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Feasibility and Acceptability Study of Preparing Corn Soy Blend with Fortified Vegetable Oil in Malawi

A Report from the Food Aid Quality Review

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Abbreviations and Acronyms

SBCC	Social and Behavior Change Communication
BMC	Beneficiary Mother/Caretaker
CHW	Community Health Worker
CRS	Catholic Relief Services
CSB	Corn Soy Blend
CSB+	Corn Soy Blend Plus
CSB13	Corn Soy Blend 13
CSB14	Corn Soy Blend 14
CSR	Center for Social Research (University of Malawi)
DHS	Demographic and Health Survey
FAQR	Food Aid Quality Review
FBF	Fortified Blended Food
FDP	Food Distribution Point
FFP	Food For Peace
FGD	Focus Group Discussion
FVO	Fortified Vegetable Oil
HHFIAS	Household Food Insecurity Access Scale
HSA	Health Surveillance Agent
MAM	Moderate Acute Malnutrition
MCHN	Maternal and Child Health and Nutrition
MoH	Ministry of Health
MUAC	Mid-Upper Arm Circumference
NHSRC	National Health Sciences Research Committee
PCI	Project Concern International
PI	Principal Investigator
PIHDC	Pakachere Institute of Health and Development Communication
PVO	Private Voluntary Organization
RUSF	Ready-to-Use Supplementary Food
SFP	Supplementary Feeding Program
SAVE	Save the Children
ToT	Training of Trainers
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WALA	Wellness Agriculture for Life Advancement
WHZ	Weight for Height Z-score

Executive Summary

Efforts to prevent and treat MAM typically rely on nutrient-dense supplementary foods, which commonly include several variations of fortified blended foods (FBFs), combinations of FBFs with other commodities, and ready-to-use supplementary foods (RUSFs). Corn Soy Blend (CSB) with fortified vegetable oil is one such combination used in Title II USAID programs to treat MAM.

The Food Aid Quality Review (FAQR) is a project of Tufts University with collaboration and funding from USAID, Food for Peace (FFP), assessing the nutritional quality of food aid products used in the prevention and treatment of moderate acute malnutrition (MAM) in children. Phase I of the FAQR recommended that CSB porridge for treatment of MAM be prepared and consumed with FVO (fortified with Vitamin A and D) in the ratio of 30 g FVO to 100 g CSB (abbreviated 30:100). Phase I also recommended providing CSB in repackaged, individual, packets with printed behavior-change messaging giving instructions on proper preparation of the porridge. These recommendation were made with the aim of increasing the caloric density of CSB porridge, improving the absorption of fat-soluble vitamins through the additional FVO:CSB ratio, and improving the preparation and use CSB porridge through SBCC. The smaller CSB packets also have the potential to streamline the distribution process and create more hygienic CSB storage. However, the programmatic feasibility of this recommendation and the extent to which caregivers' cooking practices could be altered was unknown.

From July 2013 to July 2014, Tufts University conducted a repeat cross-sectional study in Southern Malawi. This study assessed whether, and the extent to which, an increased ration of FVO, delivered with Social and Behavior Change Communication (SBCC), could influence compliance with the recommended target ratio (30:100) in CSB porridge prepared by beneficiary mothers/caretakers (BMCs). The target group in this study were BMCs and the study was conducted under a MAM treatment program in Southern Malawi. Children (children 6-59 months of age) identified as having MAM (using mid-upper-arm circumference measurements and thresholds) in their home villages were enrolled in the Supplementary Feeding Program (SFP), through which they received four monthly food rations that could be retrieved at predetermined Food Distribution Points (FDPs) on announced delivery days. BMCs with children enrolled in the SFP in 16 purposively selected FDPs across four districts: Mulanje, Chiradzulu, Machinga and Balaka served as the sampling frame for the study. BMCs were randomly selected from rosters for participation from within the FDPs.

This study had three main objectives: (1) assess feasibility of the interventions to increase the FVO:CSB ratio in porridge prepared by BMCs, and assess the effectiveness of interventions to achieve that goal; (2) determine the cost and cost-effectiveness of the interventions; and (3) assess potential determinants of effectiveness and cost-effectiveness of the interventions.

There were three rounds of data collection: (1) Baseline; (2) Intervention 1 and Control; and (3) Intervention1, Intervention 2 and Control. The control group received the standard, monthly Malawian SFP ration (one L of FVO and eight kg of CSB distributed in bulk from 25-kg sacks). Intervention Group 1 received a monthly ration of 2.6 L of FVO and eight kg of CSB in bulk, along with intensified SBCC emphasizing the importance of preparing CSB porridge at the recommended FVO:CSB ratio. Intervention Group 2 received the same intervention as Intervention Group 1 (2.6 L FVO/month, eight kg CSB/month with intensified SBCC), and received the CSB repackaged into two kg packets with

printed behavior-change messaging giving instructions on proper preparation of the porridge. Formative research was conducted prior to implementation of the interventions, in order to develop the SBCC messages used in the interventions. This report contains the results of the analysis on the comparison of the two intervention groups with the control group, based on data collected in the third round.

The primary study outcome of this study was mean FVO:CSB ratio (i.e. grams of FVO per 100 g of CSB) in prepared porridge. Additionally, to assess compliance with the target ratio, a second primary outcome was percentage of BMCs reaching or exceeding a FVO:CSB ratio of 30:100, as determined by lab analysis of porridge samples taken from beneficiary households.

A total of 584 BMCs participated in this analysis: n=192 in Intervention Group 1; n=196 in Intervention Group 2; n=196 in the Control Group. Objective I results showed that the mean FVO:CSB ratio was significantly higher in the two intervention groups than in the control: 28:100 in Intervention Group 1; 25:100 in Intervention Group 2; 12:100 in the Control Group ($p<0.001$). Additionally, the proportion of BMCs meeting or exceeding the target FVO:CSB ratio of 30:100 was significantly higher in the two intervention groups compared to the control group ($p<0.001$): 37 percent in Intervention Group 1, 30 percent in Intervention Group 2 and 5 percent in the Control Group. There was no statistically-significant difference in FVO:CSB ratios across the two intervention groups. Reported sharing (defined as anyone other than the beneficiary child consuming CSB porridge) was higher in the Control Group than the Intervention Groups. Observed sharing behavior was similar to that of reported.

Individual components included in the cost assessment (Objective II) were: commodity purchases; international shipping and national and local transportation; warehousing; labor costs; BMC travel time to/from FDPs; intervention-related costs (e.g. repackaging materials and labor) and pre-implementation investments (e.g. SBCC formative research and design of CSB repackaging). The average estimated cost per beneficiary, i.e. cost per four one-month rations distributed as programmed, was $143 US dollars in Intervention Group 1, $158 US dollars in Intervention Group 2 and $83 US dollars in the Control Group. Using the percentages of BMCs meeting or exceeding the target FVO:CSB ratio of 30:100 from Objective 1, the marginal cost of one additional BMC meeting or exceeding the target ratio in Intervention Group 1 was $188 US dollars, and in Intervention Group 2, was $300 US dollars. Overall, these findings indicate that Intervention Group 1 was the most cost-effective of the two interventions seeking to increase the FVO:CSB ratio in prepared porridge.

In order to assess the effectiveness of the SBCC component of the interventions, a composite score was developed based on BMCs' recollection of being told the following: porridge ingredients and amounts; frequency with which to feed the children; individuals who should consume the porridge; length of time to boil the porridge; storage of the CSB; and storage of the FVO. The composite SBCC score ranged from zero to six, with a score of six indicating high exposure to SBCC messaging. Mean SBCC score was 5.65, 5.67 and 5.20 in Intervention Group 1, Intervention Group 2 and the Control Group, respectively ($p<0.001$, ANOVA test). There was no statistically significant difference between the two intervention groups.

This study concludes that BMCs provided with an additional FVO ration and SBCC will, on average, prepare porridge with a higher FVO:CSB ratio, and that significantly more BMCs will prepare porridge that is at or above the 30:100 ratio recommended, compared with BMCs receiving standard

programming. The study found no added impact on measured FVO:CSB porridge ratios when delivering the CSB in two kg packages that contained messaging and cooking instructions. As expected, the average cost per beneficiary was lowest for the control group, but on average FVO:CSB ratios were low and only a small proportion of BMCs in this group were preparing porridge at or above the recommended 30:100 ratio. Increasing the amount of FVO delivered to BMCs and providing information regarding porridge preparation increased costs, but also increased both the average FVO:CSB ratios and the proportion of BMCs preparing porridge at or above the recommended FVO:CSB ratio. When extra FVO and messaging were provided, repackaging CSB into smaller, message-containing packages did not alter the FVO:CSB ratio or the proportion of BMCs reaching or exceeding the recommended FVO:CSB ratio. While repackaging of CSB in Intervention 2 was less cost-effective in terms of increasing porridge FVO:CSB ratio, there may be other benefits such as improved hygiene and BMC preference for packaging. The study design did not permit measuring the separate effects of providing the additional 1.6 L of FVO or the SBCC messaging.

Changes in programming can induce BMCs to increase the average FVO:CSB ratio in the porridges they prepare, in some cases up to or beyond recommended levels. The expected benefits of doing so in terms of improvements in child nutrition and health remain to be measured, and these benefits should be set alongside the marginal programming costs reported here in order to determine the wisdom of supplying additional FVO and SBCC. Our results suggest that repackaging CSB is not successful in influencing FVO:CSB porridge preparation ratios, although repackaging may generate other benefits that were not measured in this study: they are more hygienic than bulk distribution; their distribution at the FDP is more efficient and less time consuming; and some study subjects found that receiving packages rather than having to scoop CSB from open tubs was more dignified.

1. Introduction

In order to achieve the nutritional goals of Maternal and Child Health and Nutrition (MCHN), Phase I of the Food Aid Quality Review (FAQR) recommended that programs using fortified blended foods (FBFs), such as Corn Soy Blend (CSB), for the treatment of moderate acute malnutrition (MAM) should increase the caloric density and improve the absorption of fat-soluble vitamins in porridge prepared by caregivers. The FAQR Phase I report recommended that CSB porridge be prepared and consumed with Fortified Vegetable Oil (FVO) in the ratio of 30 g FVO: 100 g CSB [1]. In FAQR Phase 2, a study was conducted to assess the feasibility of reaching this target ratio with regard to both the awardee (procurement and distribution) and beneficiary (preparation and consumption). This study assessed the effectiveness of the following programmatic changes on caregivers' compliance with the recommended target ratio: (1) increased amount of FVO provided to beneficiaries (2.6 L FVO: 8 kg CSB per month, compared with the standard ration of one L FVO and eight kg CSB) along with social and behavior change communication (SBCC) emphasizing the importance of preparing porridge at the recommended FVO:CSB ratio; (2) repackaged CSB into two kg packets (four, two kg packets per ration) with printed preparation messaging. This study was conducted in the setting of the pre-existing United States Agency for International Development (USAID), Food for Peace (FFP) integrated food security program/supplementary feeding program (SFP) for children with moderate acute malnutrition (MAM) in four districts in southern Malawi. This program was called Wellness and Agriculture for Life Advancement (WALA). Prior to the study, the WALA program was distributing one L of FVO and eight kg of CSB to children 6-59 months of age who were diagnosed with MAM at Food Distribution Points (FDPs).

This study was designed and implemented as a collaboration among Tufts University, Catholic Relief Services (CRS), Project Concern International (PCI), Save the Children (SAVE), Africare and the Malawi Ministry of Health (MoH). The Center for Social Research (CSR), a research institution within the Faculty of Social Science of the University of Malawi in Zomba, conducted the data collection, and Pakachere Institute of Health and Development Communication (PIHDC) helped implement the behavioral change component of the study. The United States Agency for International Development (USAID), Office of Food for Peace (FFP) supported this study.

The objectives of the study were to:

1. Evaluate the effect of additional FVO ration and preparation SBCC (Intervention Group 1), and provide repackaged CSB in two kg packets with printed preparation messaging (Intervention Group 2) compared with standard programming (Control Group), on:
    a. The mean ratio of FVO:CSB in porridge prepared by beneficiary mother/caretakers (BMCs)
    b. The percent of BMCs preparing the porridge at or above the target (30:100) and comparison (13:100) FVO:CSB ratios[1]

[1] The target ratio was based on the FAQR Phase I Report recommended amount 1.Webb, P., et al., *Improving the Nutritional Quality of U.S. Food Aid: Recommendations for Changes to Products and Programs*. 2011, Tufts University: Boston, MA.; a comparison ratio of 13:100 was based on the WHO minimum fat content recommended for supplementary foods to treat MAM 2.Organization, W.H., *Technical note: supplementary foods for the management of moderate acute malnutrition in infants and children 6–59 months of age.* 2012.. Further detail can be found in the Study Methods section.

   c. Sharing, selling and targeting of ration to the beneficiary child.
2. Estimate the cost-effectiveness of the two intervention groups compared to the Control Group by assessing: (a) cost per beneficiary, and (b) cost per additional BMC preparing porridge at or above the target and comparison FVO:CSB ratios.
3. Evaluate the determinants of effectiveness; examine potential determinants of BMCs reaching the target FVO:CSB ratio in porridge.

There were three rounds of data collection: (1) Baseline; (2) Intervention 1; and (3) Interventions 1 and 2. Formative research was conducted prior to implementation of the interventions, in order to develop the SBCC messages used in the interventions. This report reflects the comparison of intervention Groups 1 and 2, and the Control Group based on data collected in Round 3.

1. **Formative Research**
   Formative evaluation aimed to provide information on the study setting. Tufts University worked with PIHDC) to develop SBCC materials (including banners displayed during ration distribution, pamphlets for lead mothers to communicate key messages to their care groups and stickers displaying messages on the repacked CSB packets) and target mothers and caretakers of malnourished children under age 5 and health workers who support the beneficiaries.

2. **Round 1 (Baseline)**
   Baseline data collection assessed current practices surrounding the FVO and CSB ration (i.e. delivery of ration, education on preparation of FVO and CSB and their use at the household level) prior to implementing the intervention.

3. **Round 2 (Intervention Group 1and Control Group)**
   In Intervention Group 1, the FVO ration increased by an additional 1.6 L from the original one L (to 2.6 L of FVO /beneficiary/month) such that FVO and CSB were distributed in the same proportion as the recommended (target) ratio of 30:100. In addition to the increased FVO, the intervention included intensive SBCC education of BMCs to promote this preparation. (Educational materials are in **Appendix Figure 2.)** The Control Group received standard programming. The control FDPs were located in comparable communities within the same districts as the intervention FDPs, but were geographically separate in order to avoid social threats to validity (such as diffusion or rivalry).

4. **Round 3 (Intervention Group 2, Intervention Group 1 and Control Group)**
   Intervention Group 2 received the same intervention as Group 1 (increased FVO ration with SBCC). Additionally, Intervention Group 2 received CSB repackaged into two kg packets with printed behavior-change and preparation messaging on the packet labels. (Please see visual in **Appendix Figure 2**)

The Malawi MoH, through the National Health Sciences Research Committee (NHSRC), and the Tufts University Institutional Review Board approved the study.

1.1 Study Rationale

1.1.1 Stunting and Wasting

Globally, there are approximately 161 million stunted children (defined as low height-for-age) [3], and at least 51 million are severely or moderately wasted (defined as low height-for-weight) [4, 5]. Almost half of preventable deaths in children younger than 5 years of age are due to undernutrition [5]. Stunted and wasted children have an increased risk of death from diarrhea, pneumonia, measles and other infectious diseases [5]. Child undernutrition is widespread in Malawi [6]. According to the 2010 Demographic Health Survey (DHS) for Malawi, 47 percent of children under age 5 are stunted, four percent are wasted and 13 percent are underweight [6]. The World Health Organization classifies children as having MAM if they have a weight for height Z-score (WHZ) <-2 and ≥-3 with absence of edema. These children have greater susceptibility to infectious disease, delayed cognitive development and decreased adult stature and productivity [7-10].

1.1.2 Supplementary Foods

Currently, in food insecure settings the prevention and treatment of MAM involve providing mothers/caregivers with supplementary foods (Ready-to-Use Supplementary Food, RUSF, or FBF) to feed to the malnourished child [2].

FBF, such as CSB, are the most commonly-used supplementary foods [11]. FBFs, including CSB, are cereal-based, with soy or other legumes added to improve nutrient content, particularly protein quality. FBFs can also include additional ingredients such as vegetable oil, whey or skim milk powder and micronutrients, and are typically prepared into porridge by boiling with water and FVO. FVO is fortified with vitamins A and D.

The composition of FVO is in **Appendix Table 4.**

The CSB distributed at the start of the WALA program was Corn Soy Blend 13 (CSB13); in the beginning of 2014, USAID shifted to providing a modified version of CSB, with a slightly different micronutrient composition, called Corn Soy Blend Plus (CSB+). The program distributed eight kg CSB/month/beneficiary enrolled in the program. (The composition and micronutrient profiles of CSB13 and CSB+ are reported in **Appendix Table 2** and **Appendix Table 3**).

1.1.3 Increased FVO

The rationale for this recommendation of providing increased FVO to meet a target ratio is derived from FAQR Phase I recommendation to increase the energy density of the supplementary food by consuming CSB porridge at a ratio of 30:100 with about 600 ml boiled water in two or three feedings per day. This preparation and consumption pattern enhances the calorie value of feedings (by the use of oil) by roughly 50 percent [1]. The additional calorie contribution would permit the intake of enough energy (with associated nutrients) to meet the needs for growth or growth recovery, which could not be achieved by CSB alone. In addition to the calorie contribution, added FVO results in higher fortified fat consumption, meeting essential fatty acid (omega-3 and omega-6) needs and vitamin A and D requirements.

Insufficient energy density of CSB has been partly addressed in SFPs by providing rations pre-mixed with FVO. However, the pre-mixed CSB does not reach the recommended target ratio, 30:100. The SFP in Malawi, provides FVO and CSB separately–to be mixed by caregivers at home.

1.1.4 Repackaging CSB into smaller packages

The widespread practice of sharing individual rations in the field suggests that careful programming, improved communication, and clear messaging on packaging may be needed to reduce the degree of leakage and increase compliance with CSB porridge preparation [12]. In addition, the smaller packets may provide a more efficient and sanitary distribution process. The packages were designed with messaging to promote compliance with recommended preparation methods.

2. Methods

2.1 WALA Program Design

The study was conducted in a USAID/FFP SFP, WALA. The WALA program treated MAM in children under 5 years of age by providing a supplementary food ration as well as health and nutrition education. The WALA program was operated through a consortium of seven private voluntary organizations (PVOs), managed by CRS. The study operated through three of the seven WALA PVOs, PCI (in Balaka and Machinga districts), SAVE (in Chiradzulu district) and Africare (in Mulanje district).

Children under 5 years of age in the WALA communities were identified as having MAM according to mid-upper arm circumference (MUAC) by Health Surveillance Agents (HSAs) at growth monitoring clinics operated by the MoH, at community based outreach clinics, at mass screenings or by Community Health Workers (CHWs) in the community.

The BMCs of children identified as malnourished are given a ration card that entitles them to collect a ration of one L of FVO and eight kg of CSB monthly, for four months. BMCs collect their rations at an assigned FDP on a designated day of the month. In some distributions, there is extra ration left over at the FDP due to beneficiaries not showing up or because of unexpected or unavoidable circumstances. The PVOs end up distributing the leftover rations immediately after the assigned distribution day. Some FDPs are so large, that the distribution actually occurs on two consecutive days. At the time they collect their ration, BMCs attend cooking demonstrations, listen to health talks and have their children measured.

BMCs in the communities are members of Care Groups. Each Care Group consists of 10 households supported by a Care Group Lead Mother/Care Group Volunteer (referred to as Care Group Lead Mothers throughout the rest of the report), a paraprofessional volunteer health worker who conducts twice-monthly home visits to deliver health messages and monitor the health of household members. Care Group Lead Mothers report to CHWs who work under the auspices of the PVOs. There are four types of CHWs: **(1) Health Facilitator** - Employed by the PVO, there is one health facilitator per FDP; each health facilitator oversees two to three health promoters. The health facilitator is trained on SBCC messaging; **(2) Health Promoter** - Employed by the PVO, there are two to three health promoters per FDP; each health promoter oversees 5 to 10 Care Group Lead Mothers. The health promoter is also trained on SBCC messaging; **(3) Health Surveillance Agent** - MoH employees, they collaborate with health promoters and are trained on SBCC messaging; and **(4) Resource Persons** - Volunteers not associated with the PVO or MoH, trained on SBCC, they may guide beneficiary mothers or lead mothers on the ration and use of porridge and may participate in health talks. **Appendix Figure 1** shows the organizational structure of the SFP.

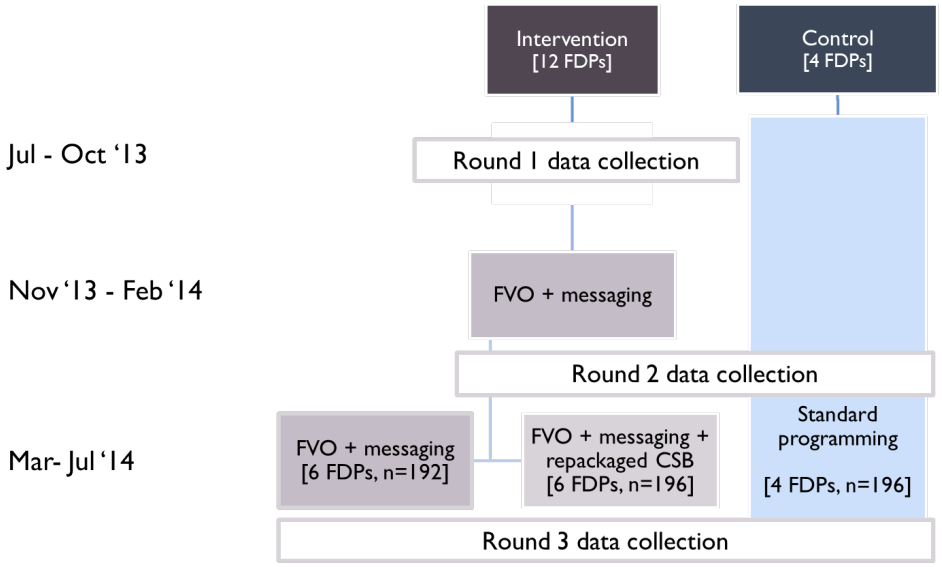
2.2 Study Design

This was a repeat cross-sectional study, assessing the effectiveness of two interventions compared to a group that received standard programming (see **Figure 1**). The study employed multistage cluster sampling, with the FDPs serving as clusters. Study subjects were drawn from the food distribution points. Selection of FDPs was purposive, while sampling of BMCs from each FDP was random. The study group classification, by PVO, is in **Table 1.**

Table 1. Classification of FDPs into study groups by district and PVO

Study Group	Project Concern International		Save the Children	Africare
	Balaka District	*Machinga*	*Chiradzulu*	*Mulanje*
Intervention FDPs Group 1	Sawali School Chilanga School		Ndunde Malimba School	Mthiramanja Muloza MCDE
Intervention FDPs Group 2	Yiula School	Bisa	Makiliyere School Mkhwayi	Chinyama Mtenjera
Control Group FDPs	Ostia/Matola	Machinga LEA	Mwanje	Bango

Figure 1. Study design and timeline of data collection



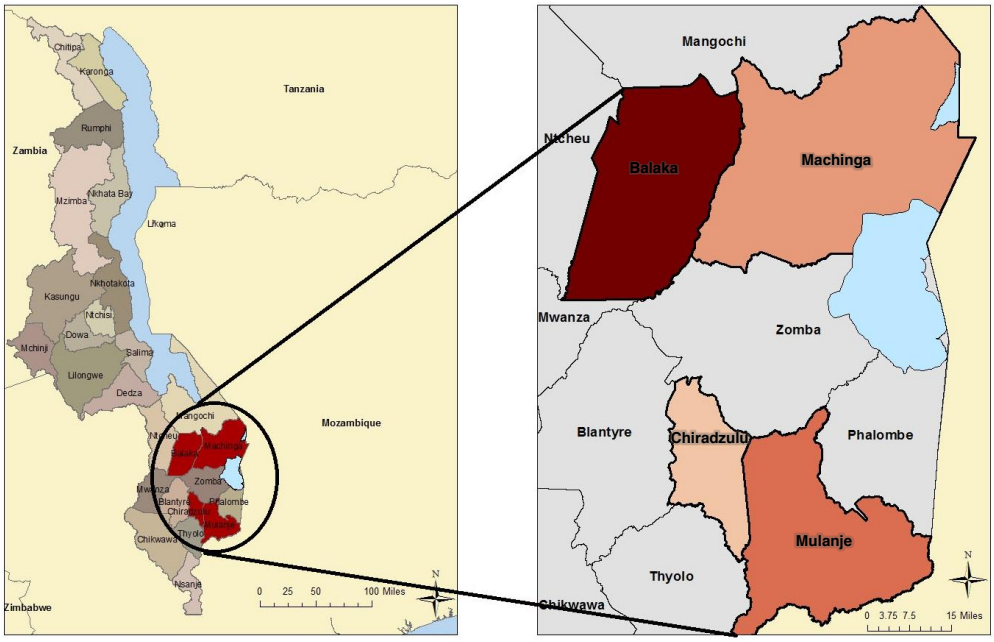
2.3 Study Setting

The study took place in four districts in Southern Malawi: Mulanje, Chiradzulu, Machinga, Balaka (see

Figure 2 below). These four districts have similar socioeconomic and cultural patterns with the rest of Malawi, characterized by high illiteracy levels, poor quality education, limited access to healthcare facilities, safe water and essential services, high household food insecurity and limited diet diversity [6, 13]. Malawi has a predictable lean season (December to March) that leaves many households food insecure [13]. The map below (

Figure 2) shows the locations of the study sites.

Figure 2. Study setting in Southern Malawi



2.4 Study Methods

2.4.1 Sample Size and Participant Selection

BMCs were drawn from the FDPs; BMCs at 12 FDPs received the intervention (six in Intervention Group 1 and six in Intervention Group 2) and the remaining four FDPs served as non-randomly assigned controls, located in similar communities. Participant BMCs were selected for interviews using PVOs' lists of SFP beneficiaries at each FDP. Two villages were randomly selected from each FDP using Probability-Proportional-to-Size technique, from which participants were randomly selected for interviews, focus group discussions (FGDs) or in-home observations. Care Group Lead Mothers interviewed were those serving the selected villages; CHWs interviewed were those serving the selected FDPs. PVO staff members interviewed were those working for one of the partner PVOs.

Sample size was calculated based on the statistical test of difference of proportions, which was applied to the outcome variables of average percent of FVO by volume in the porridge as prepared, proportion of BMCs preparing the porridge with the ratio of 30:100 and the proportion of BMCs who report the porridge is shared with other household members. With a sample size of 200 it is possible to detect a difference in proportion of mothers complying with recommendations of about 12 percentage points at alpha=0.05 and power of 0.8. A sample size of 200 also permits detection of a difference between 0.75 and 3.26 percent of FVO by weight depending on the standard deviation of percent FVO in the porridge (from 3 to 13 percent), assuming that the percent by weight contributed by FVO is normally distributed. The goal was to shift the current ratio of FVO to CSB up to 30:100 (23.1 percent) with a comparison ratio of 13:100 (15.7 percent). The target ratio is 30:100, according to the FAQR recommended amount

[1]; a comparison ratio of 13:100 was based on the WHO minimum fat content recommended for supplementary foods to treat MAM [2].[2]

A sub-sample of participating BMCs was selected for in-home observations as a way to corroborate reported findings regarding sharing. The planned sample size was 45 households, observed for 5 days each, for a total of 225 household days of observation (18 households in Intervention Group 1, 18 households in Intervention Group 2, and 9 households in the Control Group). This sample size was chosen based on feasibility.

2.4.2 Data Collection

In Round 3, data were collected during a four-month period of intervention from March to July 2014. Both qualitative and quantitative data were collected from participants in various roles, including PVO staff, CHWs, Care Group Lead Mothers and BMCs. Observational data were also collected from vendor markets and FDPs and in households.

The study collected the following data:

1. Individual household interviews of BMCs
2. Focus Group Discussions with BMCs
3. In-home observations over a period of four to five days at BMC households
4. Individual interviews with Care Group Lead Mothers*
5. Focus group discussions with Care Group Lead Mothers*
6. Interviews with CHWs and Health Promoters
7. Market observations*
8. Laboratory tests for CSB porridge samples
9. FDP observations*
10. Food distribution truck observation*
11. Cost data collection through key-informant interviews
12. Qualitative open-ended interviews with PVO staff members in their professional capacities, to learn programmatic change in implementing the interventions.*

* These data are not presented in this report.

2.4.3 Field Work

Data Collection Team

Tufts University contracted the CSR at the University of Malawi to coordinate data collection by training and supervising enumerators. The field team collected all survey data within the catchment communities and in the beneficiary households. The research team consisted of 46 enumerators, six data entry clerks, six in-home observers and six FGD facilitators.

[2] Given the very low FVO:CSB ratio at baseline and the very small proportion of BMCs reaching the 30:100 target, the team calculated the ratio of FVO:CSB that would achieve the target of 9% of calories from fat recommended as the minimum for a supplementary food for children by WHO, and used that ratio of 13:100 as a secondary target. WHO recommends at least 25g fat per 1000 kcal. Converting this to an FVO:CSB ratio for analysis: 25g fat = 25*9 kcal/g = 225 kcal; 1000 kcal – 225 kcal from fat = 775 kcal; 775 kcal/ (4 kcal/g, for a carb/protein) = 193.75; Yielding a ratio of 25g fat:194g nonfat, equating to 13g fat:100g nonfat. This ratio was calculated assuming an intrinsic CSB fat of zero to ensure the minimum fat content was met, but also because intrinsic fat was found to be variable from the specifications.

CSR conducted a total of three main trainings and three mini refresher trainings for the data collection teams. Before each data collection round, CSR recruited enumerators to undergo a seven-day training followed by field piloting, after which a three-to five-day refresher training was held. Details on the training activities can be found in **Appendix 6**.

Piloting

The research team piloted all data collection instruments prior to field data collection, and CRS assessed enumerators based on their ability to collect data successfully in the field. Piloting took place in four non-study FDPs (Ulongwe, Chembera, Nalingula and Namikhate) with approximately 30 BMCs. These FDPs Could were in similar SFPs, but were geographically separate from the study FDPs. Based on the pilot surveys, any necessary revisions were made and final pretesting was performed before the start of actual data collection.

2.4.4 Data Entry and Cleaning

Data entry clerks entered data into CSPro 6.1, after which they passed it on to another clerk for spot checks and verification before being exported into SPSS Version 16. The Field Data Manager and Data Collection Supervisors regularly audited data for data entry errors. Calculation of descriptive statistics and tabulation of variables were used to assess plausibility of values.

Data entry errors were flagged and corrected by revisiting the original paper questionnaires. All data cleaning thereafter was performed in Stata 13.1 (StataCorp, College Station, TX) and errors that remained due to implausible values were excluded from analysis. The data sets were locked following the cleaning process. All qualitative data (interviews and focus groups) were recorded with permission of the participants. FGD facilitators took notes and transcribed the recordings by hand in Chechewa language (the language used to conduct the FGDs). A trained typing assistant typed transcripts into Microsoft Word documents and trained translators translated them into English. During the transcription process, all data were de-identified. The typed, translated Word documents were then imported into QSR International's NVivo 10 qualitative data analysis software for analysis by the Tufts University team.

Original questionnaires were stored in locked cabinets at CSR in Zomba. The electronic database is accessible only to the Principal Investigators (PIs), research coordinators, analysts and in-country data managers.

2.4.5 Data Analysis

Quantitative data were analyzed using Stata 13.1. Descriptive statistics and study subject characteristics were stratified by study group – Intervention Group 1, Intervention Group 2 and the Control Group. Homogeneity of characteristics by study group was assessed using chi-square and ANOVA tests. In-home observation data were analyzed using SAS 9.3. Only descriptive statistics are reported for in-home observations. Our method for analysis had to be altered due to issues with household identification during data collection. Our analysis was therefore aggregated to household-days of observation. Data were summarized by study group over the total number of times porridge eating was observed, and the total number of times anyone other than the beneficiary child was observed eating (sharing).

Semi-structured FGDs conducted among BMCs were analyzed using QSR International's NVivo 10 qualitative data analysis software, with broad categories discussed and agreed upon by two data analysts. The FGDs were structured based on the following domains: porridge preparation; sharing and selling of ration; porridge consumption; and feelings and perceptions regarding the ration. Data were first categorized according to the broad structural domains. An inductive approach was then used to identify common conceptual themes relating to the study's objectives through line-by-line analysis of the text.

Objective I: Effectiveness and Feasibility

Descriptive analysis

The primary outcome for Objective I was the ratio of FVO:CSB used in porridge preparation, as determined by lab analysis of the porridge. The lab analysis determined the total fat and dry matter contents of the porridge after eliminating water. Dummy samples that contained no added FVO were used to determine the intrinsic fat content of the CSB. Added FVO to CSB ratio was calculated by removing the intrinsic fat value from the total fat in the sample.[3] For comparison, these ratios were also calculated for each BMC based on amounts of FVO and CSB used to make porridge reported in the in-depth interviews. Groups were compared in terms of BMCs reaching the target ratio of 30:100 from the FAQR Phase I report, as well as a comparison ratio of 13:100. This outcome was analyzed as both a continuous variable (mean ratio of FVO:CSB), and a binary variable (percent of BMCs who met each ratio threshold). Additionally, the research team assessed the difference between the reported ratio and the ratio from the lab sample analysis.

The research team first analyzed individual characteristics descriptively, in order to identify factors affecting BMCs' behaviors related to porridge preparation, and percentage of BMCs who met the target ratios.

The team assessed factors related to household food security, number of possessions and SBCC. A Household Food Insecurity Access Scale (HFIAS) category indicator, adapted from the FANTA Household Food Insecurity Access Scale for Measurement of Food Access: Indicator Guide [14], was used as a measure of the level of food security. The adaptation used eight of the nine factors in the generation of the HFIAS category indicator. The indicator used in this report excludes question six ("In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food? How often did this happen?") from the FANTA publication, and was therefore computed using the classification scheme outlined in the FANTA report, with the remaining eight questions. The number of possessions was used as a proxy for socioeconomic status, and was adapted from the 2010 Malawi DHS survey [6].

In order to contextualize and substantiate the Objective I analysis, the research team identified and summarized the themes from the qualitative data relating to porridge preparation and ability to follow porridge preparation instructions.

[3] Added fat was calculated using the following equation: CSB in 100g porridge = Non-fat content / (100-intrinsic CSB fat). We found intrinsic fat in the CSB to be, on average, 2.83. This value was used for all calculations of lab sample FVO:CSB ratios.

Regression analysis

Regression analysis was performed to determine the effect of the intervention on FVO:CSB ratio and the likelihood of the BMC reaching the target (30:100) or comparison benchmark (13:100) ratios, controlling for other factors and potential confounding variables. The research team performed three mixed effects regression analyses using the outcomes and indicators described in Objective I to assess differences among the study groups. To adjust for potential clustering, the FDP indicator was used as the random effect in all three analyses. It was determined that FDP sufficiently captured the variability across the three PVOs in this study. For each analysis, an unadjusted and an adjusted model were fit. All regression models had a sample size of 419 study participants. There were 165 observations excluded from all regression analyses due to missing data for the explanatory variables.

For the continuous outcome of mean FVO:CSB ratio, a mixed effects linear regression analysis was performed comparing each of the two intervention groups to the control group. For the two binary outcomes (meeting the target ratio 30:100 and comparison ratio 13:100), mixed effects logistic regression analyses were performed comparing each of the two intervention groups to the control group. All three adjusted models controlled for potential confounders and household and individual characteristics.

FDPs Muloza, Nthiramanja and Ntenjera demonstrated extremely high FVO:CSB ratios, and might bias the estimates. Hence, all regressions were performed including and excluding these three outlier FDPs. We found no significant difference between the estimates produced by two analyses, and therefore opted for reporting the models with all FDPs.

Sharing Within and Outside the Household

Factors related to exposure to any SFP, child consumption of the porridge and sharing within and outside the household were also assessed. Mothers reported their perception of the acceptability of the ration to the child, using a Likert scale in which the five categories ranged from "dislike a lot" to "like a lot." In-home observation data were analyzed in order to assess observed sharing behavior within the household. Sharing was defined as anyone other than the beneficiary child observed eating the porridge.

Objective II: Cost and Cost Effectiveness

Cost components collected included the commodity purchases (FVO and CSB), international shipping and national and local transportation, warehousing, distribution costs, intervention-only costs (including SBCC refresher training for health workers, monitoring of health workers and commodity repackaging), implementing PVO personnel costs, BMC time (monetized) and pre-implementation program costs (including initial training of health workers, purchasing jerry cans and crates for additional FVO ration, formative research for SBCC, design and preparation of smaller CSB packaging and package messages and pretesting). Beneficiary time, which included time to get to and from the FDP and time spent waiting for ration distribution, was valued using the Malawian government minimum wage[4]. The team collected cost data for four months of the program in each study group. Costs were tabulated by study group in

[4] 14,000 MWK per month, Malawi government set minimum wage

Microsoft Excel 2011 (Redmond, WA, USA). Costs collected in Malawian Kwacha (MWK) were converted to USD using the conversion rate of 397 MWK to 1 USD[5].

Total cost in each study group was then used to determine the estimated cost "per beneficiary" as programmed, calculated as the total costs divided by the number of four one-month rations distributed. Marginal cost-effectiveness (CE) in this study is the cost per each additional BMC meeting or exceeding the target and comparison FVO:CSB ratios of 30:100 and 13:100[6] in the prepared porridge, in the Intervention Groups compared to Control Group, determined by dividing the difference in cost per beneficiary in the Intervention and Control Groups by the additional number of BMCs that achieved the target and comparison ratios in the Intervention Groups compared with the Control Group. The proportion of BMCs meeting or exceeding these ratios based on lab analysis of porridge samples found in Objective I were used in calculating cost-effectiveness among PCI FDPs. Different sample sizes were accounted for in the calculation of marginal CE by normalizing costs per 100 beneficiaries.

Estimated cost per beneficiary = Total costs / (# of 4 one-month rations distributed)

Effectiveness = Percent of BMCs meeting/exceeding target ratio

Marginal cost-effectiveness = $(\text{Cost}_{\text{Intervention}} - \text{Cost}_{\text{Control}}) / (\text{Effectiveness}_{\text{Intervention}} - \text{Effectiveness}_{\text{Control}})$

Some assumptions were made in creating the cost model, the most important being that PCI's cost structure (which was used to develop the cost model) was similar to those of the other two implementing agencies. Sensitivity analyses were performed to test the effects of these assumptions, and of variations in important cost model components, on overall cost and cost-effectiveness.

Objective III: Determinants of Effectiveness

Objective III was to assess the relationship between individual BMC and household factors with respect to the outcome of FVO:CSB ratio. In order to do this, the research team calculated SBCC scores across the three study groups, reflecting BMCs' self-reported exposure to the SBCC messages given by health care workers in the program. The SBCC score was a composite score based on affirmative answers to six questions, shown in **Table 14**.

The research team calculated scores for the self-reported delivery of SBCC messages by the Care Group Lead Mothers and CHWs in the Intervention Groups. As it was not possible to link an individual BMC to her particular lead mother or CHW, the research team aggregated scores on the FDP level. Additionally, the team calculated descriptive characteristics and stratified by those who met the target ratio and those who did not.

Themes from the qualitative data relating to how the ration was perceived and used provided deeper understanding of the Objective III analysis. Themes included sharing and selling behavior, children's feelings about the porridge and perceptions about the CSB packaging.

[5] Exchange rate on Sept 2 2014, using Yahoo Currency Converter
[6] Target ratio based on FAQR recommendations; comparison ratio based on WHO minimum fat content for supplementary foods to treat MAM (see Study Methods for details).

3. Results

The study included a total of 584 BMCs in Round 3: n=192 in Intervention Group 1; n=196 in Intervention Group 2; n=196 in the Control Group. A descriptive summary of participants' characteristics, stratified by study group, is displayed in

Table 2. The groups were similar with respect to age, gender, household size, number of household possessions, household food insecurity, level of education of the BMC and distance to FDP. The study groups differed with respect to number of children under 5 in the household. On average, BMC age was between 27 and 28 years, household size was about five individuals, distance from the household to FDP was about three kilometers, and most participating BMCs had at least primary education or higher.

Prior exposure to other SFPs among beneficiaries is displayed in

Table 3. Significant differences among the groups were noted with respect to whether the child had been previously enrolled in another SFP ($p=0.002$), as well as the number of distributions received prior to participation in this interview ($p<0.001$). Among all three groups, few households (≤ 2) had members who received food from another program, with no significant difference noted between the groups. In most households the BMC picked up the ration herself, with only seven percent of households in the Control Group and four percent of households in each Intervention Group having the ration picked up by another individual; there was no significant difference among the groups. There were also no significant differences in the amount of time since the last time the distribution was collected; about half of the households had picked it up within the last thirty days (

Table 3).

Table 2. Household and participant characteristics by study group

	Intervention Group 1 *n=192*	Intervention Group 2 *n=196*	Control Group *n=196*	*P**
Mean ± SD				
Age (y) of BMCs	27.9 ± 8.3	28.4 ± 7.6	27.0 ± 7.0	0.18
Freq. missing	*6*	*3*	*9*	
Age (mos) of child	25.1 ± 10.9	25.1 ± 11.7	25.5 ± 13.3	0.94
Freq. missing	*4*	*9*	*5*	
No. household members	5.1 ± 1.8	5.5 ± 1.8	5.2 ± 2.0	0.08
No. possessions**	1.9 ± 2.1	1.8 ± 1.8	1.9 ± 1.8	0.67
Distance to FDP (km)	3.3 ± 2.0	3.6 ± 2.5	3.1 ± 2.0	0.07
Freq. missing	*4*	*10*	*5*	
No. children < 60 mos.†	1.3 ± 0.5[a]	1.4 ± 0.6[a]	1.5 ± 0.7[b]	0.001
n (%)				
Household Food Insecurity‡				
Food secure	38 (20)	33(17)	36 (18)	0.86
Mildly insecure	17 (9)	18 (9)	15 (8)	
Moderately insecure	35 (18)	40 (21)	47 (24)	
Severely insecure	102 (53)	104 (53)	98 (50)	
Freq. missing		*1*		
BMC level of education				
None	23 (12)	16 (8)	14 (7)	0.48
Primary (some or completed)	141 (74)	155 (80)	153 (79)	
Secondary (some, completed, or higher)	26 (14)	23 (12)	26 (13)	
Freq. missing	*2*	*2*	*3*	

*ANOVA test for discrete and continuous variables, χ^2 test for categorical variables.

**Adapted from 2010 Malawi DHS [6]

†Bonferroni method used for pairwise comparisons; superscripts with the same letter are not significantly different.

‡Adapted from FANTA Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (2007) [14]

Table 3. Exposure to supplementary feeding programs by study group

	Intervention Group 1 *(n=192)*	**Intervention Group 2 *(n=196)***	**Control Group *(n=196)***	
	n (%)	**n (%)**	**n (%)**	***P*** **(χ^2)**
Previous enrollment in a Supplementary Feeding Programs (SFPs)‡	57 (30)[a]	54 (28)[a]	30 (15)[b]	0.002
Currently enrolled in other program that provides a food ration	1 (0.5)	2 (1)	0 (0)	0.37
Other household member currently enrolled in another program	1 (0.5)	2 (1)	1 (0.5)	0.78
No. distributions received since enrollment*‡	[a]	[a]	[b]	<0.001
One	5 (3)	2 (1)	5 (3)	
Two	10 (5)	14 (7)	19 (1)	
Three	42 (22)	45 (23)	87 (44)	
Four	42 (22)	47 (24)	32 (16)	
Over four**	92 (48)	88 (45)	53 (27)	
Individual who collects ration				0.32
BMC	184 (96)	189 (96)	183 (93)	
Other	8 (4)	7 (4)	13 (7)	
Last time distribution was collected†				0.10
30 days or less ago	100 (52)	85 (44)	105 (54)	
More than 30 days ago	92 (48)	110 (56)	91 (46)	

*1 missing from Intervention Group 1

**Within 2 days, FDP gave out extra rations leftover

†1 missing from Intervention Group 2

‡Bonferroni method used for pairwise comparisons; superscripts with the same letter are not significantly different.

3.1 Objective I: Effectiveness and Feasibility

3.1.1Descriptive Analysis

The ratio of FVO:CSB assessed through laboratory analysis was similar to that based on BMC reporting in the in-depth interview. The mean reported and lab FVO:CSB ratio in prepared porridge, respectively, among BMCs in Intervention Group 1 was 30:100 and 28:100; in Intervention Group 2 was 30:100 and 25:100 and in the Control Group was 15:100 and 12:100. There were significant differences among the three groups' lab ratios

Figure 3, as well as between the reported ratios across the three groups ($p<0.001$ for both). There were also significant differences between each Intervention Group and the Control Group ($p<0.05$ for all). The reported values of the FVO:CSB ratio were, on average, consistently higher than the lab values in all three groups, though the difference between lab and reported values was not statistically significant ($p=0.556$) **(Table 4).**

In Intervention Group 1, 51 percent of BMCs reported a prepared porridge ratio that met the 30:100 target ratio, and 37 percent met this ratio according to lab values; in Intervention Group 2, 50 percent of BMCs reported this target ratio, and 30 percent met it according to lab values; and in the Control Group, four percent reported meeting this ratio, and five percent met the ratio according to lab samples. In Intervention Group 1, 97 percent of BMCs report preparing porridge with at least a 13:100 ratio, and 82 percent of the lab samples show this ratio; in Intervention Group 2, 95 percent report preparing porridge at 13:100 ratio, and 79 percent of lab samples show this ratio; and in the Control Group, 51 percent of BMCs reportedly met the 13:100 ratio, and 38 percent of lab samples show this ratio **(Figure 4, Figure 5.)** There were statistically significant differences among the three groups for both reported ($p<0.001$) and lab values ($p<0.001$), as well as between each Intervention Group and the Control Group according to chi-square analysis ($p<0.05$ for both) **(Table 4).**

Figure 5 shows the kernel density estimation of the FVO:CSB ratio by study group. As displayed in **Figure 4**, the number of BMCs preparing porridge with lower FVO:CSB ratios is significantly higher among those in the Control Group than among those in the intervention group. Correspondingly, **Table 4** shows that the number of BMCs preparing porridge at the target FVO:CSB ratio is higher in both of the Intervention Groups than in the Control Group. There is not a significant difference between the two Intervention Groups.

Figure 3. Mean FVO:CSB ratios in prepared porridge as determined by lab analysis among the three study groups

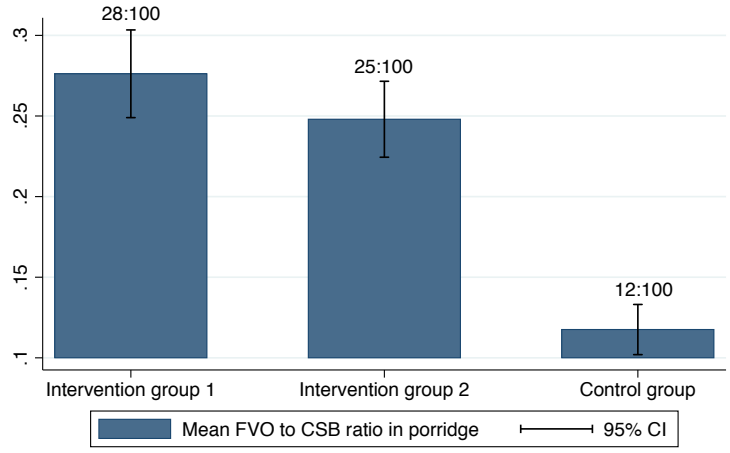


Table 4. Mean FVO:CSB ratio in prepared porridge and proportion of BMCs meeting porridge ratios, among study groups

	Intervention Group 1 *(n=192)*		Intervention Group 2 *(n=196)*		Control Group *(n=196)*		*P*‡
	n	**Mean ± SD**	**n**	**Mean ± SD**	**n**	**Mean ± SD**	
FVO:CSB ratio in prepared porridge*							
Reported**	188	0.30 ± 0.09[a]	193	0.30 ± 0.09[a]	184	0.15 ± 0.09[b]	<.001
Lab sample†	142	0.28 ± 0.16[a]	156	0.25 ± 0.15[a]	157	0.12 ± 0.1[b]	<.001
Difference between reported and lab sample, by individual	139	-0.03 ± 0.19	153	-0.05 ± 0.17	148	-0.04 ± 0.12	0.56
	n	**n (%)**	**n**	**n (%)**	**n**	**n (%)**	
BMCs who prepared porridge at or above FVO:CSB ratios§:							
Target 30:100							
Reported**	188	95 (51)[a]	193	97 (50)[a]	184	8 (4)[b]	<.001
Lab sample†	142	53 (37)[a]	156	47 (30)[a]	157	8 (5)[b]	<.001
Comparison13:100							
Reported**	188	182 (97)[a]	193	184 (95)[a]	184	94 (51)[b]	<.001
Lab sample†	142	116 (82)[a]	156	124 (79)[a]	157	60 (38)[b]	<.001

*Grams of FVO per grams of CSB

**From in-home interview

†Note that other ingredients may be in nonfat part of porridge (e.g. sugar, eggs, peanuts)

‡P-value for difference among groups from ANOVA for continuous variables or chi-square test for categorical variables. Bonferroni method used for pairwise comparisons; superscripts with the same letter are not significantly different.

§ Ratios based on FAQR recommended target amount [1], and WHO minimum fat content recommended for supplementary foods to treat MAM [2]

Figure 4. Percent of BMCs meeting target and comparison ratios of FVO:CSB in prepared porridge

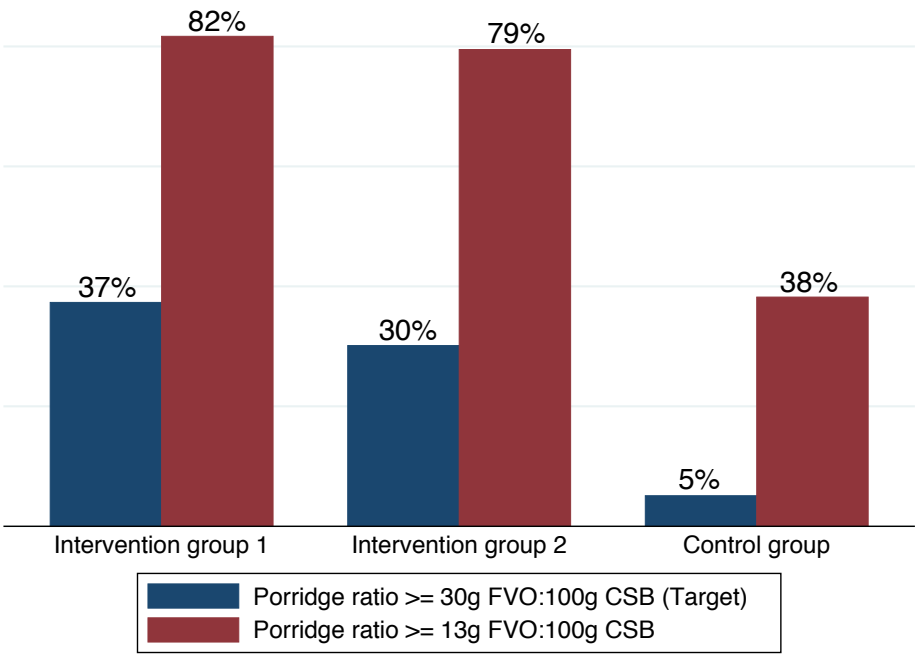
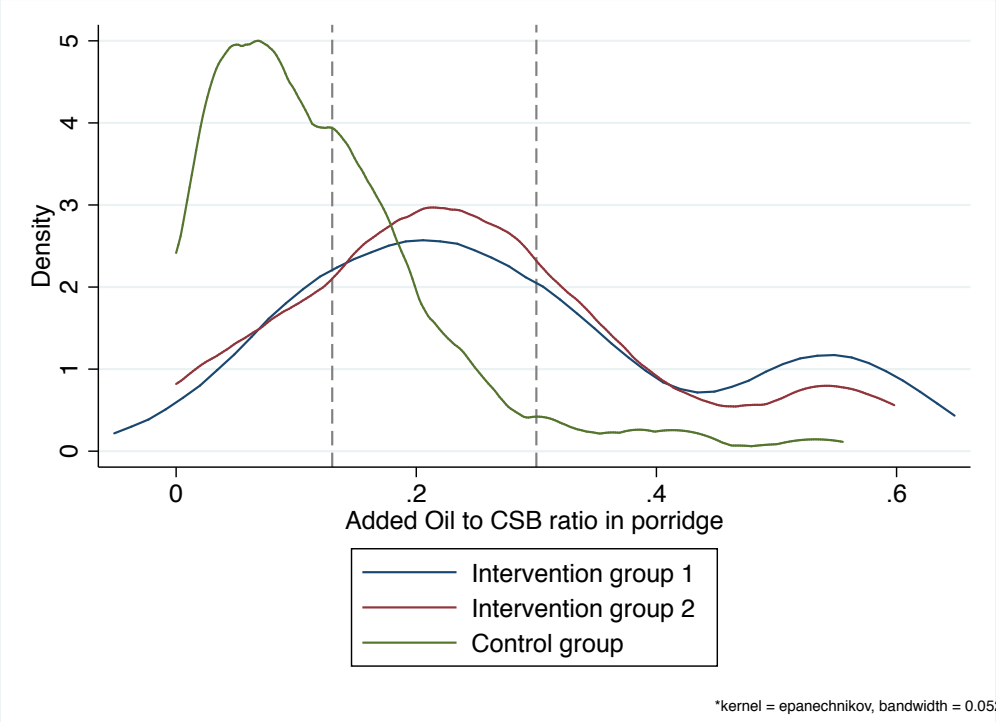


Figure 5. Kernel density of FVO:CSB ratio in porridge by study group



3.1.2 Regression Analysis

The primary outcomes in this analysis were: (1) the mean FVO:CSB ratio; (2) the proportion of BMCs meeting the target ratio of 30:100; and (3) the proportion of BMCs meeting the comparison ratio of 13:100. Both intervention groups were associated with higher mean FVO:CSB ratios than the Control Group: Intervention Group 1 was associated with a 0.18 unit increase in mean FVO:CSB ratio (p=0.004); Intervention Group 2 was associated with a 0.14 unit increase in mean FVO:CSB ratio (p=0.027). After adjusting for potential confounders in an adjusted, multivariate mixed effects linear regression, study group remained the only significant predictor of mean FVO:CSB ratio (p=0.005, p=0.039), other than the random effects parameter of FDP (p<0.001) **(Table 5).**

A plot of the residuals from this linear regression was normally distributed. Additionally, all values of Cook's distance were less than 0.03 and there were no points that appeared to be highly influential.

The research team performed two mixed effects logistic regression models to assess whether BMCs met the target ratio of 30:100 or the comparison ratio of 13:100. Unadjusted and adjusted models were fit for each of these outcomes, comparing each Intervention Group to the Control Group. Each Intervention Group was associated with greater odds of reaching the target ratio of 30:100 than the Control Group (p=0.002, p=0.018) **(**

Table 6). In the model assessing the comparison ratio of 13:100, study group and the random effects parameter were again the only significant predictors ($p<0.001$, $p<0.001$, $p=0.024$) **(**

Table 7), with BMCs in both Intervention Groups having higher odds of reaching the comparison ratio than BMCs in the Control Group.

For each logistic regression, a goodness of fit test using Pearson chi-square indicated the data were a good fit for the model.

Chi-square and t-test analysis of these 165 BMCs compared to the 419 BMCs included in the regression yielded no significant differences on the basis of: (1) study group assignment, (2) age of BMC or beneficiary child; (3) the outcome of continuous FVO:CSB ratio; (4) the outcome of the ratio 30:100; and (5) the outcome of the ratio 13:100. Based on these results, it was determined the data were missing at random.

Table 5. Factors predicting mean FVO:CSB ratio (n=419)*

	Unadjusted			Adjusted		
	Beta	**95% CI**	***P***	**Beta**	**95% CI**	***P***
Study Group						
Control Group	ref.			ref.		
Intervention Group 1	0.18	(0.06, 0.31)	0.004	0.18	(0.05, 0.31)	0.01
Intervention Group 2	0.14	(0.02, 0.27)	0.03	0.13	(0.01, 0.26)	0.04
No. household members				0.003	(-0.00, 0.01)	0.43
Age (mos) of child				0.001	(-0.00, 0.00)	0.13
Age (y) of BMCs				0.001	(-0.00, 0.00)	0.10
BMC level of education						
None				ref.		
Some or Completed Primary				0.01	(-0.03, 0.04)	0.72
Some, Completed, or More than Secondary				0.04	(-0.01, 0.09)	0.12
Previous enrollment in a SFP				0.01	(-0.02, 0.04)	0.53
Household Food Insecurity**						
Food secure				ref.		
Mildly insecure				0.04	(-0.01, 0.08)	0.12
Moderately insecure				0.03	(-0.01, 0.06)	0.11
Severely insecure				0.03	(0.00, 0.06)	0.05
No. possessions†				0.01	(-0.01, 0.00)	0.13
Distance to FDP (km)				0.002	(-0.01, 0.00)	0.49
No. distributions received since enrollment						
One				ref.		
Two				0.01	(-0.09, 0.07)	0.81
Three				0.01	(-0.07, 0.08)	0.89
Four				0.01	(-0.06, 0.09)	0.73
Over four‡				0.01	(-0.07, 0.08)	0.85
Random Effects Parameter: FDP	0.01	(0.00, 0.02)	0.001	0.01	(0.00, 0.02)	0.001

*Mixed effects linear regression, outcome is mean oil:CSB ratio.

**Adapted from FANTA Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (2007) [14].

†Adapted from 2010 Malawi DHS [6].

‡Within 2 days, FDP gave out extra rations leftover.

Table 6. Factors predicting BMC compliance with target FVO:CSB ratio of 30:100 (n=419)*

	Unadjusted			Adjusted		
	OR	**95% CI**	***P***	**OR**	**95% CI**	***P***
Study Group						
Control Group	ref.			ref.		
Intervention Group 1	26.8	(3.9, 185.9)	0.001	28.4	(3.2, 251.1)	0.003
Intervention Group 2	15.4	(2.3, 104.8)	0.01	12.7	(1.5, 109.5)	0.02
No. household members				1.1	(1.0, 1.4)	0.13
Age (mos) of child				1.0	(0.9, 1.0)	0.14
Age (y) of BMCs				1.0	(1.0, 1.1)	0.51
BMC level of education						
None				ref.		
Some or Completed Primary				1.0	(0.4, 2.5)	0.95
Some, Completed, or More than Secondary				1.8	(0.5, 6.0)	0.35
Previous enrollment in a SFP				1.3	(0.6, 2.9)	0.47
Household Food Insecurity**						
Food secure				ref.		
Mildly insecure				2.7	(0.8, 9.3)	0.13
Moderately insecure				2.4	(0.8, 6.7)	0.11
Severely insecure				2.6	(1.0, 6.7)	0.05
No. possessions†				0.8	(0.7, 1.0)	0.03
Distance to FDP (km)				1.1	(0.9, 1.2)	0.35
No. distributions received since enrollment						
One				ref.		
Two				0.9	(0.1, 6.7)	0.89
Three				0.6	(0.1, 4.3)	0.63
Four				0.9	(0.2, 6.0)	0.94
Over four‡				0.8	(0.1, 4.9)	0.79
Random Effects Parameter: FDP	1.6	(0.6, 4.5)	<0.001	2.1	(0.8, 6.0)	<0.001

*Mixed effects logistic regression, binary outcome defined as oil:CSB ratio ≥ 30:100 vs. < 30:100; probability modeled is outcome ≥ 30:100

**Adapted from FANTA Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (2007) [14]

†Adapted from 2010 Malawi DHS [6]

‡Within 2 days, FDP gave out extra rations leftover

Table 7. Factors predicting BMC compliance with comparison FVO:CSB ratio of 13:100 (n=419)*

	Unadjusted			Adjusted		
	OR	**95% CI**	***P***	**OR**	**95% CI**	***P***
Study Group						
Control Group	ref.			ref.		
Intervention Group 1	7.4	(3.1, 17.8)	<0.001	8.3	(3.5, 19.9)	0.000
Intervention Group 2	6.0	(2.6, 14.2)	<0.001	6.5	(2.8, 15.3)	0.000
No. household members				0.95	(0.82, 1.1)	0.45
Age (mos) of child beneficiaries				0.98	(0.96, 1.0)	0.09
Age (y) of BMCs				1.0	(0.99, 1.1)	0.11
BMC level of education						
None				ref.		
Some or Completed Primary				1.3	(0.59, 2.9)	0.51
Some, Completed, or More than Secondary				1.7	(0.60, 4.9)	0.32
Previous enrollment in a SFP				1.4	(0.69, 2.8)	0.37
Household Food Insecurity**						
Food secure				ref.		
Mildly insecure				1.2	(0.47, 3.3)	0.65
Moderately insecure				1.9	(0.90, 4.0)	0.09
Severely insecure				1.8	(0.92, 3.4)	0.09
No. possessions†				0.96	(0.83, 1.1)	0.54
Distance to FDP (km)				0.92	(0.8, 1.0)	0.15
No. distributions received since enrollment						
One				ref.		
Two				0.66	(0.12, 3.6)	0.63
Three				1.3	(0.26, 5.9)	0.78
Four				0.94	(0.20, 4.5)	0.94
Over four‡				0.93	(0.20, 4.4)	0.93
Random Effects Parameter: FDP	0.26	(0.07, 1.04)	0.005	0.23	(0.04, 1.2)	0.03

* Mixed effects logistic regression, binary outcome defined as oil:CSB ratio ≥ 13:100 vs. < 13:100; probability modeled is outcome ≥ 13:100

**Adapted from FANTA Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (2007) [14]

†Adapted from 2010 Malawi DHS

‡Within 2 days, FDP gave out extra rations leftover

3.1.3 Sharing Within and Outside the Household

Child consumption of the porridge, and sharing of the supplementary food across the three study groups, were assessed. The average amount of porridge consumed by the beneficiary child overall was not significantly different across the study groups, and was approximately 267 ml in Intervention Group 1, 277 ml in Intervention Group 2 and 267 ml in the Control Group (p=0.565). Although the portions consumed were similar across groups, given that the FVO:CSB ratios were higher in the Intervention Groups when compared to the Control Group, it can be assumed that beneficiary children in the Intervention Groups consumed more calories due to higher energy density in the porridge. The number of times the beneficiary child was fed per day was different across the study arms (p=0.041); however the majority of BMCs in all three groups fed the beneficiary child the porridge twice per day, and over 70 percent of the beneficiary children across the study groups were reported to like the porridge a lot based on a five-category Likert's scale ranging from "dislike a lot" to "like a lot" **(Table 9)**. In the FGDs, it was commonly described that the children like the porridge very much (see

Appendix Table 8).

There was no significant difference across the study groups regarding whether there was leftover porridge from the last preparation (p=0.217). There was, however, a significant difference in the proportion of households reporting that only the beneficiary child consumed the porridge: 53 percent, 55 percent and 30 percent of BMCs in Intervention Group 1, Intervention Group 2 and the Control Group, respectively, report that only the beneficiary child receives the porridge (as instructed) **(Table 9)** (p<0.001). The most common recipients of the porridge other than the beneficiary child are other children under age 5. Across the study groups, 99 percent of all households report not using CSB for purposes other than the porridge, while only 86 percent, 84 percent and 71 percent of BMCs in Intervention Group 1, Intervention Group 2 and the Control Group, respectively, report using FVO for porridge only (p<0.001).

During the 149 household-days of observation, porridge eating was observed a total of 189 times. Of the number of times porridge eating was observed, sharing–defined as anyone other than the target child observed eating the porridge–was highest in the Control Group (83 percent in the Control Group, 48 percent in Intervention Group 1, and 59 percent in Intervention Group 2). When sharing occurred, it was observed to be most common among children under 5 (49 percent). A description of observed sharing by study group is displayed in **Table 8**. Due to challenges with household identification during the in-home observations, mentioned previously, we present descriptive analysis only and are unable to directly compare reported and observed sharing.

In the FGDs, the most common theme related to between household sharing was regarding the leftover porridge. Participants across all three study groups described sharing the leftover porridge with others in the household, mainly other children. When probed further about sharing of the porridge, the intervention groups explicitly stated that they did not share. A common theme in the Control Group regarding challenges to follow instructions was "difficulty not sharing" within the household. This theme was not apparent in the intervention groups (see

Appendix Table 8).
Sharing outside the household was reported to be quite low, and was not significantly different among the groups **(Table 10)**. Less than one percent of all households report selling either the CSB or the FVO, and only about one to five percent of households across the study groups report giving away either of these foods. Although there is little to no reported sharing outside the household, FGD participants across all three study groups describe being asked by others in the community to share the FVO and CSB, but again state that they did not share. No one indicated that they sold the ration themselves, but mentioned, "some people give away or sell" the ration. Reasons for selling included using the money for other basic needs within the household, such as salt or soap.

Several themes emerged regarding the community's perceptions about FVO and CSB. BMCs described common beliefs and perceptions within the community:

- Perception that CSB is better than other flours;
- Jealousy of those who receive the ration;
- Desire to taste the FVO and CSB;
- Perception that others (besides the target child) are entitled to the porridge;
- General lack of understanding of the purpose of the ration;
- Lack of understanding that the FVO is to be used only for porridge;
- Lack of caring for the beneficiary child's well-being;
- Desire to use FVO for relish (family food)

Table 8. Observed sharing and breakdown of who was eating the porridge by study group

n (%)	**Control Group (n=42)***	**Intervention Group 1 (n=62)***	**Intervention Group 2 (n=85)***
Sharing**	35 (83)	30 (48)	50 (59)
Among total no. times sharing observed			
Other children age<5 in family	7 (20)	21 (70)	28 (56)
Other children age>5 in family	12 (34)	7 (23)	9 (18)
Mother	6 (17)	4 (13)	9 (18)
Other family members (adult)	1 (3)	1 (3)	1 (2)
Other children outside HH	16 (46)	4 (13)	9 (18)
Other	2 (6)	0 (0)	0 (0)

* Total number of times porridge eating observed

** Sharing is defined as anyone other than the beneficiary child observed eating the porridge.

Table 9. Reported consumption and sharing of supplementary food ration among household members

	Intervention Group 1 *(n=192)*	Intervention Group 2 *(n=196)*	Control Group *(n=196)*	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	***P*§**
Amount of porridge consumed by beneficiary child (ml)				
All ages*	267 ± 109	277 ± 101	267 ± 105	0.57
6-24 months**	253 ± 113	254 ± 102	233 ± 92	0.25
25-60 months†	283 ± 103	306 ± 97	306 ± 103	0.26
	n (%)	**n (%)**	**n (%)**	
No. times beneficiary child is fed porridge per day	[a]	[b]	[a]	0.04
Once	14 (7)	10 (5)	12 (6)	
Twice	143 (74)	167 (85)	141 (72)	
Thrice	32 (17)	16 (8)	39 (20)	
More than three times	3 (2)	3 (2)	4 (2)	
BMC's rating of child's liking of porridge				0.58
Dislike it a lot	1 (1)	1 (1)	0 (0)	
Dislike it a little	3 (2)	5 (3)	3 (2)	
Neutral	9 (5)	8 (4)	17 (9)	
Like it a little	39 (20)	35 (18)	39 (20)	
Like it a lot	140 (73)	147 (75)	137 (70)	
Households with leftovers from last porridge preparation	132 (69)	125 (64)	141 (72)	0.22
Household members consuming porridge				
Beneficiary child	192 (100)	196 (100)	196 (100)	-
Other children under five	49 (26)‡[a]	44 (22)[a]	70 (36)[b]	0.01
Other children	38 (20)‡[a]	38 (19)[a]	72 (37)[b]	<0.001
Mother or Father of beneficiary child	15 (8)‡[a]	15 (8)[a]	33 (17)[b]	0.004
Other	5 (3)‡[ab]	1 (1)[a]	10 (5)[b]	0.02
Households reporting only the beneficiary child consumed porridge	102 (53)[a]	108 (55)[a]	59 (30)[b]	<0.001
Households that *do not* use CSB for foods other than porridge	191 (99)	194 (99)	195 (99)	0.78
Households who *do not* use FVO for foods other than porridge	166 (86)[a]	165 (84)[a]	140 (71)[b]	<0.001

* n= 179 (Intervention Group 1), 187 (Intervention Group 2), 189 (Control Group)

** n=96 (Intervention Group 1), 96 (Intervention Group 2), 103 (Control Group)

† n=80 (Intervention Group 1), 79 (Intervention Group 2), 79 (Control Group)

‡ 1 missing

§ P-value for difference among groups from ANOVA for continuous variables or chi-square test for categorical variables
Within each variable, superscripts with the same letter are not significantly different at $P<.05$, based on pair-wise chi-square tests and Bonferroni methods.

Table 10. Reported sharing of ration outside the household

	Intervention Group 1 *(n=192)*	Intervention Group 2 *(n=196)*	Control Group *(n=196)*	
	n (%)	**n (%)**	**n (%)**	***P****
Households that give CSB to other households	3 (2)	5 (3)	10 (5)	0.114
Households that sell CSB	0 (0)	0 (0)	0 (0)	-
Households that give FVO to other households	1 (1)	2 (1)	3 (2)	0.615
Households that sell FVO	0 (0)	0 (0)	2 (1)	0.137

*P-value for difference among groups from ANOVA for continuous variables or chi-square test for categorical variables

3.2 Objective II: Cost and Cost-Effectiveness

3.2.1 Program Costs

The components of program costs by study group are shown in **Table 11**. Total program costs by study group over the four-month intervention were USD $21,650 in Intervention Group 1, $27,171 in Intervention Group 2, and $14,909 in the Control Group. The calculation of cost per beneficiary is based on the assumption of four one-month rations distributed to each BMC, as programmed[7]. Thus, the estimated cost per beneficiary was $143.38 in Intervention Group 1, $157.97 in Intervention Group 2, and $83.29 in the Control Group **(Table 11)**.

The majority of costs in the Control Group were attributable to the commodities and overseas transportation costs **(Figure 6)**. In addition to these costs, in the Intervention Groups a large proportion of costs were also due to intervention-related costs such as materials and labor needed for repackaging of FVO and (in Group 2) CSB, pre-implementation costs for initial training of health workers and formative research to develop SBCC messages used in training. Prior to designing the smaller CSB package, the research team completed additional SBCC in Intervention Group 2. Comparing cost per beneficiary, the cost of CSB was the same among all three groups, as was expected, given that the CSB ration and source were the same; FVO cost was $17.38 in both Intervention Groups and $6.68 in the Control Group, given the increase in ration size from one L to 2.6 L. The transport cost to Malawi was also higher in the Interventions Groups than in the Control Group, due to the increased FVO ration from one L to 2.6 L per beneficiary per month. In-country transportation, warehousing and personnel costs were also slightly higher per beneficiary in the Intervention Groups compared with the Control Group also due to the increased FVO ration.

Distribution costs per beneficiary were slightly higher in the Intervention Groups than in the Control Group ($0.27) due to distributions taking slightly longer (on average about two hours in Intervention Group 1, slightly less than two hours in Intervention Group 2, and about 1.5 hours in the Control Group) and slightly higher in Intervention Group 1 ($0.41) than in Intervention Group 2 ($0.38) because of the time saved by distributing the CSB in individual-sized packets; however, this difference represented a very small proportion of the total costs (less than one percent). Intervention-related costs (other than the cost of the additional FVO) were $27.48 in Intervention Group 2 compared with $17.09 in Intervention Group 1, due to the additional CSB repackaging costs. BMC monetized time costs were similar among the three groups.

Finally, pre-implementation investment costs were higher per beneficiary in Intervention Group 2 than Intervention Group 1 due to the formative research needed for the design of CSB repackaging and additional SBCC messaging. The pre-implementation costs represent the amount of investment needed at the beginning of the program–these would not be ongoing costs once the program was started and scaled up. If a similar project were started elsewhere, these investments would be required, but might be lower if a similar population is being served such that formative evaluation would not be needed, or packaging messages would not need to be redesigned. Since these are fixed, one-time costs, the cost per beneficiary would of course fall as the number of beneficiaries increased. The Sensitivity Analysis section discusses the impact of reducing these costs.

[7] Most BMCs reported receiving three, four, or more than four rations in the in-depth interviews.

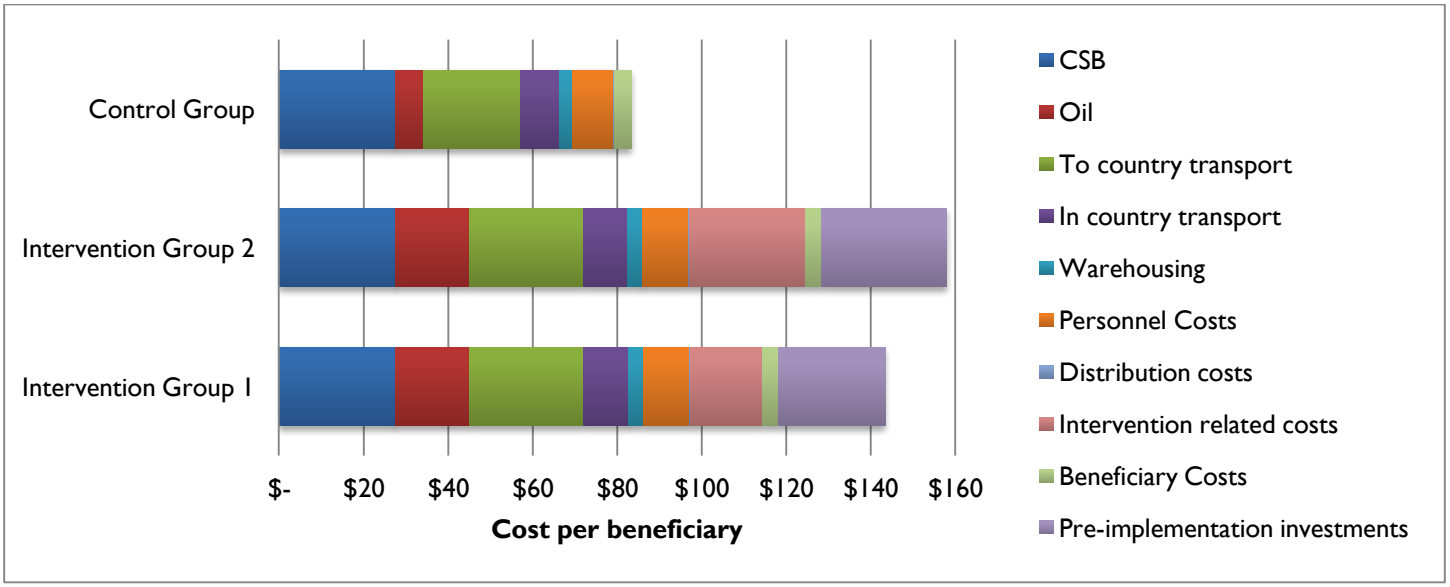
Table 11. Program component costs per beneficiary* and percent contribution of cost components to total costs by study group over the four-month intervention, USD

Cost Component	Description	Intervention Group 1	Intervention Group 2	Control Group	Intervention Group 1	Intervention Group 2	Control Group
		Number of four one-month rations distributed**			Total Costs[1] USD		
		151	172	179	21,650	27,171	14,909
		Cost per beneficiary[2] USD			Percent contribution of cost components to total		
Corn-soy blend	Product cost	27.61	27.61	27.61	19.3%	17.5%	33.2%
Fortified vegetable oil	Product cost	17.38	17.38	6.68	12.1%	11.0%	8.0%
To-country transport of CSB and FVO	From US production plants to CRS warehouse in Blantyre, Malawi	27.06	27.06	22.96	18.9%	17.1%	27.6%
In-country transportation	From CRS warehouse to PVO warehouse, then FDP	10.65	10.35	9.00	7.4%	6.6%	10.8%
Warehousing	Storage at CRS and PVO warehouses	3.56	3.56	3.18	2.5%	2.3%	3.8%
Personnel Costs	CRS and PVO program-related personnel	10.75	10.75	9.60	7.5%	6.8%	11.5%
Distribution costs	Cost of unloading and distributing rations at FDPs	0.41	0.38	0.27	0.3%	0.2%	0.3%
Intervention-related costs	Ongoing CHW training and monitoring; CSB and FVO repackaging materials and labor	17.09	27.48	-	11.9%	17.4%	-
BMC Costs	Monetized cost of BMCs time to and from FDP, and time to get ration	3.73	3.75	3.98	2.6%	2.4%	4.8%
Pre-implementation investments	Initial SBCC CHW training; FVO repackaging materials; formative SBCC evaluation, CSB package design, pretesting	25.14	29.64	-	17.5%	18.8%	-
Total cost per beneficiary, USD		**143.38**	**157.97**	**83.29**			

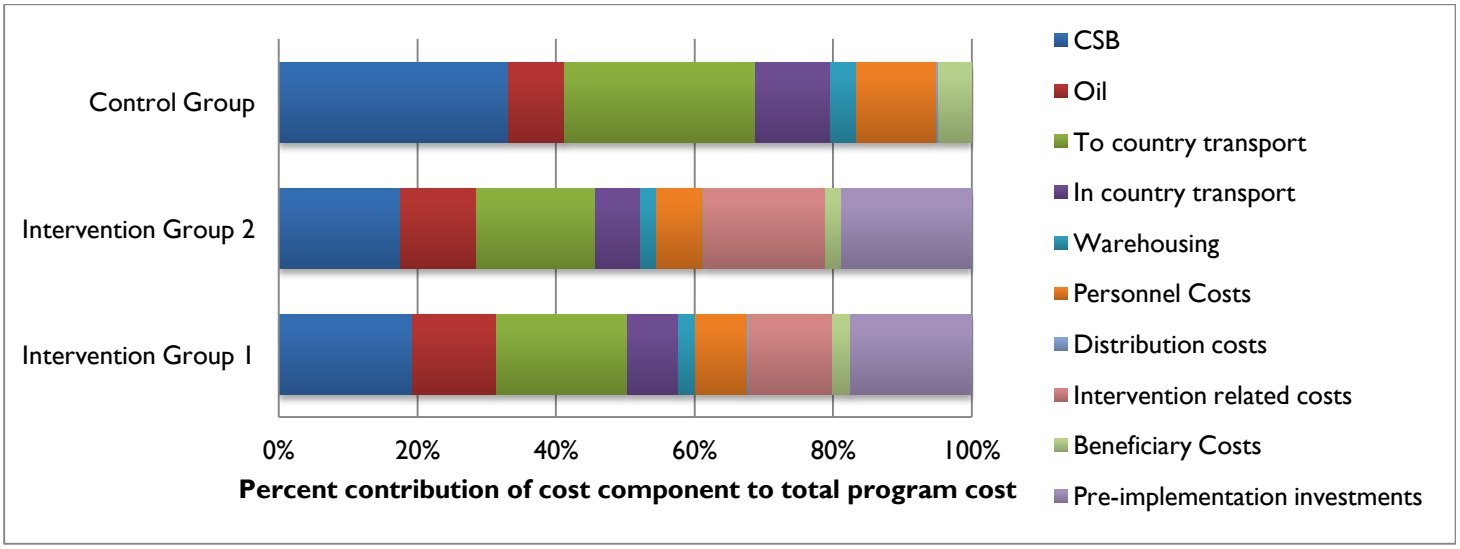
*Among PCI's FDPs for the 4-month duration of Phase 2. PVO level costs used representative data from PCI.

**As estimated by the number four one-month rations for each beneficiary enrolled in the program, as programmed.

Figure 6. Comparison of program component costs per beneficiary* and percent contribution of cost components to total costs among study groups, USD



*Based on four one-month rations distributed per beneficiary, as programmed



3.2.2 Cost-Effectiveness

The research team defined the measure of effectiveness for this study as a BMC preparing porridge at or above the target ratio of 30:100, as well as at a comparison ratio of 13:100. As reported in the results section for Objective 1, the percent of BMCs meeting or exceeding the 30:100 target ratio was 37 percent, 30 percent and five percent in Intervention Group 1, Intervention Group 2 and the Control Group, respectively; the percent of BMCs meeting or exceeding the comparison ratio of 13:100 was 82 percent, 79 percent and 32 percent, respectively. The increased cost per beneficiary resulted in higher effectiveness, as depicted in **Figure 7.**

The marginal cost-effectiveness is the cost of each *additional* BMC who prepared porridge at or above the target and comparison FVO:CSB ratios in each Intervention Group compared with the number in the Control Group **(**

Table 12**)**. The marginal cost per additional BMC meeting the target ratio was $188 in Intervention Group 1 and $300 in Intervention Group 2 **(Figure 8).** The percentages of BMCs meeting the target ratios in the two Intervention Groups were similar and not significantly different, and the increased costs in Intervention Group 2 related to repackaging of CSB conferred no additional increase in the number of BMCs meeting/exceeding the target ratio of FVO:CSB. Hence, the cost per BMC reaching/exceeding the target ratio was lowest in Intervention Group 1. Using the comparison ratio of 13:100, the magnitude of the difference in cost-effectiveness was less between the Intervention and Control Groups and the marginal cost per additional BMC meeting/exceeding the comparison ratio was $136 in Intervention Group 1 and $183 in Intervention Group 2.

Figure 7. Cost per beneficiary versus percent of BMCs meeting or exceeding the target porridge ratio of 30 g FVO to 100 g CSB among the three study groups, USD

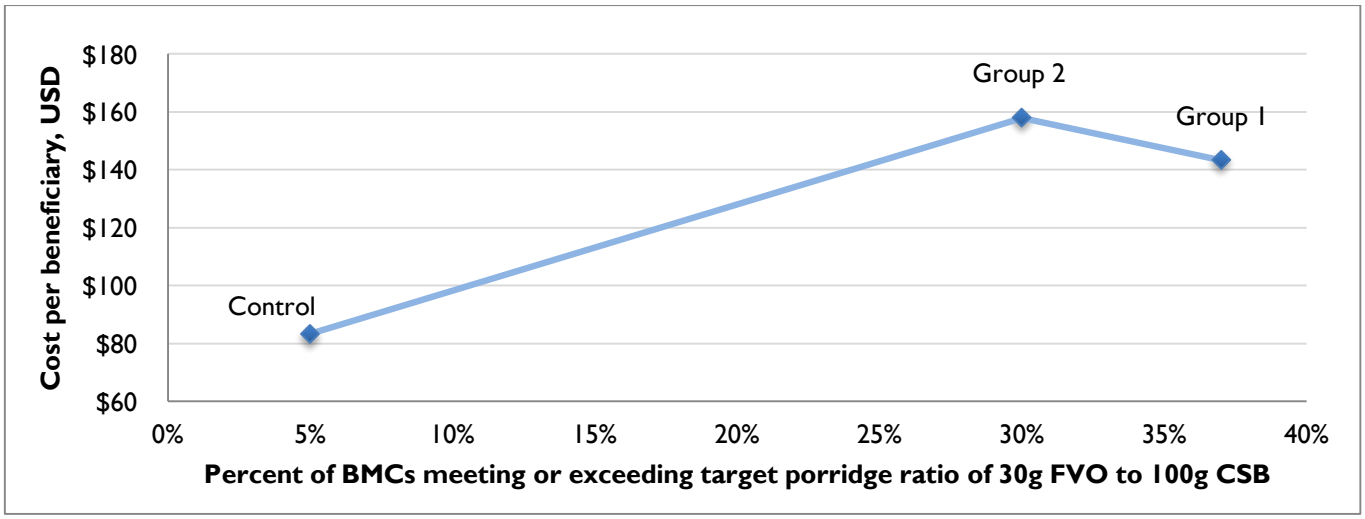


Table 12. Indicators of effectiveness and marginal cost-effectiveness among the study groups

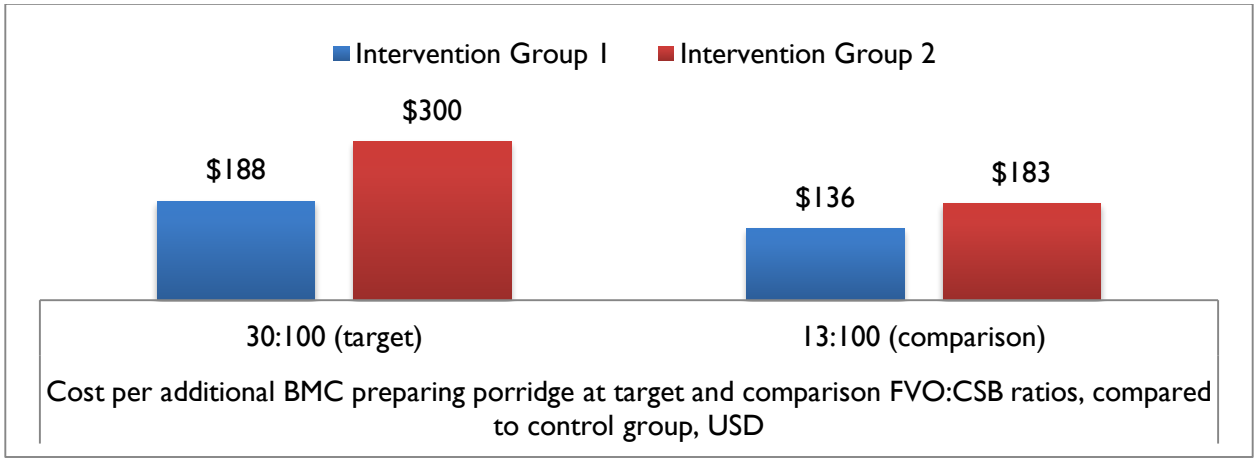
Indicator	Intervention Group 1	Intervention Group 2	Control Group
Percent of BMCs preparing porridge at or above target and comparison FVO:CSB ratios*			
30:100 (Target)	37	30	5
13:100 (Comparison)	82	79	38
Additional number of BMCs who met target and comparison ratios, compared to Control Group, per 100 beneficiaries**			
30:100	32	25	-
13:100	44	41	-
Marginal cost per 100 beneficiaries compared to Control Group, USD†	$6,000	$7,500	
Marginal cost-effectiveness: Cost per additional BMC preparing porridge at target and comparison FVO:CSB ratios, compared to Control Group, USD			
30:100	$188	$300	-
13:100	$136	$183	-

* From Objective 1 results; no significant difference between intervention group percentages

** To adjust for differences in number of BMCs among groups

† Calculated by multiplying cost per beneficiary x 100 beneficiaries, then taking difference between Control Group and intervention groups

Figure 8. Marginal cost-effectiveness: cost per additional BMC preparing porridge at target and comparison FVO:CSB ratios, compared to Control Group, USD



3.2.3 Sensitivity Analysis of Cost Variations on Cost-Effectiveness

The research team modeled variations in cost components to test the sensitivity of cost and cost-effectiveness estimates to potential cost changes and analysis assumptions.

Table 13 shows the potential effect and magnitude of changing costs and assumptions on marginal cost-effectiveness. While changes to specific cost inputs altered the precise estimates of marginal cost-effectiveness, none of these modifications altered the relationships among the three groups. Furthermore, no reasonable changes in key parameters made Intervention Group 2 more cost-effective than Intervention Group 1.

The largest cost components in the Intervention groups were the commodities, transportation costs to Malawi, pre-implementation investments (one-time costs) and ongoing intervention-related costs. The model tested the largest cost components to see how variations in these costs would affect the cost per beneficiary and cost-effectiveness. Modeling a 20 percent increase and decrease in FVO and CSB prices had a relatively small impact, resulting in a change in cost per beneficiary of less than $10 in either direction among the three groups. Removing pre-implementation investments had the largest impact on reducing cost per beneficiary (from $143 and $158 to $118 and $128 in Intervention Group 1 and 2, respectively) and improving marginal cost-effectiveness (from $188 and $300 to $109 and $129 in Intervention Group 1 and 2, respectively).

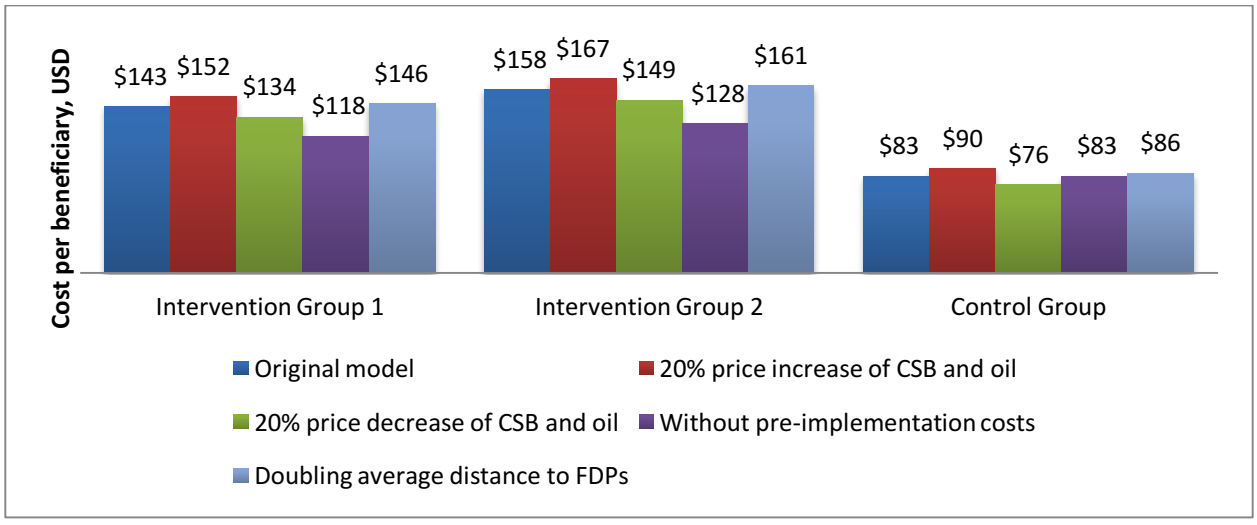
The research team modeled variations in proportionally smaller cost components. **Figure 9** shows the original and selected modeled costs per beneficiary among the three groups. The team used PCI data to calculate PVO costs. The average distance from the PVO to the FDPs varied among the PVOs, which affected transportation costs. However, modeling a doubling of the average distance from PVO warehouse to FDP (40 km to 80 km) had minimal impact on cost per beneficiary and cost-effectiveness. The research team originally modeled the commodity losses during the program (through spillage, spoilage, etc.) at 10 percent; sensitivity analysis was performed using values of five percent and 23 percent (the highest loss recorded). Losses of 23 percent mirrored results of increased FVO and CSB costs on cost per beneficiary and marginal cost-effectiveness; a modeled reduction of loss to five percent resulted in a more moderate decrease in these figures.

Overall, the cost model was robust to simulated changes in cost components, and the main findings remained consistent: Intervention Group I was the more cost-effective of the two strategies tested for increasing the ratio of FVO:CSB in porridge prepared by BMCs. To reduce program costs, the most impact could be made through reductions of commodity prices and overseas transportation costs; for example, by sourcing some or all FVO and CSB locally. Further reduction in costs may be associated with program scaled-up, and PVOs seeking to replicate the distribution and messaging methods tested here could benefit from knowledge and tools acquired/developed.

Table 13. Sensitivity analysis of cost variations on cost per beneficiary and cost-effectiveness by study group, in USD

Cost Component	Modeled Value	Cost per beneficiary (percent change from original model)			Marginal cost effectiveness: Cost per each additional BMC meeting or exceeding FVO:CSB ratio, compared with Control	
		Intervention Group 1	Intervention Group 2	Control Group	Intervention Group 1	Intervention Group 2
Cost per beneficiary as estimated		143	158	83	188	300
Price of CSB and FVO commodities: $785/MT (CSB), $1,651/MT (Oil)	20% price increase	152 (6.3%)	167 (5.7%)	90 (8.4%)	194	308
	20% price decrease	134 (-6.3%)	149 (-5.7%)	76 (-8.4%)	181	292
Commodity loss through supply chain and distribution, 10%	23%	152 (6.3%)	167 (5.7%)	90 (8.4%)	194	220
	5%	140 (-2.1%)	155 (-1.9%)	81 (-2.4%)	184	211
Distance from PVO warehouse to FDP, 40 km	80 km	146 (2.1%)	161 (1.9%)	86 (3.6%)	188	214
Without pre-implementation costs	$0	118 (-17.5%)	128 (-19.0%)	-	109	129

Figure 9. Comparison of changes to cost per beneficiary using original and modeled values of select cost components among the three study groups, USD



3.3 Objective III: Determinants of Effectiveness

In order to assess the factors related to effectiveness of reaching the target FVO:CSB ratio, a composite SBCC score was calculated. During data collection, the research team asked BMCs what they learned from their health care workers; CHWs and lead mothers were asked what they taught to the BMCs. The SBCC score ranges from zero to six, and represents a summation of the number of affirmative responses to the six questions found in **Table 14**.

Figure 10 displays the mean SBCC score for BMCs, CHWs and lead mothers, stratified by study group. The SBCC scores of BMCs, CHWs and lead mothers were uniformly high. All three groups of respondents had significantly higher scores in the two Intervention Groups than in the Control Group **(Figure 9).**

In order to understand further the factors related to the effectiveness of the intervention in achieving higher FVO:CSB ratios, the SBCC score was also analyzed among the BMCs, lead mothers and CHWs of the two Intervention Groups. The mean SBCC score among the BMCs in the Intervention Groups was 5.66; among lead mothers was 5.71; and among CHWs was 5.79 **(**

Table 15**)**.

Because the SBCC scores were uniformly high, there was insufficient variability in the score to show an effect in a multivariate regression model predicting compliance with the recommended target ratio, 30:100 (data not shown).

Table 16 displays the following determinants of effectiveness for the Intervention Groups, stratified by BMCs who met and did not meet the target ratio of 30:100: SBCC scores, BMCs' interaction with lead mothers and health workers, training of lead mothers and health workers, exposure to SBCC at FDPs, BMCs' proximity to FDP and household characteristics. There was a significant difference in mean SBCC score among BMCs between the groups that did and did not reach the 30:100 ratio (p=0.045), with those who did meet the target ratio having a lower score. Other significant differences were noted with regard to proportion of health workers reported to have received training (p=0.031) and mean number of household members (p=0.048).

Three FDPs had exceptionally high FVO:CSB ratios. For reasons described in Objective 1, they remain in the analysis. However, the BMC SBCC score does significantly differ between those who did meet the 30:100 ratio and those who did not meet the 30:100 ratio, BMC SBCC score does not significantly differ between the two groups when these three exceptional FDPs are removed from the sample (p=0.577).

An unadjusted linear regression model was fit to examine the crude relationship between BMC SBCC score and a continuous FVO:CSB ratio. Due to the successful implementation of the intervention in this study, it was not possible to isolate the effects of the intervention due to additional FVO from the effects of the intervention due to SBCC. This analysis, therefore, cannot determine which component most influenced the success of the intervention. The SBCC score calculated was tested as a predictor of the FVO:CSB ratio in a simple linear regression, and was not found to be a significant predictor (β=0.011, p=0.16). FVO quantity was constant within each group: Intervention Groups 1 and 2 received 2.6 L, and all of those in the Control Group received one L, so study group perfectly determines FVO ration quantity.

While there were no significant differences between the intervention groups with regard to the outcome, several themes emerged regarding perceptions about the CSB packets, both positive and negative, among participants from Intervention Group 2. As described in

Table 17, 56 percent of BMCs from Intervention Group 2 noticed and/or referred to the information (pictures and writing) on the CSB packet when they prepared the porridge, and 62 percent report that their training referenced these materials.

According to the FGDs, Intervention Group 2 participants report some negative feelings about the packets, including: packets do not have the right amount of CSB flour; packets are too small; packets have a lot of empty space and should be filled. Positive feelings about the packets were that they are "hygienic" and "easy to store." When probed about what participants liked specifically about the packets, the most common responses were "the pictures on the packet" and "the instructions." Respondents commonly described the pictures on the packet as especially helpful: e.g. "the child on the packet gives us hope", "the picture of the child motivates us." No one explicitly stated whether the information itself was helpful or not (see

Appendix Table 8).

Table 14. Descriptive statistics of SBCC score components by study group

	Intervention Group 1 *n=192*	**Intervention Group 2** *n=196*	**Control Group** *n=196*	
	n (%)	**n (%)**	**n (%)**	***P****
BMCs reporting being told about the ingredients that should be used to prepare the porridge	191 (100)	195 (100)	192 (100)	--
BMCs reporting being told how often to feed the child	183 (95)	192 (98)	182 (93)	0.06
BMCs reporting being told who should eat the porridge	190 (99)	194 (99)	189 (96)	0.10
BMCs reporting being told how long to boil the porridge	182 (95)	185 (94)	148 (76)	<0.001
BMCs reporting being told how to store the CSB	170 (89)	173 (88)	144 (73)	<0.001
BMCs reporting being told how to store the oil	168 (88)	167 (85)	142 (72)	<0.001
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	
Overall mean SBCC score (out of 6)	5.65 ± 0.80	5.67 ± 0.67	5.20 ± 1.09	<0.001

*P-value for difference among groups from ANOVA for continuous variables or chi-square test for categorical variables

Figure 10. BMC, CHW and lead mother mean SBCC scores by study group

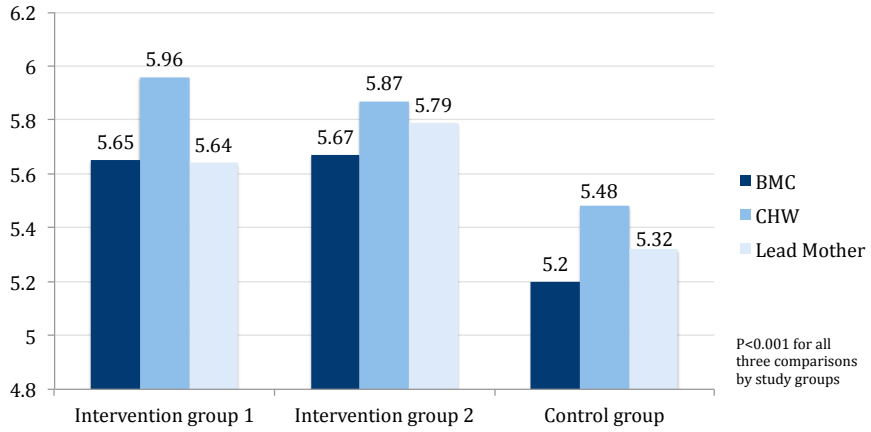


Table 15. Descriptive statistics of SBCC score components among BMCs, lead mothers and CHWs within Intervention Groups

n (%)	*BMCs (n=388)*	*Lead Mothers (n=135)*	CHWs (n=104)
They report being told/telling about ingredients to use in porridge	386 (100) 2 missing	127 (94)	97 (96) 3 missing
They report being told/telling how often to feed the child	375 (97)	134 (99)	101 (99) 2 missing
They report being told/telling who should eat the porridge	384 (99)	134 (99)	101 (99) 2 missing
They report being told/telling how long to boil the porridge	367 (95)	125 (93)	101 (99) 2 missing
They report being told/telling how to store the CSB	343 (88)	125 (93)	101 (99) 2 missing
They report being told/telling how to store the oil	335 (86)	126 (93)	101 (99) 2 missing
Overall mean score (out of 6), mean (SD)	5.66 (0.78) 2 missing	*5.71 (0.78)*	5.79 (0.8) 3 missing

Table 16. Comparison of factors influencing compliance with target ratio among intervention group BMCs

n=398, 90 missing	**BMCs who met 30:100 ratio (n=100)**	**BMCs who did not meet 30:100 ratio (n=198)**	**P-value**
	Mean ± SD	***Mean ± SD***	
BMC SBCC score	5.48 ± 1.04	5.68 ± 0.69 (2 missing)	0.05
CHW SBCC score	5.93 ± 0.12	5.91 ± 0.14	0.26
Lead Mother SBCC score	5.76 ± 0.27	5.63 ± 0.30	0.22
Proportion of health workers that receive training, reported (By FDP)	0.87 ± 0.11	0.83 ± 0.15	0.03
Proportion of Lead mothers that receive training, reported (By FDP)	0.67 ± 0.14	0.69 ± 0.18	0.43
Household proximity to FDP			
Mean Distance, km	3.47 ± 2.44 (2 missing)	3.67 ± 2.35 (8 missing)	0.50
Mean Time, min	74.08 ± 46.15	80.09 ± 49.28 (1 missing)	0.31
Number of household members	5.65 ± 1.84	5.21 ± 1.80	0.05
Mean # children under 5	1.36 ± 0.56	1.34 ± 0.60	0.82
	n (%)	***n (%)***	
Number of distributions received (proxy for exposure to SBCC at FDP)			0.09
One	2 (2)	4 (2)	
Two	9 (9)	11 (6)	
Three	23 (23)	27 (14)	
Four	26 (26)	46 (23)	
Over four	40 (40)	110 (56)	
BMCs that interacted with CHW/lead mother at the home	31 (31)	53 (27)	0.44

Table 17. Reported use and perceptions regarding repackaged CSB among intervention group BMCs

Intervention Group 2 (n=196)	***n (%)***
BMCs who notice and refer to the information (pictures and writing) on the CSB packet when they prepare the porridge *(2 missing)*	108 (56)
During training, reference to information on the CSB packet for instructions *(4 missing)*	119 (62)
BMCs reporting use of pictures versus written instructions in training *(79 missing, 2 other)*	
Pictures more	22 (19)
Written instructions more	25 (21)
Both the same	68 (58)

4. Study Limitations

The study presented some limitations:

- This was a combined intervention; therefore, we could not separate the effect of extra FVO from the effect of SBCC.
- The CSB quantity of eight kg/child/month mandated by the MoH in Malawi is substantially greater than typically provided in Title II development programs treating MAM. The FVO quantity used as part of the intervention (2.6 L/child/month) is also substantially greater than what is typically provided in Title II development programs treating MAM. This greater amount has potential implications for sharing and has limitations in its comparability to other programs.
- Although the study concluded that it is feasible to get BMCs to meet the target ratio of FVO:CSB with FVO distributed separately from CSB, it is not possible to calculate what quantities of FVO and CSB are needed to achieve this goal.

5. Summary of Main Findings and Recommendations

Objective I: Feasibility and Effectiveness

- It is feasible to get BMCs to meet the target ratio of FVO:CSB with FVO distributed separately from CSB.
- Even among those who did not reach the target ratio, the mean FVO:CSB ratio was significantly higher in the intervention groups.
- The extra FVO ration and SBCC intervention, together, are effective in achieving the target FVO:CSB ratio.
- There is no added impact of providing CSB in two kg packets with messaging.
- Sharing of CSB porridge within the household is lower in both the intervention groups. These findings are consistent in both reported and observed data.
- There is minimal reported selling of FVO or CSB in any group**.**

These results suggest that operationally, it is possible to provide FVO and CSB separately and still achieve the recommended preparation of CSB porridge with adequate amounts of FVO. The concern that FVO will inevitably be diverted to other uses and not used for the CSB porridge was not supported in this study. In fact, use of FVO for family food was greater in the control group, which received less oil, than in the two intervention groups. Further, the concern that repackaging the CSB in individual packets would promote exchange or sale of the CSB was not supported. It seems that SBCC messages were consistently delivered and received in both Intervention Groups; the additional information on the two kg packets was appreciated, but did not result in greater compliance with the recommended ratios.

Objective II: Cost-Effectiveness

- Cost-effectiveness in achieving compliance with the target ratio is substantially more favorable in the intervention groups than in the Control Group.
- Cost-effectiveness is most favorable in Intervention Group 1, because there was no added impact in Intervention Group 2, despite the additional cost for repackaging CSB.

- The major components of cost were those of the commodities themselves and their shipping from the US to Malawi. Within-country transportation, costs of distribution and management costs contributed a smaller proportion to total cost. BMC costs of participation did vary across study groups but contributed minimally to total cost estimates.
- The other substantial contributor to program cost was costs associated with implementing the intervention: formative research, SBCC development and training of health care personnel.
- Sensitivity analysis showed that changing assumptions about the individual components of program cost did not alter the relative cost effectiveness of the interventions in the two Intervention Groups and the Control Group.

These results suggest the most cost effective intervention for increasing the FVO:CSB ratio is that implemented in Intervention Group 1. Based solely on this measure, the added cost of repackaging is not justified. However, there are other possible reasons for providing CSB in sealed, individual packets, including efficiency of distribution, ease of transportation and handling, and hygiene.

Cost effectiveness depends on the degree to which fixed costs can be spread over a larger number of beneficiaries and on the degree to which improvements in efficiency can be realized as the program is implemented at scale. Cost components such as repackaging of FVO and CSB could be reduced if larger quantities were repackaged at one time than were required for the present study. Fixed costs such as development of SBCC messages and training would be reduced per BMC proportional to the number of beneficiaries included in the program.

Objective III: Determinants of Effectiveness

- Main determinant of effectiveness was the intervention
- Due to lack of variability in the implementation of the SBCC component, we cannot distinguish the effect of individual intervention components

We considered a number of possible factors that might affect the effectiveness of the interventions, including household composition, socio-economic status and wealth, age of the beneficiary child, age and education of the BMC and distance from the beneficiaries' households to the FDP. In this study, the intervention itself was the main determinant of compliance with the recommended ratio, and none of the other factors showed an independent or mediating effect on the impact of the interventions.

6. Conclusions and Next Steps

This study concluded that it is possible to achieve high rates of compliance with recommended FVO:CSB ratio in porridge preparation and to increase the FVO:CSB ratio significantly, even when FVO and CSB are distributed separately.

These results are operationally significant for USAID FFP and other agencies implementing supplementary feeding programs. World Food Programme, among other donors, prioritizes distribution of supplementary foods with FVO already included in the supplement (such as Supercereal Plus [15]), because of the concern that if is provided separately, it will be diverted to other uses and not incorporated into the porridge preparation. This study found that by providing sufficient FVO and strong SBCC, it is possible to get BMCs to prepare porridge with high ratios of FVO:CSB.

The study found that repackaging CSB in individual, sealed packets with instructional messages did not achieve greater compliance with the recommended FVO:CSB ratio than the provision of additional FVO and SBCC with the CSB distributed in bulk. Nonetheless, beneficiaries and program staff noted other advantages of the individual packets: they are more hygienic than bulk distribution; their distribution at the FDP is more efficient and less time consuming; and some respondents found that receiving packages rather than having to scoop CSB from open tubs was more dignified.

Also operationally relevant is the result that in this context, neither the FVO nor the repackaged CSB was reportedly sold, despite initial concerns that the more convenient packaging would promote diversion to the market. Analysis of data from market studies will serve to validate these self-reported findings.

These results highlight the importance of assessing cost-effectiveness of program interventions. While the cost per beneficiary was lowest in the Control Group, the cost-effectiveness was more favorable in the Intervention Groups, and specifically most favorable in Intervention Group 1, as the increased cost of repackaging CSB in Intervention Group 2 did not further increase the FVO:CSB ratio beyond that achieved in Intervention Group 1.

Cost-effectiveness assessment focused on achieving the stated goal of increasing the FVO:CSB ratio and reaching or exceeding the recommended target ratio of 30:100. The study did not assess the impact of the increased ratio on growth outcomes, which, in the case of this study, would be related to recovery from MAM. To justify the recommendation, and to justify an intervention focused on the FVO:CSB ratio, further research is needed to determine whether this ratio is related to the growth outcomes of interest.

Then further research is needed to assess the effectiveness and cost-effectiveness of these interventions compared with the possible effectiveness and cost-effectiveness of providing different supplementary foods, specifically foods that contain FVO and do not require the beneficiaries to mix FVO with CSB themselves.

7. References

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Appendix 1: Food Aid Quality Review Summary

The study falls under the auspices of the Food Aid Quality Review Phase II.

The United States Agency for International Development's (USAID) Office of Food for Peace awarded a two-year extension contract (FAQR Phase II) to Tufts University's Friedman School of Nutrition Science and Policy in October 2011 and a third-year extension in 2013 for a total of five years. FAQR Phase I, conducted from 2009 to 2011, examined the nutritional needs of beneficiary populations across the developing world and the nutritional quality of commodities currently available to meet those needs, with the objective of improving the quality of Title II food aid commodities and programming. The findings of FAQR Phase I were published as a report, *Delivering Improved Nutrition: Recommendations for Changes to US Food Aid Products and Programs* (USAID, April 2011), which is available at www.foodaidquality.org and at http://www.usaid.gov/what-we-do/agriculture-and-food-security/food-assistance/resources/research-and-policy-papers.

The FAQR is part of a series of USAID and United States Department of Agriculture (USDA) activities aimed at enhancing product choice under Title II of Public Law 480 (P.L. 480), improving quality control and assurance (of both processes and products) and updating technical guidance and the evidence base for programming approaches. The present contract builds on work performed under the original FAQR and will focus on implementing recommendations made in Phase I for changes in food aid products, programming and processes.

FAQR Phase II activities include advancing the evidence base through production and testing of improved food products, their packaging and delivery methods and comparative studies of products' nutritional effectiveness and cost-effectiveness, implementation research and pilot projects and facilitation of interagency and multi-sectoral coordination. FAQR Phase II continues its consultative process to interact with and solicit input from a wide range of stakeholders.

The work of the FAQR Phase II continues to address three areas of focus: (1) products (development and testing of new or modified nutritionally enhanced food aid commodities); (2) programs (the uses of such foods to meet nutritional goals in the context of Title II programs); and (3) processes (e.g., safety and quality assurance in the supply chain, harmonization of processes among donor agencies and coordination among agencies within the US Government). Specific areas of concentration include the following:

Products

Phase II is focusing on: the development of specifications of the updated Fortified Blended Foods (FBF) including Corn Soy Blend 14 (CSB14), recommended in the Phase I report, as well as milled flours, enhanced vegetable oil and the micronutrient premix(es); CSB laboratory and pilot production testing; acceptability trials; assessments and recommendations for supply chain and related issues.

Programs

Activities include strengthening the evidence base for food assistance programming through expert

consultations and workshops on key topics and issues with representatives of the various Title II implementing agencies and other stakeholders. Multiple activities are being undertaken which include the review of food programming guidance provided to Title II implementing agencies and a review of the data collected from Title II implementing agencies as part of required reporting and how the data are used and could be better used to inform programming. Several field studies are also underway. In Malawi, a field study that finished at the end of FY 14 study sought to assess the feasibility of ensuring that when CSB is programmed with oil, beneficiaries use the oil as instructed to prepare CSB porridge for beneficiary children.

The study also assessed the impact of package changes (providing CSB in two kg packages rather than in bulk), in conjunction with appropriate behavior change messages, on correct use and other aspects such as between and outside household sharing. Analysis of this field study will be completed in FY15. The study in Burkina Faso is assessing the effectiveness and cost effectiveness of the new CSB14, delivered with oil, as compared with alternatives such as lipid-based nutrition supplement (LNS) products and other fortified blended foods (including CSB+ and oil and WFP's formulation of Supercereal Plus (SC+) with skim milk powder and oil incorporated into the matrix), in the prevention of moderate wasting (moderate acute malnutrition or MAM), the prevention of stunting and the promotion of adequate growth in children 6-23 months. The study in Sierra Leone assessed the effectiveness and cost-effectiveness of these same foods in the treatment of MAM in children under age 5. Due to the Ebola Virus Disease Outbreak, FAQR suspended permanently the treatment study in Sierra Leone, and began scoping new countries to restart this study.

Processes

FAQR II focuses on the formation of an Interagency Food Aid Technical Committee as well as implementing regular meetings with major food aid agencies (WFP, UNICEF, USAID, USDA and others) to address the need for harmonization of food products and related procurement and quality assurance processes used in Title II food aid.

Appendix 2. Collaborating Partners

In addition to collaborating closely with CRS and the PVOs, Pakachere's organization for Behavioural Communication Change and Centre for Social Research (CSR) were subcontracted for data collection in the field.

CSR is a research institution within the Faculty of Social Science of the University of Malawi in Zomba. It was established in 1979 with support from UNICEF to appraise, monitor and evaluate development activities in Malawi, and promote the efficient exchange and utilization of research information for policy improvement. CSR has extensive experience in carrying out research on child survival, HIV/AIDS, malaria, governance, natural resources, environment and livelihoods. The CSR Director, Dr. Alister Munthali, is a professor at University of Malawi Chancellor College. He supervised the data collection (along with the Tufts Field Coordinator, Gray Maganga). Dr. Munthali has been conducting research since the 1970s.

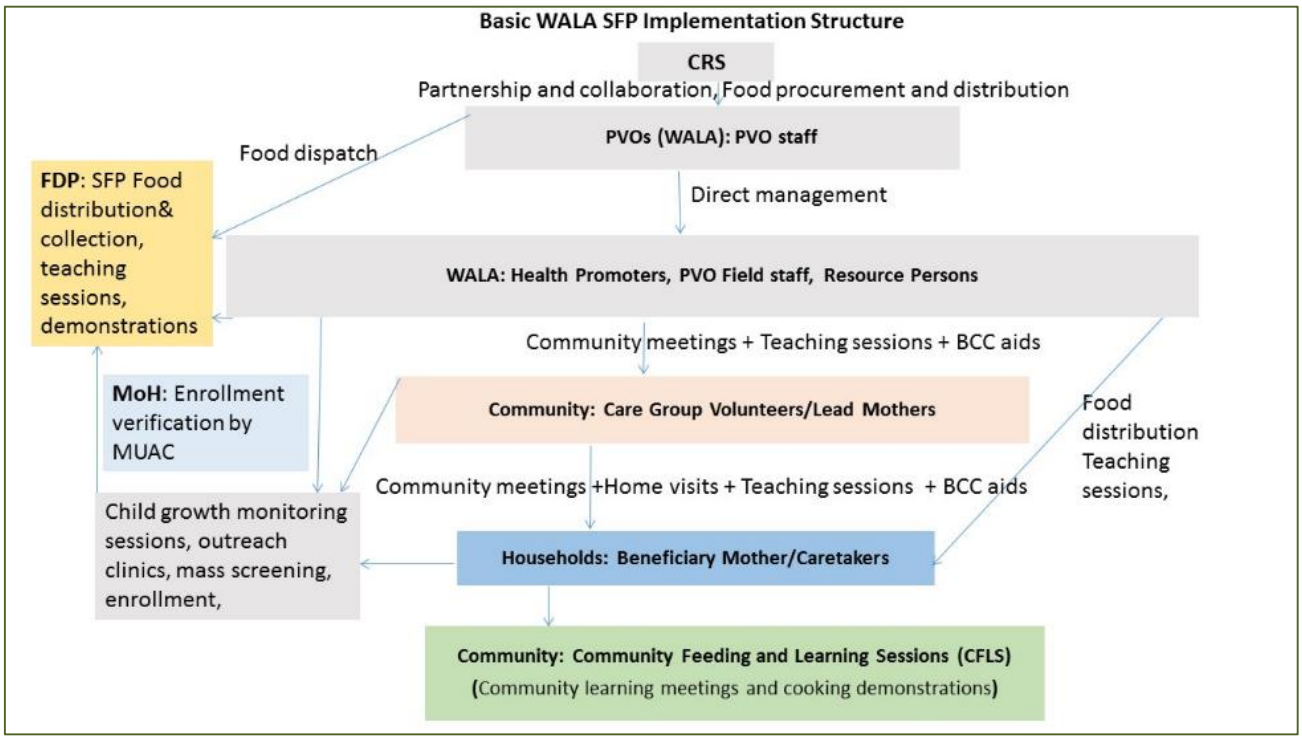
Pakachere Institute for Health and Development Coommunication (PIHDC) is one of the leading social and BCC PVOs in Malawi. Established in 2002, PIHDC has wide experience in the development of effective social and BCC campaigns and projects that cover health and development issues extensively. PIHDC is part of a Southern Africa nine-coutry regional network of health and development communication.

Other involved partners are as shown in the table below.

Appendix Table 1. Study partners and their roles

	MAIN PARTNER	ROLES
1.	**Catholic Relief Services (CRS) organization**	Managing the Wellness and Agriculture for Life Advancement (WALA) seven-partner consortium program
2.	**Save the Children International (SCI)**	Title II WALA program implementing PVO in Chiradzulu district
3.	**Project Concern International (PCI)**	Title II WALA program implementing PVO in Balaka and Machinga districts
4.	**Africare Organization**	Title II WALA program implementing PVO in Mulanje district
5.	**Center for Social Research (CSR)**	In-country research collaborator charged with data collection and data entry
6.	**Pakachere Institute for Health Development and Communication (PIHDC)**	Local research behavioral change communications (SBCC) firm that led SBCC message development, education and training component of the study intervention.
7.	**Countryside Limited**	Local company that repacked the CSB into two kg packets
8.	**OG-Plastics**	Local company that produced the two kg, 70 micron CSB repacking polythene bags, polypropylene master bags and 100 micron clear master polythene bags.
9.	**Fattani Printers**	Local company that printed message stickers for the new CSB packet
10.	**Graphic Elements**	Local designer; designed the new two kg CSB packet

Appendix Figure 1. Operational structure of SFP



Appendix Table 2. CSB13 [1]

Corn Soy Blend 13		
Nutrient	**Fortificant Form**	**Total Target per 100g (Premix+ Intrinsic)**
Macronutrients		
Energy (kcal)		376
Protein (g)		16.7
Fat (g)		6
Minerals (mg)		
Calcium	2 percent Tri-calcium phosphate	831
Copper	N/A	0.9
Iodine	Potassium iodide	0.06
Iron	EDTA and ferrous fumarate	14.7
Magnesium	Magnesium oxide	168
Manganese	N/A	0.7
Phosphorus	2 percent Tricalcium phosphate	206
Potassium	Potassium monophosphate (monocalcium phosphate)	634
Selenium	N/A	0.01
Sodium	Sodium chloride	7.3
Zinc	Zinc sulfate monohydrate	5
Vitamins (mg)		
Vitamin A	Vitamin A palmitate	2.54-4.8
Vitamin B_1 (thiamin)	Thiamin mononitrate	0.53
Vitamin B_2 (riboflavin)	Riboflavin	0.481
Vitamin B_3 (niacin)	Niacinamide	6.23
Vitamin B_5 (pantothenic acid)	D-pantothenate	3.4
Vitamin B_6	Pyridoxine hydrochloride	0.532
Vitamin B_9 (folic acid)	Folic acid	0.247
Vitamin B_{12}	Vitamin B12 0.1 percent (water soluble)	0.001
Vitamin C	Coated ascorbic acid Type EC	40
Vitamin D_3	Vitamin D3 100,000	0.005
Vitamin E	Vitamin E 50 percent CWS	8.7
Vitamin K	Dry vitamin K1 5 percent (spray dried)	0.0009

Appendix Table 3. CSB+ Ingredients [16]

Corn Soy Blend *Plus*		
Nutrient	**Target Premix per 100g**	**Total Target per 100g (Premix+ Intrinsic)**
Moisture (max)	0	10%
Energy (min)	0	380 kcal
Protein (min)	0	14% (13.3g)
Carbohydrate (g)	0	64.3
Fiber, total dietary (g)	0	5
Crude Fiber (max)	0	5%
Total Lipid (min)	0	6% (2.5g)
Minerals		
Iodine (µg)	40	40
Iron (total mg)	6.5	11.77
Iron (mg) (in the form of ferrous fumarate)	4	4
Iron (mg) (in the form of Iron-sodium EDTA)	2.5	2.5
Zinc (mg)	5	7.71
Potassium (mg)	140	724
Calcium (mg)	452	512
Phosphorous (mg)	290	596
Biotin (µg)	8.2	8.2
Vitamins		
Vitamin A RE (IU)	3460	3632
Vitamin D3 (IU)	441.61	441.61
Vitamin E TE (mg)	8.3	8.85
Vitamin K1 (µg)	30	39.6
Vitamin B1 (mg)	0.2	0.68
Vitamin B2 (mg)	1.4	1.73
Vitamin B6 (mg)	1	1.56
Vitamin C (mg)	90	91.2
Pantothenic acid (mg)	1.6	2.18
Folic acid (*as Dietary Folate Equivalents)* (µg)	110	200
Niacin (mg)	8	11.18
Vitamin B12 (µg)	2	2

Appendix Table 4. FVO ingredients [17]

Fortified Vegetable Oil				
	Oil	**Premix per 100g**		**Total (100g)**
	Intrinsic (100g)	Recommended Level	Fortificant Form	
Energy (kcal)	884			884
Total Lipid (fat) (g)	100			100
Minerals				
Iron (mg Ferrous Fumarate)	0.05			0.05
Iron: total (mg)	0.05			0.05
Zinc (mg)	0.01			0.01
Vitamins				
Vitamin A (IU)	0	6,000.00-7,500.00	Retinol palmitate	6,000.00-7,500.00
Vitamin E (alpha-tocopherol) (mg)	8.18			8.18
Vitamin D (IU)	0	1,700.00-2,100.00	D3 as cholecalciferol	1,700.00-2,100.00
Vitamin K (phylloquinone) (µg)	183.9			183.9
Lipids				
Fatty acids, total saturated (g)	15.65			15.65
Fatty acids, total monosaturated (g)	22.783			22.78
Fatty acids, total polyunsaturated (g)	57.74			57.74

Appendix 3: Details on Formative Research/Preparation Process

Pakachere Institute for Health and Development Communication (referred to as the SBCC team) led all formative research for the study. In order to prepare for the Phase I program change, the SBCC team conducted six FGDs and nine informal taste tests to develop standardized CSB porridge recipes and education materials that promoted correct preparation of CSB porridge recipes for BMCs.

Distributing 2.6L FVO in 5L Jerry cans

The SBCC team used the results of the FGDs and taste tests to develop all SBCC materials, including education modules for CHWs on how to instruct lead mothers or BMCs how to handle prepare and consume the FVO and CSB ration.

SBCC Intervention Training, Education and Monitoring

Two training sessions (Phase I: September 2013 and Phase II: January 2014) of SBCC were conducted with 303 CHWs within the study sites. These CHWs were health promoters, health facilitators and health surveillance assistants drawn from the 12 intervention FDPs. The training also included PVO staff and MoH staff from the four study districts.

Using a study-specific SBCC training manual (banners, flip-books and pamphlets), CHWs were given a Trainer of Trainers (ToT) training on the recipe of cooking CSB porridge using 30 g of FVO and 100 g of CSB. The SBCC team also educated on the local interpretation and translation of the SBCC message, and technicality of measuring "100 g" and "30 g" using locally available cooking tools like 15 ml spoons, 500 ml cups and 300 ml Coca-Cola bottles. All training sessions included cooking demonstrations, plenary sessions on creation of a SBCC fieldwork plan, and the SBCC dissemination process and monitoring milestones. The CHWs from each FDP developed work plans outlining the activities related to information flow to the lead mothers and eventually to the BMCs at household level.

Using the care group model, the SBCC team carried out monitoring visits to 12 intervention FDPs and their catchment area. This exercise aimed to see how the CHWs were passing on information to the Care Group Lead Mothers before passing it on to the BMCs at their households. The key message was to instruct BMCs to follow cooking recipe with recommended FVO:CSB ratios besides encouraging them not to share, sell or give away FVO, CSB or porridge. Phase II refresher training introduced an additional component with the objective of educating BMCs to use additional instructions printed on the two kg CSB packets.

Appendix 4: Development of CSB packages

To develop CSB packages, the research team worked with a local SBCC firm, PIHDC, to create and evaluate several message prototypes, research on packet design specifications (materials, dimensions, resealable properties, colors, pest and moisture resistance checks, etc.) and options for repacking 30 MT of CSB in Malawi–from 25 kg sacks into smaller bags carrying four, two kg packets. The development of these products followed USAID branding and marketing regulations.

Additionally, three FGDs were conducted to pretest the newly developed prototypes. Results from these FGDs were used to finalize the message design and to produce two kg packets that were used as intervention in Phase II.

Appendix Figure 2. Repackaging CSB into two kg packets with informational stickers

		
Two kg CSB Packet	Eight kg bag holding four, two kg packets	24 kg master bag holding three, eight kg bags

Appendix Table 5. SBCC Intervention Timeline

SBCC Intervention Timelines		
#	**Activity**	**Completion Time**
1.	SBCC strategy development	June 2013
2.	Formative evaluation and analysis of data	July 2013
3.	Recipe trials and recipe development	July 2013
4.	SBCC message development workshop	July 2013
5.	Development of communication strategy, training manual and banners and pamphlets	August 2013
6.	Piloting and review of SBCC instruments and aids	August 2013
7.	Training and implementation of SBCC activities in study areas	August 2013
8.	Packet and packet message design	September 2013

Appendix Table 6. Total food commodity and other supplies distributed to the study sites in each phase

Total Food Commodity and Other Supplies Distributed to the Study Sites in Each Phase							
AFRICARE PVO	**# of MU5'**	**TOT CSB***	**TOT FVO**	**FVO Bottles**	**FVO Boxes**	***CSB Packets***	***Porridge Sample bottles***
Jun, 13 – Sep'14 – Baseline	2138	22576	2684.776	0	0	--	150
Oct, '13 – Feb'14, – Phase 1	2476	29728	6722.686	1500	18	--	150
Mar-Jun, 2014 – Phase 2	3633	38768	9447.691	500	9	4,992	200
TOTAL	8247	91072	18855.15	2000	27	4,992	500
Save the Children PVO	**# of MU5'**	**TOT CSB***	**TOT FVO**	**FVO Bottles**	**FVO Boxes**	**Packets**	**Sample Bottles**
Jun, 13 – Sep'14 – Baseline	728	10800	1954.152	--	--	--	150
Oct, '13 – Feb'14, – Phase 1	545	6496	1389.463	1500	18	--	150
Mar-Jun, 2014 – Phase 2	900	11016	2396.29	500	9	4,992	200
TOTAL	2173	28312	5739.905	2000	27	4,992	500
Project Concern International PVO	**# of MU5'**	**TOT CSB***	**TOT FVO**	**FVO Bottles**	**FVO Boxes**	**Packets**	**Sample Bottles**
Jun, 13 – Sep'14 – Baseline	1579	26952	3303	0	0	--	150
Oct, '13 – Feb'14, – Phase 1	1316	14512	3586.8	1500	18	--	150
Mar-Jun, 2014 – Phase 2	2008	21984	4815.2	500	9	5,016	200
TOTAL	4903	63448	11705	2000	27	5,016	500
ALL PVOs	**# of MU5'**	**TOT CSB***	**TOT FVO**	**FVO Bottles**	**FVO Boxes**	**Packets**	**Sample Bottles**
Jun, 13 – Sep'14 – Baseline	4445	60328	7941.928	--	--	--	150
Oct, '13 – Feb'14, – Phase 1	4337	50736	11698.95	4500	54	--	150
Mar-Jun, 2014 – Phase 2	6541	71768	16659.18	1500	27	15,000	200
TOTAL	15323	182832	36300.06	6000	81	15,000	500
***Including CSB in packets**							

To reach distributions targets, special approval from FFP allowed CRS to shift some food balance from other programs to the study sites, especially, food from the intervention for pregnant and lactating women.

The study also procured data collection supporting equipment and tools. In each phase, each enumerator was equipped with a data collection tool kit as shown below:

Appendix Table 7. Data Collection Tool Kit

1) 1 kg of rice (CSB model)	10) 3 pens	20) 1 local tablespoon
2) 1 L of water (porridge model)	11) 2 plastic folders	21) 1 local teaspoon
3) 1 backpack	12) 1 clipboard	22) 1 funnel
4) 2 pairs of towels	13) 2 ink rubbers	23) 1 umbrella
5) 2 notebooks	14) data collection Instruments	24) 1 raincoat
6) 50 ml Sample collection bottles	15) 1 flashlight	25) 1 camera (for pair)
7) Ziploc plastic bags	16) 1 simple wrist digital watch	26) 1 GPS
8) data collection plan	17) 1 calibrated jug	27) 1 recorder (for pair)
9) list of study subjects	18) 1 calibrated small cup	28) 1 bicycle
	19) code book/list of codes	29) field authorization letter/s

Appendix 5: Ennumerator Training

Key training concepts and activities:

- Understanding the study objectives, all data collection instruments, study sites, participants and methodology
- Mock demonstrations of individual interviews and Focus Group Discussions (FGDs) with beneficiary mothers/caretakers of children under 5 years of age
- Mock demonstrations on individual interviews and FGDs with Lead Mothers/Care Group Volunteers
- Mock demonstrations on individual interviews with community Health Care Workers (HSAs, Health Promoters, Health Facilitators)
- Mock demonstrations on individual interviews with store owners/vendors
- Mock demonstrations of in-home observations
- Training on codes that will be used in the field for the PVOs, Districts, FDPs, Villages and CSB/FVO Beneficiaries for the study
- Demonstrations on effective measurement and procedures of food modeling processes
- Demonstrations on scooping CSB/FVO porridge for sample collection to ensure that the sample comes from an evenly mixed batch
- GPS training on taking geographic position coordinates
- Knowing the toolkit and use of toolkit items
- How to trace, identify, consent and interview a participant
- How to fill in questionnaires and recording any other side notes; and
- How to facilitate an FGD, take notes and record the FGD discussions

Appendix Table 8. Sample Quotes from FGDs

	Intervention Group 1	Intervention Group 2	Control Group
Porridge preparation			
Hygiene	*We wake up in the morning and sweep…We then clean the pot.*	*Firstly, I take a pot and clean it.*	*First I clean the kitchen.*
Amount of CSB used	*We measure CSB using the small cup (180 ml equivalent).*	*I measure CSB in that smallest cup we were given (180 ml cup).*	*I level the flour in a tea cup.*
Amount of FVO used	*I measure six tablespoons of oil and mix with the CSB.*	*We then add 6 plastic teaspoons of oil to the CSB and mix thoroughly.*	*I mix the flour with six spoons of oil.*
Challenges			
Other commitments	*Sometimes we may go to the fields and come back late… which may result into us failing to follow instructions.*	*As women we have a lot of commitments in the community so it is not always that I would be at home.*	*Some women do not cook the porridge at all because they are busy with going to the field.*
Rely on others to prepare	*Sometimes… the father or the grandparent may cook the porridge without adding FVO.*	N/A	*Some parents get busy… an older child in the household prepares the porridge as a result they do not prepare it accordingly.*
Child's appetite	N/A	*My child refuses to eat the porridge.*	*When my child gets sick, she refuses to eat anything.*
Sharing			
Difficulty not sharing	N/A	N/A	*Some older people around the household also want the porridge so I have no choice but to share.*
No sharing when asked	*Some people would still want us to share… but we do not.*	*I tell them that the ration is medicine for my sick child and I cannot share.*	*We do not share because we have reasons so we explain to them.*
Leftover porridge	*If there are leftovers of the CSB porridge, that is when I give them to other children.*	*I give the other children leftovers.*	*We give other children the porridge that is left in the pot after we have taken enough for the child.*
Giving away or selling	*Some people do share the*	*The people I know of do*	*Some sell to buy other*

	ration because they want to use the money for some basic needs.	*not sell.*	*foods for the household.*
Perceptions of CSB packets			
Pictures on the packet	N/A	*The information on the packet acts as a reminder… especially the pictures.*	N/A
Packets are too small	N/A	*The two kg packets are too small*	N/A