CGV) knowledge represented yet another aspect of program quality and also fell under the umbrella of program fidelity. Knowledge assessments measured staff knowledge of IYCF, WASH, and Nutributter messages based on modules received. Similar to what was done above, the proportion of CGV (n=70) and Promoters (n=14) who provided a "correct" answer to each question was calculated based on total staff who answered that question. Mean knowledge scores were calculated for each module among program staff who had completed that module (i.e. answered all questions in the module): one point was assigned to each correct answer and summarized for each module to create a knowledge score, for CGV and Promoters. Highest possible scores for the modules were 27 for breastfeeding (completed by n=16 CGV and n=7 Promoters), 34 for complementary feeding (completed by n=13 CGV and n=5 Promoters), 5 for WASH (completed by n=70 CGV and n=14 Promoters), and 9 for Nutributter (completed by n=65 CGV and n=14 Promoters). Total scores were not calculated given the small proportions of CGV (5.7%) and Promoters (21.4%) who completed all four training modules.

Process indicators of dose delivered and dose received were grouped under program fidelity and mirrored each other, in that dose delivered referred to units of each intervention that were delivered, and dose received represented how and how many of those units were received by the target population *for that indicator*, which in this case could be program staff and/or mothers of eligible children. Dose delivered was measured by the number of care groups formed, health staff trained in program delivery, training of SBCC cadres, billboards erected, and promotional IYCF campaigns conducted, against the targets set by the program to generate proportions. Measures of dose received were obtained from APR documents provided by WFP. Dose received was measured as the proportion of hired program staff (Promoters, n=14 and CGV, n=70) who participated in knowledge assessments and had completed training on the SBCC modules, as well as the proportion of target beneficiaries who attended a community event, heard a radio message, recognized at least 3 nutrition messages, and consumed Nutributter as directed, as collected by PDM surveys.

5.3.3.3 Program reach

Often referred to as coverage, program reach provides the proportion of the target audience that participated in each of the intervention's components. We measured program reach in the program's Nutributter component as the proportion of target beneficiaries who attended monthly distribution sessions, provided by WFP's SCOpe system. Reach of the SBCC component was obtained from PDM data, measured as the proportion of target beneficiaries who received a CGV home visit and group counseling.

5.3.3.4 Synthesis of process indicators

The synthesis of all process indicators was done using Olney and colleague's (2013) method,[32] which categorized individual proportions from each process indicator into one of the following three categories: "working well" (>75%), "needs improvement" (25-75%), and "not working" (<25%). Data from qualitative activities such as opinions by program staff on how certain components were working were also considered in this categorization, and concerns raised by more than a few respondents were classified as "needing improvement" or "not working", else coding that component as "working well". Once classified, each of the indicators captured in the process evaluation were integrated into the program's logical framework and linked with the program to highlight downstream outcomes or impacts that may be affected by the program's implementation.

All analyses of quantitative data were performed using Stata v13.1 (StataCorp, College Station, TX).

5.3.4 Ethical approval

This process evaluation falls under the umbrella of an ongoing impact evaluation study of the Ntchisi nutrition program, which was approved by institutional review boards at the Johns Hopkins Bloomberg School of Public Health, and at the College of Medicine Research and Ethics Committee (COMREC) in Malawi. This study is registered with ClinicalTrials.gov, with number NCT02985359.

5.4 Results

5.4.1 Conformity of the program to its design

5.4.1.1 Program recruitment

In the first year of program implementation, 4,659 eligible beneficiaries (20.7%) had registered their child into the program at or before 6 months of age (Table 5.3). Data on

registration at 6 months of age was not available for years 2 and 3 of the program. PDM survey data indicated that 10.2% of the mothers had not received Nutributter during the last distribution, and among these, the reasons for not receiving it included not being informed of the dates of distribution (23.4%), having other commitments (39.2%), distribution site ran out of Nutributter supplies (11.0%), self, child, or other household member illness (8.1%), and other reasons (20.9%), including having a child who was no longer eligible to receive Nutributter (Table 5.3).

5.4.1.2 Program fidelity

Based on observations of Nutributter distributions, the quality component of program fidelity was deemed to be high (Table 5.4). Although the card scanning technology worked most of the time (85.7%), in some cases the system failed during the distribution (n=1), or was not used at all even if it was functioning (n=1) (data not shown). In all observations, ID card numbers were written down by HSAs and/or Promoters, which was a major source of delay, but deemed as necessary by program staff due to previous experiences with loss of electronic data. The waiting time at the distribution point as measured by maternal report in PDM surveys was a median of 1.0 hour, while the mean (SD) duration of the distribution as observed was 2.0 (0.8) hours. In all observations, the stock of Nutributter was adequate to serve all attending mothers, as was the number of sachets distributed (Table 5.4). Distribution sessions were observed to be friendly community gatherings, which was demonstrated in the courteousness and interaction between the delivery staff and beneficiaries attending distributions (Table 5.4). Although group counseling was conducted at the initiation of every observed distribution, the lack of multiple rounds of counseling in half (n=7) of the distributions observed distributions

led to only some (in 14.3% of distributions) or most (in 57.1% of the distributions) mothers present at the time of the distribution receiving group counseling. In less than 1/3 of distribution sessions (28.6%) was it observed that all mothers in attendance received group counseling (Table 5.4). Finally, topics covered during group counseling at distributions were mostly focused on Nutributter use (100%), but also included IYCF (57.1%) and WASH (28.6%) messages (Table 5.4).

Demographic, employment, and workload characteristics of Promoters and CGV who participated in knowledge questionnaires are provided in Supplementary table 5.1. Knowledge questionnaires with CGV highlighted that knowledge of key breastfeeding, WASH, and Nutributter messages was ≥90%, with the exception of how to overcome breastfeeding challenges, which only 47.8% could answer correctly (Table 5.5). Complementary feeding knowledge was lower, both among CGV and Promoters, especially regarding messages around the 6 food groups, which only 22.9% of CGV could list correctly (Table 5.5). Trends in knowledge among Promoters mirrored those seen among CGV, with low knowledge of messages about overcoming breastfeeding problems (69.2%) and being able to name the six food groups (35.7) (Table 5.5). A comparison of mean knowledge scores among CGV and Promoters who had completed each of the four modules further demonstrated these similarities. Mean (SD, range) knowledge scores among CGV and Promoters were 23.3 (2.0, 19-26) and 24.0 (1.3, 22-26) for breastfeeding, 24.4 (3.6, 19-28) and 26.0 (3.5, 21-29) for complementary feeding, 4.9 (0.3, 4-5) and 4.6 (0.8, 2-5) for WASH, and 8.7 (0.6, 7-9) and 8.6 (0.5, 8-9) for Nutributter, respectively (Figure 5.3).

Program quality indicators showed that many of the training and mobilization activities, such as formation of care groups (100.0%), and training of health staff (99.0%) and of SBCC cadres (73.3%), were conducted according to plan (Table 5.6). Despite taking these steps needed to implement SBCC training activities, completion of training by front-line Promoters and CGV, was low (Table 5.6). Only 21.4% of promoters and 5.7% of CGV had completed all 4 training modules. For both CGV and Promoters, completion of the complementary feeding module was the lowest (18.6% and 35.7%, respectively), followed by breastfeeding module completion by 50.0% and 22.9%, respectively. Measures of program SBCC dose delivered, such as activities targeting mothers of eligible children, including promotional campaigns on IYCF, erection of billboards, and Open Nutrition Days were completed at 100.0%, 50.0%, and 57.1%, respectively (Table 5.6). Self-reported dose for messages received by mothers, such as attendance at community events (15.1%) and exposure to radio messages (42.1%) was low. Despite this, the ability of mothers to recall at least 3 nutrition messages was very high (98.9%), likely as a result of receipt of messages from Nutributter distributions (group counseling), which 92.1% of mothers reported as a source of counseling. Similarly, adequate Nutributter usage practices, such as consumption of one packet by the child in the last 24 hours (75.1%) and relatively low self-reported product misuse (sharing of 12.4%), further highlight that program messages were being received by mothers (Table 5.6).

5.4.1.3 Program reach

Over three years of program implementation, 81.0% of beneficiaries had attended at least one monthly distribution session (Table 5.7); this ranged from a low of 56.5% (July

2014) to a high of 92.2% (October 2016) (Supplementary figure 5.3). The proportion of beneficiaries who reported having been exposed to counseling by home visits from CGV and group counseling was 32.9% and 92.1%, respectively (Table 5.7).

5.4.2 Process evaluation in the context of the program's logical framework

Figure 5.4 synthesizes the results presented in tables 5.3-5.7 and demonstrates that based on a qualitative assessment of the program's process indicators, the implementation of Nutributter (LNS) distributions were working well (boxes in light gray). For instance, the communication of Nutributter messages was done at all 14 observed distributions (100.0%) and thus deemed as "working well", while the communication of WASH messages was only done at 4 out of the 14 observed distributions (28.6%), and thus categorized as needing improvement. Figure 5.5 highlights that aspects of distributions that could be improved, including: (1) the registration of beneficiaries by 6 months of age; (2) provision of IYCF and WASH messages during distributions; and (3) conducting sufficient rounds of counseling sessions per distribution to improve coverage for all participating mothers. The program's SBCC activities had less of a generalized "well-working" implementation, due to low completion of training modules by CGV and Promoters alike, despite good performance on the formation of care groups and conduct of training activities. Maternal report of exposure to various sources and types of messaging was deemed as needing improvement as well.

5.5 Discussion

In this process evaluation, we described and measured the implementation of a district-wide nutrition program that aims to reduce the prevalence of stunting among children aged 6 to 23 months living in Ntchisi district in the central region of Malawi. A variety of

data sources and research activities were used to assess the program's conformity to its original design. The integration of these results into the program's logical framework provided a qualitative picture of how the program operates, highlighting that the program component that deals with monthly Nutributter distributions functioned well. Nevertheless, enrollment of program beneficiaries at or by 6 months of age and variations in counseling strategies during Nutributter distributions to reach *all* participating mothers, rather than only those who arrive early, were categorized as needing improvement. The implementation of SBCC activities was more variable in its implementation. Though many of the community mobilization and training activities were implemented by the program as planned, completion of training modules in a small sample of front-line staff, was low. This in turn affected downstream processes, such as exposure to individual counseling and community events by target beneficiaries, which were also low.

This process evaluation demonstrated that less than ¼ of children had first received Nutributter at or by the targeted age of 6 months in the program's first year. This statistic is important to consider due to the identified importance of *duration* of exposure to Nutributter supplementation in improving growth.[15] Under its original design, children were intended to receive Nutributter for a period of 18 months, but delays in enrolment, in addition to unanticipated events that may have caused a child to miss a month or more of supplementation throughout the period of eligibility, could minimize both the total months of supplementation and subsequently, Nutributter's potential impact on growth. Nevertheless, and when interpreting this indicator, two caveats deserve mention here. Since the program includes all children between the ages of 6 to 23 months in a geographic area, the known mobility of the population (i.e. children in the targeted age

range moving into the district), as well as the calendar (rather than aged) start date of the program (January 2014) may have contributed to an erroneously inflated denominator in the calculation of this indicator, thereby lowering the proportion of children enrolled by 6 months of age cited here. Secondly, data on program recruitment was available (and presented) only for the first year of implementation, and may have improved as the program matured. This indicator should thus be interpreted with caution, as it is not solely reflective of program functioning, rather of the inherent challenges of implementing such an intervention in a programmatic context.

Our assessment of program fidelity captured aspects of quality, integrity, and dose of implementation, which was found to be highly satisfactory for the Nutributter distribution component. Distribution sites were plentiful and conveniently located, and distributions were run efficiently. The implementation of the SBCC component, however, was observed to be both more challenging to implement, as well as its success more difficult to measure. Despite the 100% formation of care groups (n=511) and full roll-out of SBCC activities cited by program implementers, these measures reflected the saturation and geographic distribution of Promoters and CGV in a manner sufficient to cover all households in the district, as opposed to the complete and fully functional implementation of SBCC activities by Promoters and CGV on the ground. Two findings led us to this conclusion. First, and despite CGV's self-report of visiting a mean of 10.5 households per month, less than 1/3 of mothers who participated in post-distribution monitoring surveys throughout the entirety of the program's implementation to date reported having received a home counseling visit by a CGV.

Second, and after almost three years since the program's start, the completion of all four training modules by Promoters and CGV, and delivery of messages by CGV from each of these respective modules was observed to be incomplete and variable across the district in our sample of CGV. The lack of completed training by front-line staff, however, was not seen as a reflection of trainings not being conducted as planned. On the contrary, this study found that all care groups were formed according to plan, with corresponding training activities of 73% of greater for SBCC cadres and health staff. The low proportion of Promoters and CGV having completed training may thus rather be reflective of the realities associated with depending on a network of volunteers, who have competing priorities or other responsibilities that prohibit them from conducting or attending training sessions, yielding a "spotty" completion of lessons and modules. Nevertheless, and likely balanced by the high attendance recorded at distribution sessions, which also included a counseling component, a very high proportion of mothers were able to recall at least 3 nutrition messages. This could be verified by the more than 90% of mothers who reported having received messages from group counseling. Other community-level SBCC activities and mobilization may have also contributed to a high exposure and recall of nutrition and sanitation messages.

There are a few limitations of this study that deserve mention. This process evaluation was dependent on a variety of sources, including data that relied on self-report of practices and/or observation, which are prone to social desirability bias[47] and reactivity to the observer,[48] respectively. Social desirability bias is the systematic error that occurs in self-reported measures resulting from the "desire of respondents to project a favorable image to others".[47] Data specific to fulfillment of CGV's work responsibilities, and home

usage of Nutributter for example, were both based on self-report by the CGV and mothers, respectively, and may therefore have been systematically less reliable or reflective of actual practices for fear of "being caught" in doing the wrong thing or not following instructions. One example of this lies in the discrepancy observed across various sources of reported sharing of Nutributter by mothers of beneficiary children. Although reactivity to the observer may have caused program staff to behave differently during Nutributter distributions and one-on-one counseling sessions, the use of direct observations was considered a strength in this study because it allowed us to see, experience, and assess program implementation rather than to depend on *reported* implementation.[49] The use of various methods and sources employed in this study, however, promoted the triangulation of information to more accurately understand program operations and procedures, as well as product usage by eligible beneficiaries.

Another limitation of this study is the purposive, non-representative sampling strategy used for the knowledge assessments with nutrition Promoters and care group volunteers. Although the sampling strategy responded well to the objective of this activity to grasp a broad understanding of program staff's training and knowledge retention, our conclusions and inferences cannot be applied to the army of more than 500 nutrition Promoters and 5000 care group volunteers operating across the district. Efforts to expand this type of research activity to a representative sample would clarify the additional need for reinforcement of training activities, and in what modules specifically, of front-line staff.

Lastly, the timing of data collection on program functioning (direct observations) and quality (knowledge questionnaires) was conducted only once and late into the program's implementation, and are therefore unlikely to inform program fixes. Repeated

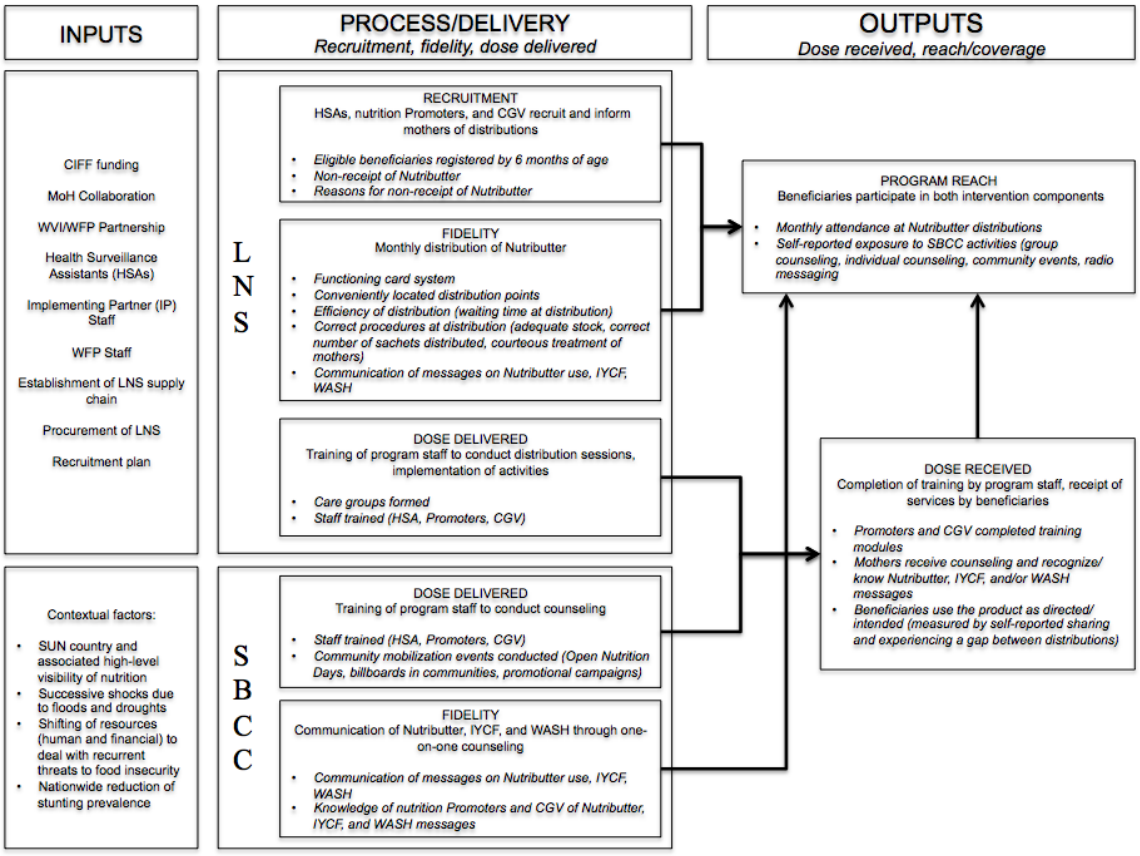
measurements that started earlier in the program's implementation would have been valuable for course correction as well as for providing a basis for comparison over time. For example, process evaluations in Bangladesh, Ethiopia, and Vietnam under the Alive & Thrive Initiative collected data on program implementation early on and throughout the life of the program to identify and correct bottlenecks and challenges in a timely manner.[30,31] Nevertheless, the use of various sources of existing data and the availability of well-established and continuous program monitoring data collected at different times since the program's initiation, promoted the efficiency with which this process evaluation was conducted, and allowed for data-driven triangulation of findings and conclusions.

This study is among the few known process evaluations of a large-scale nutrition program delivering a combined package of a lipid-based nutrient supplement and nutrition education to all children aged 6-23 months in a district of rural Malawi. The measurement of this program's processes and interventions, and how they can be modified to achieve their objectives more efficiently and effectively,[27] adds to the growing body of evidence on how a food supplement can be delivered to large numbers of geographically dispersed and rural beneficiary populations frequently and effectively in combination with group and individual social behavioral change initiatives, and the challenges that arise in doing so. This study also responds to the newly established Society for Implementation Science for Nutrition's mandate to generate, consolidate, and share program experiences of efficient and effective scale-up of proven nutrition interventions,[50] which has been described by global nutrition experts as requiring greater attention.[51–55]

This process evaluation study measured the recruitment, fidelity, and reach, of a large-scale nutrition program being implemented in Ntchisi district, Malawi. While certain aspects of the program were identified as requiring continued improvement in their implementation, the program was effective in reaching a large proportion of the target population with many of its planned activities. Strengthening the individual, household-level counseling by care group volunteers under the SBCC component, would bring this program closer to its original design and to achieving child growth outcomes in this rural and poor sub-Saharan African setting.

Tables and Figures

Figure 5.1. Implementation theory for the nutrition program implemented in the district of Ntchisi, Malawi



LNS: Lipid-based nutrient supplement; SBCC: Social and behavioral change communication; CGV: Care Group Volunteer; HSA: Health Surveillance Assistant; IYCF: Infant and Young Child Feeding; WASH: Water, Sanitation, and Hygiene

Table 5.1. Summary of data collection methods, sample, and indicators used for the process evaluation of the nutrition program in Ntchisi district, Malawi

Type of process variable	Objective	Data source	Sample size	Measurement/ Indicators
Program recruitment	To clarify procedures and methods used to recruit participants, and identify reasons for non-participation.	Review of available program design and implementation documents Informal discussions with program design and implementing staff	N/A	• Description of procedures used to attract and recruit participants • Reasons for non-participation
		IDI with mothers	n=34	
		IDI with household members	n=11	
		FGD with: • Promoters • CGV	 n= 12 n=10; n=11	
		Program M&E systems: SCOpe	n=22,556	• Eligible beneficiaries registered by 6 months of age, %
		Program M&E systems: PDM surveys	n=2,901	• Mothers who did not receive Nutributter at last distribution, % • Reasons for not receiving Nutributter, among mothers who did not receive it in previous distribution, %
Program fidelity: Quality	To evaluate the extent to which the program is being delivered as it was intended, including an assessment of the *quality* and *integrity* of its delivery.	Direct observations of Nutributter distributions	n=14[1]	• Functioning of card scanning technology, % • Duration of the distribution session, mean hours • Adequate stock of Nutributter at the distribution, % • Correct distribution of Nutributter, % • Courteous treatment of mothers at distribution, % • Communication of Nutributter usage messages, % • Communication of IYCF and WASH messages, % • Receipt of group counseling at distribution, %
		Direct observations of CGV delivering SBCC	n=14	• Communication of IYCF and/or WASH messages, % • Communication of Nutributter usage messages, %
		Knowledge assessments with Promoters Knowledge assessments with CGV	n=14 n=70	• Training completed by Promoters and CGV, % • Promoter and CGV knowledge of Nutributter messages • Promoter and CGV knowledge of IYCF messages

Type of process variable	Objective	Data source	Sample size	Measurement/ Indicators
				• Promoter and CGV knowledge of WASH messages
		Program M&E systems: PDM surveys	n=2,901	• Waiting time at distribution point, median hours
Program fidelity: Dose delivered	To measure how much of the program's intended activities were delivered to the target beneficiaries.	Program M&E systems: SCOpe	N/A	• Care groups formed, % • Health staff trained in program delivery, % • Training of SBCC cadres, % • Open Nutrition Days conducted, % • Billboards erected, % • Promotional campaigns on IYCF, %
Program fidelity: Dose received	To measure the extent to which all program components are received and utilized by target beneficiaries	Knowledge assessments with CGV	n=70	• Households visited per month by CGV, mean
		Program M&E systems: PDM surveys	n=2,901	• Target beneficiaries who attended a community event, % • Target beneficiaries who heard a radio message, % • Mothers who recognized at least 3 nutrition messages, % • Consumed 1 sachet of Nutributter in last 24 hours, % • Nutributter shared, % • Households experiencing a gap in Nutributter supply, % • Gap days among households experiencing a gap in supply, mean
Program reach	To measure the % of eligible beneficiaries who are reached by the program.	Program M&E systems: SCOpe	n=41,617	• Target beneficiaries attending monthly Nutributter distribution sessions, %
		Program M&E systems: PDM surveys	n=2,901	• Target beneficiaries who received a CGV home visit, % • Target beneficiaries who received a group counseling, %

CGV: Care Group Volunteers; EDP: Extended Distribution Point; FGD: Focus group discussions; IDI: In-depth interviews; M&E: Monitoring and Evaluation; PDM: Post-distribution monitoring; SCOpe: System for Cash Operations.

1 An imbalance in observations of Nutributter distributions at the health center and EDP resulted from a misunderstanding of distribution dates, which yielded one more EDP-based observation than planned, and one less health center-based observation than planned. Nevertheless, the total number of observations of Nutributter distributions (n=14) remained as planned.

Table 5.2. Linnan and Steckler's (2002) definition of key process evaluation components included in this study

Process evaluation component	Definition
Recruitment	Procedures used to approach and attract participants. Recruitment often occurs at the individual and organizational/community levels.
Fidelity	The extent to which the intervention was delivered as planned. It includes three critical elements of quality, dose delivered, and dose received.
Quality	The quality and integrity of the intervention as conceived by the developers.
Dose delivered	The number of intended units of each intervention or each component that are delivered
Dose received	The extent to which the target audience (of the dose delivered indicator) actively engages with, interacts with, is receptive to, and/or uses materials or recommended resources.
Reach	The proportion of intended target audience that participates in an intervention, often measured by attendance. Reach is a characteristic of the target audience.

Figure 5.2. Content of social and behavior change communication messages discussed during direct observations (n=14) of one-on-one counseling sessions by Care Group Volunteers in Ntchisi district, Malawi

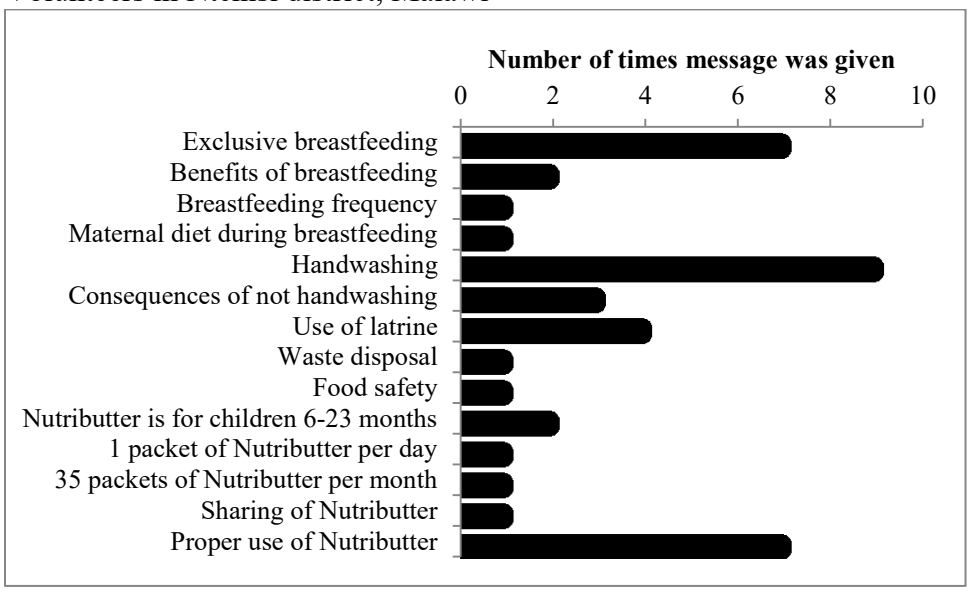


Table 5.3. Program recruitment and reasons for non-participation in the Ntchisi nutrition program, Malawi

Process indicator	n (%)
Eligible beneficiaries registered by 6 months of age[1]	4,659 (20.7)
Did not receive LNS at the last distribution[2]	296 (10.2)
Reasons for not receiving LNS at last distribution[2]	
Mothers not informed of last distribution	70 (23.4)
Other commitment	116 (39.2)
Not enough Nutributter at distribution point	33 (11.0)
Illness (self or family member)	24 (8.1)
Other	62 (20.9)

1 Calculated using data from SCOpe (n=22,456).
2 Calculated using data from post-distribution monitoring surveys (n=2,901).

Table 5.4 Program fidelity: quality of implementation of Nutributter distributions (n=14) and one-on-one counseling sessions (n=14)

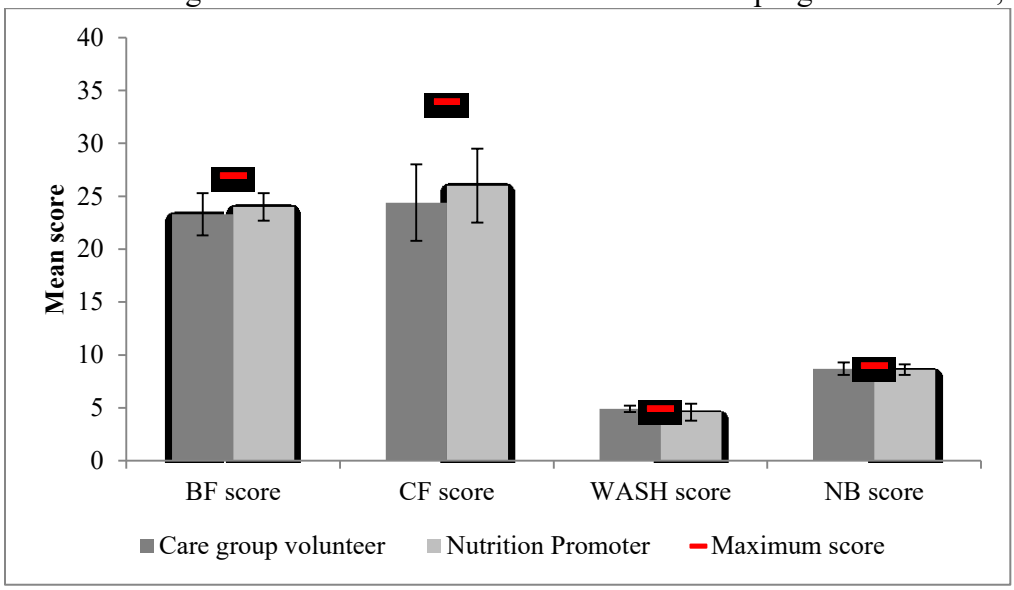
Nutributter distribution	n (%)
Card scanning functioning and used at distributions	12 (85.7)
Duration of distribution session, mean (SD) hours	2.0 (0.8)
Adequate stock of Nutributter at distribution	14 (100.0)
Correct number of sachets distributed	14 (100.0)
Courteous treatment of mothers	
Most of the time	2 (14.3)
All of the time	12 (85.7)
Nutributter use messages communicated	14 (100.0)
IYCF messages[2] communicated	8 (57.1)
WASH messages[3] communicated	4 (28.6)
Receipt of group counseling at distribution	
Some of the mothers	2 (14.3)
Most of the mothers	8 (57.1)
All of the mothers	4 (28.6)
One-on-one counseling	**n (%)**
Nutributter usage messages communicated	2 (14.3)
IYCF messages communicated	9 (64.3)
WASH messages communicated	9 (64.3)

Table 5.5. Knowledge of Promoters (n=14) and Care Group Volunteers (n=70) on three select key messages per training module (breastfeeding, complementary feeding, water, sanitation and hygiene, Nutributter), based on knowledge questionnaires with program staff[1]

	CGV n=70	Promoter n=14
Module 1: Breastfeeding	n (%)	n (%)
1. Begin breastfeeding within 1 hour after birth	63 (95.5)	14 (100.0)
2. One instruction on how to overcome breastfeeding challenges	22 (47.8)	9 (69.2)
3. Not to give child water or other liquid or food before 6 months, even in hot weather	62 (91.2)	14 (100.0)
Module 2: Complementary feeding	n (%)	n (%)
4. Foods other than breastmilk (complementary feeding) should start at 6 months of age	60 (85.7)	10 (71.4)
5. Can list the 6 food groups	16 (22.9)	5 (35.7)
6. Three foods that can be added to porridge to improve its nutritional value	58 (85.3)	12 (92.3)
Module 3: Water, Sanitation, and Hygiene	n (%)	n (%)
7. Three critical time points for washing hands	69 (98.6)	12 (85.7)
8. Use of water and soap to wash hands	69 (98.6)	13 (92.9)
9. Handwashing is important for preventing disease	70 (100.0)	14 (100.0)
Module 4: Nutributter	n (%)	n (%)
10. Nutributter is for children 6-23 months	64 (98.5)	14 (100.0)
11. Children should eat 1 packet of Nutributter per day	61 (93.9)	14 (100.0)
12. Nutributter should not be shared	61 (93.9)	12 (85.7)

1 Proportions presented are based on the number of staff who stated having completed the lesson to which the question corresponds. Messages 1, 2, and 3 were completed by n=66, n=46, and n=68 CGV, respectively. Messages 4, 5, and 6 were completed by n=70, n=69, and n=68 CGV, respectively. Messages 10, 11, 12 were completed by n=65 CGV. All messages except message 6 (n=12) were completed by all promoters.

Figure 5.3. Program fidelity: mean (SD) and maximum knowledge scores of Care Group Volunteers and nutrition Promoters who completed breastfeeding, complementary feeding, water, sanitation and hygiene, and Nutributter training modules under the social behavior change communication activities of the nutrition program in Ntchisi, Malawi



BF: breastfeeding; CF: complementary feeding; WASH: water sanitation and hygiene; NB: Nutributter

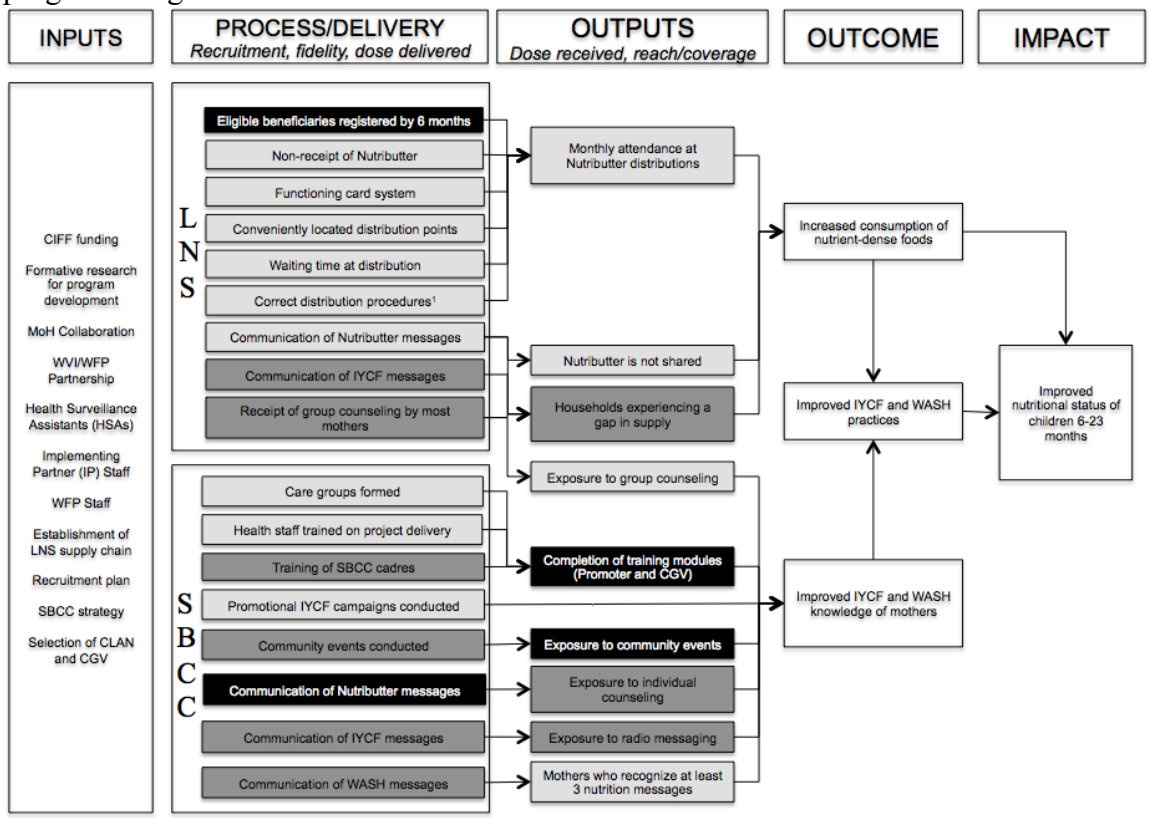
Table 5.6. Program fidelity: dose delivered, program quality, and dose received for the nutrition program in Ntchisi district, Malawi

Dose delivered	Program target, n	Achieved n (%)
Care groups formed	511	511 (100.0)
Health staff trained on project delivery	312	309 (99.0)
Training of SBCC cadres	90	66 (73.3)
Open Nutrition Days conducted	7	4 (57.1)
Billboards erected	14	7 (50.0)
Promotional campaigns on IYCF	12	12 (100.0)
Program quality: Training of nutrition Promoters (n=14)		n (%)
Training completed by promoter		3 (21.4)
Breastfeeding module		7 (50.0)
Complementary feeding module		5 (35.7)
Water, sanitation and hygiene module		14 (100.0)
Nutributter module		14 (100.0)
Program quality: Training of Care Group Volunteers (CGV) (n=70)		n (%)
Training completed by CGV		6 (8.6)
Breastfeeding module		16 (22.9)
Complementary feeding module		13 (18.6)
Water, sanitation and hygiene module		70 (100.0)
Nutributter module		65 (92.9)
Dose received: Target beneficiaries (n=2,901)		n (%)
Target beneficiaries who attended a community event		438 (15.1)
Target beneficiaries who heard a radio message		1,245 (42.9)
Mothers who recognized at least 3 nutrition messages		2,869 (98.9)
Children aged 6-23 months who consumed 1 packet of Nutributter in the last 24 hours		2,196 (75.7)
Nutributter shared		360 (12.4)
Household who experienced a gap in LNS supply		1,259 (43.4)
Gap days, mean (SD)		10.1 (2.4)
Households visited per month by CGV, mean (SD) (n=70)		10.5 (2.7)

Table 5.7. Program reach (coverage) of Nutributter distributions and social behavior change communication activities in the nutrition program in Ntchisi district, Malawi

Process indicator	N	n (%)
Target beneficiaries attending monthly LNS distributions	44,617	33,710 (81.0)
Exposure to SBCC activities	2,901	
Target beneficiaries who received CGV home visit		954 (32.9)
Target beneficiaries who received group counseling		2,672 (92.1)

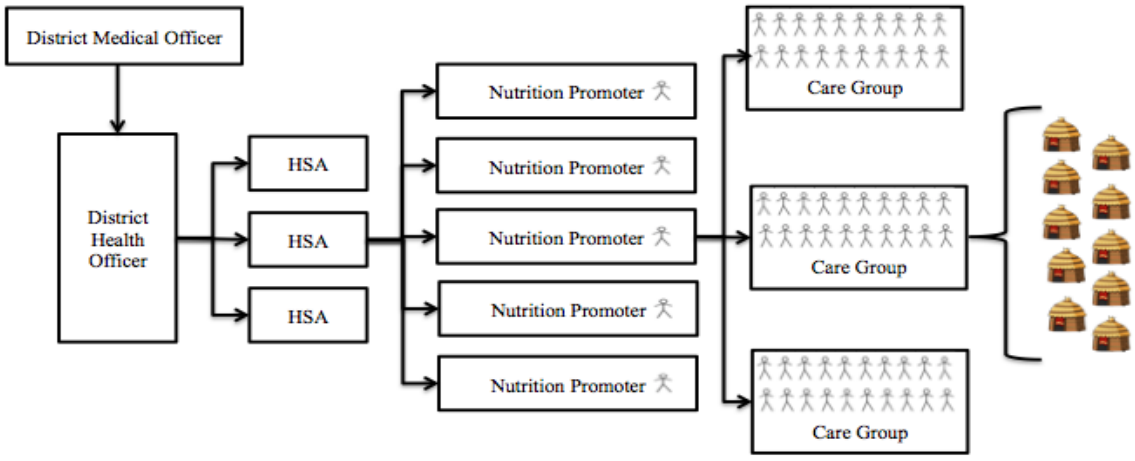
Figure 5.4. Summary of process evaluation results in the context of the Ntchisi nutrition program's logical framework



Legend:
- Working well (>75%)
- Needs improvement (25%-75%)
- Not working well (<25%)
- Not measured in this evaluation

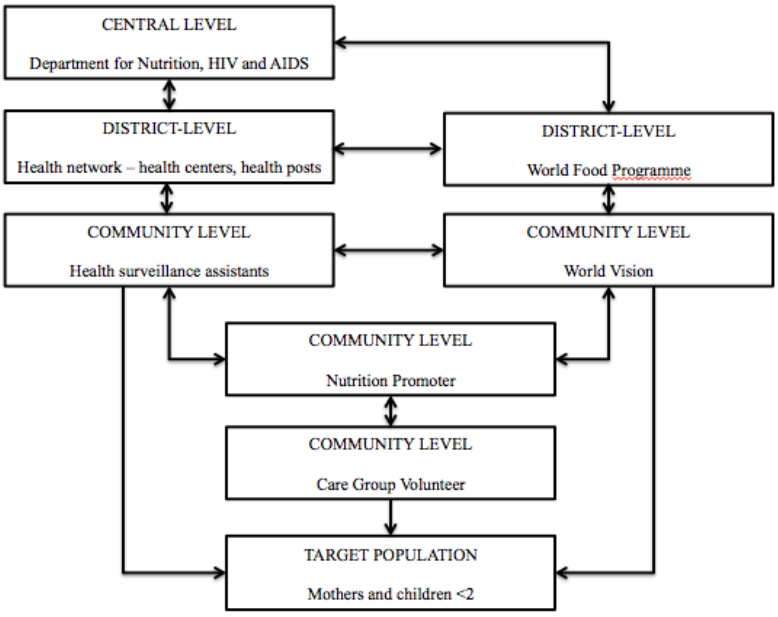
Using Olney and colleague's (2013) method. LNS: lipid-based nutrient supplement; SBCC: social behavior change communication; IYCF: infant and young child feeding; WASH: water, sanitation and hygiene; CGV: care group volunteer.

Supplementary figure 5.1. The Promoter-led Care Group model in Malawi



HSA: Health surveillance assistant

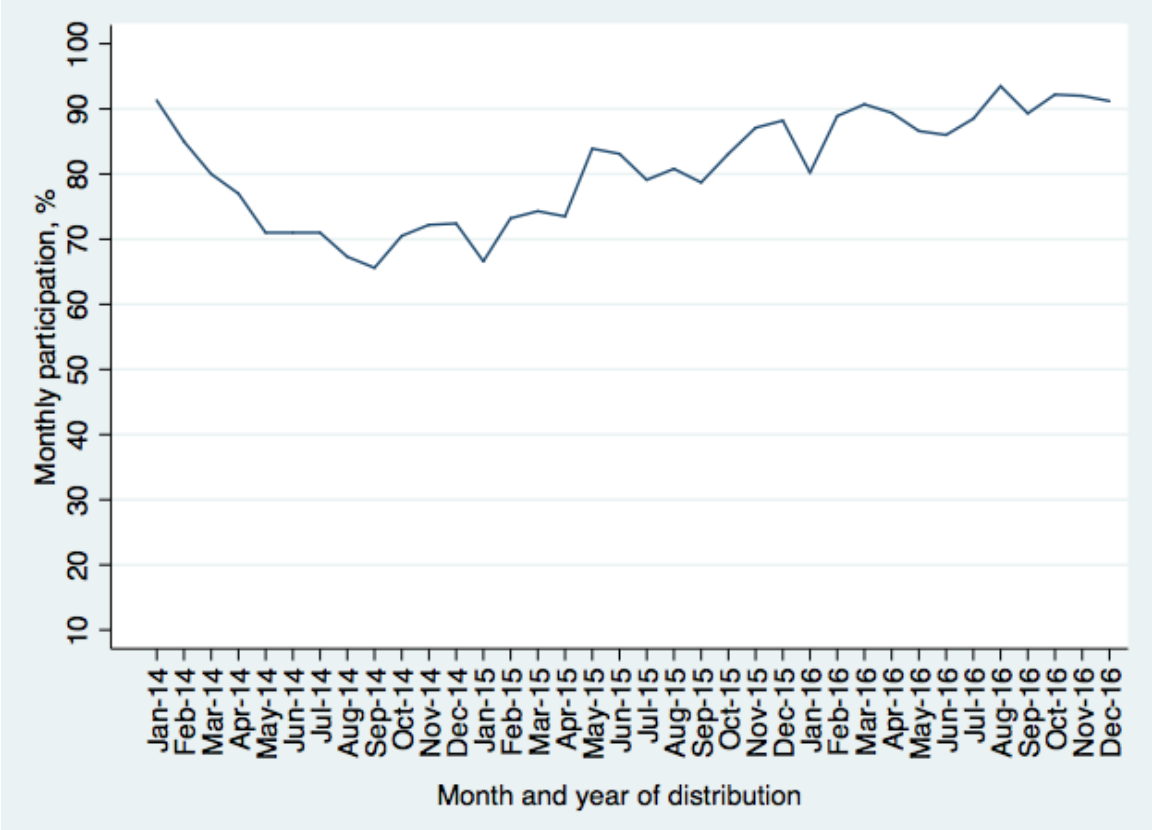
Supplementary figure 5.2. Operational schema of program actors for the nutrition program in Ntchisi district, Malawi



Supplementary table 5.1: Sociodemographic characteristics of Promoters (n=14) and CGV (n=70) who participated in knowledge questionnaires under the process evaluation of the nutrition program in Ntchisi district, Malawi

	Promoter n=14	CGV n=70
Demographic characteristics		
Age, mean years (± SD)	36.5 (± 6.1)	32.7 (± 7.7)
Male, n (%)	50.0	27.1
Education, mean years (± SD)	9.9 (± 1.4)	7.2 (± 2.2)
Married, n (%)	92.9	95.7
Main occupation, n (%)		
Agriculture	100.0	97.1
Business/self employment	0.0	2.9
Years living in the community, mean (± SD)	31.4 (± 9.8)	24.1 (± 11.5)
Employment characteristics		
Years in this position, mean (± SD)	5.9 (± 7.2)	3.25 (± 2.0)
Previously worked as community volunteers, n (%)	7 (50.0)	32 (45.7)
Sanitation and hygiene	8 (57.1)	22 (31.4)
Family planning	2 (14.3)	8 (11.4)
Reproductive health	3 (21.4)	4 (5.7)
Nutrition	6 (42.9)	18 (25.7)
Other	2 (14.3)	5 (7.1)
Previously financially compensated for this type of work, n (%)	1 (12.5)	1 (3.6)
Workload characteristics		
Number of days per month to perform work responsibilities, mean (± SD)	5.7 (± 4.0)	4.0 (± 2.7)
Conducted training in last 6 months, n (%)	12 (92.3%)	N/A
Number of households visited per month, mean (± SD)	N/A	10.5 (± 2.7)
Time spent at each household, n (%)		
<15 minutes	N/A	16 (22.9)
16-30 minutes	N/A	30 (42.9)
31-60 minutes	N/A	15 (21.4)
>60 minutes	N/A	9 (12.9)
Did not conduct individual counseling in last 6 months, n (%)	N/A	0 (0.0)

Supplementary figure 5.3. Program participation in monthly Nutributter distributions from January 2014 to December 2016 under the nutrition program in Ntchisi district, Malawi



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Chapter 6: Household and individual factors associated with participation in a large-scale nutrition program in Ntchisi district, Malawi

6.1 Abstract

Background: Lipid-based nutrient supplements (LNS) and social behavior change communication (SBCC) interventions have improved child growth in some settings. When delivered in a programmatic context, however, household, maternal, and individual factors may influence the uptake of services, thus compromising the potential impact of these interventions. Understanding what these factors are is critical to improving targeting and maximizing program uptake and impact.

Objective: Using data collected as part of a 1-year impact evaluation, this study aimed to measure which household, maternal, and individual characteristics were associated with varying levels of participation in a nutrition program's two intervention components. A secondary objective of this study was to assess whether levels of participation were associated with infant and young child feeding practices and anthropometric outcomes.

Methods: A district wide nutrition program being implemented in Ntchisi district in Malawi aims to reduce stunting through the monthly distribution of a small-quantity LNS, Nutributter (Nutriset, Malaunay, France), and group counseling to promote optimal infant and young child feeding (IYCF), including hygiene practices among participating caretakers to all children aged 6-23 months. The program supports and builds on the existing nationwide SBCC campaign that uses a network of Care Group Volunteers (CGV) and nutrition Promoters to deliver IYCF messages at the individual, group, and community (mass media) levels. Data from the midline survey of the impact evaluation of the nutrition program in Ntchisi and the comparison district of Dowa is used in this

analysis to examine the association between household, maternal, and individual characteristics and levels of program exposure and participation, as well as the extent to which varying participation is associated with infant and young child nutritional and dietary outcomes. Individual-level data on attendance at monthly Nutributter distributions is collected under the program's monitoring system, SCOpe. Using this, percent participation was dichotomized into high and low using the median as the cut-off (<71.4%). The comparison district of Dowa was the referent group (no exposure). SBCC exposure, occurring in both districts, was measured using self-reported data by the mothers who participated in the survey. A SBCC score was generated by assigning 1 point to each exposure including one-on-one counseling, group counseling, and mass media messaging. Because group counseling was done during monthly distributions of Nutributter in the program district, 2 points were assigned to those with high participation, defined as above, 1 point to those with low participation in Nutributter distributions and 0 to no participation (in Dowa). The total SBCC score (range 0-4) was further categorized into three groups. Low exposure was defined based on median exposure (score of ≤1) and score of 2-4 for high exposure, whereas those who were never exposed to any of the three SBCC channels were assigned a score of "0". Household characteristics included land and livestock ownership, having experienced a negative event in the last 6 months, wealth, and household food insecurity. Maternal characteristics assessed were maternal age, completion of primary school, marital status, and occupation. Child characteristics included age, sex, 7-day morbidity (diarrhea, malaria, acute respiratory infection, and fever), and usage of a mosquito net for the child. Household wealth was measured by creating an index based on self-reported asset

ownership and dwelling characteristics to place households into wealth quintiles. Household food insecurity was measured using the Household Food Insecurity Access Scale (HFIAS), which categorizes households into a spectrum of food insecurity based on the frequency with which they perceive or experience certain conditions of food restriction and/or availability. Multivariable multinomial logistic regression was used to examine the association between household, maternal, and child characteristics and varying exposure to Nutributter distributions and SBCC. For the second objective, nutrition outcomes assessed against program exposure included length-for-age (LAZ), weight-for-age, (WAZ), and length-for-weight (WLZ) z-scores, and stunting, wasting, and underweight were defined as LAZ, WLZ, and WAZ less than -2, respectively. Using 24-h food intake recalls done at the time of the survey, indicators of dietary intake were constructed including: (1) dietary diversity score (DDS), defined using number of food groups consumed and ranging from 0-7; (2) minimum dietary diversity (MDD), defined as consuming ≥4 food groups; (3) minimum meal frequency (MMF), defined as consuming the minimum number of meals by age group and breastfeeding status; and (4) minimum acceptable diet (MAD), defined as achieving both MDD and MMF. Data on drinking water source and sanitation and hygiene practices were used to construct a handwashing score (range 0-4), based on handwashing at 4 critical time points. Treatment of drinking water and providing treated water to children, were also assessed against varying program exposure. Multivariable linear and logistic regression models for continuous and binary outcomes, respectively, were used to estimate the association between varying exposure to program components and child nutrition outcomes, dietary intakes, and hygiene practices. Confounders included wealth, maternal education, child

age, child sex, and household food insecurity. Study design (village-level clustering) was accounted for in all models using a clustered sandwich estimator of variance. Wald tests were used to measure differences between categories of participation.

Results: A total of 2,047 children aged 6-23 months were included in this analysis. Median (IQR) participation in Nutributter distributions in the program district was 71.4% (50.0%-85.7%), and median (IQR) SBCC score was 2 (2-3) and 1 (1-1) in Ntchisi and Dowa districts, respectively. In a multivariable analysis, land and livestock ownership were both positively associated with high participation in Nutributter distributions (PR=2.16, 95% CI 1.03, 4.54 and PR=1.68, 95% CI 1.15, 2.44). Household food insecurity was associated with higher exposure to SBCC (PR=0.50, 95% CI 0.27, 0.94). No maternal characteristics were associated with exposure to either program component, with the exception of agriculture as a primary occupation, which was associated with increasing exposure to SBCC (PR=1.74, 95% CI 1.04, 2.91 for low exposure and PR=2.16, 95% CI 1.21, 3.86 for high exposure, as compared to no exposure). Children who were older (PR=1.04, 95% CI 1.01, 1.08), who experienced diarrhea (PR=1.78, 95% CI 1.12, 2.85) and malaria (PR=1.68, 95% CI 1.03, 2.75) in the last 7 days had a higher likelihood of being in the high Nutributter participation group, whereas those with ARI symptoms (PR=2.72, 95% CI 1.07, 6.92) had a higher likelihood of high exposure to SBCC. Mosquito net use was negatively associated with high participation in Nutributter distributions (PR=0.52, 95% CI 0.27, 0.99). In a multivariable model, high and low participation in the program's Nutributter distributions was associated with higher WLZ of 0.21 and 0.17, respectively, compared to those with no participation (both $p<0.05$); differences in WLZ between high and low participation groups were not significantly

different from each other given the overlap in confidence intervals observed between the high and low groups. Levels of participation in Nutributter distributions and exposure to SBCC were not associated with any other anthropometric outcomes studied (LAZ, WAZ, stunting, wasting, underweight). Low and high exposure, as compared to no exposure to SBCC were associated with increases in DDS of 0.22 and 0.21 (both $p<0.05$), respectively. Differences in DDS between high and low SBCC exposure were not significantly different from each other. The odds of achieving MMF was higher in the group with high exposure to SBCC, as compared to the no SBCC exposure group (OR=1.62, 95% CI 1.02, 2.56); low exposure was not associated with this outcome (OR=1.03, 95% CI 0.69, 1.55). SBCC improved the provision of treated water to children in both exposure groups (OR=0.27, 95% CI 0.12, 0.65 and OR=0.40, 95% CI 0.16, 1.00 in low and high versus no exposure to SBCC, respectively).

Conclusion: Some household and individual characteristics, namely morbidity, were associated with higher levels of exposure to the program's two components. These findings can be useful for improved targeting of interventions, such as tailoring program messages to promote participation among all children in the target age group, even among those who do not exhibit signs of illness. At one year of implementation, higher participation in the nutrition program was associated with child WLZ, though not in a dose response manner. Though not associated with anthropometric outcomes, higher exposure to SBCC was associated with improvements in some IYCF measures. A longer duration of program exposure may be necessary for seeing dose-response relationships extended to other child growth and IYCF outcomes.

6.2 Introduction

Globally, 165 million children under the age of five are stunted, and 34% of them live in Africa.[1] Despite the demonstrated efficacy of nutrition interventions that can be used to prevent child stunting,[2] their implementation at scale has been a challenge, partly due to our limited knowledge about how to deliver them effectively and in a programmatic setting.[3–5]

Given the difficulty of meeting the high nutrient requirements of young children in resource-poor and food-insecure settings, fortified, small quantity lipid-based nutrient supplements (SQ-LNS) represent promising avenues for delivering essential micronutrients, fatty acids, amino acids, and energy to growing children.[6] The increasing variety of products available, the shelf stability of LNS,[7] ease of use at the household level,[8–11] and demonstrated acceptability of the products[10,12–21] further adds to their appeal. Additionally, several randomized controlled trials have demonstrated the efficacy of such products in reducing stunting and wasting in many low income settings [9,22–24] Social behavior change communication (SBCC) activities such as individual or group counseling to promote optimal infant and young child feeding (IYCF), have also shown significant effects on linear growth improvements among children 6-23 months of age; the addition of supplementary food to SBCC interventions can amplify the effects of nutrition education alone.[2,25] The effect of complementary food supplementation on linear growth specifically has been demonstrated as being more pronounced in food insecure as opposed to contexts that are food secure, where improvements are mostly observed on weight.[2] In Malawi, where the burden of stunting was estimated at 37% among children under five in 2015,[26] the impact of LNS on child growth has been mixed.

Only 3[27–29] out of a total of 9 studies that tested this intervention[27–35] showed a modest positive impact on linear growth.[28,29]

Since January 2014, the Government of Malawi has implemented a comprehensive nutrition program in the district of Ntchisi to reduce the prevalence of stunting among children 6-23 months. The program includes the monthly distribution of a daily ration of a SQ-LNS (20g), Nutributter (Nutriset, Malaunay, France), in combination with a SBCC campaign to promote optimal IYCF and hygiene behaviors and practices. An impact evaluation of the program that includes three cross-sectional surveys (base-, mid-, and end-line) was conducted in the program (Ntchisi) and a neighboring, comparison district of Dowa at 0, 1, and 3 years of implementation, respectively.

The programmatic setting under which the program's interventions are delivered often complicates the achievement of results.[36] Specifically, household, maternal, and individual factors may influence the uptake of services, thus compromising the potential impact of these interventions. Understanding what these factors are is critical to improving targeting and maximizing program uptake and impact among program beneficiaries. Using data from the midline survey and program monitoring systems, the present analysis sought to explore which sociodemographic and individual characteristics are associated with high vs. low participation in the program. A secondary objective of this analysis was to examine the dose response relationship between program participation and child nutrition outcomes and IYCF practices.

6.3 Methods

6.3.1 The Ntchisi Nutrition Program

The main objective of the Ntchisi nutrition program is to prevent stunting among children ≤23 months of age. The program also aims to reduce maternal and childhood anemia, and to improve IYCF knowledge and practices among program participants through two primary intervention components: (1) the monthly, blanket distribution of a daily SQ-LNS, Nutributter, to all children 6-23 months of age in the program district; and (2) the roll-out of a national-level SBCC campaign targeted at health workers, the community, and caregivers, that is centered on promoting a range of nutrition, health, and hygiene behaviors. Nutributter (Nutriset, Malaunay, France) is a small (20g), peanut-based product that contains protein, lipid, carbohydrate, providing 108 kcal per sachet, and fortified with essential amino acids, vitamins, and minerals (contents provided in Supplementary figure 6.1) needed to fill the identified nutrient gap during this critical period of child growth development. The SBCC component is part of the national-level Scaling Up Nutrition[37] effort to deliver nutrition education through various channels and platforms, including one-on-one and group counseling, and via mass media. SBCC messages are therefore delivered in both the program and comparison district using the cited platforms, but implemented through different NGO networks. Additional details of the nutrition program are published elsewhere (chapters 3 and 5), but the group counseling on IYCF and/or instructions on Nutributter use that occurs at the initiation of, or during distribution sessions is different in the program area of Ntchisi. Thus, participation in distribution sessions is an indication not only of the receipt of Nutributter, but also, of group-level SBCC messaging, albeit some variability may occur in the delivery of these messages related to site-specific factors.

Monthly attendance of program participants at distribution sessions is tracked via a program identity card and corresponding participant number provided to mothers of all beneficiary children upon registration. Ownership and use of this card during monthly distributions allows program implementers to track beneficiaries' participation in quasi real-time using a card-scanning technology that is linked to an electronic monitoring system. This study used de-identified monthly attendance data of beneficiaries who participated in the program during the first year of implementation (January-December 2014) collected as part of this monitoring system.

6.3.2 Impact evaluation of the Ntchisi nutrition program

The independent impact evaluation of the nutrition program was conducted by the Johns Hopkins University Bloomberg School of Public Health's Center for Human Nutrition (JHU CHN), with the objective of assessing the program's 1- and 3-year impact on child growth, maternal and child anemia, and IYCF and hygiene knowledge and practices. A comparative study design was used and included the program district of Ntchisi and a neighboring, comparable district of Dowa. Three cross-sectional surveys (base-, mid-, and endline) were conducted in both districts in 217 medium-to-large sampled villages with mothers of children 6 to 23 months of age (n=1,200 children per district per survey, total n=7,200). Cross-sectional survey data were collected by interviewing mothers of children aged 6-23 months using structured survey questionnaires, by a team of 16 trained field workers. Interviewers participated in a one-week interactive training on use of survey questionnaires, and anthropometric measurements. For anthropometric measurements, all field workers participated in a two-day standardization exercise, which involved the conduct of repeated length and weight

measurements on a group of 10-15 children; measurements were compared to a gold standard measurer. All interviews were administered in the local language, Chichewa, and all anthropometric measurements were conducted by the five top-performing standardized measurers.

Survey data collected in the cross-sectional midline survey used for this analysis included household-and maternal socioeconomic characteristics, such as asset, land, and livestock ownership, dwelling characteristics, access to sanitation and water variables, food insecurity, and maternal age, occupation, and education. Data collected on child characteristics included age and sex, individual 24-hour food frequency recalls, maternal caring and child feeding and nutrition knowledge and behaviors, 7-day child morbidity, and maternal reports on program participation and exposure to SBCC channels. Anthropometric data included supine length and weight, which were measured using a Seca 417 length board and Seca 374 infant scale, respectively.

6.3.3 Ethical approval

Approval for the JHU CHN-led impact evaluation study was obtained from the Johns Hopkins University Bloomberg School of Public Health Institutional Review Board (JHSPH IRB) and the College of Medicine Research and Ethics Committee (COMREC) in Malawi. This study is registered with ClinicalTrials.gov, with number NCT02985359.

6.3.4 Variable creation

6.3.4.1 Measurement of program "dose" or exposure

Program exposure was measured and defined for the two program components. Individual-level program participation in Nutributter distributions was measured using the program monitoring system to calculate the number of months the child received

Nutributter as compared to the total months that the child was eligible to receive Nutributter (6-23 mo of age, i.e. duration of 18 mo), expressed as a percentage. Program exposure was dichotomized into high and low in the program district using the median value (<71.4% vs. >=71.4%) as the cut-off, given the relatively high levels of participation observed among children in the program district (IQR for program participation: 50.0%-85.7%). Children without a recorded participant ID card/number were excluded from the analysis (n=334). Children in the comparison district of Dowa were used as the referent category and coded as having "no or 0% participation"; no children in the program district had 0% participation.

Exposure to SBCC was measured by assigning one point each to self-reported exposure to individual, group, and mass media (radio, billboards, community-level events) messages, to create an SBCC score. Given the inclusion of group counseling in distribution sessions, all study participants from the program districts received 1 or 2 points for exposure to group counseling depending on low or high participation in Nutributter distributions, respectively. Exposure to group counseling in the comparison district of Dowa was coded as 1 for those who self-reported having received messages from that source, and zero for those who did not. SBCC score therefore ranged from 0-3 in the comparison district, and 1-4 in the program district. SBCC score was then categorized into high and low exposure based on median (≤1) SBCC score across both districts, and mothers with an SBCC score of zero (i.e. did not receive messages from any of the three possible channels) served as the referent category. Important to note is the absence of *quality* or content of messages in this categorization of exposure; exposure to

SBCC refers strictly to the number of channels as opposed to the content of specific messages included in the campaign.

6.3.4.2 Household, maternal, and individual characteristics

Household socioeconomic characteristics that were assessed against program exposure were collected using a household questionnaire administered to the mother of the eligible 6-23 month old child, and included self-reported land and livestock ownership (yes/no), having experienced a negative event in the 6 months preceding the survey (yes/no) wealth, and food insecurity. Household wealth is often associated with nutrition outcomes [38] and was measured by a wealth index, which was created using published methodology used in Demographic and Health Survey (DHS) reports.[39] This involves the use of socioeconomic variables including access to electricity and sanitation, ownership of basic consumer items (fan, radio, bicycle, mobile phone, landline phone, tape/CD player, bed, mattress, sofa, table and chairs, refrigerator, sewing machine, paraffin lamp, pounding mortar), and household dwelling characteristics. A principal components analysis was conducted to create a factor score with these assets, which was then used to create wealth quintiles for ease of interpretation. Briefly, following a removal of items with low variability (<5%) and stepwise reduction of assets with <0.3 factor loading, assets that were included in the wealth index were household ownership, sand as a flooring material, mud and brick as a wall material, a thatch or galvanized sheet roof, ownership of a latrine, radio, bicycle, mobile phone, tape or CD player, bed, mattress, sofa, and table with chairs.

Household food insecurity was calculated based on the Household Food Insecurity Access Scale (HFIAS) methodology,[40] which used indicators of the food insecurity

experience to categorize households on a spectrum of food insecurity status that ranged from food secure to severely food insecure. The HFIAS methodology focuses on three domains of food insecurity, including anxiety and uncertainty about the household food supply (1 question), insufficient quality of food (3 questions), and insufficient food intake and its physical consequences (5 questions). For each of the questions, participants who reported having experienced any of the conditions were then asked to state the frequency with which they experienced it (rarely, sometimes, or often), with which they were categorized as food secure, and mildly, moderately, and severely food insecure. Households were categorized as increasingly food insecure as they responded affirmatively to more severe conditions and the frequency with which they experienced them, as illustrated in Supplementary table 6.1.

Maternal/caregiver characteristics included age (years), education, measured dichotomously as having completed primary school or not (8 years in Malawi), marital status (married or other), and agriculture as a primary occupation.

Child characteristics included child age (months), sex, 7-day morbidity, and usage of a mosquito net. Child morbidity was measured as maternal self-report of the child having experienced symptoms from diarrhea, malaria, acute respiratory infection (cough, wheezing, chest in-drawing, labored breathing), and fever, over the 7 days preceding the survey, among those who had experienced them in the 30 days preceding the survey. Usage of a mosquito net was specific to the use by the child and measured as a binary variable (yes/no).

6.3.4.3 Dependent variables for dose-response analysis: Nutritional status, IYCF, and hygiene knowledge and practices

Outcomes against which dose response were tested included anthropometric outcomes and caregiver IYCF and hygiene knowledge and practices. Child anthropometric outcomes included length-for-age z-score (LAZ), weight-for-age z-score (WAZ), weight-for-length z-score (WLZ), which were derived from length and weight measurements using the median of the WHO Growth Reference Standards.[41] Children with LAZ, WAZ, and WLZ less than -2 were categorized as stunted, underweight, and wasted, respectively. Children <6 and >23 months of age (n=10), and with outlying or biologically implausible length (≥97cm)(n=1) or weight (≥ 70kg)(n=2) measurements were excluded from all analyses.

IYCF knowledge was assessed using a score derived from correct responses on 8 IYCF items, including knowledge of breastfeeding initiation, exclusive breastfeeding, feeding frequency at 6, 9, and 12 months of age, nutritious foods for young children, and feeding during and after illness. Variables to evaluate IYCF practices used 24-hour dietary recall data from the cross-sectional midline survey to construct WHO/UNICEF indicators including: (1) dietary diversity score (DDS), a continuous measure (range 0-7) calculated based on the consumption of 7 foods groups; (2) minimum dietary diversity (MDD), which referred to the consumption of 4 or more food groups; (3) minimum meal frequency (MMF), which was based on a minimum number of meals consumed, defined by the child's age and breastfeeding status (2 meals for breastfed children 6-8 months; 3 meals for breastfed children 9-23 months; 4 meals for non-breastfed children 6-23 months); and (4) minimum acceptable diet (MAD), which combined MDD and MMF and thus represented children who met both the diversity and frequency criteria.[42]

Hygiene practices included handwashing behaviors, for which a composite score ranging from 0-4 was created, where 1 point was awarded for mention of handwashing *with soap* at any of 4 critical time points (before cooking, before feeding the child, after using the toilet, after cleaning the child's nappy). Water treatment and provision of treated water to the child were also assessed as measures of optimal sanitation and hygiene practices, and categorized based on the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation's definitions.[43]

6.4.4 Statistical analysis

Cross-tabulations of levels of program exposure to each outcome and basic child, maternal, and household characteristics were done and tested using chi-square for categorical variables and Kruskal-Wallis H tests for continuous outcomes. The cltest option in Stata, which provides optional support for group stratified outcomes, was used to adjust for village level clustering when measuring for differences in continuous and binary outcomes across levels of program exposure.[44]

Multinomial logistic regression models were used to examine household, maternal, and child characteristics associated with high and low exposure to Nutributter distributions and SBCC vs. no exposure as the dependent variable. Risk factors tested in the model included household, maternal and child characteristics (described above), and estimated risk (prevalence) ratios (PR) and 95% confidence intervals (CI) for each level of participation (high and low) compared to the reference category of 0 or no participation. Although program participation is an ordinal outcome, ordered logistic regression was inappropriate for this analysis as many of the independent variables tested violated the parallel regression assumption, as measured by the Brant test.[45] Moreover,

obtaining PR for each level of participation was preferable for our interpretation of findings.

Multiple linear and logistic regression models for continuous and binary outcomes were run, respectively, to estimate the association between level of exposure to Nutributter and/or SBCC and anthropometric outcomes and IYCF practices. The study's sampling strategy (village-level clustering) was accounted for in all models using a clustered sandwich estimator of variance to ensure the robustness of standard error calculations.[46] Using this option, the calculation of standard errors allowed for intragroup correlation by relaxing the usual requirement that observations be independent within groups (villages).[46] Models were adjusted for child age, sex, maternal education, and household wealth. Models that included hygiene outcomes also included confounders such as distance to a water source, while models that included IYCF and anthropometric outcomes were also adjusted for household food insecurity. To assess for differences between high and low categories of exposure, the overlap in confidence intervals between the two categories were assessed; an overlap would indicate the lack of a statistically significant difference between groups.

Model selection and fit for all models was performed using likelihood ratio tests that tested whether the addition of variables significantly improved the fit of the model (full vs. nested). Significance of all outcomes of interest was tested at $P < 0.05$. Given the multiple outcomes (comparisons) (n=14) that were assessed against the same program exposure predictors, a Bonferroni correction (α/n) for multiple comparisons was applied to the outcomes presented. Based on this method, the Bonferroni-corrected significance

level was calculated as $p<0.004$. All statistical analyses were performed using Stata version 13.0 (Stata Corporation, College Station, TX, USA).

6.5 Results

Exposure to the program's Nutributter and SBCC was available for 2,047 and 2,045 children 6-23 months, respectively, who participated in the impact evaluation's midline study. Median (IQR) participation in Nutributter distributions was 71.4% (50%-85.7%), ranging from 7.1% to 100% (Table 6.1). Median (IQR) exposure to SBCC across both districts was 1 (1-2). Due to the inclusion of a counseling component in Nutributter distributions, median (IQR) SBCC exposure was higher in Ntchisi than Dowa [score of 2 (2-3) in Ntchisi and 1 (1-1) in Dowa] (Table 6.1).

Table 6.2 presents basic child, maternal, and household-level socioeconomic characteristics of study participants, by level of participation in Nutributter distributions and exposure to SBCC. Household food insecurity was high, with 83.9% of households experiencing some degree of food insecurity, which was categorized as severe among 35.5% of households. The mean (SD) age and education of mothers was 27.0 (6.4) and 5.2 (3.3) years, respectively, with less than a third (27.7%) having completed primary school (8 years). A majority of mothers were married (88.3%) and employed in agriculture (80.9%). The mean (SD) age of children was 15.3 (4.8) months with a majority being breastfed (97.3%). Land and livestock ownership, experiencing a negative event, and child age and morbidity from diarrhea, malaria, and fever, were significantly different across children in different categories of participation in the program's Nutributter component (all $p<0.05$). Characteristics that varied significantly by exposure

to SBCC were household land and livestock ownership, household food insecurity, maternal age, and child morbidity from acute respiratory infection (ARI) (all $p<0.05$).

Adjusted analyses of the characteristics associated with participation in Nutributter distributions showed that land and livestock ownership, increasing child age, 7-day morbidity from diarrhea, and malaria, and usage of a mosquito net for the child, were all positively associated with being in the high participation category (Table 6.3). Mothers from households who owned land and livestock were more likely to demonstrate high participation in Nutributter distributions as compared to those who did not participate (PR 2.16, 95% CI 1.03,4.54 and PR 1.68, 95% CI 1.15, 2.44, respectively, both $p<0.05$)(Table 6.3). Increasing child age and 7-day morbidity from diarrhea and malaria were also positively associated with increased PR (95% CI) of 1.04 (1.01, 1.08), 1.78 (1.12, 2.85) and 1.68 (1.03, 2.75)(all $p<0.05$), respectively, as compared to non-participants. Experiencing a negative event in the last 6 months decreased the likelihood of low participation in Nutributter distributions (PR 0.70, 95% CI 0.52, 0.94). Household food insecurity lowered the risk of both low (PR 0.64, 95% CI 0.49,0.83) and high (PR=0.70, 95% CI 0.53, 0.92) exposure to SBCC, while agriculture as a primary occupation increased the risk of SBCC exposure (PR 1.92, 95% CI 1.03, 3.57 for low exposure and PR 1.67, 95% CI 0.98, 2.85 for high exposure). Symptoms of acute respiratory infection in the past 7 days was associated with increased risk of high exposure to SBCC (PR 2.72, 95% CI 1.07, 6.92, $p=0.04$).

Participation in Nutributter distributions demonstrated a significant, dose-response relationship with WLZ, which was 0.21 (95% CI 0.06, 0.36) higher in high and 0.17 higher (95% CI 0.03, 0.31) in low versus non-participating groups (both $p<0.05$) (Table

6.4). Although the association is stronger among those with a higher than a lower dose, as compared to control, differences in WLZ between the high and low participation categories do not point towards a dose-response association given the overlap in confidence intervals between the two participation categories (95% CI 0.03-0.30 and 0.05-0.35 among low and high categories, respectively). Participation in Nutributter distributions was marginally associated with improved WAZ in both high and low participating groups (p=0.08 and 0.06, respectively), and wasting in the low versus no participation group (p=0.07). No other anthropometric indicators (LAZ, stunting, underweight, or wasting) were associated with any level of participation in the program's Nutributter component. In contrast, adjusted models of high and low doses of exposure to SBCC suggested a dose-response trend towards improved nutrition outcomes as compared to no exposure, but these differences were not significant (Table 6.4). There was a trend for WAZ and WLZ to be higher, and prevalence of stunting, underweight, and wasting to be lower among those with low and high, as compared to no exposure to SBCC, albeit none of the coefficients were significant (all $p>0.05$).

Despite the lack of significant associations with any of the anthropometric outcomes studied (all $p>0.05$) (Table 6.4), high and low, versus no, exposure to SBCC was associated with increases in DDS of 0.21 (95% CI 0.01, 0.42) and 0.22 (95% CI 0.03, 0.41) (both $p<0.05$), respectively (Table 6.5). Though significantly different from the referent category, there does not appear to be a dose-response between high and low dose of SBCC exposure given the observed overlap in confidence intervals. The odds of achieving MMF were 1.62 (95% CI 1.02, 2.56, $p<0.05$) higher among those with high exposure to SBCC, as opposed to those with no exposure.

6.6 Discussion

This study complemented the results of a process evaluation for a nutrition program in Ntchisi district, Malawi, by measuring the characteristics associated with varying levels of program exposure. Furthermore, it complemented the midline impact evaluation study, by measuring the association between varying doses of exposure to two intervention components on child nutrition and feeding and hygiene practices.

Various household, maternal, and child characteristics were found to be positively associated with participation in Nutributter distributions, including land and livestock ownership, child age, and 7-day child morbidity from diarrhea and/or malaria. Having experienced a negative event in the last 6 months was negatively associated with low participation in Nutributter distributions. Characteristics associated with SBCC exposure included food insecurity, agriculture as a primary occupation, and 7-day morbidity from symptoms of acute respiratory infection.

Though not specific to nutrition, studies that have done similar assessments of household and individual characteristics associated with uptake of health interventions (immunizations and HIV treatment), demonstrate lower service utilization and/or participation patterns among the poorest households with uneducated parents, with little access to media, and with low health seeking behaviors.[47,48] Wealth (in this case land and livestock ownership) and maternal education were both associated with higher participation in this setting, and are thus broadly aligned with these findings. Interestingly, Wiysonge and colleagues also identified clustering effects of non-participation, wherein children from the same communities had similar service utilization patterns, providing evidence of common contextual influences that determine

participation.[47] The clustering of exposure to this nutrition program's interventions deserves further study in this context.

Our finding of sicker children, as measured by 7-day morbidity, being more likely to exhibit high levels of participation is aligned with findings from a study in Western Uganda, where children who were underweight were much more likely to be fed a lipid-based supplement.[49] The perception of some community members that Nutributter contains "medicine", "the 6 foods groups", and "contents similar to those found in breastmilk" (Chapter 4), may further help to explain why more children with these morbidity characteristics demonstrated high levels of participation in the Malawi program. These findings are especially relevant given the known and strong association between child morbidity and growth,[50–52] as well as the demonstrated, increased benefit of LNS among children who exhibited higher levels of growth restriction in Burkina Faso.[24]

In the interpretation of the factors associated with program participation, it is important to highlight the results of the univariate analyses of these factors, which demonstrated district-level differences for many of these characteristics. Thus, the associations observed between these characteristics and participation levels may be the result of inherent district-level differences, rather than determinants of program exposure.

Our dose-response analysis demonstrated a positive association between exposure to Nutributter distributions and weight-for-length z-score, and exposure to social and behavior change communication channels with some infant and young child feeding and hygiene outcomes. Exposure to high levels of SBCC, as compared to none, was

associated with improved dietary diversity score, and higher odds of achieving minimum meal frequency.

The qualitative dose-response association seen between participation in Nutributter distributions and weight-for-length z-scores is promising not only in that it confirms findings of the midline evaluation assessment that found a difference in WLZ of 0.30 between the program and comparison districts ($p<0.001$) (unpublished), while further suggesting that the level of participation could be important for maximizing program benefits on certain nutritional outcomes. For the average child, and given a mean (SD) WLZ in this study population of 0.18 (1.09), the magnitude of impact of 0.21 z-scores among the high participating group represents a more than doubling (117% increase) of this score at the population level. This magnitude of impact of lipid-based nutrient supplements on weight-for-length z-scores has been demonstrated in similar sub-Saharan African settings, including Burkina Faso,[24] Niger,[53] Sudan,[54] and Bangladesh,[22] though not in a dose-response manner. Nevertheless, and given the large overlap of confidence intervals between high and low participants, we cannot confirm that the differences in the magnitude of weight-for-length z-scores represent a true dose-response trend in this analysis. Also, and although the magnitude of impact on WLZ is demonstrably high, it is equally important to consider the prevalence of wasting in this population, which is relatively low (2.5%, data not shown). Thus, we can conclude that despite a clinically relevant improvement in WLZ, what this translates to in terms of total number of children is going to be low given the low prevalence of wasting in this population.

The lack of impact on other anthropometric indicators of growth, especially length-for-age z-score and stunting, was not surprising given its alignment with findings from

the overall impact evaluation at midline for those outcomes. At midline, children in the program district demonstrated LAZ and WAZ (SE) of 0.03 (0.09)(p=0.71) and 0.23 (0.08)(p<0.01) higher than the comparison district, respectively, and a 0.9% (p=0.80), 6.4% (p=0.02), and 3.9% (p<0.01) lower prevalence of stunting, underweight, and wasting, respectively. Although evidence of impact on linear growth with 12 months or less of supplementation has been demonstrated in many settings including Malawi,[22–24,29,55,56] differences in study design, nutrient composition, and study activities likely contributed to their findings. For example, many of these studies used randomized and/or longitudinal designs. Also, supplements used ranged in quantity (often larger, such as the use of Plumpy'Doz (46g) in Chad and Bangladesh)[22,56] and compositions.[22] Finally, some studies included the provision of additional supplementary foods[56] and/or morbidity surveillance and treatment.[24] This study's cross-sectional design and survey conducted after only 12 months of program implementation, both inherently limited our ability to see impact on linear growth indicators at this interim assessment. First, the cross-sectional design we used included all children aged 6-23 months at one time point, meaning that children in the younger age ranges were exposed to the program for as little as 1 or 2 months. Second, and since the program had been in operation for only one year, the maximum dose that could have been received was 12 months, and this was only among children who were 23 months at the time of the survey (approximately 5% of the sample in the program district) and who were more likely to be in the higher participation and/or exposure categories. Thus, any impact on growth among children who were older and exposed for longer periods may have been diluted by the short duration of exposure among younger children in the sample.

An alternative, or complementary hypothesis to explain to the lack of impact of varying doses of program exposure on linear growth, all the while demonstrating impact on weight-for-height, is that in this setting, restoring deficits in weight may have biologically taken precedence over restoring those in height. Evidence to support the biological sequence of weight vs. height restoration has not been identified, but our findings of a marginally significant impact of dose on weight-for-age z-scores and wasting, as well as the improvement of weight-for-length z-scores, would support this hypothesis.

The lack of significant associations between SBCC exposure and any of the nutrition outcomes presented in this study were also are aligned with what as seen in the Alive & Thrive Initiative studies. Of the two programs studied in Bangladesh and Ethiopia and despite large and significant improvements in almost all complementary feeding indicators measured, those impacts were not accompanied by significant improvements in child growth.[57–59] Nevertheless, Bhutta and colleagues' systematic review[2] that demonstrated a positive impact of nutrition education interventions on measures of growth highlights that impact on height- and weight-for-age z-scores can be achieved even in food insecure settings such as this one.

The improvement of infant and young child feeding practices with various doses, or channels, through which to deliver social and behavior change communication messages, has been demonstrated in some settings. In Bangladesh, exposure to more than one messaging platform (inter-personal counseling, mass media, and community mobilization) was associated with large and significant gains in the proportion of children achieving minimum dietary diversity, minimum meal frequency, minimum acceptable

diet, and consumption of iron-rich foods.[57] In India, an increase in the number of channels a mother was exposed to was associated positively with improved breastfeeding and complementary feeding practices.[60] Many other examples of the success of targeted training and messaging for improved infant and young child feeding behaviors among caregivers exist,[58,61–68] but to our knowledge, those that assess the dose-response relationship, as we did here, are limited to the Bangladesh and India studies.

The improvement of dietary diversity with social behavior change communication, though it did not translate to achieving minimum dietary diversity or acceptable diet, is also important for the program district in particular, as it allays concerns of substitution and/or displacement effects of lipid-based nutrient supplements on breastmilk and/or traditional complementary foods. On the contrary, the higher dietary diversity scores observed with higher exposure to social and behavior change communication are aligned with studies that have investigated this "substitution" effect in Malawi and other similar contexts, and demonstrated that neither breastmilk nor complementary foods were displaced as a result of supplementation.[9,69–72]

A few limitations of this study deserve mention here. First, this study used data that was collected after only one year of program implementation, which was also the program's first year in operation. Thus, in addition to study participants not having the opportunity to experience the full, intended program dose of 18 months of supplementation with Nutributter (from 6 to 23 months of age) and exposure to SBCC messaging beginning as early as pregnancy, the roll out may have been uneven, delayed, or inadequate due to implementation bottlenecks that are more likely to occur early in a program's lifecycle. Repeating this type of assessment with data collected during the

endline survey at 3 years post-implementation, may offer more robust findings on dose-response associations between exposure to various program components and anthropometric and infant and young child feeding outcomes. A second limitation of this study has to do with the measurement of SBCC exposure, and the automatic assignment of 1 or 2 points to the SBCC score in the program district due to known participation in distributions that include a counseling component. Although group counseling is indeed a core component of distribution sessions, direct observations of Nutributter distributions indicated that oftentimes, counseling was done only at the beginning of the distribution and therefore mothers who arrived even 10 minutes late, were not exposed (chapter 5). Thus, our categorization of all mothers in the program district as having received group counseling, may have in fact over-estimated exposure to this SBCC channel. A third limitation is the sample size of the midline impact evaluation survey that was not powered to detect differences in anthropometric outcomes in this stratified analysis (categories of participation). This limitation is evident in the discordance observed between the midline impact evaluation findings on certain outcomes, such as WAZ, that were not reflected in this analysis. Despite this limitation, this analysis is viewed and valued as a more accurate representation of the impact that can be expected from documented and varying levels of participation. Lastly, close to 1/3 of children included in the midline dataset in the program district were excluded from this analysis due to a missing program ID variable. Post-study, manual matching of such children using the program monitoring database was attempted and was not only time consuming and cumbersome, but it also did not yield a high number of additional children to be included in this analysis. Furthermore, the lack of details regarding why this large number of

children did not have a recorded ID (i.e., loss or misplacement of card versus never registered) limited our ability to make firm conclusions about how the characteristics of households and individuals of various participation levels influenced the outcomes studied here.

This interim assessment demonstrated that at 1-year of program implementation, high participation in Nutributter distributions and exposure to social and behavior change communication was associated with improvements in various nutrition and infant and young child feeding behaviors, as compared to no dose or low versus no dose. Our findings of a dose-response association between participation in Nutributter distributions and weight-for-length z-score mirrored findings from the midline impact evaluation assessment (unpublished), but further highlighted that higher participation could potentially contribute to maximizing program benefits on this outcome. This finding has important implications for program planners and implementers, who should continue to implement and adapt programs so that they reach their target beneficiaries with the intended program dose. Further, we speculate that a longer duration of program exposure may be necessary for seeing stronger dose-response relationships between SBCC and infant and young child feeding practices, as well as to extending those relationships to other child anthropometric outcomes.

Tables and Figures

Table 6.1. Participation in the program's Nutributter distributions, and exposure to the social and behavior change communication (SBCC) activities, by district

	All		Ntchisi (n=838)		Dowa (n=1,208)	
	n	Median (IQR) or %	n	Median (IQR) or %	n	Median (IQR) or %
Exposure to SBCC						
Median score	2,045	1 (1-2)	838	2 (2-3)	1,207	1 (1-1)
None	204	10.0	0	0.0	204	16.9
1	871	42.6	88	10.5	783	64.9
2-3	970	47.4	750	89.5	220	18.2
Participation in Nutributter distributions[1]						
Median participation			838	71.4 (50-85.7)	0	0.0
None	1,208	59.0	0	0.0	1,208	100.0
Low (<71.4%)	393	19.2	393	46.9	0	0.0
High (≥71.4%)	446	21.8	445	53.1	0	0.0

1 Measured by monthly attendance at Nutributter distribution sessions over the period of child eligibility (6-23 months), using program monitoring data (SCOpe).

Table 6.2. Child, maternal, and household socioeconomic characteristics of the study sample, by varying levels of participation in Nutributter distributions and program exposure to social behavior change communication (SBCC) activities

	All	Participation in Nutributter distributions[1] (n=2,047)				Exposure to SBCC[1] (n=2,045)			
		None (n=1,207)	Low (n=394)	High (n=446)		None (n=204)	Low (n=871)	High (n=970)	
	mean (SD) or n (%)	mean (SD) or n (%)			p-value[1]	mean (SD) or n (%)			p-value[1]
Household characteristics									
Own land, %	1,843 (90.2)	1,049 (86.9)	371 (94.4)	423 (95.5)	<0.01	183 (89.7)	755 (86.8)	904 (93.4)	0.04
Own livestock, %	1,268 (66.5)	719 (63.5)	256 (67.9)	293 (73.8)	0.01	113 (56.5)	522 (64.9)	633 (70.2)	<0.01
Experienced a negative event in last 6 months, %	903 (44.2)	587 (48.7)	145 (36.8)	171 (38.6)	<0.01	89 (43.6)	411 (47.2)	403 (41.6)	0.22
Wealth quintile, %					0.72				0.39
1st (poorest)	417 (20.4)	238 (19.7)	82 (20.9)	97 (21.9)		60 (29.4)	164 (18.9)	192 (19.8)	
2nd	416 (20.4)	223 (18.5)	88 (22.4)	105 (23.7)		50 (24.5)	153 (17.6)	213 (22.0)	
3rd	407 (19.9)	232 (19.2)	83 (21.1)	92 (20.8)		27 (13.2)	175 (20.1)	205 (21.2)	
4th	383 (19.2)	250 (20.7)	73 (18.6)	70 (15.8)		31 (15.2)	188 (21.6)	174 (18.0)	
5th (richest)	410 (20.1)	264 (21.9)	67 (17.1)	79 (17.8)		36 (17.7)	190 (21.8)	184 (19.0)	
Household food insecurity, %					0.29				0.05
Food secure	322 (15.8)	179 (14.8)	74 (18.8)	69 (15.6)		17 (8.3)	147 (16.9)	158 (16.3)	
Food insecure	1,721 (84.2)	1,028 (85.2)	319 (81.2)	374 (84.4)		187 (91.7)	723 (83.1)	810 (83.7)	
Maternal characteristics									
Age (years), mean	27.0 (6.4)	26.9 (6.4)	27.3 (6.6)	27.2 (6.4)	0.36	26.6 (6.4)	26.7 (6.3)	27.4 (6.5)	0.03
Completed primary school or higher, %	564 (27.7)	341 (28.4)	105 (26.7)	118 (26.6)	0.84	47 (23.0)	250 (28.8)	267 (27.6)	0.52
Married, %	1,808 (88.3)	1,056 (87.9)	358 (90.9)	304 (90.8)	0.29	180 (88.2)	769 (88.3)	859 (88.6)	0.99
Agriculture as primary occupation, %	1,656 (80.9)	936 (77.9)	341 (86.6)	379 (85.4)	0.09	153 (75.0)	693 (79.6)	810 (83.5)	0.35
Child characteristics									
Age (months), mean	15.3 (4.8)	15.1 (5.0)	15.2 (4.3)	16.2 (4.7)	<0.01	15.2 (5.0)	15.2 (4.9)	15.5 (4.6)	0.39
Child sex (% male)	1,015 (49.7)	606 (50.4)	191 (48.5)	231 (51.8)	0.59	107 (52.7)	420 (48.4)	486 (50.1)	0.50
7-day child morbidity									
Diarrhea	272 (13.3)	137 (11.3)	54 (13.7)	81 (18.2)	<0.01	28 (13.7)	102 (11.7)	142 (14.6)	0.22
Malaria	211 (10.3)	101 (8.4)	45 (11.5)	65 (14.6)	0.01	22 (10.8)	74 (8.5)	115 (11.9)	0.15

	All	Participation in Nutributter distributions[1] (n=2,047)				Exposure to SBCC[1] (n=2,045)			
		None (n=1,207)	Low (n=394)	High (n=446)		None (n=204)	Low (n=871)	High (n=970)	
	mean (SD) or n (%)	mean (SD) or n (%)			p-value[1]	mean (SD) or n (%)			p-value[1]
ARI	164 (8.0)	99 (8.2)	29 (7.4)	36 (8.1)	0.87	8 (3.9)	69 (7.9)	87 (9.0)	0.06
Fever	218 (10.7)	113 (9.4)	43 (10.9)	62 (13.9)	0.03	28 (13.7)	85 (9.8)	105 (10.8)	0.26
Usage of mosquito net[2]	1,402 (95.3)	837 (96.4)	275 (94.5)	290 (93.0)	0.09	127 (93.4)	599 (96.0)	675 (95.1)	0.54

1 Kruskal-Wallis H and chi-squared tests adjusted for village-level clustering were used to measure differences in continuous and binary outcomes across levels of exposure to SBCC and Nutributter distributions.
2 This variable includes only those who report having a treated insecticide net (n=1,470).

Table 6.3. Household, maternal, and child characteristics associated with varying participation in the program's Nutributter distributions and exposure to social behavior change communication (SBCC)

	Participation in Nutributter distributions (n=2,047)			Exposure to SBCC (n=2,045)		
	None (Ref) (n=1,207)	Low (n=394)	High (n=446)	None (Ref) (n=204)	Low (n=871)	High (n=970)
	Mean (SD) or n (%)	Adjusted PR (95%CI)[1]		Mean (SD) or n (%)	Adjusted PR (95%CI)[1]	
Household characteristics						
Own land	1,049 (86.9)	1.72 (0.70, 4.23)	2.16 (1.03, 4.54)*	183 (89.7)	0.57 (0.28, 1.15)	0.95 (0.46, 1.94)
Own livestock	719 (63.0)	1.08 (0.79, 1.48)	1.68 (1.15, 2.44)**	113 (56.5)	1.20 (0.77, 1.86)	1.43 (0.92, 2.23)
Experienced a negative event in last 6 months	587 (48.6)	0.70 (0.52, 0.94)*	0.81 (0.58, 1.12)	89 (43.6)	1.17 (0.73, 1.89)	0.98 (0.61, 1.59)
Wealth quintile	3.1 (1.43)	0.88 (0.77, 1.00)	0.89 (0.76, 1.02)	2.7 (1.48)	1.17 (0.98, 1.40)	1.08 (0.89, 1.30)
Food insecure	1,028 (85.2)	0.80 (0.55, 1.17)	0.99 (0.62, 1.57)	187 (91.7)	0.50 (0.26, 0.96)*	0.50 (0.27, 0.94)*
Maternal characteristics						
Maternal age, yr	26.9 (6.38)	1.01 (0.99, 1.04)	1.01 (0.99, 1.04)	26.6 (6.37)	1.00 (0.97, 1.04)	1.03 (1.00, 1.06)*
Completed primary school or higher	341 (28.4)	1.19 (0.82, 1.71)	1.13 (0.80, 1.62)	47 (23.0)	0.79 (0.49, 1.28)	0.99 (0.60, 1.64)
Married	1,057 (87.9)	1.14 (0.70, 1.85)	1.03 (0.61, 1.74)	180 (88.2)	0.84 (0.43, 1.62)	0.82 (0.45, 1.52)
Agriculture as primary occupation	936 (77.5)	1.52 (0.88, 2.64)	1.59 (0.88, 2.89)	152 (75.0)	1.74 (1.04, 2.91)*	2.16 (1.21, 3.86)*
Child characteristics						
Child age, months	15.1 (4.96)	1.02 (0.99, 1.05)	1.04 (1.01, 1.08)*	15.2 (5.01)	0.97 (0.93, 1.02)	0.98 (0.94, 1.02)
Child sex (% male)	597 (49.6)	0.98 (0.75, 1.27)	1.21 (0.91, 1.60)	96 (47.3)	0.92 (0.65, 1.31)	0.97 (0.69, 1.35)
Child morbidity (7-day)						
Diarrhea	137 (11.3)	1.41 (0.96, 2.07)	1.78 (1.12, 2.85)*	28 (13.7)	0.95 (0.57, 1.59)	1.18 (0.68, 2.06)
Malaria	101 (8.4)	1.24 (0.77, 2.00)	1.68 (1.03, 2.75)*	22 (10.8)	0.91 (0.45, 1.83)	1.25 (0.62, 2.52)
ARI	99 (8.2)	0.97 (0.55, 1.71)	1.17 (0.71, 1.94)	8 (3.9)	2.12 (0.81, 5.58)	2.72 (1.07, 6.92)*
Fever	113 (9.4)	1.21 (0.73, 2.00)	1.23 (0.76, 1.97)	28 (13.7)	0.89 (0.40, 1.97)	0.65 (0.30, 1.38)
Usage of mosquito net for child	837 (96.4)	0.67 (0.35, 1.68)	0.52 (0.27, 0.99)*	127 (93.4)	1.76 (0.80, 3.88)	1.42 (0.67, 2.98)

*** p<0.001; ** p<0.01; * p<0.05

1 Multinomial logistic regression model adjusted for all variables presented in this table were used to estimate adjusted prevalence ratios (PR) (95% CI) of low and high exposure to Nutributter distributions and SBCC. For the reference group, means are presented for wealth quintile and child age, with proportions presented for all remaining variables.

Table 6.4. Associations between varying doses of one year of program exposure to Nutributter distributions and social behavior change communications (SBCC) on nutrition outcomes among children aged 6-23 months in the district of Ntchisi and a comparison district, Dowa, Malawi

	Participation in Nutributter distributions (n=2,047)			Exposure to SBCC (n=2,045)		
	None (Ref) (n=1,207)	Low (n=394)	High (n=446)	None (Ref) (n=204)	Low (n=871)	High (n=970)
	Mean (SD)	Adjusted Difference (95%CI)[1]		Mean (SD)	Adjusted Difference (95%CI)[1]	
Nutrition outcomes						
LAZ	-2.00 (1.09)	0.01 (-0.13, 0.16)	0.02 (-0.15, 0.19)	-2.10 (1.18)	0.06 (-0.13, 0.25)	0.08 (-0.12, 0.28)
WAZ	-0.91 (1.11)	0.13 (-0.01, 0.27)	0.13 (-0.01, 0.27)	-1.03 (1.25)	0.12 (-0.08, 0.31)	0.03 (-0.17, 0.24)
WLZ	0.16 (1.13)	0.17 (0.03, 0.31)*	0.21 (0.06, 0.36)**^	0.10 (1.20)	0.09 (-0.09, 0.26)	-0.08 (-0.28, 0.12)
	n (%)	Adjusted OR (95% CI)[2]		n (%)	Adjusted OR (95% CI)[2]	
Stunting	582 (50.0)	0.88 (0.72, 1.14)	1.05 (0.76, 1.47)	104 (53.3)	0.91 (0.64, 1.30)	0.96 (0.64, 1.45)
Underweight	152 (13.0)	0.78 (0.49, 1.23)	0.80 (0.52, 1.24)	35 (17.7)	0.67 (0.43, 1.05)	0.84 (0.52, 1.37)
Wasting	36 (3.1)	0.38 (0.13, 1.07)	0.49 (0.19, 1.27)	8 (4.1)	0.65 (0.26, 1.63)	0.92 (0.31, 2.75)

LAZ, WAZ, and WLZ: length-for-age, weight-for-age, and weight-for-length z-score, respectively. **p<0.01; *p<0.05; ^Bonferroni-corrected multiple comparisons p<0.004.

[1]Multivariable linear regression models, adjusted for child age, child sex, household wealth quintile, mother's education, household food insecurity, and village-level clustering (study design) were used to measure adjusted differences in LAZ, WAZ, and WLZ outcomes by program exposure.

[2]Multivariable logistic regression models, adjusted for child age, child sex, household wealth quintile, mother's education, household food insecurity, and village-level clustering (study design) were used to measure adjusted OR for stunting, underweight, and wasting outcomes by program exposure.

Table 6.5. Association between varying doses of one year of program exposure to the social behavior change communications (SBCC) and infant and young child feeding and hygiene practices among children aged 6-23 months in the district of Ntchisi and a comparison district, Dowa, Malawi

	Exposure to SBCC (n=2,045)						
	None (n=204)	Low (n=871)			High (n=970)		
	Mean (SD)	Mean (SD)	Unadjusted Difference (95% CI)	Adjusted Difference (95% CI)[1]	Mean (SD)	Unadjusted Difference (95% CI)	Adjusted Difference (95% CI)[1]
IYCF Knowledge (range 0-8)	6.8 (1.21)	7.0 (1.01)	0.12 (-0.04, 0.28)	0.08 (-0.10, 0.25)	7.0 (1.01)	0.14 (-0.01, 0.30)	0.06 (-0.15, 0.27)
Dietary diversity score (range 0-7)[3]	2.4 (1.20)	2.7 (1.17)	0.28 (0.11, 0.45)**^	0.22 (0.03, 0.41)*	2.5 (1.01)	0.11 (-0.06, 0.28)	0.21 (0.01, 0.42)*
Handwashing score (range 0-4)[4]	1.6 (0.95)	1.6 (0.87)	0.01 (-0.24, 0.26)	-0.01 (-0.17, 0.16)	1.5 (1.00)	-0.05 (-0.30, 0.20)	0.10 (-0.09, 0.30)
	n (%)	n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)[2]	n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)[2]
MDD[3]	34 (16.7)	201 (23.1)	1.50 (1.01, 2.24)*	1.39 (0.86, 2.22)	141 (14.5)	0.85 (0.56, 1.28)	1.23 (0.74, 2.05)
MMF[3]	153 (75.0)	663 (76.1)	1.06 (0.74, 1.51)	1.03 (0.69, 1.55)	722 (74.4)	0.97 (0.69, 1.37)	1.62 (1.02, 2.56)*
MAD[3]	31 (15.2)	177 (20.3)	1.42 (0.94, 2.16)	1.26 (0.78, 2.04)	128 (13.2)	0.85 (0.55, 1.30)	1.21 (0.72, 2.04)
Water treatment[4]	73 (36.0)	359 (41.3)	1.25 (0.91, 1.72)	1.25 (0.82, 1.89)	367 (37.9)	1.09 (0.79, 1.49)	1.33 (0.84, 2.08)
Provide treated water to child[4]	67 (91.8)	268 (74.2)	0.26 (0.11, 0.61)**^	0.27 (0.12, 0.65)**	263 (72.1)	0.23 (0.10, 0.55)**^	0.40 (0.16, 1.00)

*** p<0.001; ** p<0.01; * p<0.05; ^Bonferroni-corrected multiple comparisons p<0.004.

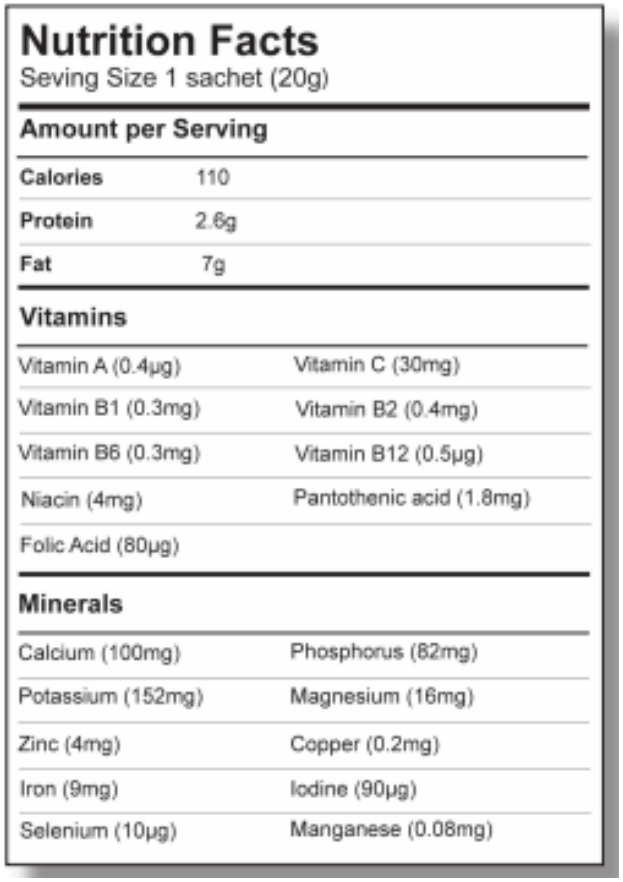
,1 Multivariable linear regression models, adjusted for child age, sex, household wealth, maternal education, participation in Nutributter distributions, and study design (village-level clustering) were used to calculate adjusted differences (95% CI) in IYCF knowledge score, dietary diversity score, and handwashing score.

2 Multivariable logistic regression models, adjusted for child age, sex, household wealth, maternal education, participation in Nutributter distributions, and study design (village-level clustering) were used to calculate adjusted OR (95% CI) of meeting minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD), treating water, and provision of treated water to child.

3 Additional confounders controlled for in this model included infant and young child feeding knowledge score and household food insecurity.

4 Additional confounders controlled for in this model included distance to a water source.

Supplementary figure 6.1 Nutrient composition and content of Nutributter supplement



Nutrition Facts

Seving Size 1 sachet (20g)

Amount per Serving	
Calories	110
Protein	2.6g
Fat	7g

Vitamins	
Vitamin A (0.4µg)	Vitamin C (30mg)
Vitamin B1 (0.3mg)	Vitamin B2 (0.4mg)
Vitamin B6 (0.3mg)	Vitamin B12 (0.5µg)
Niacin (4mg)	Pantothenic acid (1.8mg)
Folic Acid (80µg)	

Minerals	
Calcium (100mg)	Phosphorus (82mg)
Potassium (152mg)	Magnesium (16mg)
Zinc (4mg)	Copper (0.2mg)
Iron (9mg)	Iodine (90µg)
Selenium (10µg)	Manganese (0.08mg)

Supplementary table 6.1. Categories of food insecurity in the Household Food Insecurity Access Scale (HFIAS)

Question	Frequency		
	Rarely	Sometimes	Often
1. In the past four weeks, how often did you worry that your household would not have enough food?			
2. In the past four weeks, how often were you or any member of your household not able to eat the kinds of foods you preferred because of a lack of resources?			
3. In the past four weeks, how often did you or any household member have to eat a limited variety of foods due to a lack of resources?			
4. In the past four weeks, how often did you or any household member have to eat foods that you really did not want to eat because of a lack of resources to obtain other types of foods?			
5. In the past four weeks, how often did you or any household member have to eat a similar meal than you felt you needed because there was not enough food?			
6. In the past four weeks, how often did you or any household member have to eat fewer meals in a day because there was not enough food?			
7. In the past four weeks, how often was there ever no food to eat of any kind in your household because of lack of resources to get food?			
8. In the past four weeks, how often did you or any household member go to sleep hungry because there was not enough food?			
9. In the past four weeks, how often did you or any household member go a whole day without eating anything because there was not enough food?			

Food secure

Mildly food insecure

Moderately food insecure

Severely food insecure

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Chapter 7: Conclusions and public health implications

Preventing child undernutrition during the window of opportunity that begins at conception and closes by approximately 2 years of age is critical for child survival and for maximizing physical and cognitive development.[1] Efficacious interventions to improve child growth are known; nutrition education to promote optimal infant and young child feeding practices from birth to 2 years,[2,3] and supplementation with fortified foods, such as lipid-based nutrient supplements,[4–9] are two of them. The nutrition program that was the focus of this dissertation implemented both of those interventions to reduce the burden of undernutrition and stunting, among children 6-23 months in Ntchisi district in rural Malawi. The delivery of these interventions at this scale presents important challenges for achieving intended impacts on child nutritional status, given the difficulty of reaching adequate coverage and quality of implementation.[10] With this context, the present study sought to understand and document the quality of implementation of the nutrition program, the drivers of program participation, including community perceptions about the program, characteristics associated with participation in the program, and influence of level of participation on feeding and hygiene behaviors and anthropometric outcomes. The study used secondary data from the impact evaluation of the nutrition program and from the program's routine monitoring and evaluation systems. Additional data were collected under the impact evaluation's activities, for the qualitative study on facilitators and barriers to program use, and for the process evaluation, to understand program functioning and knowledge of front-line staff.

7.1 Summary and synthesis of study findings

In the first paper (Chapter 4), using a grounded theory approach[11] and qualitative data collection methodology, we examined community and participant facilitators and barriers to participation in the Ntchisi nutrition program. We found that family members and the community viewed the lipid-based nutrient supplement, Nutributter, positively. Perceived benefits related to visible changes in child growth and health were ascribed to the introduction of the program and of the food supplement, which may have been an important motivator of program participation and adherence. Barriers that affected participation had to do with competing tasks and priorities, and inappropriate use of the food product at the household level. Additionally, when asked to state and explain infant and young child feeding messages, mothers who were interviewed demonstrated limited and superficial knowledge of these messages, which was seen as an important barrier to implementing improved practices at the household level. For instance, mothers knew that young children should eat from six food groups, but could not name more than just a few of them. In combination with the realities faced in this resource-constrained environment where physical access to nutritious foods is problematic, implementing optimal feeding behaviors may be that much more difficult. In the context of this district-level program in Ntchisi district, understanding how mothers, household members, and the community received interventions and messages holds important programmatic and policy implications for future scale-up to other districts in Malawi. In addition, findings of how messages are understood, resonate with, and are implemented by mothers provides future guidance on contextual factors that need to be considered as the Government and its partners actively working to scale up their Nutrition Education and Communication

Strategy (NECS), both to maximize the potential impact of the program on child feeding practices and nutrition outcomes in Ntchisi and beyond.

The second paper (Chapter 5) reported the results of a process evaluation that assessed the program's recruitment, fidelity, and reach. Data sources included secondary data from the program's routine monitoring and evaluation system and from the impact evaluation's qualitative study. Direct observations of program processes and knowledge questionnaires that were administered to front-line program staff also informed this study. Measured process indicators were categorized into various levels of "functioning", defined as "working well" (>75%), "needing improvement" (25-75%), and "not working"(<25%). Aspects of the program, such as timely enrolment of beneficiary children, the completion of training on certain modules by program staff, and implementation of individual-level counseling, required improvement in their implementation. Many of the program's activities, such as following correct procedures during distributions and high knowledge of program staff on messages on which they were trained, were well implemented and functioning. Our process evaluation was designed to generate lessons for program planners and implementers by highlighting which aspects functioned well, and which were more challenging to implement based on the program's measured conformity to its original design. The lack of timely enrolment in the first year of the program's implementation, for instance, calls for strengthening of program recruitment procedures so that children are enrolled at or by 6 months of age to increase the child's chances of receiving the "full" program dose (18 months). Similarly, documenting the variability in training completion by volunteer staff despite a cited "complete roll-out" of social and behavior change activities exposed the inherent

difficulties and time associated with establishing a comprehensive and fully functioning network of community-based nutrition educators. Measuring each of this program's activities in depth and using a range of indicators and methods, shed light on how specific implementation processes could affect downstream impact on maternal behaviors and child nutrition more broadly in the context of this program.

The third paper (Chapter 6) presented the results of an analysis of the household, maternal, and individual characteristics associated with program exposure, as well as a dose-response analysis of the association between program exposure to the supplementation and SBCC component on outcome measures of nutritional status and infant and young child feeding and hygiene practices. We found that land and livestock ownership, as well as child age and recent child morbidity from diarrhea and malaria, were all positively associated with increased participation in the program's Nutributter component, while maternal education, agriculture as a primary occupation, and experiencing ARI symptoms were associated with higher SBCC exposure. Usage of a mosquito net was associated with lower likelihood of high participation in Nutributter distributions, as was food insecurity with higher SBCC exposure. Participation in the program's Nutributter distributions demonstrated a positive, qualitative dose-response association with weight-for-length z-score, but not on other anthropometric and nutrition indicators including LAZ, WAZ, stunting, underweight, and wasting. Exposure to the program's social behavior change communications component did not demonstrate an association with any of the anthropometric indicators studied, but was positively associated with dietary diversity score and achieving minimum meal frequency. Our findings of an increase in weight-for-length z-score (WLZ) with participation in the

program's Nutributter component, as well as the lack of impact on indicators of child length (LAZ, stunting), mirrored findings from the midline impact evaluation assessment of program impact on these same indicators (JHU midline report, unpublished), but emphasized how higher levels of participation could be important for maximizing program benefits on WLZ specifically. In combination with our findings of the characteristics associated with exposure to the program's two components, this study provides program implementers clarity regarding the drivers of higher program participation, which can be used to improve targeting mechanisms, and what types of results can be expected from such investments after one year of program implementation.

Most valuable across this dissertation research is the complementarity of findings. For example, the process evaluation highlighted the low completion of complementary feeding modules among front-line staff, low levels of knowledge associated with certain complementary feeding messages, and limited counseling on these same messages during one-on-one household visits. In parallel, our findings from the qualitative study (Chapter 4) demonstrated the superficial knowledge and limited recall by mothers on this same topic. The combination of these findings is suggestive of a trickle-down effect that begins with program implementation and that touches numerous downstream processes to affect intermediate, and potentially, final outcomes associated with infant and young child feeding behaviors and nutrition outcomes.

The findings of child morbidity being associated with higher participation in the program's Nutributter component (Chapter 6) resonated with perceptions of mothers captured during the qualitative study of the contents of Nutributter (Chapter 4). For instance, some mothers mentioned Nutributter containing "medicine", having "contents

similar to those found in breastmilk", which would indicate the potential link between those beliefs and the increased participation in the Nutributter component specifically, among children who experienced illness.

The two examples provided here are among many, and highlight triangulation and explanation of findings. Most importantly, they contribute to the attributability of the program's impact evaluation results to the program's implementation, strengthening the internal and external validity of the evaluation findings.

7.2 Study strengths and limitations

There are several strengths of this study that should be highlighted. First, this study used both qualitative and quantitative methods, which provided both depth and breadth to understanding the program and results from the impact evaluation. The use of qualitative methods allowed for a thorough characterization of the nutrition program, its activities, and how it was perceived in the community. This deep knowledge of program processes was critical for subsequent process evaluation planning and analysis. In addition, the use of various data sources, methods (both quantitative and qualitative), and respondent types (mothers, household members, community members) allowed for the triangulation of findings across the various sub-studies, which strengthened the validity of our findings. Another strength of this study was the use of attendance records to better estimate program participation and dose. Although the impact evaluation's cross-sectional survey collected data on program exposure, the ability to create a direct linkage to obtain individual-level participation data bypassed potential errors driven by recall bias.

This study also had some limitations. The first limitation is specific to the qualitative study and the narrow focus and short timeline under which it was conducted. Although

the study was designed to include various activities (interviews, focus group discussions, observations), the focus was specific to answering the research questions, and, in combination with the short timeline, limited the extent to which follow-up activities could be conducted. Nevertheless, frequent de-briefings and discussions, close supervision, review of incoming transcripts, and re-training of the data collection team to probe on commonly emerging themes allowed for expansion on these themes and their incorporation into continuing data collection activities. The second major limitation of this study was the heavy reliance of process evaluation findings on program monitoring data, which was not collected by the JHU study team and thus lacked the "independent" research perspective. The use of various data sources, however, allowed for triangulation of the same or similar indicators collected under the impact evaluation, which was used to make more valid conclusions for specific indicators in which discrepancies were identified. A third limitation of this study was related to the use of maternal report of practices that were being promoted by the program. As such, mothers may have felt a pressure to respond in a different way than their actual practices would demonstrate (social desirability bias). The use of direct observations of maternal care and feeding practices, Nutributter distributions, and one-on-one counseling, shed light on to what mothers did, as compared to what they reported in IDIs or through other survey methods. Again, this triangulation of data supported a more accurate description and understanding of maternal behaviors. A fourth limitation of the study was the lack of repeated measurements on some of the process indicators collected, such as those related to staff training and knowledge. Collecting this type of data earlier and repeatedly would have been more useful for making modifications to program implementation and for making

comparisons across time, respectively. Nevertheless, and given the time required to roll-out the social and behavior change component, the timing of data collection for the process evaluation allowed for an accurate assessment of front-line worker training and knowledge in a "fully functional" setting. In addition, the complete establishment of the care group volunteer network promoted the use of random sampling from a roster of volunteers, which had not been available until the time during which the process evaluation study was conducted. A fifth limitation of this study was the use of data that was collected after only one year of program implementation for the dose-response assessment, which did not allow for program participants to have experienced the full, intended dose of the program. Not only was the dose incomplete, but the use of data from first year, when the program's roll out may have been uneven, delayed, or inadequate, limited our ability to make firm conclusions about dose-response associations with program outcome measures.

Lastly, we consider the findings of this study to have limited generalizability to other contexts. The findings from the qualitative study were critical for deepening our understanding of the context in which mothers make decisions and practice certain behaviors. The daily challenges they face, and the local, cultural traditions that dictate such behaviors, however, are specific not only to Malawi, but often to the village and/or the district itself. As such, the transferability of those findings is limited. Furthermore, the timing of data collection for the process evaluation and dose-response analyses, as well as the sample sizes used in the process evaluation's knowledge assessment, limited the generalizability of some of our findings to the program itself and to other contexts. For instance, our sample of front-line workers was not representative. Although workers were

selected randomly, the small sample size could provide only a snapshot of what could be occurring at the district level; however, a larger sampling and selection strategy would be necessary to make conclusions about the program's functioning as it relates to training and knowledge of its workers at the district level.

7.3 Future directions for research

Further research is needed to better understand and document how the program's social and behavior chance communication component is delivered, and how messages are (or are not) implemented by target beneficiaries at the household level. The process evaluation partly contributed to this gap in knowledge, but the conditions under which direct observations of one-on-one counseling were conducted, were not fully representative of how they occur in the program context, and may have been subject to reactivity. Thus, the use of different research methods to provide more representative data on quality and content of social behavior change communication messages is needed to generate more tangible and specific programmatic guidance on the delivery of this program component. Similarly, the way in which mothers use the messages they receive to change their behaviors in this resource-constrained environment, should be assessed using measures that are not prone to social desirability bias. The use of a social desirability scale, for example, has been used in some studies to account for this type of bias,[12,13] and could be considered in this context to strengthen the validity of self-reported findings related to program and product use.

The qualitative study and process evaluation confirmed a potential misuse of the program ration at the household level, which had already been documented in this setting. Thus, research to clarify household-level utilization patterns of the program ration would

contribute to our understanding of what the actual dose is in this type of a programmatic context, but also which specific aspects of consumption require further emphasis in counseling strategies.

Lastly, measuring the pathways through which this program achieves impact on anthropometric outcomes, stunting especially, deserves further attention given its complementary to program effectiveness evaluations. Understanding which program elements were associated with specific outcomes is critical to highlighting not only which types of interventions can yield the greatest impact in this and other similar settings, but also to maximizing the efficiency of financial and human resource allocation.

7.4 Implications

This study expanded on an already vast programmatic and research portfolio of the Ntchisi nutrition program, by deepening our understanding of how the program functions, what the community's perceptions of the program are, what perceived and observable factors were associated with participation in the program, and how varying levels of exposure to the program influenced child feeding, sanitation, and nutrition outcomes. These findings thus have important and immediate implications not only for the program's implementation and interpretation of impact evaluation results, but also for future research and policy and programming, as described below.

7.3.1 Research implications

The mixed methods, multi- data source approach employed in this study to understand the *how* and *why* of program operations and impact, respectively, contributes to the burgeoning field of implementation science in nutrition. The process evaluation filled a number of current research gaps, including: (1) how to apply process evaluation

as a necessary and complementary component of impact evaluation, to understand how and why a program achieves impact (or not); (2) the use of a systematic process and clearly defined indicators for measuring program implementation; and (3) which methods and sources, whether quantitative or qualitative, can be used to define program and implementation theories, and how these can be used to characterize, measure, and interpret nutrition program implementation. In addition, the inclusion of the research activities undertaken as part of this dissertation were complementary to the impact evaluation study and demonstrate what a well-designed and comprehensive program effectiveness evaluation looks like, and how each of the findings complement each other to provide the "full picture" of program implementation and evaluation.

Perhaps this study's biggest contribution is thus to the evidence base for "program effectiveness", which has received all too little attention in nutrition research efforts to date.[14] Understanding how and why interventions work under "real-world" settings is critical for both strengthening implementation and for bridging the gap between efficacious and effective interventions, both of which are needed to achieve nutrition impact at scale.[15]

7.3.2 Policy and program implications

In 2011, a group of more than 100 entities, ranging from the United Nations, multi- and bi-lateral development agencies, foundations, developing countries, non-governmental organizations, to academia and others, collectively rallied together around a framework for action to scale up nutrition in countries most deeply affected by the burden of malnutrition.[16] One of the four main elements of the framework was to "sharply scale up evidence-based cost-effective interventions to prevent and treat

undernutrition, with highest priority to the minus 9 to 23 month window of opportunity where we get the highest returns from investments."[16] Shortly thereafter, in March 2011, Malawi became among the first countries to formally join the Scaling up Nutrition (SUN) Global Movement, which publicly demonstrated its willingness and commitment to tackling undernutrition. This move also inherently made the government more accountable towards making progress in undernutrition, which had stalled for more than a decade.[17–19] Since joining the SUN movement, Malawi has made great strides in policy and program development, as reflected in the National Nutrition Education and Communication Strategy (NECS) and, on a smaller scale, the implementation of the Ntchisi nutrition program.

Each of the research objectives of this study were designed to feed back into the program directly, for informational, knowledge generating, and course-correction purposes. Thus, the findings were especially relevant for programming in Ntchisi district, but also extended beyond that, to other districts in Malawi and further, to countries that continue to work towards scaling up nutrition interventions in similar contexts. The detailed documentation of the perceptions, facilitators and barriers to, and implementation of a large-scale nutrition program, for instance, generate important lessons on the processes associated with the design and implementation of appropriate nutrition interventions in a highly food insecure, resource-constrained setting, and the challenges that arise in doing so. In this study, for instance, we found that the roll out of the National Nutrition Education and Communication Strategy had to first put in place an extensive network of community-based volunteers. This was a significant undertaking that, even after 3 years of implementation, failed to fully reach its intended saturation and

reach due to various logistical and contextual realities, as discussed by program staff during focus groups discussions under the qualitative study (Chapter 4), and measured by process evaluation indicators presented in Chapter 5. Furthermore, and although in theory the care group model that was employed to roll out the Nutrition Education and Communication Strategy comprises a sustainable model to individual, household, and community-level behavior change, the dependence of the system on volunteers who have competing priorities and responsibilities, presents a challenge in this and similar environments. As such, it requires multiple years to establish, refine, and succeed.

The generation of practical knowledge such as that generated by this study can translate into policy by way of improving nutrition program functioning and equitable access to interventions in this and other, sub-Saharan African contexts exhibiting similar characteristics to those observed in Malawi. Furthermore, the dissemination and sharing of findings through the National Information Platforms for Nutrition (NIPN), an initiative specifically targeted to SUN countries, supports strategic and evidence-based decision-making by policy and program planners working to address undernutrition.[20]

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Appendices

Appendix A: Quality control checklist used in the qualitative study

Person Conducting Quality Assurance _____

Date _____

Type of IDI/FGD _____

Interviewer _____

I. Data Collection

	Indicators	Please circle	Comments
1.	Was the IDI participant appropriate (ie she had a child < 24 months or was a father/grandparent of child < 24 month	No/Yes	
2.	Was the participant talkative; If not did the interviewer terminate the interview? Talkative Terminate	 No/Yes No/Yes	
3.	Was consent taken by reading the script?	No/Yes	
4.	Were all areas of the field guide covered?	No/Yes NA	
5.	Was the participant comfortable and at ease?	No/Yes	
6.	Was the interviewer able to probe?	No/Yes NA	
7.	Was the interviewer confident?	No/Yes	
8.	Was the interviewer listening actively	No/Yes	
9.	Were there any disruptions to the interview	No/Yes	
10.	Was the interview conducted in privacy?	No/Yes	

II. Description of the interview

Your Comments

III. Transcription

Name of person who has transcribed _____

Name of person checking transcription quality _____

Date _____

	Indicators	Please circle	Comments
1.	Is the transcript rich in description?	No/Yes	
2.	Does the transcript describe events and incidents	No/Yes	
3.	Are there paragraphs with disconnected sentences? Please identify	No/Yes	
4.	Are some sections of the transcript weak in detail?	No/Yes	
5.	Does the transcript cover all sections of the guide?	No/Yes	
6.	Has it been translated verbatim?	No/Yes	
7.	Does the transcript require grammar edit?		

IV. Transcription

Your Comments

Appendix B: In-depth interview guide for mothers and household members participating in the qualitative study

Please turn on the recorder and record the below information.

Mother ID: ☐☐

Mother Name: _____

Village Name: _____

Health Center: _____

Interviewer Name: _____

Interviewer ID: ☐☐☐ Interview start time: ☐☐ : ☐☐

Date: ☐☐ ☐☐ 20☐☐ Interview end time: ☐☐ : ☐☐

DD MM YY

a. Introduction:

Before we get into the interview, I'd like to ask you a few basic questions about you and your family

Tisanayambe kucheza kwathu ndikufuna ndikufunseni mafunso angapo okhudza inu ndi anthu apa banja panu.

Maternal and household characteristics:

Mother's age	Highest grade completed	Mother's Occupation	# of living children	# of children 6-24 months	Total # of HH members
☐☐	☐☐		☐☐	☐☐	☐☐

For children 6-24 months:

Child Name	Date of birth	Age (months)	Sex (M/F)
	☐☐/☐☐/☐☐ D D M M Y Y	☐☐	☐
	☐☐/☐☐/☐☐	☐☐	☐

	D D M M Y Y ☐☐/☐☐/☐☐ D D M M Y Y	☐☐	☐

Before beginning the interview, be sure to observe and take note of the setting in which the interview is taking place. Record the setting in detail, including the type of house (condition, construction materials used, cleanliness around the household, latrine).

b. Exploration

1. Tell me what you do on a normal day, from morning to night.

Tsopano tandifotokozereni mmene tsiku lanu limakhalira kuchokera mmawa mpakana madzulo?

2. Tell me about some of the main daily concerns you face here in your community.

Tandiuzeni ena mwa mavuto amene mumakumana nawo tsiku ndi tsiku mdera lanu lino?

Now I'd like to talk about the nutrition program here in Ntchisi.

Tsopano tikambe za ndondomeko ya nthanzi yomwe ikuchitika ku ntchisi kuno.

3. What do you know about the Nutributter program?
- *Can you describe the program to me?*

Kodi mukuidziwa ndondomeko imeneyi?

4. Can you think back to a time when you first found out about the Nutributter program, what did you think about it at that time?

Mungathe kukumbukira nthawi yomwe ndondomeko/pulogalamu ya nutributter munaimva koyamba, Nthawi imeneyo mumayiganizira bwanji?

5. What made you decide to enroll your child into the Nutributter program?

Chomwe chinakupangitsani kuti mulembetse mwana wanu mu ndondomeko/pulogalamu ya nutributteryi ndi chiyani?

- *What else?*
- *Who in the family did you discuss this with?*
- *What did they think?*
- *How did you hear about the program? (People in the community? Family members? HSAs? Radio? Banner?)*

6. In the last 3 months, how many times have you or your family ever picked up the Nutributter?

Pa miyezi itatu yomwe yapitayi, ndikangati kamene inu kapena wina wa pabanja panu anapita kukatenga/kulandira nutributter?

- *In the past 3 months, how many times were you or a family member not able to pick up the Nutributter?*
- *Tell me about the reasons why you or a family member were not able to pick it up.*
- *Does anyone in your family help you pick up Nutributter?*

7. Can you tell me what you think about the Nutributter program?

Mungandiuze maganizo anu okhudza ndondomeko/pulogalamu ya nutributter?

- *Can you tell me about some of the positive/negative things about this program?*
  - *How has that influenced your participation in the program?*
  - *Tell us about your experiences with the distributions (time of day for pick up, place, days, frequency, waiting time, staff).*
  - *What happens if you or someone picking up the Nutributter forgets to bring the participant card?*

8. Now I want to talk about the Nutributter. What do you think about it?

Tsopano ndikufuna tikambirane zokhudzana ndi ntributter. Kodi maganizo anu ndi otani pa Nutributter?

- *How easy or hard is it to use? (quantity, packet design)*
- *How does Nutributter compare to Chiponde? (different?)*

9. Great, now I'd like to talk about what it's like to feed the Nutributter to your child. Tell me about some of the things that make it easy for you to give your child the Nutributter.

Chabwino, Tsopano ndikufuna tikambirane za mmene zimakhalira mukamadyetsa mwana wanu nutributter. Mundiuze zinthu zomwe zimapangitsa kudyetsa mwana wanu nutributter kukhala kosavuta?

- *Easy to feed?*
- *Describe the child's reaction to being fed Nutributter. (Happy? Unhappy?)*
- *Has it changed over time?*
- *How does the child eat it? (Feed him/herself, fed by you or someone else? Mixed in other food?)*
- *How has Nutributter changed the way your child eats other foods? (Preferences, quantity, demand)*

10. Tell me in detail how you fed your child yesterday? ***

Tsopano mundiuze mwa tsatane tsatane mmene munamudyetsera mwana wanu nutributter dzulo?

- *What types of food did you feed to your child?*
- *Did you breastfeed your child? Tell me a bit about that.*
- *How many times did you feed your child yesterday?*
- *Can you tell me a bit about how you prepared the food?*

- *Did you feed your child Nutibuttter yesterday? (Ask about last time she fed Nutributter if not fed yesterday)*
- *What happened when you fed the Nutributter?*
- *Did your child eat the whole packet?*

11. Are there times when your child did not consume Nutributter? Tell me about what happened with the Nutributter.

Pamakhala nthawi ina imene mwana wanu samadya nutributter? Mungandiuzeko zina zomwe zinachitika ndi nutributter?

- *Do other household members and other individuals (friends, neighbors, relatives) eat the Nutributter?*
- *How do you store Nutributter in your home?*
- *Do you have problems with loss or theft of the Nutributter?*
- *Has it ever happened that you forgot to give your child nutributter?*
- *How many days does your Nutributter typically last?*

12. Tell me about what you have been told when you pick up the Nutributter?

Mungandiuzeko za zimene mwakhala mukuwuzidwa pa nthawi imene mumakatenga nutrubutter?

This may refer to how to feed the Nutributter to your child, or how to feed and care for your child.

- *Are you able to do what they recommend to you? (Why/why not?)*

Now I'd like to talk about some of the things you've heard, possibly from a neighbour or member of your community, which may have been given to you in your home or elsewhere, individually or in groups, while participating in the Nutributter program.

Tsopano tikambirane za ma uthenga amene mwamvapo kuchokera kwa woyandikana nawo nyumba kapena modzi mwa anthu a mdera lino, omwe munapatsidwa pakhomo panu kapena kwina,,panokha kapena mmagulu, pamene mukutenga nawo gawo mu ndondomeko/pulogalamu ya nutributter?

13. Can you tell me what you think about all of the things the care group volunteers told you? ***

Mungathe kundiuzako zomwe mukuganiza pa uphungu okhudzana ndi nthanzi kuchokera kwa alangizi a keya gulupu

- *What are some of the things that the care group volunteer told you to do?*
- *For each of the things that the mother mentions, ask:*
  - *What did you think about what they told you?*
  - *Was the information useful?*
  - *Are you able to do the things they told you to do? Why or why not?*
- *Of all of these things, which would you say is the most important?*

14. Do you have access to radio/tv? * What have you seen or heard about child health and feeding on the television, radio, or on billboards or posters in the community (including at health centers)?**

Tandiueni zimene mwaona kapena kumva zokhudzana umoyo ndi kadyetsedwe ka mwana kudzera pa kanema, pawailesi, kapena amene mwawerenga kapena kuwona pa zikwangwangwani kapena mapepela opachika(ma positala) mdera lino kuphatikizako mu zipatala.

- *For each of the things that the mother mentions, ask:*
  - *What did you think about what you saw or heard on radio, TV, posters, billboards?*
  - *Are you able to do the things they told you to do? Why or why not?*
- *Of all of these things, which would you say is the most important?*

c. Willingness to Pay

15. We want to understand how important you think Nutributter is for your child's health. Imagine that you had to buy Nutributter from the market. How many kwachas would you pay to buy a packet of Nutributter? ***

Tikufuna timvetsetse kufunika komwe inuyo mumaona kwa Nutributter pa moyo wa mwana wanu. Tayerekezani kuti Nutributter sakuperekedwa mwaulele mdera lanu lino, mmalo mwake mukugula pa msika. Mungakonde kugula ndalama zingati paketi imodzi ya nutributter?

- *Over the period of one month, how many packets would you buy for (child's name)?*

d. Closure

16. Is there anything else about the Nutributter program that you'd like to tell me about?

Kodi palinso chinthu china chokhudzana ndi ndondomeko/pulogalamu ya nutributter chimene mungandiuze.

- *What else?*

17. Can you think of any suggestions to make the Nutributter program better?

Kodi muli ndi maganizo ena ali wonse amene angapititse patsogolo ndondomeko/pulogalamu ya nutributter?

- *Can you give me an example of a specific recommendation you would give?*

This is the end of our interview today. Again, I would like to thank you for taking the time to speak with me. Do you have any questions you'd like to ask me?

Appendix C: Direct observation guide for the qualitative study

Mother ID: ☐☐ Mother Name: _____

Village Name: _____

Health Center: _____

Observer ID: ☐☐☐ Observer Name: _____

Date: ☐☐ ☐☐ 20☐☐ Observation start time: ☐☐ : ☐☐
DD MM YY

Observation end time: ☐☐ : ☐☐

Meal Observed: _____

Age of child (months): ☐☐ Sex of Child (M/F): ☐

Note the initial activity of each household member (multiple activities are possible)

Activity codes:

1. Cooking

2. Cleaning vessels

3. Chatting

4. Feeding animals

5. Bathing child

6. Playing

7. Eating Nutritbutter

8. Eating

9. Washing clothes

10. Other (please specify)

	HH Member	Activity when observer enters the house
1.	Mother	
2.	Index child	
3.	Father	
4.	Sister	
5.	Brother	
6.		
7.		
8.		
9.		

SECTION I. Environment

1. General/ overall household compound cleanliness?

☐ Clean ☐ Somewhat clean ☐ Dirty

1a. If dirty, why is it dirty?

☐ Feces ☐ Rubbish ☐ Leaves and other organic compounds ☐ Does not apply

☐ Other_____

2. If feces is present, what is the amount around the household compound

☐ Small ☐ Medium ☐ Large

1b. From what type of animal?

☐ Chicken/ Fowl

☐ Goats

☐ Pigs

☐ Cattle

☐ Dogs

☐ Other_____

3. Household construction materials

☐ Mud

☐ Brick

☐ Wood

☐ Iron sheets

☐ Cement

☐ Grass

☐ Plastic

☐ Other_____

4. Presence of animals in and around the household compound?

☐ Chicken

☐ Goats

☐ Pigs

☐ Cattle

☐ Dogs

☐ Other_____

3a. Do the animals roam inside the house?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

5. How many other children are around? _____

4a. What is their appearance?

☐ Sick ☐ Healthy ☐ Dirty ☐ Clean ☐ Cannot tell

4b. Approximate ages of other children around? _____

SECTION II. Mother/caretaker appearance

6. General caretaker appearance (clothing)

☐ Has shoes

TOP:

☐ Traditional clothing ☐ Western clothing

☐ New clothing ☐ Old clothing

☐ Clean clothing ☐ Dirty clothing

☐ Other _____

BOTTOM:

☐ Traditional clothing ☐ Western clothing

☐ New clothing ☐ Old clothing

☐ Clean clothing ☐ Dirty clothing

☐ Other _____

7. Cleanliness of hands

☐ Clean ☐ Somewhat dirty ☐ Very dirty

SECTION III. Index Child Appearance

8. General child appearance

☐ Looks healthy

☐ Looks sick

☐ Wet runny nose

☐ Dried snot

☐ Coughing

☐ Scabs on head

☐ Eye discharge

☐ Fussy/ crying frequently

☐ Thin but bloated stomach

☐ Other _____

☐ Happy/smiling demeanor

☐ Playing with others

☐ Other _____

9. Independence of child

☐ Clinging to mother

☐ Entertains self

☐ Playing with other children

☐ Carried by other children/siblings

☐ Other _____

10. Child's clothing

☐ Has shoes

TOP:

☐ Traditional clothing ☐ Western clothing

☐ New clothing ☐ Old clothing

☐ Clean clothing ☐ Dirty clothing

☐ Other _____

BOTTOM:

☐ Traditional clothing ☐ Western clothing

☐ New clothing ☐ Old clothing

☐ Clean clothing ☐ Dirty clothing

☐ Other _____

11. Flies/Bugs

☐ Flies/bugs on face

☐ Flies/bugs around child

☐ No flies/bugs

10a. Child's reaction to flies/bugs

☐ Pays no attention ☐ Swats away ☐ Does not apply

SECTION IV. Household Hygiene

12. Latrine access

☐ Yes ☐ No

☐ Shared ☐ Private ☐ Does not apply

13. Presence of handwashing station near or around the latrine

☐ Yes ☐ No ☐ Does not apply

14. Is the handwashing station functional? (presence of water/soap in bottles)

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

15. Did anyone use the handwashing station after using the latrine?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

16. Proximity of latrine and handwashing station

☐ Close (1-10m) ☐ Far (>10m) ☐ Was not observed ☐ Does not apply

17. What is included in handwashing station?

☐ Water ☐ Soap ☐ Containers/Jugs ☐ Nothing, empty ☐ Does not apply

15a. Number of containers _____

15b. Size of containers and contents

☐ 1/2L _____ _____

☐ 1L _____ _____

☐ 2L _____ _____

☐ 1 gallon _____ _____

15c. Was there soap?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

18. Latrine hole covered?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

19. Is the hole full?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

20. Are there flies around the latrine?

☐ More than normal ☐ Some ☐ None ☐ Was not observed ☐ Does not apply

21. How would you rate the smell?

☐ Better than usual ☐ Normal ☐ Worse than usual ☐ Was not observed

☐ Does not apply

22. Is the area around the hole clean? (ie. no feces around the outside of the hole)

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

23. What does mother do when child defecates?

☐ Cleans child, specify:_____

☐ Removes clothing/diaper

☐ Changes clothing/diaper

☐ Washes own hands with water, no soap

☐ Washes own hands with water and soap

☐ Washes child's hands with water, no soap

☐ Washes child's hands with water and soap

☐ Was not observed

☐ Other _____

24. What does mother/caretaker do when child urinates?

☐ Cleans child

☐ Removes clothing/diaper

☐ Changes clothing/diaper

☐ Washes own hands with water, no soap

☐ Washes own hands with water and soap

☐ Washes child's hands with water, no soap

☐ Washes child's hands with water and soap

☐ Was not observed

☐ Other _____

25. Does the mother/caretaker wash his/her hands after latrine use?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

SECTION V. Food Preparation

26. Kitchen environment

☐ Open ☐ Enclosed ☐ Was not observed ☐ Does not apply

27. Kitchen construction materials

☐ Mud

☐ Brick

☐ Wood

☐ Iron sheet

☐ Cement

☐ Grass

☐ Plastic

☐ Does not apply

☐ Other_____

28. Windows in kitchen?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

29. Cleanliness of kitchen?

☐ Clean ☐ Partly Dirty ☐ Dirty

27a. If partly dirty or dirty, why?

☐ Feces ☐ Dirty clothes ☐ Animals ☐ Old food

☐ Other _____

30. What is present in the kitchen/ kitchen area?

☐ Stove ☐ Pots/pans ☐ Cooking utensils (spoons, forks, knives) ☐ Food

☐ Bricks for cooking ☐ Plates

☐ Other _____

31. Is food being stored in the kitchen/ kitchen area?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

29a. If yes, what is the food?

☐ Maize ☐ Rice ☐ Vegetables ☐ Meat ☐ Oil ☐ Cooked food

☐ Other _____

29b. If yes, where is it being stored?

☐ Open Container ☐ Closed container ☐ Other _____

29c. If yes, how much is being stored?

☐ One day's supply ☐ Less than one days supply ☐ More than one days supply

32. What is the type of fuel used for cooking?

☐ Firewood ☐ Charcoal ☐ Grass ☐ Maize stalk ☐ Propane

33. What is the level of smoke in the kitchen?

☐ No smoke ☐ Some light smoke ☐ A lot of smoke

34. Is there water available for cooking?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

32a. Appearance of water?

☐ Clean (clear) ☐ Partly unclean (not very clear) ☐ Very unclean (murky/cloudy)

☐ Does not apply

35. Who is cooking the observed meal?

☐ Mother ☐ Father ☐ Grandparent ☐ Sibling ☐ A different mother/neighbor

☐ Other _____

36. Is anyone helping with the food preparation?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

34a. If yes, who?

☐ Mother ☐ Father ☐ Grandparent ☐ Sibling ☐ A different mother/neighbor

☐ Other _____

37. Does mother wash pans/plates before cooking/feeding?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

35a. If yes, with what?

☐ Water only ☐ Water and Soap ☐ Water and sand ☐ Water and ash

☐ Other _____

38. What tools are used during feeding preparation?

☐ Spoon ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Knife ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Fork ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Chipande ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Pots/ Pans ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Cups ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Nthiko ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

☐ Other_____ ☐ Wooden ☐ Plastic ☐ Metal ☐ Clay

39. When a food item is ready, does preparer cover it while finishing other food preparation?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

37a. If yes, what is used to cover it?

☐ Other plate ☐ Straw mat ☐ Banana leaf ☐ Other _____

40. Who is watching/caring for the index child while mother/ food preparer cooks?

☐ Mother ☐ Father ☐ Siblings ☐ Grandparent ☐ Neighbor women

☐ Neighbor child ☐ No one

☐ Other _____

41. Overall estimation of meal preparation time (from beginning to end)? _____ minutes

***Legend for quantity**:*

*Leaves: uncooked: **bunches**; cooked: **cups***

*Nsima: uncooked (flour): **cups**; cooked: **lumps***

*Porridge: uncooked (flour): **cups**; cooked: **cups***

*Beans: uncooked: **cups**; cooked: **cups***

42. What type of food is prepared: details about food preparation:

Food	Quantity *Be as specific as you can*		Cooking method
	Before cooking	After cooking	
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Comments			

SECTION VI. Feeding/ Mealtime

Feeding start time ☐☐ : ☐☐

43. Where does eating take place?

☐ Inside ☐ Outside

☐ Floor, no mat ☐ Floor, with mat ☐ Chairs ☐ Table

☐ Other_____

44. Where are the plates/bowls that contain the food?

☐ Floor, no mat ☐ Floor, with mat ☐ On laps ☐ Table

☐ Other_____

45. Cleanliness of feeding area?

☐ Clean ☐ Partly Dirty ☐ Dirty

43a. If partly dirty or dirty, why?

☐ Feces ☐ Dirty clothes ☐ Animals /animal feces ☐ Old food

☐ Other _____

46. Are index child's hands washed before eating?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

44a. If yes, with what?

☐ Water only ☐ Water and Soap

47. Does mother/person feeding the child wash his/her hands before the meal?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

45a. If yes, with what?

☐ Water only ☐ Water and Soap

48. Who is eating with young child (6-24m)?

☐ Mother ☐ Other young children (6-36 months) ☐ Other children (3-7 years) ☐ Older children (>7 years) ☐ Father ☐ Grandparent

☐ Other _____

49. Is the young child (6-24m) using a shared bowl with other children?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

47a. If yes, with how many others is the plate shared? _____

50. How does the young child (6-24m) eat?

☐ Feeds self ☐ Fed by other sibling ☐ Fed by mother

☐ Other _____

51. How are the interactions between the mother and child during feeding?

☐ Mother is attentive to the child's cues of hunger and fullness (ex: feeds child when child wants food, stops feeding child when he turns his head, eats with child and/or talks with child during meal)

☐ Mother is not paying attention to child (ex: leaves child to eat by him/herself)

☐ Mother uses force while feeding (ex: pushing food into the mouth, yelling at child to eat, tricking/bribing child to eat)

☐ Mother restricts types and/or amounts of food (ex: takes food away even when child wants it, doesn't allow second helpings)

☐ Mother gives child whatever he/she wants (ex: child refuses family meal and mother replaces with a treat)

☐ Other_____

52. How does the child react to how the mother is feeding him/her?

☐ Eats without fussing ☐ Eats but fusses ☐ Refuses to eat ☐ Does not apply

53. How quickly does the mother respond to the child's fussing during feeding?

☐ Immediately ☐ Between 30-60 seconds ☐ Doesn't respond at all

☐ Other_____

54. What does the child eat? *List each food and quantity. Pay close attention to what the child is actually consuming and not only what is on his/her plate. For example, does the child consume only broth or broth + leaves?*

Food & Condition (ie how it was cooked: boiled, fried, raw, etc.)	Mother's Mood	Baby's Mood	Quantity *Be as specific as you can*
1.			

2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Comments			

55. What happens when the child's plate is empty?

☐ Refilled with more food ☐ Left there ☐ Taken away

56. Is there any beverage offered to the child during feeding?

☐ Water ☐ Juice ☐ Tea ☐ Coffee ☐ Other _____

57. What happens when everyone is done eating?

- ☐ Mom cleans
- ☐ Mom washes child's hands with water
- ☐ Mom washes child's hands with water & soap
- ☐ Mom washes own hands with water
- ☐ Mom washes own hands with water & soap
- ☐ Other_____

58. What happens if there is food left on the plate?

- ☐ Makes child finish the food
- ☐ Saves the food for later
- ☐ Throws the food away
- ☐ Someone else eats the food
- ☐ Other_____
- ☐ Was not observed
- ☐ Does not apply

Feeding end time ☐☐ : ☐☐

59. Create a drawing of the mealtime feeding arrangement. Who sits where and with whom?

SECTION VII. Nutributter

60. Where is the Nutributter stored in the house?

☐ Bedroom ☐ Kitchen ☐ Common room ☐ Other_____

☐ Under lock and key ☐ On floor ☐ Off floor ☐ Out of reach of older children

61. Is the Nutributter washed before feeding?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

62. Are the child's hands washed before feeding Nutributter?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

63. How is Nutributter fed?

☐ Child feeds self (sucks out of bag): ☐ On a lap ☐ On ground ☐ Alone

☐ Someone feeds it to child: ☐ On a lap ☐ On ground ☐ Alone

☐ Mixed into other food: ☐ On mom's lap ☐ On ground ☐ Alone

59a. If someone else feeds the child, who was it?

☐ Mother ☐ Father ☐ Sibling ☐ Grandparent ☐ Other neighbor child

59b. If it is mixed in with other food, what food is it?

☐ Porridge ☐ Other _____

64. Does child seem to recognize Nutributter?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

65. What is the child's reaction when s/he sees Nutributter?

☐ Happy ☐ Fussing/ Upset ☐ No reaction ☐ Refusal ☐ Accepts

66. Does the child eat the whole sachet?

☐ Yes, all of it ☐ Only eats ¼ ☐ Only eats ½ ☐ Only eats 3/4

67. Does the child eat more than one sachet?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

63a. If yes, how much many additional sachets were consumed? _____

68. Does anyone else eat some of the sachet?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

64a. If yes, who?

☐ Mother ☐ Father ☐ Sibling ☐ Grandparent ☐ Other neighbor child

☐ Other_____

64b. If yes, how much was consumed?

☐ Yes, all of it ☐ Eats ¼ ☐ Eats ½ ☐ Eats 3/4

69. Does child get any Nutributter on other body parts?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

65a. If yes, where?

☐ Hands ☐ Arms ☐ Face ☐ Legs

65b. If yes, what happens to it?

☐ Licks it off ☐ Wipes it off ☐ Mother wipes it off ☐ Noting happens to it

☐ Other _____

70. Does anything else happen to the Nutributter?

☐ No ☐ Child plays with it ☐ Thrown in dirt ☐ Thrown in water

☐ Animal takes it ☐ Other _____

66a. After any of these, does child puts Nutributter back in mouth/ continues eating it?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

66b. If yes, was the Nutributter packet washed before the child continued eating it?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

SECTION VIII. Breastfeeding

71. Number of times child is breastfed during observation? _____

72. What was the purpose of each breastfeeding episode?

☐ To feed (3 min or more on breast, can see active suckling/swallowing)

☐ To soothe/pacify

SECTION IX. Child Care

73. Is mom generally aware of child and what he/she is doing?

☐ Yes ☐ No ☐ Was not observed ☐ Does not apply

74. What is the mother's reaction when the child cries/fusses?

☐ Picks him/her up ☐ Gives breast ☐ Is attentive to child ☐ Soothes child

☐ Pays no attention to child ☐ Appears irritated by child ☐ Distracts child by playing with

her/her ☐ Other_____

75. How quickly does the mother respond to the child's fussing?

☐ Immediately ☐ Between 30-60 seconds ☐ Doesn't respond at all

☐ Other_____

Other Notes/ Comments about observation:

Appendix D: Focus group discussion guides (village leaders, nutrition Promoters, Care Group Volunteers) for the qualitative study

Focus Group Discussion Guide: Village Chief, Religious Leaders, Community Leaders

Welcome to our focus group. Joining me today is _____, who will be taking notes and will be here to assist me.

I would like for everyone to participate and for the discussion to be informal. I encourage you to respond to each other's comments, I just ask that everyone speak one at a time and be respectful of other participants.
I might interrupt at points during the discussion to ensure that we have enough time to cover all of the topics. If you don't understand a question, please let me know. We are here to ask questions, listen, and make sure everyone has a chance to share.

- Please speak loudly and clearly so that our tape recorder can pick up your voice and what you are contributing.
- Please speak one at a time and do not have side conversations.
- Please give each other a chance to speak.
- There are no right or wrong answers, and we will have different points of view. We encourage you to talk to each other as a gro\, and to share reactions or disagreement with respect.
- You are free to say what occurred at this meeting. Please also respect each other's confidentiality and do not repeat who was at this meeting or what certain people said.
- If you feel uncomfortable at any point, you are free to decline to participate.

Note: Prior to beginning the interview, please record the following information:

FOCUS GROUP NUMBER: ☐☐

Location: _____

Number of participants: ☐☐

Type of participants: ☐ Village Leaders/Chiefs ☐ Promoter
☐ Care Group Volunteers

Moderator name:_____Note-taker name: _____

Moderator worker ID: ☐☐☐ Note-taker ID: ☐☐☐

Date: ☐☐ ☐☐ 20☐☐ (DD MM YY) Start time: ☐☐ : ☐☐

End time: ☐☐ : ☐☐

Icebreaker (10 minutes)

Let's begin. Let's find out more about each other by going around the room one at a time. In about a minute or less, tell the group about yourself. I'll start…

Community perceptions on the nutrition program

Let's talk about the nutrition program here in Ntchisi.

1. **What do you know about the Nutributter program?**
   - *Can you describe the program to me?*

   3 components:
   1. Distribution of Nutributter
   2. Individual counseling on child feeding and care
   3. Group counseling on child feeding and care

   Kodi mukuidziwa ndondomeko imeneyi?

2. **Can you think back to a time when you first found out that the Nutributter program was coming to your community, what did you think about it at that time?**

   Mungathe kukumbukira nthawi yomwe ndondomeko/pulogalamu ya nutributter munaimva koyamba, Nthawi imeneyo mumayiganizira bwanji?

3. **Why is the Nutributter program being implemented in Ntchisi?**

4. **What do you think about the Nutributter program?**

   Mungandiuze maganizo anu okhudza ndondomeko/pulogalamu ya nutributter?

   - *Tell me about specific benefits/negative aspects this program has had for the children in your community.*

   Now I'd like to talk about some of the specific aspects of the program. Let's start with the Nutributter packet. *(Show a packet of the Nutributter so that participants know what you are referring to)*

5. **Tell me what you think about the Nutributter.**

   Tsopano ndikufuna tikambirane zokhudzana ndi ntributter. Kodi maganizo anu ndi otani pa Nutributter?

   - *How easy or hard is it for the mothers in your community to use it? (quantity, packet design)*

6. **How does Nutributter compare to Chiponde?**

7. **How has Nutributter impacted the children in your community?**

- *What are the positive/negative impacts you think Nutributter has had on the children in your community?*

You are all providing great information about the program. Now, I'd like to talk about what you think about the discussions and information that is given to mothers in your village about how to care for and feed their children (both with Nutributter and more generally).

8. **Can you tell me about the women in your community who provide information to other mothers about how to feed and care for their children (care group volunteer)?**
   - *Do you have a name for these women in your community?*
   - *How many of these women are in your village?*
   - *What are some of the things they do in your community?*

9. **What have you seen or heard about child health and feeding on the television, or radio? What about on billboards or posters?**
   - *For each of the things mentioned, ask:*
     - *What did you think about what you saw or heard on radio, TV, posters, billboards?*
     - *Do you think mothers are able to do the things they are told? Why or why not?*
   - *Of all of these things, which would you say is the most important?*

Closing

10. **Is there anything else about the Nutributter program that you'd like to tell me about?**

    Kodi palinso chinthu china chokhudzana ndi ndondomeko/pulogalamu ya nutributter chimene mungandiuze.

    - *What else?*

11. **As a group, can you discuss among yourselves and think of some suggestions to make the Nutributter program better?**

    Kodi muli ndi maganizo ena ali wonse amene angapititse patsogolo ndondomeko/pulogalamu ya nutributter?

    - *Can you give me an example of a specific recommendation you would give?*

    I am now going to turn off the tape recorders. Thank you again for your help and for sharing your opinions with us today. We really appreciate your time and contribution. Feel free to ask any additional questions at this time.

Focus Group Discussion Guide: Nutrition Promoters

Welcome to our focus group. Joining me today is _____, who will be taking notes and will be here to assist me.

I would like for everyone to participate and for the discussion to be informal. I encourage you to respond to each other's comments, I just ask that everyone speak one at a time and be respectful of other participants.
I might interrupt at points during the discussion to ensure that we have enough time to cover all of the topics. If you don't understand a question, please let me know. We are here to ask questions, listen, and make sure everyone has a chance to share.

- Please speak loudly and clearly so that our tape recorder can pick up your voice and what you are contributing.
- Please speak one at a time and do not have side conversations.
- Please give each other a chance to speak.
- There are no right or wrong answers, and we will have different points of view. We encourage you to talk to each other as a gro\, and to share reactions or disagreement with respect.
- You are free to say what occurred at this meeting. Please also respect each other's confidentiality and do not repeat who was at this meeting or what certain people said.
- If you feel uncomfortable at any point, you are free to decline to participate.

Note: Prior to beginning the interview, please record the following information:

FOCUS GROUP NUMBER: ☐☐

Location: _____

Number of participants: ☐☐

Type of participants: ☐ Village Leaders/Chiefs ☐ Promoters ☐ Care Group Volunteers

Moderator name:_____Note-taker name: _____

Moderator worker ID: ☐☐☐ Note-taker ID: ☐☐☐

Date: ☐☐ ☐☐ 20☐☐ Start time: ☐☐ : ☐☐

DD MM YY

End time: ☐☐ : ☐☐

Icebreaker (10 minutes)

Let's begin. Let's find out more about each other by going around the room one at a time. In about a minute or less, tell the group about yourself. I'll start…

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Let's talk about the nutrition program here in Ntchisi.

1. **What do you know about the Nutributter program?**
   - *Can you describe the program to me?*

   3 components:
   1. Distribution of Nutributter
   2. Individual counseling on child feeding and care
   3. Group counseling on child feeding and care

   Kodi mukuidziwa ndondomeko imeneyi?

2. **Why is the Nutributter program being implemented in Ntchisi?**

3. **What do you think about the Nutributter program?**

   Mungandiuze maganizo anu okhudza ndondomeko/pulogalamu ya nutributter?

   - *Tell me about specific benefits/negative aspects this program has had for the children in your community.*

   Thank you, you are all giving me great information. Now I'd like to talk about your work as a care group volunteer in this program and in your community.

4. **What do people in your community call you?**

5. **Please describe how you were selected for this work.**
   - *Why were you selected?*
   - *Did you volunteer?*

6. **Please describe your responsibilities as a CLAN.**
   - *How do you support the distribution of Nutributter?*
   - *How do you support the care group volunteers?*
   - *Can you give me some specific examples of your daily or weekly responsibilities as a CLAN?*

7. **Please tell me about what you talk about when you meet with care group volunteers in your community.**
   - *Can you give me some specific examples of things you tell care group volunteers to help them do their job? (training, support)*

8. **What do you think makes it most difficult for mothers in your community to properly feed and care for their children?**
   - *Can you give me some examples of specific challenges mothers face?*
   - *Tell me about how these challenges are related to specific practices.*

Closing (10 minutes)

9. **Is there anything else about the Nutributter program that you'd like to tell me about?**

   Kodi palinso chinthu china chokhudzana ndi ndondomeko/pulogalamu ya nutributter chimene mungandiuze.

   - *What else?*

10. **As a group, can you discuss among yourselves and think of some suggestions to make the Nutributter program better?**

    Kodi muli ndi maganizo ena ali wonse amene angapititse patsogolo ndondomeko/pulogalamu ya nutributter?

    - *Can you give me an example of a specific recommendation you would give?*

I am now going to turn off the tape recorders. Thank you again for your help and for sharing your opinions with us today. We really appreciate your time and contribution. Feel free to ask any additional questions at this time.

Focus Group Discussion Guide: Care Group Volunteers

Welcome to our focus group. Joining me today is _____, who will be taking notes and will be here to assist me.

I would like for everyone to participate and for the discussion to be informal. I encourage you to respond to each other's comments, I just ask that everyone speak one at a time and be respectful of other participants.
I might interrupt at points during the discussion to ensure that we have enough time to cover all of the topics. If you don't understand a question, please let me know. We are here to ask questions, listen, and make sure everyone has a chance to share.

- Please speak loudly and clearly so that our tape recorder can pick up your voice and what you are contributing.
- Please speak one at a time and do not have side conversations.
- Please give each other a chance to speak.
- There are no right or wrong answers, and we will have different points of view. We encourage you to talk to each other as a gro\, and to share reactions or disagreement with respect.
- You are free to say what occurred at this meeting. Please also respect each other's confidentiality and do not repeat who was at this meeting or what certain people said.
- If you feel uncomfortable at any point, you are free to decline to participate.

Note: Prior to beginning the interview, please record the following information:

FOCUS GROUP NUMBER: ☐☐

Location: _____

Number of participants: ☐☐

Type of participants: ☐ Village Leaders/Chiefs ☐ Promoters
☐ Care Group Volunteers

Moderator name:_____Note-taker name: _____

Moderator worker ID: ☐☐☐ Note-taker ID: ☐☐☐

Date: ☐☐ ☐☐ 20☐☐ Start time: ☐☐ : ☐☐
DD MM YY

End time: ☐☐ : ☐☐

Icebreaker (10 minutes)

Let's begin. Let's find out more about each other by going around the room one at a time. In about a minute or less, tell the group about yourself. I'll start…

Community perceptions on the nutrition program

Let's talk about the nutrition program here in Ntchisi.

1. **What do you know about the Nutributter program?**
   - *Can you describe the program to me?*

   3 components:
   1. Distribution of Nutributter
   2. Individual counseling on child feeding and care
   3. Group counseling on child feeding and care

   Kodi mukuidziwa ndondomeko imeneyi?

2. **Why is the Nutributter program being implemented in Ntchisi?**

3. **What do you think about the Nutributter program?**

   Mungandiuze maganizo anu okhudza ndondomeko/pulogalamu ya nutributter?

   - *Tell me about specific benefits/negative aspects this program has had for the children in your community.*

   Thank you, you are all giving me great information. Now I'd like to talk about your work as a care group volunteer in this program and in your community.

4. **What do people in your community call you?**

5. **Please describe how you were selected for this work.**
   - *Why were you selected?*
   - *Did you volunteer?*

6. **Please describe your responsibilities as a care group volunteer.**
   - *How many mothers do you visit in a day? In a week?*
   - *How many mothers are you responsible for visiting each week?*
   - *How long does each visit last?*

7. **Please tell me about what you talk about when you meet with the women in your community.**
   - *Can you give me some specific examples of things you tell mothers to help them improve their child's health and nutrition? (child care, feeding, hygiene)*

8. **How do you think the mothers you talk to feel about what you discuss with them?**

- *Can you tell me about your relationship with the mothers you meet with in the community?*
- *Do you think that the mothers you interact with are more or less likely to participate in the program?*
- *Do you feel that the information you provide them is well/not well received, and if so, why?*

9. **What do you think makes it most difficult for mothers in your community to properly feed and care for their children?**
   - *Can you give me some examples of specific challenges mothers face?*
   - *Tell me about how these challenges are related to specific practices.*

   Closing (10 minutes)

10. **Is there anything else about the Nutributter program that you'd like to tell me about?**

    Kodi palinso chinthu china chokhudzana ndi ndondomeko/pulogalamu ya nutributter chimene mungandiuze.

    - *What else?*

11. **As a group, can you discuss among yourselves and think of some suggestions to make the Nutributter program better?**

    Kodi muli ndi maganizo ena ali wonse amene angapititse patsogolo ndondomeko/pulogalamu ya nutributter?

    - *Can you give me an example of a specific recommendation you would give?*

    I am now going to turn off the tape recorders. Thank you again for your help and for sharing your opinions with us today. We really appreciate your time and contribution. Feel free to ask any additional questions at this time.

Appendix E: Qualitative study codebook

Malawi Qualitative Study Codebook

Main code	Sub code	Description
Geographic information	Village	Village in which respondent lives.
	Health center	Health center that the respondent goes to.
Sociodemographic characteristics	Age	Age of the respondent.
	Occupation	Respondent's occupation
	Marital status	Marital status of the respondent
	Number of children	Number of children of the respondent. In cases where the respondent is a grandmother, this refers to the number of children she has had, not the number of children in the household in which she lives (for example if the household is her daughter or son's).
	Household size	Number of people who live in the household, that is, who share food from the same plate.
	Education level	Years of education of the respondent.
Housing characteristics	Housing materials	What the house is built with, materials used
	Appearance of house (cleanliness)	Presence of animal or human feces in and around the HH compound, presence of trash and other rubbish
	Appearance of latrine	Description of the appearance of the latrine, including presence or ownership of the latrine
	Number of rooms	Number of rooms inside the house
Child characteristics	Child behavior	Any description of child behavior during the interview
	Child age and DOB	Parental report of child's date of birth and/or age.
Respondent responsibilities	Daily chores	Fetching water, going to the garden, gathering food, cooking
	Food preparation	Description of food preparation process
Concerns/problems affecting the family/community	Household concerns	Main concerns at the household level/things that the household worries about and reasons they worry about them
	Community concerns	Things that the interviewee mentions are problems in the

Main code	Sub code	Description
		community and how it affects the household
	Causes of undernutrition in Ntchisi	This can include traditional practices that are seen as influencing child nutrition
	Challenges mothers face	This refers to challenges the mother faces, but from the perspective of other people (CLAN, CGV, village heads, or other family members)
Food insecurity	Food theft	Theft of foods from the field and/or household and that contribute to household hunger/food insecurity
	Staying hungry -adults	Food distribution in the household, adults skipping meals
	Skipping meals - children	Children skipping meals due to lack of food
	Coping strategies	Any activity household members engage in to cope with food security issues, includes “gyanyu” (cheap labor)
	Traditional practices	Mention of traditional practices that may contribute to food insecurity in the household. For example, preferentially feeding certain household members with nutritious foods.
Health seeking behaviors		Any description of a family’s health seeking behaviors
Nutributter program	Program description	Description of the program from the point of view of the interviewee (or FGD participant)
	First heard about the program	Includes how (from whom) and when they first heard about the program, and reactions to the program when they first heard about it
	Criteria for receiving program benefits	What are the requirements for being able to participate in the program
	Reason for the program in Ntchisi	What are the reasons that the program is being implemented in Ntchisi, why was this district chosen
	Positive things about the	Any mention of positive things

Main code	Sub code	Description
	program	about the program (not only the NB)
	Negative things about the program	Any mention of negative things about the program (not only the NB), including mention of corruption
Nutributter - general	Name used to describe Nutributter	What mothers call the packet of Nutributter
	Positive things about the Nutributter	Can include changes in child health and behaviors
	Negative things about the Nutributter	Includes side effects of consumption, quantity/packet size
	Things that influence participation	Things in the program – positive or negative that interviewees mention influence their participation in the program
	Contents of Nutributter	Things that the mother says the Nutributter contains, or what she thinks is in it that makes it what it is
	Nutributter storage	Place where the Nutributter is stored
	Difference between chiponde and Nutributter	Interviewee's description of the difference between chiponde and Nutributter
	Reason NB is given to children 6-24	Reason it is given to this age group, and reason it is or is not given to older children
Respondent perceptions	Nutributter content	The mother may say it's a medicine, or contains the six food groups, etc.
	Stunting	How the mother describes or perceives stunting
	Child malnutrition	How the mother describes or perceives a malnourished child
	Care group volunteer	Mother's perceptions of CGV
Nutributter feeding	How they are told to feed the Nutributter	Any and all advice mothers have received about how to feed the Nutributter – can be advice from the CGV, CLAN, or someone else at the distribution center.
	How they feed the Nutributter	How the mothers actually feed it to their child, and can include descriptions of why they choose to feed it in this way

Main code	Sub code	Description
	Amount of Nutributter consumed yesterday	Description of whether the child ate a packet yesterday and if so, did they eat the whole thing or only half, etc.
	Child reactions to NB	Descriptions of how the child reacts to the Nutributter: do they like it, not like it, ask for it, side effects (vomiting), etc.
	Change in reactions	If the interviewee describes any change in reactions from when they were first fed the Nutributter to now
	Sharing of Nutributter	Any description of someone other than the target child being fed the Nutributter
	Ease of use	Description of how easy or hard the NB is to feed and why/why not
	Consumption of other foods/food preferences	How has the Nutributter changed consumption of other foods or changed food preferences
	Running out of stock	Does the allotted stock of NB last as long as it should, if not why not. What are some of the reasons that the NB doesn't last the whole month.
	Reasons for target child not eating Nutributter	Can include running out of stock, forgetting to feed, sharing with other household members, theft of NB, spoilage, child doesn't consume whole packet, etc.
	Size of packet	
	Packet design	
	Disposal of nutributter packets	Any description of disposal of Nutributter packets. And reasons mentioned such as "soil infertility" that is caused by Nutributter packets.
Nutributter pick-up	Informs mothers about pick-up dates	Description of who informs mothers of days to go pick up Nutributter
	Amount of Nutributter received	Amount of Nutributter that was received at the last distribution or that is regularly received when the

Main code	Sub code	Description
		mother goes to pick it up
	Regularity of pick-up	How often does household pick up, how many times they have failed to pick up
	Reasons for missing NB pick-up	Description of what happened when an interviewee mentions she missed a pick-up
	Alternatives to pick up	What do they do if they can't pick up the Nutributter – includes someone else picking it up for them and who that person is
	Things that happen at pick-up	Any description of procedures during pick up or what happens when the mother goes to pick up the Nutributter. Includes treatment received by staff, messages given to the mother about how to feed the NB
	Waiting time	How long does the mother typically wait. Includes any description of waiting time and things that affect the amount of time mothers wait (truck is late, workers are late, etc.)
	Pick-up location	Name and description of pick up location, distance to pick-up location
	Pick up days	Discussion around the days of pick up and whether they are convenient or not, 2 days is enough/not enough
	Name of people who distribute the Nutributter	The name of the people who are tasked with distributing the NB to the mothers
	Forgotten/lost card	What happens if the mother or person picking up forgets to bring their card or has lost their card when they pick up the NB
	Problems with distribution	This includes any problems mentioned that are associated with Nutributter distributions, for example people being late and not receiving the NB
Program enrollment	Reasons for enrollment	Reasons for why the mother enrolled the child into the program

Main code	Sub code	Description
	Age at enrollment	Age at which the mother enrolled the child
	Enrollment procedures	Description of how children in the community were identified to be enrolled in the program when the program first started and procedures that were followed to get children enrolled (ie. Photographs, card distribution, etc.)
Program participation	Facilitators	Positive things about the program that have influenced her participation
	Barriers	Negative things about the program that have influenced her participation
	Consequences of non-participation	Description of what happens if the mother does not participate in the program (pick up the Nutributter or feed it to the child as instructed, or not implement the behaviors that are counseled)
Program staff	Volunteers	Who are the volunteers, what are their responsibilities, what are they called in the community
Source and perception of program messages	Messages received	What are the messages mothers have received through the program
	Opinion of messages received	What do mothers think about the messages they received
	Source of messages	TV, radio, billboard, HAS, distribution session, etc.
	Messages received on TV	Description of messages received from each of these avenues
	Messages received at group meeting	
	Messages received from newspapers	
	Messages received at home or individually	
	Messages received on radio	
	Messages received at community nutrition events	
	Messages received on billboard	
	Messages received on poster	
	Messages received at health	

Main code	Sub code	Description
	center	
	Messages received at distribution center	
Program messages – group (at health center or distribution session)	Be clean	General hygiene and sanitation (body, household, toilet, food preparation)
	Feed from 6 food groups	Description of the 6 food groups or just mention of the 6 food groups and benefits of feeding from 6 food groups
	Breastfeeding	Frequency, duration, age ranges, benefits
	Complementary feeding	When to start, types of food to feed, frequency of feeding
	Loving and caring for your child	Messages about how to care for the child, including being attentive, responsive, playing with the child, singing to them, etc.
	Clean/wash Nutributter packet before feeding	When mothers are told to clean the packet before feeding it to the child.
	Massage Nutributter packet	Including mention of massaging to distribute oil evenly in the packet and why to do so
	One packet per child per day	Messages about nutributter use, specifically, feeding only one packet per day for the target child.
	Mix Nutributter with porridge	Any mention of how to consume the Nutributter, specifically, mixing it with porridge.
	No sharing	Specific messages about how the Nutributter should be for the target child only and not shared with other siblings, household members, or friends.
	Keep sachets and present at end of the month	To show that the child is eating the sachets they should be eating
	Other	Can include other types of messages mothers receive in a group setting for example about child weight gain and attending growth monitoring and promotion sessions, what to do when a child is not gaining weight, etc.
Program messages -	Be clean	General hygiene and sanitation

Main code	Sub code	Description
individual		(body, household, toilet, food preparation)
	Feed from 6 food groups	Description of the 6 food groups or just mention of the 6 food groups and benefits of feeding from 6 food groups
	Breastfeeding	Frequency, duration, age ranges, benefits
	Loving and caring for your child	Messages about how to care for the child, including being attentive, responsive, playing with the child, singing to them, etc.
	Clean/wash Nutributter packet before feeding	When mothers are told to clean the packet before feeding it to the child.
	Massage Nutributter packet	Including mention of massaging to distribute oil evenly in the packet and why to do so
	One packet per child per day	Messages about nutributter use, specifically, feeding only one packet per day for the target child.
	Mix Nutributter with porridge	Any mention of how to consume the Nutributter, specifically, mixing it with porridge.
	No sharing	Specific messages about how the Nutributter should be for the target child only and not shared with other siblings, household members, or friends.
	Keep sachets and present at end of the month	To show that the child is eating the sachets they should be eating
	Other	Can include other types of messages mothers receive in a group setting for example about child weight gain and attending growth monitoring and promotion sessions, what to do when a child is not gaining weight, etc.
Importance of messages		Which message is most important
Program improvement		Suggestion to improve the program
Care group volunteers	Name	What are they called in the community
	Knowledge of CGV	Has interviewee heard of CGV?

Main code	Sub code	Description
		Are they working in her community?
	Selection of CGV	Timing and selection of care group volunteers, how they were selected to be CGV
	Refusal to be a CGV	Reasons why CGV refused to take on the CGV role
	Motivation to be a CGV	What are the reasons people accepted to be CGV
	CGV training	Training received by CGV to do their job
	Benefits of being a CGV	This can include personal benefits like personal learning on how to better care for their own families and children
	CGV role at distribution sessions	What do the CGV do during distribution sessions – what is their role during this activity
	Work responsibilities of CGV	What do CGV say they are responsible for as a CGV
	Number of households of CGV	Number of households they are responsible for visiting and how this number was derived
	Schedule of visits	How many days does it take the CGV to visit all of their households, what is their schedule (frequency) for visiting households
	Workload of CGV	Whether the CGV feel that their workload is manageable
	CGV interaction with mothers	Description of how the CGV interact with mothers (including how they visit them – location – or disseminate their messages)
	Duration of counseling sessions	How long do sessions last
	Content of CGV counseling sessions	Examples of messages that are given, or description of how the CGV decides which messages to talk about
	Questions asked by the mother during CGV counseling sessions	In the case that the mother asks questions what types of questions does she ask
	Challenges of CGV	Challenges faced by CGV in performing their work responsibilities, including negative

Main code	Sub code	Description
		perceptions of CGV by community memebrs
	Training of CGV	Types of materials received by the CGV, including books, and who the training is conducted by
	Replacement of CGV	How does CGV go about resigning if they no longer want this responsibility: what are the options
	Incentives	What would incentivize the CGV to better do their jobs
	CGV influence on program participation	How to CGV influence mother's participation in the program
	Reporting to CLANs	Any discussion of reporting procedures from CGV to CLAN (or other), what is included in the reports, frequency of reporting, format of reports
Interaction between CLAN and CGV	Reporting	Any discussion of reporting procedures from CGV to CLAN (or other), what is included in the reports, frequency of reporting, format of reports
	Frequency of meetings	How often do CGV meet with CLAN
	Matters discussed	What is the purpose of the meetings, what is discussed with the CLAN during these meetings
Child feeding	Foods consumed in last 24 hours	What did the child eat in the last day
	Feeding episode	Description of feeding episodes in the last day
	Breastfeeding	Whether the child was breastfed yesterday, number of times breastfed, whether it was more or less than usual
	Morning meal	Description of each of these meals, including foods fed/consumed, preparation, and quantity
	Midday meal	
	Evening meal	
	Barriers to food diversity	Anything the interviewee mentions that makes it difficult for children to eat a varied diet
	Seasonal variations in child's diet	Any mention of variation in eating patterns during lean season versus other seasons

Main code	Sub code	Description
Willingness to pay	Amount per packet	How many kwachas for one packet
	Number of packets in 1 month	Amount of packets they would purchase in 1 month at the stated price
Quotation		Any “quote’ that eloquently describes one of the codes and which we may want to use in the report or for a presentation
Local lexicon		Local terms in the transcript that provides better context
CLAN	CLAN role at distribution sessions	Descrption of the CLANs role during distribution sessions.
	Name	Name that is used to refer to the CLAN.
Concerns/questions about the program		Any questions or concerns that the participant mentions about the program, typically at the conclusion of the interview.
WASH Behaviors		Any mention of WASH behaviors, such as hand washing, using the toilet, cleaning the child, bathing, etc. Hygiene and sanitation behaviors reported by the study participant in the context of the child and caregiver.
Nutrition behavior		Breastfeeding and complementary feeding behaviors reported by the study participant in the context of the index child.
HSA		The health surveillance assistant who distributes Nutributter at the health center.
Social norm or social pressure		Enrolment for Nutributter because “others” were doing so. Wanting the child to eat what other children are eating.
Mothers perception of messages		How mothers interpret the program messages. For example, one mother says “my child has to eat heavily”
Partner/spousal communication		Discussion with partner/spouse on any topic (Nutributter, child, malnutrition etc.). Or with friends, family etc.
Gender inequality		Any descriptions of gender roles or

Main code	Sub code	Description
		unequally based on gender

Appendix F: Direct observation guide for Nutributter distributions, process evaluation study

Village Name: _____

Health Center/Extended distribution point: _____

Observer Name: _____

Observation time start: _____ Observation time end: _____

Date of observation: ☐☐ ☐☐ 20☐☐
DD MM YY

Estimated time that *most* mothers arrive to distribution: ☐☐ : ☐☐ AM / PM

Arrival of food commodity: ☐☐ : ☐☐ AM / PM

Arrival of distribution staff: ☐☐ : ☐☐ AM / PM

Arrival of other (CLAN, CGV, other) staff: ☐☐ : ☐☐ AM / PM

Distribution start time: ☐☐ : ☐☐ AM / PM

Distribution end time: ☐☐ : ☐☐ AM / PM

Number of staff at distribution: ☐☐

Number of mothers at distribution: ☐☐☐☐

Functioning card reading system? ☐ 1= Yes; 2=No

Availability of LNS at distribution? ☐ 1= Yes; 2=No

- If no, write the number of mothers who did not receive LNS and describe the instructions or information they received:

Instructions: Observe the distribution session and make a note of the frequency with which each of the actions takes place.

	All of the time	Most of the time	Some of the time	None of the time
Staff are friendly with mothers				
Staff are attentive to questions made by mothers				
Staff answer mothers' questions				
Staff scan mothers' cards upon pick-up of the Nutributter				
Staff explain to mothers that the child should consume 1 sachet per day				
Staff instruct mothers to provide the Nutributter to the target child only				
	All mothers	Most mothers	Some mothers	Don't explain to any mothers
Staff explain to mothers that Nutributter is complementary and should be fed in addition to breastfeeding and complementary feeding				
Staff provide instructions about how to use/feed the Nutributter				
Who should get Nutributter (6-24 months)				
# of packets that should be consumed daily				
Sharing of Nutributter				
Wash hands before feeding				
Wash child's hands before feeding				
Wash packet				
Massage packet				

Mix with porridge				
Feed straight out of packet				
Other: Specify below				

Using the table below, describe in as much detail as possible the setting or environment of the LNS distribution.

Setting (school, church, health center, administrative office, other?)	
Environment (# of mothers, children, staff, husbands, others present?)	
Distribution arrangements (where do mothers sit? Do mothers sit or stand?How do staff distribute- are there tables? Chairs? Does it look/feel crowded?)	
Waiting time (how long do mothers wait? How long do staff wait?)	
Other activities (other activities mothers engage in while waiting? Group counseling? Song and dance? Theater? Other?)	
Staff-mother interaction (are staff: friendly? Attentive? Courteous? Rushed? Stressed? Able to answer questions? Are mothers: frustrated? Satisfied? Rushed? Patient?)	

Appendix G: Direct observation guide for one-on-one, household level counseling, process evaluation study

Village Name: _____

Health Center: _____

Observer Name: _____

Observation time start: _____ Observation time end: _____

Date of observation: ☐☐ ☐☐ 20☐☐
DD MM YY

Counseling session start time: ☐☐:☐☐ AM / PM

Counseling session end time: ☐☐:☐☐ AM / PM

Describe in as much detail as possible the setting under which the counseling session takes place. Include details about location where the session takes place. For example, does it take place in passing at the trading center? At the household? At the borehole? At the river? Who is present (mother alone, children, neighbors, other family)? What is the mother doing during the counseling session (washing clothes? Cooking? Sitting and taking a break)?

Describe in as much detail as possible the interaction you observe between the mother and the CGV during the counseling session. Include observations about the mother's interest level, the CGV's attitude/courteousness towards the mother, and mother's receptiveness to the CGV.

Use the table below to describe the content of the counseling session. Include whether the information was clearly described (very clear, somewhat clear, not clear) as well as whether you perceived the mother to have understood the message (well understood, partially understood, minimally understood), based on the interaction. Fill the information for the messages delivered only.

	Message	Clarity of delivery 1= Very clear 2= Somewhat clear 3= Not clear	Perceived mother's understanding 1= Well understood 2= Partially understood 3= Minimally understood
BREASTFEEDING			
1	Exclusive breastfeeding 0-6 months		
2	Benefits of breastfeeding		
3	Initiation of breastfeeding		
4	Feeding and benefits of colostrum (yellow milk)		
5	Breastfeeding frequency		
6	Expressing breastmilk		
7	Positioning and breastfeeding problems		
8	Maternal nutrition and diet during breastfeeding		
9	Breastfeeding with HIV		
10	Other message: Specify below		
COMPLEMENTARY FEEDING			
11	Child malnutrition in the community/Malawi		
12	Age at which foods and/or other liquids than breastmilk should be introduced (complementary feeding should begin)		
13	Consequences of beginning complementary feeding too early		
14	Feeding children from the six food groups		
15	Description of the 6 food groups		
16	How to feed a 6 month child (frequency, consistency, attentiveness, etc.)		
17	How to feed a 7-8 month old child (frequency, consistency, attentiveness)		
18	How to feed a 9-11 month old child (frequency, consistency, attentiveness)		
19	How to feed a 12-24 month child (frequency, consistency, attentiveness)		
20	How to encourage a child to eat		
21	Feeding a child during illness		
22	How to fortify foods		
23	Attending growth monitoring		
24	How to interpret growth charts		

	Message	Clarity of delivery 1= Very clear 2= Somewhat clear 3= Not clear	Perceived mother's understanding 1= Well understood 2= Partially understood 3= Minimally understood
25	Micronutrient supplementation (vitamin A, iodized salt, deworming)		
26	Other message: Specify below		
WATER, SANITATION, HYGIENE			
27	Handwashing (when, with what)		
28	Consequences of inadequate WASH practices		
29	Use of the latrine		
30	Other message: Specify below		
NUTRIBUTTER			
31	Reason Nutributter is given to children/benefits of Nutributter		
32	Who should be getting/eating Nutributter (children 6-24 months)		
33	When and how to enroll the child		
34	Number of packets that should be consumed by the child per day		
35	Number of packets received at distribution		
36	Sharing of Nutributter		
37	Attending distribution sessions		
38	Instructions about how to feed Nutributter		
	A Wash hands before feeding		
	B Wash child's hands before feeding		
	C Wash packet		
	D Massage packet		
	E Mix with porridge		
	F Feed straight out of packet		
	G Other instruction: Specify below		
39	Other message: Specify below		

Using the table below and for each of the topics mentioned by the CGV from the list above, please describe in as much detail as possible how the CGV presented this information to the mother and the mother's receptivity to the messages (i.e. did the CGV use a flip chart or other tools or images to explain the concepts? Was the CGV able to answer mother's questions? Did the mother seem to understand?).

Topic #	**Description**	**Mother's receptivity**

Appendix H: Knowledge questionnaire for program staff, process evaluation study

Knowledge Assessment: Care Group Volunteers

Traditional Authority ☐ Health Center ☐☐ EDP ☐☐

Village name _____

Date of interview: ☐☐☐☐ 20☐☐
DD MM YY

SECTION A. CGV IDENTIFIERS

Name	Age	Sex 0= Male 1= Female	Marital status 0= Never married 1= Currently Married 2= Widowed 3=Separated 4=Divorced	Years of schooling completed 00=None 01-18= No. of years completed	Main occupation 0= Not working 1= CGV 2= Agriculture/livestock/fisheries 3= Wage employment 4= Student 5= Business/self employment 6= Salaried worker 7= Other
	☐☐	☐	☐	☐☐	☐

SECTION B. STAFF INFORMATION

1	**How many years have you lived in this community?** *Kodi mwakhala mdera lino kwa zaka zingati?*	☐☐	0-50= Number of years 99= Don't know
2	**Is this the first time you have served as a health volunteer in your community?***Kodi aka ndi koyamba inu kugwira ntchito yodzipereka(volunteer) ya za umoyo mdera lanu?*	☐	0= No 1= Yes→*Skip to question 3*
2a	**What type of information have you communicated in your previous work in the community?***Kodi ndi uthenga wa mtundu wanji umene munaperekapo mmbuyomu pa ntchito yanu ku dera kwanu?* *(List up to 5)*	☐☐☐☐☐	1= Sanitation and hygiene 2= Family planning 3= Reproductive health 4= Nutrition 5= Agriculture/farming 6= Other_____
2b	**Which organization did you report to?***Zotsatila(ma report) mumakapereka ku Bungwe lanji?* *(List all that apply)*	☐☐☐☐	1= World Relief 2= Save the Children 3= World Vision 8= Other
2c	**Were you ever financially compensated for your work?***Kodi munalipidwapo ndalama pa ntchito yanu?*	☐	0= No 1= Yes

3 **How long have you been a care group volunteer?** *Kodi mwagwira nthchito ngati opereka chisamaliro mongodzipereka (care group volunteer)kwa nthawi yayitali bwanji?*

☐☐.☐☐

00-98=Number of years
99= Don't know

4 **What training modules have you completed?***Kodi ndi magawo ati a maphunziro amene mwamaliza kuphunzira?*

1= Breastfeeding
2= Complementary feeding
3= WASH
4= Nutributter
5= Key messages module
9= Don't know

4a. **How many lessons in each of those modules have you completed?***Kodi ndi maphunziro angati a mmagawo amene mwamaliza kuphunzira?*

01-15 = Lessons completed
99= Don't know

5 **When was the date of your last training?***Kodi tsiku lomalizira limene munapanga maphunziro ndi liti?*

☐☐ / ☐☐ / ☐☐

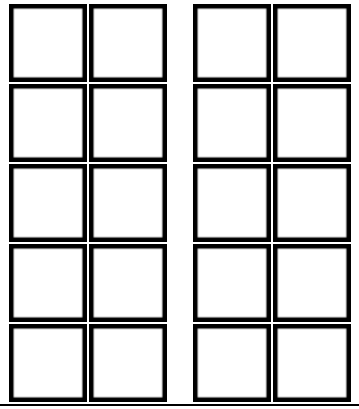
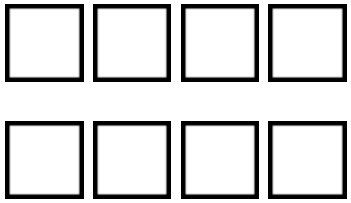
DD **MM** **YY**

SECTION C. STAFF KNOWLEDGE

Instructions: Ask the participant each question and do not read the answers aloud unless it is clearly specified. Many questions allow for more than 1 response; please mark each response mentioned by the respondent. If a respondent mentions something that is not a pre-coded option, please be sure to code it as "other", and specify

MODULE 1: BREASTFEEDING

LESSONS 3 AND 4: BENEFITS OF BREASTFEEDING FOR CHILD, MOTHER, FAMILY, WORLD

1	**What are the benefits of breastfeeding for children?***Kodi kuyamwitsa ana mkaka wa mmawere kuli ndi ubwino wanji kwa anawo? (List as many as are mentioned)*		01= Breast milk is clean and safe 02= Breast milk protect children from illness 03= Breastmilk helps child grow and develop better 04= Breastmilk contains all the food and water the child needs 05= Breatmilk is easy to digest 06= Breastmilk is aways at the right temperature 07= Breastmilk quenches the child's thirst 08= Breastmilk helps the child's skin be healthy 09= Breastfeeding helps with facial muscle development 10= Creates a bond between mother and child 88= Other_____ 99= Don't know
2	**What are the benefits of breastfeeding for the mother?***Kodi kuyamwitsa ana mkaka wa mmawere kuli ndi ubwino wanji kwa mai? (List as many as are mentioned)*		1= It helps the placenta to come out during labor 2= It prevents excess blood loss after labor 3= It helps the uterus return to normal size 4= Prevents the mother from becoming pregnant again (family planning) 5= Breastmilk is free 6= Breastfeeding promotes love and bonding between the mother and her child 7= Breastfeeding reduces the risk of ovarian, breast, and uterine cancers 8= Other _____ 9= Don't know

3	**What are the benefits of breastfeeding for the whole family?***Kodi kuyamwitsa mkaka wa mmawere kuli ndi ubwino wanji kwa banja lonse? (List up to 6)*	☐☐☐ ☐☐☐	1= Breastmilk is free, so the money saved can be used to provide other things for the family 2= Does not require cooking so less work for the mom 3= The child is sick less often 4= Less stress for the family 5= Less money spent on hospital visits 6= Breastfeeding serves as family planning for the first 6 months 8= Other _____ 9= Don't know
4	**What are the benefits of breastfeeding for the whole world?***Kodi kuyamwitsa mkaka wa mmawere kuli ndi ubwino wanji padziko lonse? (List up to 5)*	☐☐☐☐ ☐	1= Children grow strong and healthy 2= Because children are healthier, lower health expenditures for the country 3= Greater number of children who survive death and disease 4= Breastfeeding is economical – less money spent on importing milk 5= Breastfeeding does not create waste so is better for the environment 8= Other _____ 9= Don't know
LESSON 5: INITIATION OF BREASTFEEDING			
5	**How long after birth should a child start breastfeeding?***Kodi mwana akabadwa pakuyenera kutha nthawi yayitali bwanji kuti ayambe kuyamwa?*	☐	1= Within 1 hour after birth (includes immediately) 2= Some hours but less than 24 hours 3= 1 day later 4= More than 1 day later 8= Other _____ 9= Don't know
6	**Why should a mother put the child to the breast quickly after birth?***Kodi ndi chifukwa chiyani mai akuyenera kumuika mwana kubere mwachangu akangobadwa? (List up to 8)*	☐☐☐☐ ☐☐☐☐	1= So that the child gets the yellow milk 2= It promotes the love and bond between mother and child 3= It helps to make the breast milk come in 4= It protects the child from disease 5= The child feels warm because it is held 6= Helps the placenta to come out after delivery 7= Prevents excess blood loss after labor 8= Other _____ 9= Don't know

7	**What should a mother do with the "first milk" or colostrum (yellow milk)?***Kodi mayi akuyenera kuchita chiyani ndi mkaka oyambirira kapena wachikasu?*	☐	1= Feed it to the child by breastfeeding soon after birth 2= Discard it and start breastfeeding when the milk comes in 8= Use for other purpose 9= Don't know
8	**Are there benefits to the "first milk" (yellow milk)?***Kodi mkaka oyambirira(wachikasu) uli ndi ubwino ulionse?*	☐	0= No*(Skip to lesson 6)* 1= Yes
	8a What are the benefits of the first, yellow milk?*Kodi mkaka oyambirira, wachikasu uli ndi ubwino wanji?* *(List up to 4)*	☐☐☐☐	1= Protects against infection/illness 2= Provides all of the food the child needs 3= It helps to expel the child's first bowel movement 4= Prevents the child from being constipated 5= It helps the child to recover from disease quickly 8= Other _____ 9= Don't know

LESSON 6: BREASTFEEDING FREQUENCY

9	**What is the minimum number of times a mother should breastfeed her child in the day and in the night combined?***Kodi mai ayenera kuyamwitsa mwana wake kosachepera kangati patsiku kuphatikiza kukangocha ndi usiku*	☐☐	00-98= Number of times 99= Don't know
10	**What happens to the mother when the mother breastfeeds frequently?***Kodi chimachitika ndi chiyani mai akamayamwitsa mwakathithi? (kawiri kawiri)*	☐	1= She produces more milk 8= Other _____ 9= Don't know

11	**When a child is brestfeeding, is it important for him/her to empty the breast?***Kodi mwana akamayamwa ndikofunika kuti ayamwe mpaka amalize mkaka onse mmawere?*	☐	0= No *(Skip to lesson 7)* 1= Yes
11a	**Why is it important for the child to empty the breast?***Kodi ndi chifukwa chiyani kuli kofunika kuti mwana ayamwe mpaka amalize mkaka onse mmawere?* *(List up to 3 reasons)*	☐☐☐	1= To maintain milk production 2= So that the child gets the first milk and has their thirs quenched 3= So that the child gets hindmilk and gets enough fat (fatty milk) 8= Other _____ 9= Don't know

LESSON 7: EXPRESSING BREASTMILK

12	**What do you tell a breastfeeding mother to do if she needs to be away from her child for more than one hour, or the child is not taking the breast, or she is very sick herself?***Kodi mumawauza azimai oyamwitsa kuti achite chani ngati akufuna kuchokapo nkumusiya mwana kopitilira ola limodzi, kapena ngati mwana akukana kuyamwa kapena ngati mayiyo wadwala kwambiri?*	☐	1= She can express her breastmilk and have someone else feed it to the child 2= She should leave a food for the child to eat 3= She should leave a liquid for the child to drink 8= Other _____ 9= Don't know

LESSONS 8 AND 9: POSITIONING AND BREASTFEEDING PROBLEMS

13 **If women are having problems breastfeeding, for example swollen and painful breasts or nipples, what can you tell her to do?***Kodi amai atakhala ndi vuto loyamwitsa, mwachitsanzo kutupa ndi kupweteka kwa mawere kapena nsonga za mawere, mungawauze kuti achite chani?*
(List up to 6)

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1= Change the child's positioning on the breast
2= Continue breastfeeding
3= Apply milk to the breasts after breastfeeding
4= Advise or show her how to change the child's positioning
5= Put a cool cloth (soaked in water) on her breasts
6= Wash and clean breasts without soap
8= Other _____
9= Don't know

14 **What are some of the reasons a mother might not be producing enough milk?**
(List up to 4) Kodi zina mwa zifukwa zimene zingamulepheretse mayi kukhala ndi mkaka wa mmawere okwanira ndi chani?

☐☐☐☐

1= Stress
2= Fatigue
3= Lack of support and motivation from other family members
4= Child did not breastfed soon after birth
8= Other _____
9= Don't know

15 **What can you tell a mother who thinks she is not producing enough milk to do?***Kodi mungamuuze chani choti achite mai yemwe akuganiza kuti sakupanga mkaka okwanira wa mmawere?*
(List up to 4)

☐☐☐☐

1= Take a rest/take a break
2= Drink more liquids
3= Breastfeed more
4= Ask the husband to support her
8= Other _____
9= Don't know

LESSON 10: EXCLUSIVE BREASTFEEDING

16 **What is exclusive breastfeeding?***Kodi kuyamwitsa mwakathithi ndi chiyani?*

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1= Feeding only breastmilk from 0 to 6 months with no other liquids, solids, or pastes
2= Feeding breastmilk and water from 0 to 6 months
3= Feeding breastmilk and some other liquids or pastes from 0 to 6 months
8= Other _____
9= Don't know

17	**What are the benefits of exclusive breastfeeding?***Kodi ubwino oyamwitsa mwakathithi ndi chani?* *(List up to 8)*	☐☐☐☐ ☐☐☐☐	1= Strengthens the child's immune system 2= Protects the child against diseases like diarrhea 3= Contains all of the nutrients and water the child needs 4= Contains everything the child needs for proper development in the first 6 months 5= Contains everything the child needs for good health in the first 6 months 6= Easy to digest by the child 7= Satisfies the child's thirst so no need to give water 8= Other _____ 9= Don't know
18	**Should children under 6 months of age be given water when the weather is hot?***Kodi ana ochepera miyezi 6 akuyenera kupatsidwa madzi okumwa nyengo ikatentha?*	☐	0= No 1= Yes 9= Don't know
19	**What could happen if a mother gives water or other liquids or foods to the child in the first 6 months?***Kodi chingachitike ndi chiyani ngati mai amupatsa mwana madzi akumwa kapena zakumwa zina kapena zakudya mu miyezi 6 yoyambirira?* *(List up to 4)*	☐☐☐☐	1= Diarrhea or other infections/illnesses 2= Malnutrition (including child doesn't grow welll) 3= Child won't want to breastfeed 4= Child death 8= Other _____ 9= Don't know
LESSON 11: MATERNAL NUTRITION AND DIET DURING BREASTFEEDING			
20	**What kind of food should a breastfeeding mother eat?***Kodi mzimayi yemwe akuyamwitsa akuyenera kudya zakudya zanji?* *(List up to 8)*	☐☐☐☐ ☐☐☐☐	1= Foods from the 6 food groups 2= Carbohydrates 2= Foods with oil 3= Fruit 4= Vegetables 5= Beans/legumes 6= Foods that come from animals 7= Salt with iodine 8= Other _____ 9= Don't know

21	**Why do breastfeeding mothers need to eat well?***Kodi ndi chifukwa chiyani mzimayi yemwe akuyamwitsa akuyenera kudya bwino?* *(List up to 4)*	☐☐☐☐	1= To maintain strength to work 2= To recover from childbirth 3= To produce enough milk for the baby 4= To be healthy 8= Other _____ 9= Don't know
22	**Should a breastfeeding mother receive a vitamin A supplement?***Kodi mai woyamwitsa akuyenera kulandira mankhwala a Vitamin A owonjezera?*	☐	0= No *(Skip to lesson 12/13)* 1= Yes
23	**How long after birth should a breastfeeding mother receive a vitamin A supplement?** *Kodi mai amene wabereka komanso akuyamwitsa akuyenera kulandira Vitamin A pakapita nthawi yayiyali bwanji kuchokera nthawi imene wabereka?*	☐	1= Within 8 weeks after childbirth 2= More than 8 weeks after childbirth 8= Other _____ 9= Don't know
24	**Why should breastfeeding mothers receive a vitamin A supplement after giving birth?***Kodi ndi chifukwa chiyani a zimai omwe akuyamwitsa ayenera kulandira mankhwala a vitamin A akabereka?* *(List up to 3)*	☐☐☐	1= The child gets vitamin A from the mother's breastmilk 2= Vitamin A gives good health to the mother 3= Vitamin A gives good health to the child 8= Other _____ 9= Don't know

LESSONS 12 and 13: BREASTFEEDING WITH HIV

25 **Can you tell me about some of things that can increase a child's susceptibility to HIV infection if the mother is HIV Positive?** *Tandiuzeni zina zomwe zimaonjezera chiopsyezo choti mwana angatenge kachirombo ka HIV ngati mai ake ali ndi kachirombo ka HIV?*
(List up to 8)

☐☐☐☐
☐☐☐☐

1= The mother is very sick
2= The child is fed foods or liquids other than breastmilk
3= The mother has lesions or infection on her breast
4= The child has sores in his/her mouth
5= The mother has STIs
6= The chid is breastfed for too long (too old)
7= The mother has been recently infected with HIV
8= Other _____
9= Don't know

26 **Should a mother who is HIV positive exclusively breastfeed her child?** *Kodi mai yemwe ali ndi kachirombo ka HIV akuyenera kuyamwitsa mwana wake mwakathithi?*

☐

0= No
1= Yes
9= Don't know

27 **What are some of the things an HIV positive mother can do to prevent mother-to-child transmission of HIV?** *Kodi zina mwa zomwe mai yemwe ali ndi ka chirombo ka HIV angatsate pofuna kuteteza kuti iyeyo asamupatsire mwana ka chirombo ka HIV ndi chani?*
(List up to 5)

☐☐☐☐
☐

1= Take anti-retroviral therapy as directed
2= Use protection (condoms) when she has intercourse with her husband
3= Exclusively breastfeed her child from 0 to 6 months
4= Compliance with hospital regulations (including taking child to under-five clinics and giving child prescribed medicines)
8= Other _____
9= Don't know

MODULE 2: COMPLEMENTARY FEEDING

LESSON 1: CHILD MALNUTRITION IN MALAWI

28 **What are some of the reasons that children become malnourished in your community?** *Kodi zina mwa zifukwa zomwe zimapangitsa ana kunyentchera ku dera kwanu ndi chiyani? (List up to 8)*

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☐☐☐☐

1= Don't eat a variety of foods
2= Don't eat enough food
3= Don't eat frequently enough
4= Healthy foods are not available
5= Children get sick often
6= Child doesn't have a good appetite
7= Not enough food to feed the children
8= Other _____
9= Don't know

29 **What are some of the ways that mothers can prevent their children from becoming malnourished in this community?** *Kodi njira zina zimene azimai angatsate pofuna kuteteza ana awo kuti asanyentchere kudera kuno ndi chiyani? (List up to 8)*

☐☐☐☐
☐☐☐☐

1= Breastfeed more
2= Increase the amount of food in each meal
3= Feed children more frequently
4= Feed children different kinds of foods
5= Feed children foods they like
6= Encourage the child to eat
7= Seek care when the child is sick
8= Other _____
9= Don't know

LESSON 2: COMPLEMENTARY FEEDING

30 **At what age should a child start to receive liquids other than breastmilk?** *Kodi mwana akuyenera kuyamba kudya zakudya zamadzi madzi kupatula mkaka wa mmawere akafika msinkhu uti?*

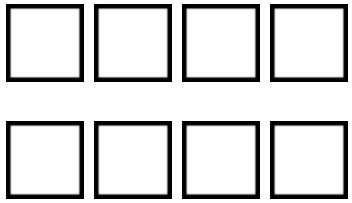
☐☐

01-98= Number of months
99= Don't know

31	**At what age should a child start to receive foods other than breastmilk, like porridge?***Kodi mwana akuyenera kuyamba kudya zakudya zina kuonjezera pa mkaka wa mmawere monga phala akafika pa msinkhu uti?*	☐☐	01-98= Number of months 99= Don't know
32	**At what age should a child start to receive animal source foods (chicken, pork, beef, duck, egg, fish)?***Kodi mwana akuyenera kuyamba kudya zakudya zochokera kuziweto monga (nkhuku, nyama ya nkhumba,nyama ya ng'ombe,abakha, madzira, nsomba) ali pamsinkhu uti?*	☐☐	01-98= Number of months 99= Don't know
33	**What might happen if a child starts eating liquid or food other than breastmilk too early?***Kodi chingachitike ndi chiyani ngati mwana atayamba kudya zakudya za madzi madzi kapena zolimba kupatula mkaka mwachangu?* *(List up to 6)*	☐☐☐ ☐☐☐	1= The child will breastfeed less 2= The child will become healthy 3= The child will become unhealthy (get sick or die) 4= The child might become malnourished 5= Mom will produce less breastmilk 8= Other _____ 9= Don't know
34	**How long should a mother continue to breastfeed?***Kodi mai akuyenera kuyamwitsa mwana kwa nthawi yayitali bwanji?*	☐☐	00-59= Age in months 60= More than 5 years 99= Don't know

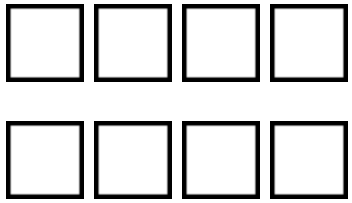
LESSON 3: FEEDING CHILDREN FROM THE 6 FOOD GROUPS

35 **What are the 6 food groups?**
Kodi magulu 6 a zakudya ndi ati?
(List up to 8)



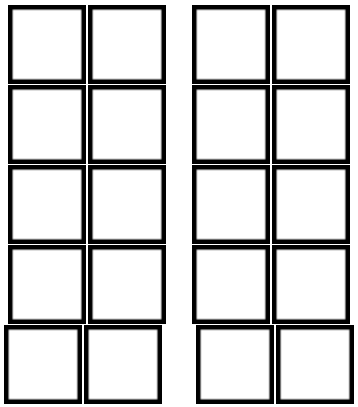
1= Carbohydrates
2= Vegetables
3= Fruits
4= Legumes
5= Animal products
6= Oils and fats (including groundnut and sunflower seeds)
7= Sweets
8= Other _____
9= Don't know

36 **Why is it important that children eat from the 6 food groups?***Kodi ndi chifukwa chiyani ndi kofunika kuti mwana azidya zakudya za m'magulu 6?*
(List up to 8)



1= Helps them grow tall
2= Helps them grow well
3= Protects against disease
4= Makes them look healthy/be healthy/have strength
5= Makes them happier
6= Makes them more intelligent
7= Improves nutrition
8= Other _____
9= Don't know

37 **What foods does a young child (6 to 24 months) need to grow well?***Kodi mwana wamng'ono (wa miyezi 6 mpaka 24) akuyenera kudya zakudya zanji kuti akule bwino?*
(List up to 12)



01= Porridge, nsima, bread, rice, other grains
02= Animal foods (meat, chicken, organ meat)
03= Fish
04= Egg
05= Fruits (including citrus)
06= Dark green leafy vegetables
07= Other vegetables
08= Orange fruits and vegetables
09= Beans and soya
10= Oils and fats
11= Groundnuts and seeds
88= Other _____
99= Don't know

		☐☐ ☐☐	
LESSON 4: FEEDING A 6 MONTH OLD CHILD			
38	**How many times per day should a 6 month old child who is still breastfeeding eat?***Kodi mwana wa miyezi 6 yemwe akuyamwabe akuyenera kudya kangati patsiku?*	☐	1-7= Number of times 8= 8 or more times 9= Don't know
39	**What is the consistency of the porridge for a 6 month old child?***Kodi phala la mwana wa miyezi 6 likuyenera kukhaka lolimba bwanji?*	☐	1= Thin/watery 2= Thick, like a paste 8= Other _____ 9= Don't know
LESSON 5: FEEDING A 7 to 8 MONTH OLD CHILD			
40	**How many times per day should a 7 to 8 month old child be given porridge?***Kodi mwana wa miyezi 7 mpaka 8 akuyenera kudya phala kangati patsiku?*	☐	0-7 = Number of times 8= 8 or more times 9= Don't know
41	**What is the consistency of the porridge for a 7 to 8 month old child?***Kodi phala la mwana wa miyezi 7 mpaka 8 likuyenera kukhala lolimba bwanji?*	☐	1= Thin/watery 2= Thick, like a paste 8= Other _____ 9= Don't know
LESSON 6: FEEDING A 9 TO 11 MONTH OLD CHILD			
42	**How many times per day should a 9 to 11 month old child who is still breastfeeding eat, including snacks like fruit or bread?***Kodi mwana wa miyezi 9 mpaka 11 yemwe akuyamwabe*	☐	1-7= Number of times 8= 8 or more times 9= Don't know

	akuyenera kudya kangati patsiku kuphatikizapo zakudya zotolatola monga zipatso kapena bread?		
LESSON 7: FEEDING A 12 TO 24 MONTH OLD CHILD			
43	**How many times per day should a 12 to 24 month old child who is still breastfeeding eat, including snacks like fruit or bread?***Kodi mwana wa miyezi 12 mpaka 24 yemwe akuyamwabe akuyenera kudya kangati patsiku kuphatikizirapo zakudya zongotolatola monga zipatso kapena bread?*	☐	1-7= Number of times 8= 8 or more times 9= Don't know
44	**At what age can a child start eating food that the whole family is eating, but that is still soft and easy to swallow?***Kodi mwana akuyenera kuyamba kudya zakudya zomwe Khomo limadya koma zili zofewa ndi zosavuta kumeza ali msinkhu uti?*	☐	1= 0-5 months 2= 6-7 months 3= 8-9 months 4= 10-11 months 5= 12 months or more 9= Don't know
LESSON 8: METHODS TO ENCOURAGE CHILD FEEDING			
45	**What should a mother do while she is feeding the child to encourage him/her to eat?***Kodi mai akuyenera kuchita chiyani nthawi imene akumudyetsa mwana kuti amulimbikitse kuti adye? (List up to 6)*	☐☐☐ ☐☐☐	1= Play, talk, or sing with the child 2= Give love and attention to the child 3= Feed the child more when he/she eats well 4= Avoid disturbing the child while he/she eats 5= Let the child feed him/herself 8= Other _____ 9= Don't know
46	**What are some of the reasons a child might refuse to eat?***Kodi zina mwa zifukwa zimene mwana angakanire kudya ndi ziti?*	☐☐☐☐☐	1= Sickness 2= Lack of appetite 3= Exhaustion/being tired 4= Tired of eating the same food 8= Other _____

	(List up to 4)		9= Don't know
47	**What should a mother do if a child refuses to eat?***Kodi mai akuyenera kuchita chiyani mwana akamakana kudya?* *(List up to 5)*	☐☐☐☐☐	1= Try a different food 2= Offer food various times throughout the day 3= Keep food nearby and ready to eat and offer frequently 4= Eat with the child 5= Model healthy eating behaviors 8= Other _____ 9= Don't know
48	**Should a mother force a child who refuses to eat?***Kodi mai akuyenera kukakamiza mwana yemwe akukana kudya kuti adye?*	☐	0= No 1= Yes 9= Don't know
LESSON 10: FEEDING A CHILD DURING ILLNESS			
49	**Should a mother breastfeed her child more, less, or the same if her child has diarrhea?***Kodi mai akuyenera kuyamwitsa mwana wake mochuluka, mochepa kapena chimodzimodzi nthawi zonse ngati mwanayo akutsegula mmimba?*	☐	1= Less than usual 2= Same as usual 3= More than usual 9= Don't know
50	**What are some foods or liquids that can be given to a sick child?***Kodi zina mwa zakudya kapena zakumwa zomwe zingaperekedwe kwa mwana yemwe akudwala ndi chani?* *(List up to 8)*	☐☐☐☐ ☐☐☐☐	1= Breastmilk 2= Nutritious drinks made from fruits (fruit juices) 3= Foods the child loves 4= Fruits/vegetables high in vitamin A (mango, papaya, carrots) 5= Fruits high in vitamin C (oranges, bwemba, matowo, baobab) 6= ORS 7= Foods with oil 8= Other _____ 9= Don't know

51 **Should a mother feed her child who is recovering from illness more, less, or the same?***Kodi mai akuyenera kudyetsa mwana wake yemwe akuchira ku matenda chakudya chochuluka, chochepa kapena chimodzimodzi nthawi zonse?*

☐

1= Less than usual
2= Same as usual
3= More than usual
9= Don't know

52 **Should children with HIV (or other chronic illnesses) eat more, less, or the same as children who do not have HIV?***Kodi ana omwe ali ndi kachirombo ka HIV(kapena oti adwalika) akuyenera kudya kwambiri, mochepa kapena chimodzimodzi ndi ana omwe alibe kachirombo ka HIV?*

☐

1= Less
2= Same
3= More
9= Don't know

LESSON 11: IMPROVING CHILD FOODS

53 **What are some foods that can be added to porridge to make it more nutritious for children?***Kodi zina mwa zakudya zomwe zingaonjezeredwe kuphala kuti likhale lopatsa thanzi kwa mwana ndi chani?*
(List up to 10)

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☐☐☐☐
☐☐☐☐
☐☐☐☐

01= Nuts or nut butters
02= Beans or legumes
03= Eggs
04= Milk
05= Fish or other animal products
06= Cooking oil
07= Vegetables
08= Fruits
09= Dairy (other than milk)
10= Nutributter
88= Other _____
99= Don't know

	☐☐☐☐	
LESSON 12: GROWTH MONITORING		
54 **How often should mothers take their children to get weighed from birth to five years?***Kodi azimai akuyenera kutengera ana awo kusikelo mowirikiza bwanji kuchokera akangobadwa mpakana akafika zaka 5?*	☐	1= Weekly 2= Monthly 3= Every 2 months 4= Every 3 months 5= Every 6 months 6= Every year 8= Other _____ 9= Don't know
55 **Why is it important for mothers to take their children to get weighed regularly?***Kodi ndi chifukwa chani zili zofunika kuti azimai azikakwezetsa ana awo Sikelo pafupipafupi? (List up to 8)*	☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐	01= To see how their child is growing 02= To detect malnutrition 03= To vaccinate children 04= To receive education about health and nutrition 05= To receive vitamin A 06= To receive deworming 07= To connect to organizations or other programs that can help the mother 08= To monitor the health of the mom 88= Other _____ 99= Don't know
LESSON 13: CHILD GROWTH CHARTS		
56 **When reading a child growth chart, what would be concerning to see?***Kodi mukamaona khadi lakusikelo lammene mwana akukulira chimene chingakukhuzeni ndi chani?*	☐	1= A drop in the line of child growth 2= An increase in the line of child growth 8= Other _____ 9= Don't know
LESSON 15: VITAMIN A		
57 **How often should mothers take their children aged 6-59 months to receive vitamin A supplements?***Kodi azimai akuyenera*	☐	1= Every 6 months 2= Every year 8= Other _____ 9= Don't know

kukawalandilitsa ana awo a miyezi 6 mpaka 59
Vitamin A owonjezera mowirikiza bwanji?

58 **What happens if a child does not have enough vitamin A?***Kodi mwana akakhala kuti alibe Vitamin A okwanira chimachitika ndi chani?*
(List up to 2)

☐☐

1= Get sick more often
2= Increased risk of death
8= Other _____
9= Don't know

59 **What foods contain vitamin A?***Kodi ndi zakudya ziti zimene ziri ndi Vitamin A?*
(List up to 6)

☐☐☐☐☐☐

1= Eggs
2= Liver
3= Orange and yellow vegetables (carrot, sweet potato)
4= Orange and yellow fruits (Mango, papaya)
5= Green leafy vegetables
6= Palm oil
8= Other _____
9= Don't know

LESSON 16: IODINE

60 **What are the problems associated with mothers and children not consuming enough iodine?***Kodi ndi mavuto ati amene amai ndi ana omwe sadya Iodine okwanira amakumana nawo?*
(List up to 3)

☐☐☐

1= Inadequate brain development in children
2= Miscarriage in pregnant women
3= Poor thryoid health
8= Other _____
9= Don't know

61 **What is the best source of iodine in food?** *Kodi chakudya chomwe chiri ndi Iodine wambiri ndi chani?*

☐

1= Iodized salt
8= Other _____
9= Don't know

LESSON 17: DEWORMING

62	**How often should mothers take their children aged 6-59 months to receive deworming medicine?** *Kodi azimai omwe ali ndi ana a miyezi yoyambira 6 mpaka 59 akuyenera kutengera ana awo kokalandira mankwala a njoka za mmimba mowirikiza bwanji?*	☐	1= Every 6 months 2= Every year 8= Other _____ 9= Don't know

MODULE 3: WASH

63	**What are the times that a mother should wash her hands?***Kodi ndi nthawi ziti zimene mayi akuyenera kusamba mmanja?* *(List up to 6)*	☐☐☐☐☐☐	1= After using the toilet 2= After cleaning the child's nappy 3= Before cooking 4= Before eating 5= Before feeding the child 6= After feeding the child 8= Other _____ 9= Don't know
64	**When should a mother wash the child's hands?** *Kodi mai akuyenera kusambitsa mwana mmanja nthawi yanji?*	☐	1= Before the child eats 8= Other _____ 9= Don't know
65	**How should a mother wash her and her child's hands?***Kodi mai ndi mwana akuyenera kusambira chani mmanja?*	☐	1= With water 2= With water and soap 3= With water and ash 8= Other _____ 9= Don't know
66	**Why should a mother wash her and her child's hands in this way?**,*Kodi mai ndi mwana*	☐	1= To be clean 2= To prevent diseases 8= Other _____

	akuyenera kutsata njira imeneyi chifukwa chani? (List up to 2)		9= Don't know
67	**Where should adults defecate?***Kodi akulu akulu akuyenera kunyera kuti? (List up to 3)*	☐	1= In the latrine 2= In the river 3= In the field 8= Other _____ 9= Don't know
	MODULE 4: NUTRIBUTTER		
68	**Why is Nutributter being given to children in Ntchisi?** *Kodi ndi chifukwa chani Nutributter(chiponde) akuperekedwa kwa ana aku Ntchisi? (List up to 4)*	☐☐☐☐	1= Children in Ntchisi are malnourished 2= To improve their health 3= To improve their nutrition 4= To improve their development 8= Other _____ 9= Don't know
69	**Who should be eating Nutributter?***Kodi amene akuyenera kudya Nutributter ndi ndani?*	☐	1= Children 6 to 24 months 2= Children 0-6 months 3= Children older than 2 years 4= Adults 5= Everyone
70	**How many packets do children receive every month during distributions?***Kodi ndi mapaketi angati amene mwana amalandira mwezi ulionse pa nthawi yogawa?*	☐☐	00-98= Number of packets 99= Don't know
71	**At what age should mothers register their children to begin receiving Nutributter?***Kodi azimayi akuyenera kukalembetsa ana awo kuti ayambe kulandira Nutributter akafika pamsinkhu*	☐☐	00-98= Age in months 99= Don't know

uti?

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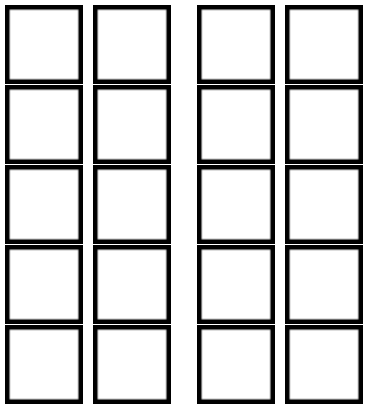
72 **What are the benefits of Nutributter for children?** *Kodi Nutributter ali ndi ubwino wanji kwa ana?*
(List up to 10)



01= Improves child nutrition
02= Contains all 6 food groups
03= Improves child health
04= Improves child development/children are more intelligent
05= Children are happier
06= Children's bodies become smooth
07= Reduces mom's work load because less cooking/preparation required
08= Easy to feed
09= Saves money because it is free
10= Environmentally friendly
88= Other _____
99= Don't know

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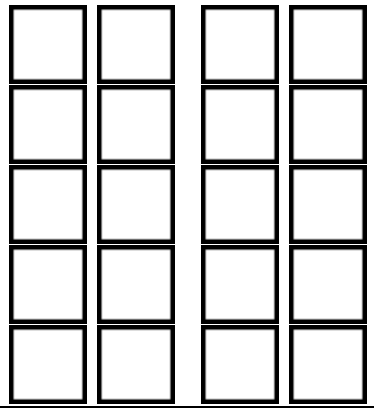
73 **What are the instructions you give to mothers about how to use the Nutributter?***Kodi ndi malangizo otani amene mumapereka kwa azimai a mmene angagwiritsire ntchito Nutributter?*
(List up to 10)



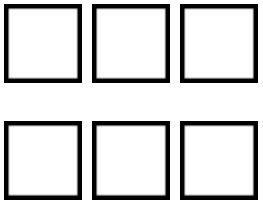
01= For the 6-24 month old child only
02= One packet per day
03= No sharing
04= Mix with porridge
05= Clean packet before feeding
06= Massage packet before feeding
07= Breastfeed child before feeding
08= Wash hands before feeding the child
09= Feed half in the morning, half in the afternoon
88= Other _____
99= Don't know

74	**How many packets of Nutributter should a child eat each day?***Kodi mwana akuyenera kudya mapaketi a Nutributter angati patsiku?*	☐	0-6= Number of packets 7= 7 or more packets 8= Other _____ 9= Don't know
75	**Is it okay for mothers to allow other friends or family members eat the Nutributter?***Kodi ndi zovomerezeka kuti azimai azilola anzawo ena kapena anthu ena apakhomo kudya Nutributter?*	☐	0= No 1= Yes 9= Don't know
76	**What are the instructions you give to mothers to dispose of the Nutributter packets?** *Kodi mumawapatsa azimai malangizo otani a mmene angatayire paketi lotsala la Nutributter? (List up to 5)*	☐☐☐☐☐	1= Take used packets to the hospital 2= Put packets in a disposal bin 3= Put packets in a dug pit 4= Burn the Nutributter packets 8= Other _____ 9= Don't know

SECTION D. WORKLOAD

77	**How many days in a month does it take you to perform your responsibilities as a CLAN?***Kodi pa mwezi mumatenga masiku angati kuti mugwire ntchito zanu monga ogwira ntchito modzipereka? (CLAN)*	☐☐	01-31= Number of days 32= More than 1 month 88= Other _____ 99= Don't know
78	**Do you ever visit households yourself?**	☐	0= No *(skip to question 80)* 1= Yes
79	**On average, how much time do you spend at each household that you visit?***Mongoyerekeza mumakhala nthawi yayitali bwanji pa Khomo lirilonse limene mwaliyendera?*	☐	1= Less than 15 minutes 2= Between 15 to 30 minutes 3= Between 31 minutes to an hour 4= Between 1 and 2 hours 5= More than 2 hours 9= Don't know
80	**Have you conducted training in the last 6 months?***Kodi pa miyezi 6 yapitayi mwa perekapo uphungu wa payekha payekha?*	☐	0= No 1= Yes *(skip to question 82)*
81	**Why haven't you conducted training in the last 6 months?***Ndi chifukwa chani simunapereke uphungu wapayekha payekha mu miyezi 6 yapitayi?* *(List up to 6 reasons)*	☐☐☐ ☐☐☐	1= Have not received training 2= Don't have any new topics to discuss 3= Too busy with other things 4= Don't like my job 5= Lack of motivation 6= Lack of incentive 8= Other _____ 9= Don't know
82	**What topics did you cover during training in the last 3**		1= Breastfeeding 2= Complementary feeding

months?*Kodi munakambirana mitu iti pamene mumapereka uphungu wa payekha payekha pa miyezi itatu yapitayi? (List all that are mentioned)*



3= WASH
4= Nutributter use
5= Child illness
8= Other _____

Curriculum Vitae

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Program in Human Nutrition
Department of International Health
The Johns Hopkins University
Bloomberg School of Public Health
Baltimore, MD

EDUCATION

2013-2017 **PhD**, Program in Human Nutrition, Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD.
Thesis: Growing the evidence for nutrition programming: Perceptions, implementation, and uptake of a package of lipid-based supplementation and behavior change communication interventions in Malawi

2009 **MPH in Global Health**, George Washington University School of Public Health and Health Services, Washington DC.
Thesis: Evaluating vitamin A adequacy of complementary foods given to Mozambican children 6-24 months

2005 **BS in Health Sciences**, Minor in Nutrition, James Madison University, Harrisonburg, VA.
Semester abroad at Bond University, Gold Coast, Australia (2004).
Alternative Spring Break (2003) in La Florida, El Salvador, volunteering alongside community members on agricultural operations and facilitating communication between community members and volunteers.

PROFESSIONAL EXPERIENCE

2013- **Research Assistant**, Program in Human Nutrition, Department of International Health, The Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD.
Responsibilities: Support with IRB submission and processes, development of questionnaire forms, training of data collection staff, quality assurance and data collection support, data analysis, and report preparation for the impact evaluation of a WFP-implemented Children's Investment Fund Foundation (CIFF)-funded stunting prevention program in the district of Ntchisi, Malawi. Support to all aspects involved with the implementation of this evaluation is ongoing and responsibilities vary based on evaluation phase.

2016- **Consultant (short-term),** World Bank Health, Nutrition and Population division of the Human Development Network, Washington, D.C.
Responsibilities: Drafted and finalized an Investment Case for the Government of Senegal, in collaboration with Senegalese authorities and World Bank staff, based on a series of analytic reports that review the rationale, political economy, climate, and budgetary needs for implementing a multisectoral strategy for nutrition in Senegal.

2016 **Consultant (short-term)**, World Bank Education division of the Human Development Network, Washington, D.C.
Responsibilities: Developed and conducted a nutrition training for the Project Implementation Unit of the Education for All Project in Haiti. The training focused on learning how to evaluate the quality, validity, and compliance with nutritional requirements of menus submitted within school feeding segments of proposals.

2015-2016 **Research Assistant**, Department of International Health, The Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD and the United Nations World Food Programme (WFP)
Responsibilities: Review of the literature on delivery platforms used to reach adolescent girls with health and nutrition services in four low and middle-income countries (Burkina Faso, Indonesia, Kenya, Tanzania). A report of findings was prepared and appended to a comprehensive report of the "Condition of the Adolescent Girl in Six Countries" (additional countries include Afghanistan, Pakistan, and Zambia), which sought to better understand the situation of adolescents, their environments, and ways to target them.

2014-2015 **Research Assistant**, Sight and Life, Basel, Switzerland.
Responsibilities: Analysis of a World Health Organization dataset on micronutrient deficiencies over time and first authorship of a manuscript on the state of global hidden hunger.

2014-2015 **Teaching Assistant**, Department of International Health, The Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD.
Responsibilities: Assistance in the management, preparation of course materials, and grading for the following masters and doctoral level courses:

Introduction to International Health (4th term, 2014)
Principles of Human Nutrition (1st term, 2014 and 2016)
Issues in the Reduction of Maternal and Neonatal Mortality (2nd term, 2014)
Nutrition and Life Stages (3rd term, 2015)

2014 **Research Assistant**, Department of International Health, The Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD and the United Nations Children's Fund (UNICEF) Headquarters, New York, NY.
Responsibilities: Review of large-scale nationally representative cross-sectional surveys, namely of Demographic and Health Surveys (DHS), and Multiple-Indicator Cluster Surveys (MICS) to assess variations in methodology over time and survey rounds, as it relates to the way in which low birth weight (LBW) is captured and reported, and whether these differences might skew global estimates of LBW. A manuscript was prepared and is under review for submission to the MICS Methodological Papers Series.

2009-2013 **Consultant (short- and extended-term)**, World Bank Health, Nutrition, and Population, Washington, D.C.
Responsibilities: Technical support and assistance to the Health, Nutrition, and Population group and client governments in the areas of maternal and child nutrition and health; nutrition and agriculture linkages, including management and implementation of the SecureNutrition Knowledge Platform (2011-2013); and social protection programming. Client governments and country experience includes: Argentina, Benin, Democratic Republic of the Congo, Ecuador, Haiti, Panama, Peru, and Togo.

2011 **Consultant (short-term)**, the Inter-American Development Bank Health division, Washington, D.C., and Panama City, Panama.
Responsibilities: Technical support and guidance in the development of nutrition components in two health projects in Panama: the Meso American Health Initiative and the Health Systems Strengthening and Equity Improvement Project.

2009 **Supervisor and Data Quality Editor**, HarvestPlus, the International Food Policy Research Institute, Zambézia Province, Mozambique.
Responsibilities: Field supervision and data quality editing for the 2009 nutrition and dietary intake impact survey of the HarvestPlus Reaching End Users Orange-Fleshed Sweet Potato Project in the province of Zambézia, Mozambique. Position was based in Zambézia Province, Mozambique, for the duration of data collection (5 months).

2008-2009 **Center Manager**, the Supplemental Nutrition Program for Women, Infants, and Children, Community Clinic, Inc., Takoma Park, MD.
Responsibilities: Supervision and management of the Community Clinic, Inc's Langley/Takoma Park WIC Clinic and staff management (of 7-10 employees) to provide high quality, cost-efficient, and culturally sensitive WIC services that comply with all Federal, State, and Local agency procedures. This position also included ensuring timely compliance with

agency requirements for completing state reports, maintaining check security, and adequate inventory of supplies and materials.

2006-2008 **Nutrition Counselor**, the Supplemental Nutrition Program for Women, Infants, and Children, Community Clinic, Inc., Takoma Park, MD. Responsibilities: Delivery of WIC services at a CCI clinic site, including completion of all certification procedures such as participant enrollment, anthropometric and hemoglobin measurements, individual nutrition counseling, and group-based nutrition education in English, Spanish, and French.

HONORS AND AWARDS

2017 George G. Graham Professorship Endowment, Program in Human Nutrition, Department of International Health, Johns Hopkins University Bloomberg School of Public Health

2016 Fellowship in Nutrition tuition scholarship for 2016-2017 academic years, funded by the Children's Investment Fund Foundation through the Program in Human Nutrition's Impact Evaluation of the Malawi Nutrition Program

2016 Elsa Orent Keiles Fellowship in Nutrition Award, Program in Human Nutrition, Department of International Health, Johns Hopkins Bloomberg School of Public Health

2016 Harry D. Kruse Publication Award, for the "Global Update and Trends in Hidden Hunger, 1995-2011." publication, Program in Human Nutrition, Department of International Health, Johns Hopkins Bloomberg School of Public Health

2015 Harry D. Kruse Fellowship in Nutrition Award, Program in Human Nutrition, Department of International Health, Johns Hopkins Bloomberg School of Public Health

2014 George G. Graham Professorship Endowment, Program in Human Nutrition, Department of International Health, Johns Hopkins University Bloomberg School of Public Health

2013 Department of International Health full tuition scholarship for 2013-2014 academic year, Johns Hopkins University Bloomberg School of Public Health, Program in Human Nutrition.

2013 Bacon Field Chow Memorial Fellowship, Department of International Health, Johns Hopkins University Bloomberg School of Public Health.

2009 Global Health Service Fellows Program, George Washington University School of Public Health and Health Services.

2009 Capitol Connection Fund Fieldwork Award, George Washington University School of Public Health and Health Services.

PUBLICATIONS

Peer Reviewed Publications

Ruel-Bergeron J, Stevens G, Sugimoto J, et al. Global Update and Trends in Hidden Hunger, 1995-2011. PLoS One 2015;10(12):1–13.

Technical Research Reports

De Pee S, Chang K, **Ruel-Bergeron J**. Improving Nutrition Among Adolescent Girls. Sight Life Mag 2016;30(2):99–105.

Ruel-Bergeron JC, Elder L, Herforth A. Maximizing the nutrition impacts of health sector actions. In: Improving nutrition through multisectoral approaches. Washington, D.C.: The World Bank, 2013:Module E. Available from: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/02/05/000356161_20130205130807/Rendered/PDF/751020WP0Impro00Box374299B00PUBLIC0.pdf

Bassett LK, **Ruel-Bergeron JC.** Promoting healthy child growth and development: advances and opportunities for community-based programs in Central America. Washington, D.C.: The World Bank, 2012. (Conference proceedings). Available from: http://siteresources.worldbank.org/INTLACREGTOPNUT/Resources/EnglishfinalReport.pdf

Bassett LK, **Ruel-Bergeron JC.** Promoting nutrition security in Haiti: an assessment of pre- and post-earthquake conditions and recommendations for the way forward. Washington, D.C.: The World Bank, 2010. Available from: http://siteresources.worldbank.org/NUTRITION/Resources/HaitiNutritionAssessmentEnglishFINAL.pdf

Book Chapters

Lavadenz F, **Ruel-Bergeron JC**, Leyton A. Hacia un Perú más saludable: Desafíos y oportunidades del sistema de salud. In: Goldmark SG, Jaramillo FC, Silva-Jauregui C, eds. Perú en el lumbral de una nueva era: Lecciones y desafíos para consolidar el crecimiento económico y un desarrollo más incluyente. Política Volumen II ed. Lima, Perú: World Bank, 2012:434.

SCIENTIFIC POSTERS AND PRESENTATIONS

Ruel-Bergeron JC, de Pee S, Black RE, Christian P. A Review of Delivery Platforms for Reaching Adolescent Girls with Micronutrient Interventions in 4 Low and Middle-Income Countries. Presented at the Micronutrient Forum global conference, Cancun, Mexico, October 2016.

Ruel-Bergeron JC. Adolescents in Low and Middle Income Contexts. Presented at the annual spring CORE Group meeting, Alexandria, VA, April 2015.

Ruel-Bergeron JC, Christian P, Hurley K, Bou Monclus AM, Phuka J, Shu Fune Wu L, Klemm RDW, West KP. Water, Sanitation and Hygiene (WASH) and Breastfeeding Contribute to Child Stunting in Rural Malawi. Poster presentation at the Experimental Biology conference, Boston, MA, March 2015.

Ruel-Bergeron JC, Stevens GA, Sugimoto JD, Roos FF, Ezzati M, Black RE, Kraemer K. Global Update and Trends in Hidden Hunger, 1995-2011. Poster presentation at the Experimental Biology conference, Boston, MA, March 2015.

Ruel-Bergeron, JC. Stone Soup: Working Multisectorally to Improve Nutrition. Presented at the 2013 World Bank Human Development Network Learning Week in Washington, DC. January 2013.

Ruel-Bergeron, JC. Programas de Promoción de Crecimiento con Base Comunitaria. Presented at the Technical Workshop for Child Development sponsored by the World Bank *Creciendo Nuestras Guaguas* Project in Chimborazo, Ecuador. March 2012.

Ruel-Bergeron, JC. La Nutrition: Résumé et Expériences Mondiales. Presented to Hasna Barkat Daoud, Minister of the Promotion of Women & Family Welfare & Social Affairs of Djibouti, in Washington, DC. April 2012.

EDITORIAL ACTIVITIES

Technical Reviewer

Save the Children. Food for Thought: Tackling child malnutrition to unlock potential and boost prosperity. London: Save the Children Fund, 2013. Available from: http://www.savethechildren.org.uk/sites/default/files/docs/Food_for_Thought_UK.pdf

Peer Reviewer

PLoSOne

PROFESSIONAL ACTIVITIES

Memberships

2017- Society for Implementation Science in Nutrition (SISN)
2014- American Society for Nutrition (ASN)

LANGUAGES

French – fluency, both written and oral
Spanish – fluency, both written and oral
Portuguese – good reading ability, intermediate speaking ability, limited written ability

ADDITIONAL INFORMATION

My research and programmatic interests are in the area of program delivery for improved maternal and child nutrition, and research related to the implementation of programs so that they achieve their goals. More specifically,

1. Program efficacy and the use of program impact pathways to asses aspects of program delivery and impact
2. Nutrition during pre-pregnancy and pregnancy
3. Infant and young child nutrition
4. Adolescent nutrition and delivery platforms for reaching adolescents in low and middle-income countries