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Acceptability of Lipid-Based Nutrient Supplements and Micronutrient Powders among Pregnant and Lactating Women and Infants and Young Children in Bangladesh and Their Perceptions about Malnutrition and Nutrient Supplements

Malay K. Mridha, Camila M. Chaparro, Susana L. Matias, Sohrab Hussain, Shirajum Munira, Stacy Saha, Louise T. Day, Kathryn G. Dewey

February 2012

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Abbreviations and Acronyms

ANOVA	analysis of variance
CHDP	Community Health and Development Program
CHW	community health worker
CI	confidence interval
CMW	community midwife
dl	deciliter(s)
FANTA-2	Food and Nutrition Technical Assistance II Project
FGD	focus group discussion
g	gram(s)
ICDDR,B	International Centre for Diarrhoeal Disease Research, Bangladesh
iLiNS	International Lipid-Based Nutrient Supplements (Project)
IRB	Institutional Review Board
IYC	infants and young children
kcal	kilocalorie(s)
kg	kilogram(s)
L	liter(s)
LNS	lipid-based nutrient supplement(s)
µg	microgram(s)
mm	millimeter(s)
MNP	micronutrient powder(s)
MUAC	mid-upper arm circumference
NIPORT	National Institute of Population Research and Training
NGO	nongovernmental organization
PCG	primary caregiver
PLW	pregnant and lactating women
SD	standard deviation(s)
U.N.	United Nations
UNIMMAP	U.N. international multiple micronutrient preparation
VHV	village health volunteer
WHO	World Health Organization

Abstract

Bangladesh has a high prevalence of undernutrition and micronutrient deficiencies among pregnant and lactating women (PLW) and infants and young children (IYC), and therefore presents an appropriate setting to evaluate the effectiveness of lipid-based nutrient supplements (LNS) and micronutrient powders (MNP). This study was carried out to assess the acceptability of LNS among PLW and IYC, and MNP among IYC, as well as to understand perceptions about malnutrition and nutrient supplements prior to implementing an effectiveness study.

The study was carried out in three wards of the Fatejongpur union of the Chirirbandar sub-district of the Dinajpur district in Bangladesh. Acceptability was assessed for three products: LNS for PLW (LNS-PLW), LNS for IYC (LNS-IYC), and MNP for IYC (MNP-IYC). Assessment of each product was conducted in three phases:

- Test-feeding (mixed with rice)
- Home use
- Focus group discussions (FGDs)

There were two flavors of LNS: regular (peanut) and cumin for LNS-PLW and regular and cardamom for LNS-IYC. Therefore, a randomized crossover design was used for the test-feeding phase with LNS. For the home-use phase, each participant received only one randomly determined flavor of LNS. FGD participants were randomly selected.

Forty-eight subjects (PLW or IYC 6–24 months of age) participated in the assessment of each product. Percent consumption of the rice-LNS-PLW and rice-LNS-IYC mixtures did not differ by flavor on either of the two test-feeding days. The median rating of overall acceptability of LNS-PLW, LNS-IYC, and MNP-IYC (as reported by the PLW or the caregivers for the IYC) was 5 (“liked a lot”) in each week of home use. Over the 2-week period of home use, 95% (LNS-PLW), 92% (LNS-IYC), and 96% (MNP-IYC) of the recommended number of sachets were consumed. Only one PLW and a few caregivers (16.0%, 8.7%, and 0.0% in the LNS-IYC-regular, LNS-IYC-cardamom, and MNP groups, respectively) reported sharing supplements with others.

During the FGD, the PLW or caregiver participants opined that the supplements were beneficial for them (LNS-PLW) or their children (LNS-IYC and MNP). The program staff also had a favorable opinion about the supplements and the benefits of their use in the population they serve. In addition, the preference among PLW, caregivers, and program staff was to position the supplement as a special food instead of a medicine. PLW and caregivers preferred the supplements to be delivered to their homes, but also indicated their willingness to pick them up somewhere else. Program staff were willing to deliver the supplements; they said that home delivery, although difficult, was possible. A preference for weekly or fortnightly distribution was indicated. Storing the supplement out of reach of children was seen as necessary to reduce sharing. Program staff suggested feeding the supplement under observation (by them) to make sure that it is eaten by the target person. The main community barrier identified during the FGD was misinformation and spreading of incorrect information in the communities, which could affect consumption.

In conclusion, all three supplements were acceptable, in terms of both the amount of the test meal consumed and the rankings of overall acceptability. The home-use trials and FGD data confirmed acceptability and indicated that sharing of supplements with others was uncommon.

Introduction

Undernutrition is common among women of reproductive age (15–49 years) and infants and young children (IYC) in Bangladesh. The 2007 Bangladesh Demographic and Health Survey (National Institute of Population Research and Training [NIPORT], Mitra and Associates, and Macro International, 2009) showed that:

- 29.7% of women ages 15–49 years old were underweight (defined as body mass index < 18.5 kg/m^2)
- 43.2% of under-5 children were stunted (height-for-age < −2 standard deviations [SD])
- 41.0% were underweight (weight-for-age < −2 SD)
- 17.4% were wasted (weight-for-height < −2 SD)

Anemia is also a public health problem in Bangladesh. Results from other surveys indicated that 45% of pregnant women (Ahmed et al., 2005) and 49% of under-2 children (Harun-Or-Rashid et al., 2009) had anemia (defined as hemoglobin concentration < 11.0 g/dl), and 31% of children ages 2–6 years old suffered from iron deficiency anemia (serum ferritin < 12 µg/L) (Faruque et al., 2006).

Other micronutrient deficiencies are also present among Bangladeshi women and children. The prevalence of iodine deficiency, defined as urinary iodine excretion < 100 µg/L, was 33.8% in 6–12-year-old children, 38.6% in women of childbearing age (Yusuf et al., 2008), and 40% among pregnant women, nationally (Ahmed et al., 2005). Among rural pregnant women in Bangladesh, 18.5% had vitamin A deficiency (serum retinol < 0.7 µg/L) (Lee et al., 2008). In addition, in a subgroup of pregnant women followed longitudinally, 66% gained less than 4 kg of weight during their last trimesters (Ahmed et al., 2005).

Maternal undernutrition increases the risk of intrauterine growth retardation, low birth weight, and preterm birth (Bhutta et al., 2009), carrying over its negative effects into the next generation. Similarly, micronutrient deficiency in IYC affects infants' and children's health, growth, and development. Children with zinc deficiency are at increased risk of disease and death from infectious disease such as diarrhea and pneumonia (Black, 2003), and they have higher risk of poorer motor development (Black, 2003a). Furthermore, iodine and iron deficiency have been linked to cognitive deficits in children (Black, 2003b).

"Lipid-based nutrient supplements" (LNS) refers generically to a range of fortified, lipid-based products, including highly concentrated nutrient supplements (1–4 teaspoons/day, providing < 100 kcal/day) suitable for "point-of-use" fortification (Chaparro and Dewey, 2010). LNS contain vitamins, minerals, and essential fatty acids, and have the potential for preventing malnutrition and micronutrient deficiencies among pregnant and lactating women (PLW) and IYC. Micronutrient powder (MNP) is another product that is suitable for "point-of-use" fortification, and is already being used in Bangladesh. MNP contains only vitamins and minerals and hence is devoid of essential fatty acids and energy. Due to the high prevalence of undernutrition and micronutrient deficiencies, Bangladesh presents an appropriate setting in which to evaluate the effectiveness of LNS for preventing maternal malnutrition, improving birth outcomes, and preventing undernutrition and micronutrient deficiencies among IYC, as well as its relative effectiveness compared to MNP for IYC.

For a nutrient supplement to be effective, it must be acceptable and regularly consumed (Young et al., 2010). Since our ultimate aim is to carry out an effectiveness study of LNS among PLW and their children in Bangladesh, we first wanted to assess the acceptability of LNS and MNP in these target groups. We also wanted to explore the perceptions of PLW and primary caregivers toward malnutrition in their communities, nutrient supplements, and barriers and obstacles for the successful use of the proposed supplements (LNS and MNP). LNS have not been used for home fortification in Bangladesh, and MNP are not currently in use in the study area population (though they are in use in other areas of Bangladesh, and several research trials have been conducted in the country).

We therefore conducted two randomized crossover acceptability trials for two different flavors of LNS products,[1] implemented sequentially in a randomly determined order. One trial was for the two flavors of LNS formulated for PLW, and the second trial was for the two flavors of LNS formulated for IYC. We also implemented a separate acceptability trial for the one version of MNP formulated for IYC. As part of this work, we also conducted focus group discussions (FGDs) with PLW and staff and volunteers of LAMB,[2] a nongovernmental organization (NGO) operating in Bangladesh, that will be involved in the distribution of the proposed supplements in the future effectiveness study, to explore the themes outlined above (perceptions of malnutrition in their communities, nutrient supplements, and barriers and obstacles for the successful use of the proposed supplements). Additional goals of the FGDs beyond discussing the acceptability of the supplements were to:

- Identify ways to minimize intra-household sharing of LNS and MNP
- Explore strategies for "positioning" the product (e.g., to be used as a "special supplement" for IYC or for PLW) and possible delivery mechanisms
- Collect information to help develop simple, key messages on appropriate use of LNS-PLW, LNS-IYC, and MNP for IYC to accompany delivery of the intervention.

We have presented the results of this research in two parts. Part 1 describes the results from the acceptability trials for all of the supplements tested, and includes portions of the FGDs most relevant to the concept of acceptability of the supplements. Part 2 describes the remaining FGD results that are not as directly related to the acceptability of the supplements tested.

1 Crossover trials are ones in which all participants are supposed to receive all options being tested. In the case of these two trials, all participants in each trial were assigned to receive both flavors.

2 LAMB is derived from "Lutheran Aid to Medicine in Bangladesh." However, the organization is formally known by the acronym only.

Part One. Acceptability of Lipid-Based Nutrient Supplements and Micronutrient Powders among Pregnant and Lactating Women and Infants and Young Children in Bangladesh

A. Materials and Methods

A.1 STUDY DESIGN

Three acceptability studies were conducted: lipid-based nutrient supplement (LNS) for pregnant and lactating women (PLW) (LNS-PLW), LNS for infants and young children (IYC) (LNS-IYC), and micronutrient powder (MNP) for IYC (MNP-IYC). Each study contained three phases:

- Test-feeding
- Home use
- Focus group discussions (FGDs)[3]

In addition, to make sure that there were no allergic reactions to the supplements, a test dose was provided under observation by study staff during enrollment. For the LNS products, a randomized crossover design was used for the first phase (test-feeding) because there were two different flavors of each type of LNS. For the second phase of the acceptability studies of LNS, each participant received only one randomly determined flavor of LNS. For the acceptability study of MNP, similar methods were used as with the LNS, but there was only one MNP version to test; thus, no crossover design was used.

A.2 PRODUCTS

LNS for PLW and IYC were initially developed as part of the International Lipid-Based Nutrient Supplements (iLiNS) Project[4] by Nutriset S.A. in France. The iLiNS Project is a research collaboration committed to accelerating progress in preventing malnutrition. Currently, iLiNS investigators are conducting research projects testing these same LNS in Burkina Faso, Ghana, and Malawi. The micronutrient composition of the LNS developed for PLW is similar to that of other multiple micronutrient prenatal supplement formulations, such as that developed by UNICEF, the World Health Organization (WHO), and the United Nations (U.N.) University (the U.N. international multiple micronutrient preparation [UNIMMAP]), with some modifications. Some of these modifications (e.g., increasing to twice the recommended nutrient intake for thiamin, riboflavin, niacin, vitamin B6, vitamin B12, vitamin E, zinc, copper, and selenium) were found to be beneficial in a previous trial of a prenatal multiple micronutrient tablet in Guinea-Bissau (Kaestel et al., 2005) and, thus, were adopted for LNS-PLW. The other modifications included addition of several nutrients (pantothenic acid, vitamin K, calcium, phosphorus, potassium, magnesium, iodine, and manganese) that were not included in the original UNIMMAP formulation for cost or feasibility reasons.

The LNS-IYC formulation is similar in ingredients and micronutrient profile to the commercially available LNS Nutributter®, with a few changes in raw ingredients (e.g., a 50% reduction in sugar content) and in vitamin/mineral content. Details about the formulation of Nutributter® and the LNS products used are given in Tables 1 and 2 (pages 26 and 27). MNP-IYC was a product already available in Bangladesh.

A.2.1 LNS-PLW

For this trial, we tested the acceptability of two different flavors of LNS-PLW that had similar nutrient content (Table 1). One of them (LNS-PLW-regular) was the standard flavor with peanut as one of the ingredients. The other one (LNS-PLW-cumin) had soy protein isolate in place of some of the peanut as

[3] Note that only the FGD results related to acceptability of the supplements are presented in Part 1; the remaining FGD themes are presented in Part 2 of this report.

[4] http://ilins.org.

one of the ingredients and was flavored with cumin. The cumin flavor was selected in accordance with the taste preferences of the Bangladeshi population. The other ingredients of LNS-PLW-cumin and LNS-PLW-regular included vegetable oil, dried skimmed milk, maize starch, premix (complex of vitamins and minerals), and lecithin. LNS-PLW was packaged in single-dose 20 g sachets with no descriptive markings. The sachets were given codes only ("D" for LNS-PLW-regular, "Z" for LNS-PLW-cumin) so that the field assistants and PLW were blind to which LNS was being provided. The supplement was semisolid and yellowish in color and had a sweetish taste.[5]

A.2.2 LNS-IYC

For this trial, we tested the acceptability of two different flavors of LNS-IYC that had similar nutrient content (Table 2). One of them (LNS-IYC-regular) was the standard flavor with peanut as one of the ingredients. The other flavor (LNS-IYC-cardamom) replaced peanut with soy protein isolate as one of the ingredients and was flavored with cardamom. The cardamom flavor was selected in accordance with the taste preferences of the Bangladeshi population. The other ingredients of LNS-IYC-cardamom and LNS-IYC-regular included vegetable oil, dried skimmed milk, maize starch, premix (complex of vitamins and minerals), sugar, and lecithin. LNS-IYC was packaged in single-dose 10 g sachets with no descriptive markings. The sachets were given codes only ("M" for LNS-IYC-regular, "T" for LNS-IYC-cardamom) so that the data collectors and primary caregivers (PCGs) of the IYC were blind to which LNS was being provided. The supplement was semisolid and yellowish in color and had a sweetish taste.

A.2.3 MNP-IYC

MNP for IYC (Monimix®) was developed by Renata Pharmaceuticals Ltd. and marketed by Social Marketing Company in Bangladesh. Monimix® has five micronutrients (Table 2).[6] MNP-IYC was packaged in single-dose 1 g sachets. The supplement was in powder form, whitish in color with no odor and a salty taste.

A.3 STUDY AREA

The acceptability research was carried out in three wards of the Fatejongpur union of the Chirirbandar sub-district of the Dinajpur district in Bangladesh.[7] The Fatejongpur union was selected because it was one of the unions where the NGO LAMB was operating (implementing its Community Health and Development Program [CHDP]) and had, in a previously conducted socioeconomic survey, identified each household. LAMB's key activities include community health services, clinical services, management of disability, training, and research. Community health services provided by LAMB include maternal health services during pregnancy, delivery care services, postpartum care, neonatal care, and child health services. These services are delivered by the CHDP, which covers 21 unions and 1 municipality in 3 districts (Dinajpur, Rangpur, and Nilphamari).

The Fatejongpur union has three large wards, and each one was randomly assigned to one of the products tested (i.e., LNS-PLW, LNS-IYC, and MNP-IYC). Ward 1 was assigned to the MNP-IYC trial, Ward 2 to the LNS-PLW trial, and Ward 3 to the LNS-IYC trial.
The first two phases of each acceptability study (test-feeding and home use) were conducted in the households of the study participants; the third phase (FGDs) was conducted in a suitable place in the village or at a nearby health center.

[5] Although the LNS-PLW did not contain sugar, it still had a "sweetish" taste because of the presence of milk powder.

[6] Monimix® is commercially available in Bangladesh, but will not be the MNP used in the effectiveness study. The acceptability testing was performed prior to making a final decision on the MNP formulation to be used in the eventual effectiveness research.

[7] Bangladesh is divided into seven administrative divisions, which are further divided into districts. There are 64 districts in Bangladesh, each further subdivided into sub-districts (*upazilla)*. The rural areas of sub-districts are divided into approximately 7–10 unions, with each union consisting of multiple villages and roughly 27,000 people. Each union is subdivided into three large wards, and each large ward is subdivided into three small wards. Unions are the lowest administrative units in the rural areas of Bangladesh. The urban areas of sub-districts and districts are called municipalities.

A.4 SUBJECTS

For each ward, participants were randomly selected from a list of beneficiaries participating in LAMB's CHDP and invited to participate.

Eligible women for the acceptability trial of LNS-PLW met the following criteria:

- In the second or third trimester of pregnancy (and, if in the third trimester, the expected date of delivery was not within 3 weeks of the recruitment date) or breastfeeding a child between 3 days and 6 months of age
- At least 18 years old
- No life-threatening pregnancy-related complications (e.g., pre-eclampsia, antepartum hemorrhage)
- Apparently healthy and not presently suffering from an acute illness (e.g., fever, diarrhea, acute respiratory tract infection)
- Living in the study area for at least 6 months
- No known allergy to peanuts, soy protein, or milk products
- Planning to remain in the study area for at least 3 weeks following recruitment

Eligibility criteria for children to participate in the acceptability trials of LNS-IYC and MNP- IYC were:

- 6–24 months of age
- Consuming semisolid or solid foods for at least the past 30 days
- Apparently healthy and not presently suffering from an acute illness (e.g., fever, diarrhea, acute respiratory tract infection)
- Living in the study area for at least 6 months
- No known allergy to peanuts, soy protein, or milk products
- Without severe acute malnutrition (mid-upper arm circumference [MUAC] > 115 mm)
- Planning to remain in the study area for at least 3 weeks following recruitment

The sample size calculation for each supplement (LNS or MNP) tested was based on the proportion of the test dose consumed during the test-feeding phase. We assumed that the mean consumption of the test dose of any of the supplements (LNS or MNP) would be at least 75%, with a SD of 30%, and that the lower bound of the 95% confidence interval (CI) would be above 50%, based on 80% power and attrition of 10%. This requires a sample size of 18 (of IYC and of PLW), which we rounded up to 20. Thus, for any supplement (i.e., LNS-PLW, LNS-IYC, or MNP-IYC) to be considered "acceptable," the lower end of the 95% CI of the proportion of the test dose consumed would have to be at least 50%. Other measures of acceptability were also assessed and are explained in more detail below. Thus, the following sample sizes were used.

- **LNS-PLW trial.** Since two flavors of the LNS-PLW were going to be tested, we needed to carry out the LNS-PLW trial in two areas, with 20 PLW per area (n=40).
- **LNS-IYC trial.** Similarly since two flavors of the LNS-IYC were going to be tested, we needed to carry out the LNS-IYC trial in two areas, with 20 IYC per area (n=40).
- **MNP-IYC trial.** Though there was only one MNP to test, the sample size for the MNP was matched to the LNS-IYC trial, i.e., n=40, for comparative purposes.

A.5 RECRUITMENT AND TEST-DOSE PROCEDURES

Field staff (nine interviewers and three qualitative researchers) were recruited by LAMB and trained by Malay K. Mridha (one of the authors of this report) on standardized data collection methods. Six interviewers collected data for the IYC trial, and three others collected data for the PLW trial.

Study field assistants administered a screening questionnaire in the homes of potential participants to determine their eligibility for participation in the study. Each field assistant was assigned to recruit four participants on each recruitment day. Recruitment of participants took place during December 2009 and

January 2010. Written, informed consent to participate in the study was provided by willing and eligible PLW or the PCG of eligible children. The study was approved by the Institutional Review Board (IRB) of the University of California, Davis, and LAMB's ethics review committee. The clinical trial registration number of the study is NCT01129089.

For allocation into groups, subjects or PCGs were asked to draw a card from a box containing four cards: two cards were labeled with code "D" and two with code "Z" for the LNS-PLW trial. For the LNS-IYC trial, two cards were labeled with code "M" and two with code "T." The codes D, Z, M, and T were used for LNS-PLW-regular, LNS-PLW-cumin, LNS-IYC-regular, and LNS-IYC-cardamom, respectively. Since there was only one version of MNP-IYC, there was no need for randomization. The chosen code determined which type of LNS subjects or PCGs would receive first in the test-feeding trial (see below) and which type of LNS they would receive for the entirety of the home-use trial. Each field assistant followed the same recruitment and randomization process, which was independent from that of other field assistants (i.e., each field assistant had a box with four cards).

On the recruitment day for the LNS-PLW trial, each woman received a small test dose (~ 5 g) of either LNS-PLW-regular or LNS-PLW-cumin (depending on which one she was assigned to first) mixed with rice to check for any side effects related to consumption of peanut or milk powder (e.g., skin, respiratory, or gastrointestinal symptoms). On the recruitment day for the LNS-IYC and MNP-IYC trial, each child received a small test dose (~ 5 g) of either LNS-IYC-regular or LNS-IYC-cardamom (depending on which one the child was assigned to first) or MNP-IYC (~ 1 g) mixed with rice. After consumption, they were asked to remain under observation by the field assistant for at least 1 hour. After this initial test, the subjects or PCGs were given the project's cell phone number to call in case they perceived any possible side effects during the next few hours. The participating women and PCGs had easy access to cell phones in the study area.

A.6 PHASE 1: TEST-FEEDING

Field assistants visited each participant in her house the day after her recruitment. This second day was Day 1 of test-feeding, during which data were recorded. PLW were asked to consume approximately 40 g (~ 3 tablespoons) of rice mixed with one 20 g sachet (~ 4 teaspoons) of LNS. PCGs were asked to feed their children approximately 20 g (~ 2 tablespoons) of rice mixed with one 10 g sachet (~ 2 teaspoons) of LNS or one 1g sachet of MNP. Each PLW or PCG received a bowl and spoon from the project to assist with proper dosage. The field assistant weighed the LNS-rice mixture or MNP-rice mixture prior to consumption and the amount remaining after 15 minutes using standardized food scales (± 0.2 g). The amount of the rice-LNS or rice-MNP mixture consumed within 15 minutes was then calculated. PLW and PCGs were asked to rate the mixture's color, odor, taste, consistency, and overall degree of liking using a five-point hedonic scale. The responses (score) of the hedonic scale were (see Appendix 1):

- Dislike a lot (1)
- Dislike a little (2)
- Neither like nor dislike (3)
- Like a little (4)
- Like a lot (5)

On the third day (Day 2 of test-feeding), the PLW and IYC consumed the other type of LNS or the same type of MNP (for IYC only); the field assistant collected data in the same way as on Day 1 of test-feeding. Thus, for each PLW, there were two test-feeding days, one for each of the two types of LNS-PLW. For each IYC in the LNS trial, there were two test-feeding days, one for each of the two flavors of LNS-IYC. There were also two test-feeding days for the IYC in the MNP-IYC trial, but the same type of MNP was tasted on both days. Participating women and PCGs provided the rice for the test-feeding. Field assistants also administered structured questionnaires to collect additional data on the characteristics of the participants and their households.

A.7 PHASE 2: HOME USE

PLW and PCG of children that participated in test-feeding were given a 2-week supply of one type of LNS (the type to which they had been randomized to receive first at recruitment) or MNP. PLW were asked to add the supplement to their prepared food once per day during the 2-week home-use phase. To ensure that they consumed the entire daily dose, they were advised to mix each dose with 2–3 tablespoons of food and consume the mixed amount before consuming the rest of the food. PCGs of child participants received either 28 10-g sachets of LNS or 14 1-g sachets of MNP, and were asked to add the supplement to 1–2 tablespoons of the child's prepared food twice (for LNS-IYC) or once (for MNP-IYC) daily during the 2-week home-use phase. PCGs were advised to feed the mixture to the child before feeding the rest of the child's food. The PLW and PCGs were advised not to cook the supplement with the food and to store the supplement at room temperature. At weekly home visits, field assistants counted the number of sachets consumed and interviewed the PLW or PCG using semi-structured questionnaires to record data on preferred time of consumption, intra-household sharing of the supplement, perceived side effects, and health problems.

A.8 PHASE 3: FOCUS GROUP DISCUSSIONS

On the recruitment day, each field assistant asked the PLW and the PCGs of the children entering the study to draw a card from a box of four cards in which two were labeled "focus group" and two were labeled "no focus group." Therefore, half of the participants were selected for FGDs. When a PLW or PCG was selected for a focus group, information about the time and venue for the focus group was provided. All FGDs were conducted in a suitable place in the village or at a nearby health center. FGDs were scheduled to occur after the home-use phase had ended, so that the PLW or PCG had experience using the supplement.

Three qualitative researchers were recruited by LAMB and trained on standardized data collection methods. FGDs with PLW were conducted to explore opinions about opportunities and barriers to using a nutrient supplement, perceptions about the consumption and organoleptic properties of LNS, and overall acceptability of LNS. FGDs with the PCGs were conducted to explore important characteristics of foods appropriate for IYC, opinions about opportunities and barriers to using a nutrient supplement in the family, perceptions of the use of nutrient supplement for IYC, and recognition of the problem of malnutrition in their communities. FGDs also explored appropriate names and packaging designs for LNS products in Bangladesh and appropriate messages for promotion of LNS and reducing intra-household sharing of LNS.

Additionally, FGDs were carried out with LAMB village health volunteers (VHVs), community health workers (CHWs), and community midwives (CMWs) to explore similar issues. There were four FGDs: one with the VHV in each large ward (i.e., one FGD for each type of supplement) (VHVs were asked about the supplement distributed in their area) and one with the CHW and CMW (they were asked about all three supplements). VHVs carry out pregnancy surveillance in 165–340 households (approximately 900–1,500 people). They also identify eligible couples for services, conduct health promotion activities, and assist CHWs during health education sessions. CHWs supervise VHVs, carry out health education sessions, provide antenatal care and postnatal care, and keep records of PLW and under-5 children. CHWs are in charge of 600–1,400 households (approximately 2,500–6,000 people). CMWs conduct deliveries at the safe delivery units and provide health care to mothers and children at the safe delivery units and in the community.

Separate guidelines for FGDs for PLW, PCGs, and LAMB health staff were developed. The guidelines were designed to provide both "demand" and "supply-side" viewpoints about malnutrition in the community and use of nutrition supplements. Two qualitative researchers (Sohrab Hussain and Shirajum Munira), one facilitator, and one notekeeper conducted each FGD. The discussions were audiotaped.

A.9 DATA ANALYSIS

Quantitative data were double-entered in a database template using Microsoft Access. All data were imported to SPSS 16.0 (SPSS Inc., Chicago, Illinois, USA) and SAS 9.2 (SAS Institute Inc., Cary, North Carolina, USA) for analysis. Two-tailed independent and paired sample t-tests, repeated measures analysis of variance (ANOVA), and mixed linear models were used for analysis of continuous variables (e.g., amount of LNS-rice mixture consumed). Responses to the questions that used hedonic scales (e.g., color, taste, odor, consistency, overall liking of LNS) were analyzed using Wilcoxon signed rank test and Chi-square or Fisher's exact tests. A p-value < 0.05 was considered significant.

The audiotapes of the FGDs were transcribed and entered separately as Microsoft Word documents. The two qualitative researchers independently read and coded the transcripts by hand to identify and categorize recurrent topics. A thematic framework approach was used for analyzing the transcripts. The approach involved reading the transcripts to identify emerging sub-themes, which were then grouped into main themes. The themes included perceptions about malnutrition, factors that may influence the consumption of supplements, organoleptic properties of supplements, advantages and disadvantages of consuming supplements, overall acceptability of the supplements, suggestions about the names and packaging of the supplements, and health education messages for the promotion of the supplements. The perceptions about malnutrition, suggestions about the names and packaging of the supplements, and health education messages for the promotion of the supplements are reported in Part 2 of this report.

B. Results

B.1 LNS-PLW TRIAL

B.1.1 Participants

Details about recruitment, allocation, and follow-up of the PLW participants are given in Figure 1. Forty-eight women were enrolled in the PLW trial (slightly more than the needed sample size): 24 were pregnant and 24 were lactating. Characteristics of the 48 PLW that took part in the test-feeding and home use phases are shown in Table 3. The mean age was 23. Most of them were Muslim, had at least 1 year of formal education, and identified their primary occupation as housewife.

Of the 48 PLW, 24 women were selected for FGDs, and 22 women participated.

B.1.2 Phase 1: Test-Feeding

Table 4 presents findings of the test-feeding trial with PLW. The women that tasted LNS-PLW-regular on Day 1 received LNS-PLW-cumin on Day 2, and vice versa. On Day 1 of the test-feeding trial, women consumed 93.4% ± 18.1% (95% CI, 86.2%–100.1%) of the offered dose of the LNS-PLW-regular and rice mixture and 85.7% ± 26.4% (95% CI, 75.2%–96.3%) of the LNS-PLW-cumin and rice mixture. On Day 2, mean consumption of these two mixtures was 93.1% ± 12.2% (95% CI, 88.2%–97.9%) and 95.7% ± 7.1% (95% CI, 92.9%–98.6%), respectively. Results using mixed linear modeling indicate that consumption of the rice-LNS-PLW mixture did not differ by flavor (p=0.28), but did differ by testing day (p=0.04). Given these results, we compared consumption by flavor for each day separately; consumption of the rice-LNS-PLW mixture did not differ by flavor on either of the 2 test-feeding days (p=0.25 on Day 1, and p=0.36 on Day 2).

The median scores for the organoleptic properties (color, odor, taste, consistency) of each of the two flavors of LNS-PLW did not differ significantly by the test-feeding day. With data for both days combined, the percentage of women that rated each property either 4 ("liked a little") or 5 ("liked a lot") was 100% for color, taste, and consistency for both the LNS-PLW-regular and rice mixture and the LNS-PLW-cumin and rice mixture. For odor, the proportion with ratings of 4 or 5 was 91.7% and 100% for these two mixtures, respectively. Overall acceptability of each type of LNS-PLW is shown in Figure 4; all responses were either "liked a lot" (68.8% for LNS-PLW-regular; 83.3% for LNS-PLW-cumin) or "liked a little" (31.2% for LNS-PLW-regular; 16.7% for LNS-PLW-cumin).

On each test-feeding day, field assistants collected data on reported health problems of the PLW before beginning the test-feeding. The majority of women were healthy throughout the test-feeding trial and only a few suffered from a cough (n = 3), breathing difficulty (n = 3), nausea or vomiting (n = 2), or skin infection (n = 3). There was no difference in prevalence of any of these symptoms prior to consuming the supplements on Day 1 or Day 2. No women reported any side effects from consuming the supplement on Day 1 or Day 2.

B.1.3 Phase 2: Home Use

Table 5 shows the results of the 2-week home-use phase with PLW. Because there was no significant difference in results between Week 1 and Week 2 regardless of the type of LNS-PLW consumed (based on paired t-tests; data not shown), data were analyzed for the 2 weeks combined. Over the 2-week period, women reported consuming 95% of the recommended number of sachets of LNS-PLW, with no significant difference between LNS-PLW-regular and LNS-PLW-cumin.

Most women mixed the supplement with rice (89% for LNS-PLW-regular, 83% for LNS-PLW-cumin) or other foods, but a few (10%–15%) ate LNS-PLW by itself. They preferred to consume the supplement during breakfast or lunch. The preferred time of consumption depended on the time they cooked rice, as many of the women wanted to mix the supplement with hot rice before eating it. Almost all women reported finishing the entire sachet of LNS-PLW every time. Only one woman reported sharing the supplement with someone else. When asked about the supplement dosage and frequency, the women indicated that one sachet per day was a desirable dosage frequency because it would enhance compliance and minimize wastage compared to supplementation with more than one sachet per day.

During Week 1 of the home-use phase with PLW, two women that received LNS-PLW-regular and one woman who received LNS-PLW-cumin complained about the odor of the supplement. The woman who disliked the odor of LNS-PLW-cumin said that it smelled like soybean oil, which she found disagreeable. The women were reassured by the study staff that the supplements were safe and requested to continue taking them. After 2 weeks of home use of LNS-PLW, 72.7% of the respondents that received LNS-PLW-regular and 87.0% of the respondents that received LNS-PLW-cumin reported that they liked everything about the supplement. Those that disliked something about the supplements complained mainly about the smell, though one woman complained about the “sand-like” texture of the supplement. The median rating of overall acceptability was 5 (“liked a lot”) for both LNS-PLW-regular and LNS-PLW-cumin. Nearly all women reported that they liked the supplement “a lot” or “a little” (Figure 4), with only one woman (receiving LNS-PLW-cumin) reporting that she disliked the supplement (during Week 1 only).

Data on reported health problems of the PLW and any perceived side effects of the supplements were collected during the weekly home visits. The majority of women were healthy throughout the home-use phase. During the first week of supplementation, a few women reported illnesses or symptoms, including a cough (n=6), breathing difficulty (n=1), nausea or vomiting (n=1), skin infection (n=3), and vertigo (n=1). There was no increase in prevalence of any of these symptoms during Week 2, but one woman (receiving LNS-PLW-cumin) reported having abdominal pain.

We asked the women whether they would like to continue taking the supplements, if they were made available for a longer period. All said yes except one woman (who received LNS-PLW-cumin during the home-use phase) who said that she would not be willing to continue taking the supplements due to the fear of obstetrical complications from delivering a large baby.

B.1.4 Phase 3: Focus Group Discussions

Two FGDs were conducted with the participants in the LNS-PLW trial. In addition, one FGD conducted with VHVs was focused on the LNS-PLW.

Factors That May Influence LNS-PLW Consumption

PLW were generally happy to consume the supplements, and they expressed disappointment that some women in their community did not receive them. They mentioned that color, odor, taste, name, mode of

delivery, promotional messages, cultural beliefs, and socioeconomic conditions may all affect consumption of the supplements. Everyone was decisive about calling the supplements a "special food" instead of a "medicine." They argued that medicine should be from doctors or hospitals, and medicines were for sick people. They suggested a local name for the supplements, such as *pushtikor khabar* or *pushti khaddo*, both of which translate as "nutritious food." The majority of women stated that monthly delivery of the supplements would be suitable and would facilitate consumption, although some women feared that others would consume the supplements if a larger quantity was given at once or that the supplements might be wasted if a the larger quantity was not stored properly and was therefore vulnerable to being eaten or damaged by rodents or other pests. They said that women in rich families might think that they were already eating nutritious food every day and, thus, they might be reluctant to consume the supplements. They also mentioned that women in the community believe that nutritional supplementation leads to large babies and obstetrical complications. Women with this belief might not be willing to take the supplements. A few women suggested that the opinion of husbands might play an important role. An uninformed husband might not allow his wife to consume the supplements.

FGDs with LAMB health staff revealed similar beliefs about the factors that may influence consumption of the supplements. However, the health workers, especially CHWs, opined that door-to-door delivery of the supplements would require a lot of time. They were in favor of monthly group meetings with the women to discuss the use of the supplements before delivery of the supplement.

Organoleptic Properties of the LNS-PLW

Preferences about the organoleptic properties of LNS-PLW were further explored in the FGDs. The women did not have any problem with the color of the supplements. The odor was also generally acceptable to them, though one woman said the odor made her feel like vomiting. PLW were divided in their opinion about the taste of the supplements. Some said that the supplements should be sweeter, while others said that they would not care about the taste as long as the supplements were beneficial for their health. Some women said that the supplement tasted better when it was eaten directly from the sachet. They liked the semisolid consistency of the supplement (compared to a liquid or solid) because it allowed them to easily mix it with rice or any other food, although one woman had problems with mixing the supplement with rice.

> "The supplement tastes a bit bitter when mixed with plain rice. If I eat the supplement without mixing with anything, I feel better. The taste is better if the supplement is mixed with hot rice. And, it does not taste good when mixed with cold rice. Otherwise, the supplement is good. The smell of the supplement is like peanut."

Though most of the women were happy about the packaging of the supplements, a few expressed an opinion that the supplements should be delivered in more attractive and brightly colored sachets. Many women expressed the desire for having a larger quantity of supplement per day.

Overall, the VHVs reported that the women liked the color and consistency of the supplements. They said that a semisolid consistency is better than a powder form because a lot of supplements can be wasted if they are in the form of powder and sometimes powder does not mix well with food. All but one VHV stated that women thought the amount of supplements given was alright. However, one VHV said that the amount of supplement given should be more, as more nutrients can be given at the same time. Another VHV said that there was one woman who had problems with the smell of the supplements. One VHV explained:

> "The supplement is all right. If it were dry powder, there would be problems to mix it with water or food. People will not be able to mix a specific amount (of the supplement)."

The LAMB staff also mentioned that the women might not be willing to consume the supplements if they are not tasty. They said that women are not interested in taking iron tablets for that reason.

Health or Side Effects of LNS-PLW

The caregiver participants talked about a number of health benefits of the supplements they consumed for 14 days. They said that the supplement improved their health; increased production of breast milk; replenished their bodies with vitamin and minerals; reduced symptoms, including vertigo, headaches, and blurring of vision; and improved appetite. They also reported that they felt better and could do more work after taking the supplement. Some of them mentioned that they had infections in their mouths that were cured after taking the supplement. The lactating women thought that their children were getting more breast milk and that they could reduce the amount of food for complementary feeding of their children. They also mentioned that the supplement reduced weakness and cured itching and skin infections. One woman described:

> "I had dizziness, which reduced after eating the medicine (supplement). I did not have enough minerals in my body, (the supplement) replenished my need. I had lack of vitamins; I can understand that (the supplement) refilled my body. I had feeling of pain in my arms and feet, now I do not have the feeling. I do not have vertigo. I needed support to walk around, I do not need the support any more. I did not have any problems after taking the supplement."

All women except one reported that they did not have any problems after taking the supplements. One woman mentioned that she developed feeling of pain in her arms and feet after eating the supplement. She also developed abdominal pain, which subsided but did not go away even a few days after of consumption of the supplement.

The following are results from the FGD with LAMB staff. About the health benefits of LNS-PLW, the VHVs said that the PLW were feeling better and energetic and that the lactating mothers were producing more milk. The supplements increased appetite, improved strength, increased mobility, and reduced vertigo. One VHV explained what she came to know from a mother receiving the supplement:

> "(A mother) told me that she had tingling sensation over her arms and feet and she no more had it after taking the supplements. She was weak and had dizziness, which got cured. She was able to walk and got her appetite back."

The CHWs and VHVs also reported that they heard similar things from the women.

Overall Acceptability of LNS-PLW

Overall, PLW stated that the supplements were highly acceptable and did not report any disadvantages. They also suggested that the supplements should be provided to every woman if possible. They said that if it was impossible to provide them to every woman, the poorer women should have priority. They also said that if there was a scarcity of resources to supplement every woman, a method of rotational supplementation could be implemented in which women would get the supplements at least for some weeks or months while pregnant or breastfeeding.

B.2 LNS-IYC AND MNP-IYC TRIALS

B.2.1 Participants

Figures 2 and 3 show details about recruitment, allocation, and follow-up of the IYC participants. A total of 96 children were enrolled in these trials: 48 in the LNS-IYC and 48 in the MNP-IYC trial. Characteristics of the children and their PCGs that took part in the test-feeding and home-use phases are shown in Table 6. In both samples, the mean age of the children was 16 months. Except for one instance, the PCGs of the children were mothers, and they were all female. The mean age of PCGs was 25 and 26 in the LNS-IYC and MNP-IYC samples, respectively. In both samples, most of the caregivers were Muslim, had at least 1 year of formal school, and identified their primary occupation as housewife. The proportion of breastfed children (defined as receiving any breast milk) was 91.7% in the LNS-IYC and 97.9% in the MNP sample.

Twenty-four PCGs were selected for FGDs in each sample; 22 PCGs took part in FGDs of the LNS-IYC group and 22 attended FGDs of the MNP group.

B.2.2 Phase 1: Test-Feeding

Table 7 shows results of the test-feeding trials with IYC. Children that tasted LNS-IYC-regular on Day 1 received LNS-IYC-cardamom on Day 2, and vice versa. However, eight children received the same LNS flavor during both test-feeding days due to an error by the research assistant (four children tasted only LNS-IYC-regular and four others only tasted LNS-IYC-cardamom). The following results are based on the whole sample receiving LNS-IYC (n=48); we conducted further analyses with the subset of children that received the correct crossover design (n=40) and obtained similar results. On Day 1 of the test-feeding phase, IYC consumed 66.3% ± 32.3% (95% CI, 53.1%–70.5%) of the offered dose of the LNS-IYC-regular and rice mixture and 80.7% ± 26.2% (95% CI, 70.5%–91.0%) of the LNS-IYC-cardamom and rice mixture. On Day 2, mean consumption of these two mixtures was 82.4% ± 25.5% (95% CI, 72.4%–92.4%) and 82.6% ± 26.6% (95% CI, 71.7%–93.5%), respectively. Using mixed linear modeling we found that consumption of the rice-LNS-IYC mixture did not differ by flavor (p=0.96), but it did differ by testing day (p=0.01). Given these results, we compared consumption by flavor for each day separately. Consumption of the rice-LNS-IYC mixture did not differ significantly by flavor on either of the test-feeding days (p=0.09 on Day 1, and p=0.98 on Day 2).

On average, children in the MNP-IYC group consumed 74.8% ± 27.8% (95% CI, 66.9%–82.7%) of the MNP and rice mixture on Day 1 and 79.9% ± 26.9% (95% CI, 72.3%–87.5%) of the mixture on Day 2. Paired t-test samples revealed that there was no significant difference between the consumption on Day 1 and Day 2 (p=0.22).

The median scores for the organoleptic properties (color, odor, taste, consistency) of the LNS- IYC did not differ significantly by day, for either sequence of LNS-IYC given. Similarly, the median scores for the organoleptic properties of the MNP did not differ significantly by day. When we combined data for Days 1 and 2 for the LNS-IYC group, 100% of PCGs liked (either “a little” or “a lot”) the supplement color for both flavors; 93.8% of PCGs liked the odor of both flavors; 97.9% and 100% of PCGs liked the taste of the LNS-IYC-regular and -cardamom, respectively; and all PCGs liked the consistency of both flavors. Even though the MNP-IYC was supposed to be colorless, odorless, and tasteless, we explored organoleptic preferences among PCGs: 97.9% of the PCGs liked the color, 84.4% liked the odor, 88.5% liked the taste, and 93.7% liked the consistency of the supplement. The median rating of overall acceptability of the LNS-IYC among the children (as reported by their PCGs) was 5 (“liked a lot”) for both flavors on both test-feeding days (Figure 5), and overall acceptability rating of the MNP was 4 (“liked a little”) on Day 1 and 5 (“liked a lot”) on Day 2. Furthermore, in both LNS-IYC groups and also in the MNP group, all PCGs indicated that they were willing to continue giving the supplement to the child on a daily basis.

During the test-feeding trial, interviewers recorded any perceived side effects after supplement use by observing the IYC. After consumption of the LNS-IYC, only in one instance was a perceived side effect observed (itching on Day 1 in the LNS-IYC-cardamom group). There were no observed side effects after consumption of MNP on either of the test-feeding days.

B.2.3 Phase 2: Home Use

Findings of the 2-week home-use phase with IYC are shown in Table 8. Since consumption of LNS-IYC did not differ between Week 1 and Week 2 for either flavor (p=0.10 for LNS-IYC-regular, and p=0.75 for LNS-IYC-cardamom, both based on paired t-tests), data were analyzed for the 2 weeks combined. Over the 2-week period, consumption of the LNS-IYC was high and did not differ by flavor (p=0.57): IYC consumed 93.4% ± 11.6% of the recommended number of sachets of LNS-IYC-regular and 90.8% ± 18.9% of recommended number of sachets of LNS-IYC-cardamom. Among children in the MNP group, 95.7% ± 6.8% consumed the recommended number of doses during the 2-week trial. Comparison of the three groups (both LNS flavors and MNP) indicated that consumption of the recommended dose of supplements did not differ among them (p=0.29).

Ninety-two percent of children that consumed the LNS-IYC-regular ate the supplement mixed with rice, while all children that consumed the LNS-IYC-cardamom did so. In the MNP group, most children consumed the supplement mixed with rice (88.3%), while some consumed it mixed with other foods. Most caregivers in the LNS-IYC groups (98.0% in the regular and 93.3% in the cardamom group) followed the instruction of giving the supplement to the child twice a day. In the MNP group, most caregivers (94.7%) also gave the supplement as instructed (i.e., once per day).

Regarding the preferred time of consumption, most PCGs gave the supplement to the child during the morning (98.0% in the LNS-IYC-regular group, 91.1% in LNS-IYC-cardamom group, and 61.7% in the MNP group). PCGs reported that most children finished the mixture of supplement and food every time or almost every time (94.0% in the LNS-IYC-regular group, 93.3% in the LNS-IYC-cardamom group, and 96.8% in the MNP group). Some PCGs reported to have shared the supplement with others during the 2 weeks of home use (16.0%, 8.7%, and 0.0% in the LNS-IYC-regular, LNS-IYC-cardamom, and MNP group, respectively, p=0.01). The median rating of overall acceptability of the LNS-IYC among the children (as reported by their PCGs) was 5 (“liked a lot”) for both flavors in each week of home use (Figure 5). The same is true for the MNP group in each week of home use. Thus, most PCGs indicated that the child liked the supplement, either a little or a lot (92.0% in the LNS-IYC-regular group, 90.9% in the LNS-IYC-cardamom group, and 95.7% in the MNP group; p=0.64). All PCGs in the LNS-IYC and MNP groups reported that they would be willing to continue feeding the child the supplement.

When PCGs were asked if their child had any health problems after consuming the LNS-IYC during the first week of LNS-IYC use, some PCGs indicated that their child had a cough (n=21), breathing problems (n=7), diarrhea (n=6), fever (n=5), nausea or vomiting (n=8), and skin problems (n=3). The frequency of these reported health problems did not differ significantly between the first and second weeks of supplement use (p=0.40 for a cough, p=0.34 for breathing problems, p=0.25 for fever, p=0.37 for nausea or vomiting, and p=0.69 for skin problems), except for diarrhea, for which there were no cases reported in Week 2 (p=0.03).

PCGs’ report of health problems after consuming the MNP during Week 1 included a cough (n=13), breathing problems (n=6), diarrhea (n=7), fever (n=6), nausea or vomiting (n=4), asthma (n=2), and skin problems (n=2). PCGs reported that health problems did not change significantly during Week 2 (p=0.47 for a cough, p=0.29 for breathing problems, p=0.18 for diarrhea, p=0.29 for fever, p=0.17 for nausea or vomiting, p=0.15 for asthma, and p=0.65 for skin problems).

B.2.4 Phase 3: Focus Group Discussions

Four FGDs were conducted with PCGs, two with those that participated in the LNS-IYC trial and two with those from the MNP-IYC trial. In addition, two FGDs were conducted with VHVs, one focused on the LNS-IYC and another for the MNP-IYC.

B.3 FACTORS THAT MAY INFLUENCE LNS-IYC AND MNP-IYC CONSUMPTION

PCGs were generally happy to feed their children the supplements (LNS-IYC and MNP-IYC) supplied. The PCGs that received LNS-IYC mentioned that the supplement contained all nutrients for the children and they did not need to prepare it by themselves. Almost all of them opined that the supplement should be promoted as a “special food” instead of a “medicine.” Medicines, they argued, are usually supplied by doctors. They also mentioned that the supplement would not cure any diseases and therefore should not be called a “medicine.” They suggested local names for the supplements, such as *pushti* or *pushti jatiyo khabar*, which translate as “nutrition” and “nutritious food,” respectively. They were in favor of fortnightly delivery of the supplement. In support of fortnightly delivery, they argued that it would ensure more frequent visits by health workers of whom they would be able to ask questions if they had any problems with the supplement. They feared that a monthly supply would be a lot for them to store and that supplements could end up being wasted. Some women stated that a weekly supply would be preferable. However, one woman was in favor of one month’s supply. They also suggested that morning would be an ideal time to deliver the supplement.

The PCGs of the children that received MNP-IYC agreed that the supplement was beneficial for their children. They suggested that the supplement should not be called “medicine” but rather “special food,” because medicine is supposed to be prescribed by the doctors. They also mentioned that they liked the name Monimix®. Most of them were in favor of fortnightly delivery of the supplement, as it would ensure frequent visits of health workers to their house. Most of them mentioned that they would prefer morning delivery of the supplements.

The opinions of LAMB staff on this theme did not differ from those of the PCGs.

B.4 ORGANOLEPTIC PROPERTIES OF THE LNS-IYC AND MNP-IYC

Preferences about the organoleptic properties of LNS-IYC were further explored in the FGDs. The PCGs did not have any problem with the consistency and color of the supplement. They liked the consistency, as the supplement easily mixed with hot rice. They agreed that the color was good, and children did not refuse to eat the supplement. Though they agreed that the children liked the taste, a few mentioned that because children like sweetened food, more sweetness could be added to the supplement. All but two of the PCGs mentioned that their children liked the odor. The two women that did not like the odor said that that their children did not eat too much of the supplement-food mixture, and they suspected that it was because of the odor of the supplement. One woman said:

> “I think the children may not like the odor. If the supplement did not have any odor, there would not be any problem. It the supplement was plain (without any odor), there would be no problem. The taste is all right, the color is all right.”

They reported that one of the advantages of the supplement was that it could be mixed with all types of food. The semisolid consistency was suitable, as the children did not like solid and hard foods. All PCGs were happy about the packaging of the supplement, as it was airtight and waterproof. One PCG suggested that the sachets could be delivered inside a glass jar, which would prevent insects from eating through the sachets and destroying them.

The PCGs that received MNP-IYC liked the consistency, color, odor, and packaging of the supplement. They expressed that the white color of the supplement matched the color of rice perfectly. Although most of them were satisfied with the taste, a few mentioned that if the supplement was sweet, it would be more acceptable to the children. They also pointed out that the supplement is odorless, and an odorless supplement is better because it can be mixed with any food and children would not be able to identify that something was mixed with their food.

> “Everything is all right with the supplement. There will be problems if something is changed. If the supplement is red or yellow, the children will not eat it. When I mix it (the supplement) with rice and curry, nobody identifies that something is added to food. (The child) eats without any complaint.”

The PCGs also said that the powder supplement mixed with rice easily.
The VHVs living in the area where LNS-IYC was tested suggested that the sachets should contain more supplement and the consistency should be softer. They said that people needed to squeeze the supplement to get it out of the sachets. They reported that the PCGs of the children that received that supplement had positive comments about the taste, color, and smell of the supplements. Some VHVs said that the supplement mixed well with hot rice and that the children and mothers liked it. One VHV described:

> “The color of the supplement is compared to ghee (clarified butter). When it is mixed with hot rice, it mixes well like butter. The taste of the supplement is good. I asked the women about the supplement and they said the smell was nice and the taste was good.”

The CHWs and CMWs had similar opinions about the organoleptic properties, except some of them suggested a bright and attractive color. They reported that a metallic taste remained in the mouth of the

women that ate the supplement. They all agreed that providing supplements in sachets was a better idea, as many women would not be able to consume the supplement in the right amount if a larger quantity of supplement is open at a given time.

The CHWs and CMWs also echoed that a sweeter supplement will be more acceptable and had similar opinions about the organoleptic properties. Some of them mentioned that instead of two doses per day, three doses a day would be more helpful, as the children eat at least three times a day. Others argued that twice a day was fine, since most of the households cook twice a day.

The VHVs from the area where MNP-IYC was tested reported that the PCGs liked the supplement. They reported that the packaging and its color were fine. The supplement can be sprinkled on any type of foods, and they considered this an advantage. They said that one sachet per day was alright. They also reported that if the supplement were sweet and could be used like oral rehydration saline, compliance would have been even better. They also suggested that lemon flavor could be added to the supplement. According to one VHV:

> "Some (women) said if the supplement was like tasty saline (one type of oral rehydration saline), the children would have liked them more. A little sweet taste is needed. For example, I cannot drink the common oral rehydration saline, but I can drink tasty saline. It will be nice if lemon flavor can be added."

The CHWs and VHVs had similar comments. They also said that one of the advantages of Monimix® is that the supplement could be mixed with water and consumed like oral rehydration salt. Some of them wanted MNP-IYC to be given with every meal to help the child get used to the supplement.

B.5 HEALTH OR SIDE EFFECTS OF LNS-IYC AND MNP-IYC

During the FGDs, the PCGs did not mention any harmful effects from the supplements. They said that the supplements increased appetite and that the children were eating regular food as well. A few mothers claimed that their children were sleeping better after they started eating the supplement; they said that the children were *of shundor mon* (joyful and playful and did not cry), and that the supplement contained minerals and replenished the mineral needs of their children. A few others mentioned that their children were so fond of the supplement that they were crying for more. Some of the children were suffering from mouth infections and their infections were cured after eating the supplement. Some women claimed that their children got so used to the supplement that they were reluctant to eat rice without the supplement. They also pointed out that if they could continue feeding the supplement, the children would be more intelligent and suffer from fewer diseases. A woman explained:

> "My child became used to the supplement; he is pleased and thrilled. After it (the supplement) was given to him, he is gladly eating. He is not bothering me. He is playing fine. He finishes his food and wants more."

However, there were different opinions, too. One woman mentioned that her child had vomiting and diarrhea a few days after eating the supplement. Her child was not eating well when he was sick. Another woman stated that her child did not want to eat the supplement mixed with rice. She had to force her child to eat the supplement.

The PCGs of the children that received MNP did not mention any disadvantage of the supplement, even after probing. The most frequently mentioned health benefit was that the supplement improved appetite of their children. They said that their children were glad when they saw the supplement. One woman claimed that she used to see a doctor very frequently, and her child did not need a doctor during the weeks when the supplement was given. Another PCG claimed that her child did not want to eat even three times a day, but started eating four times a day after consuming the supplement. Another woman said:

> "My child did not have appetite. Her appetite improved after I gave her (the supplement). I added the supplement with rice and mustard oil and fed my child. Her hunger increased. My daughter now uses her own hand to eat food."

During the FGDs with LAMB staff, the VHVs also mentioned several benefits of the supplements. One VHV from a village where the LNS-IYC was distributed said:

> "(Due to the use of the supplement) the mothers are getting time to do household work. The children remain free from diseases. The fathers are spending less money. The children are getting cured from illnesses. The children are getting their meals regularly. The supplements will help them to grow tall. The children are healthy."

The CHWs and CMWs also reported hearing similar things from the PCGs of the children that got LNS-IYC.

The VHVs from areas where MNP-IYC was distributed stated that the supplements would improve the cognitive development of the children, that the growth of the children's brains would be optimum, that the children would not suffer from illnesses, and that the children will be energetic and healthy. They said that the mothers told them that the supplements improved the children's appetites and that they became joyful. They also said that some mothers that were not participating in the study quarreled with them, as their children did not get the supplements with the purported benefits. One VHV explained how mothers described the benefits of the supplements:

> "She (mother of a child who got the supplement) told me about some benefits of the supplements. Her child suffered from lack of appetite, which got cured. The child is eating like a healthy child. As the child is healthy, the mother is happy. The mother also said that she would be willing to give the supplement to her child again."

The CHWs and CMWs reported to hearing similar comments from the PCGs of the children that got MNP-IYC.

B.6 OVERALL ACCEPTABILITY OF LNS-IYC AND MNP-IYC

Overall, PCGs of the children that received LNS-IYC stated that the supplements were acceptable. They felt that they could not afford to buy all the minerals and vitamins, so everything provided in the same food would be better for their children. The women expressed their concern that a few PCGs in the community that did not participate in the study were not happy, because their children did not receive the supplement. They also complained that some malnourished children in the community did not receive the supplement while some healthy children did. They suggested that the supplement should be either given to all, or at least to all malnourished children.

The opinion of the PCGs of the children that received MNP-IYC was no different. They agreed that their children benefited from the use of the supplement. They also had the similar concerns about the selection of a few children in the community for the delivery of the supplement. They said that even if the selection is done through lottery, disappointment could not be avoided. They suggested that the supplement be made available to all.

FGDs with LAMB health staff revealed similar opinions about the overall acceptability and delivery of the supplements.

C. Discussion

C.1 LNS-PLW TRIAL

The LNS-PLW-regular and LNS-PLW-cumin supplements we tested were found to be acceptable by this population of rural women in Bangladesh, in terms of both the amount of the test dose consumed and their rankings of different organoleptic characteristics. The mean consumption of the two flavors of supplements was similar during the test-feeding trial. The women liked the color, odor, taste, and consistency of both the flavors of LNS-PLW supplements. There was high adherence (95%) for both of the supplements during the home-use phase. This is higher than (Bhutta et al., 2009; Sunawang et al., 2009) or comparable to (Aguayo et al., 2005) adherence rates reported from studies that used micronutrient tablets for supplementation. The use of the supplements with food, their ease of use, and positioning the supplements as a special food for PLW may enhance adherence. However, the home-use phase lasted only 2 weeks, and adherence may change with longer-term supplementation. We agree with the conclusions of Young and colleagues that a clear understanding of how supplements are perceived and the barriers and factors that facilitate their use, combined with educational campaigns based on this knowledge, is required to ensure adequate long-term adherence (Young et al., 2010).

The responses regarding the organoleptic properties of the two supplements provided no conclusive evidence that one supplement was preferred over the other, though there was a tendency toward a higher rating in overall acceptability for LNS-PLW-cumin over LNS-PLW-regular. Women in Bangladesh are familiar with cumin; it is a spice commonly used in food preparation. It was expected that they would like the cumin-flavored LNS.

The women were advised to consume the supplements mixed with food, and most mixed them with rice. Some of the women consumed the supplement without mixing it with any food. During the test-feeding trial days, we mixed the supplements with rice and this probably influenced the women during the home-use phase. The women preferred to consume the supplements during the morning or at noon. Many families in the rural communities of Bangladesh cook a meal only once a day, and the timing of consumption of the supplements may be related to their food preparation practices. The women almost always finished the whole daily dose of the supplement at one sitting. These findings have implications for the development of educational messages for programs that include such supplements. For example, the data suggest that a message to mothers to consume the supplement all at once with their daily meal would be both feasible and acceptable.

We did not observe any change in the prevalence of common illnesses or symptoms during the test-feeding or home-use phases. We implemented the study during the winter season, and a few women had a cough, breathing difficulties, or fever, as might be expected. Despite these illnesses, they did not stop taking the supplements. We have not located comparable data on consumption patterns during illness for other types of supplements taken by PLW.

Over time, complaints about the organoleptic properties of the supplements decreased (though there were few such complaints even initially), and overall acceptability increased. It appeared that the longer the women consumed the supplements, the more they got used to them. These findings suggest that during the first few weeks of supplementation, reassurance and ongoing health and nutrition education may enhance sustained use of the supplements. This implies that health and nutrition programs that promote the use of such supplements may be most effective if frequent contacts are scheduled during the first few weeks of delivery of the supplements to each woman.

The cultural context should be taken into consideration when designing and implementing nutrient supplementation programs. One woman told us that she would discontinue supplementation because she was afraid that she would have a large baby. In a society where mortality during childbirth is common, women are often afraid of death during childbirth. Shannon et al. reported that, despite high levels of awareness of nutritional dietary requirements, 50% of pregnant women in a study in rural Bangladesh did not increase their food intake, or even reduced it, during pregnancy; 22% of these women explained that this was because of the fear of obstetrical complications from delivering a large baby. They also reported

that food avoidances are common among rural pregnant women in Bangladesh (Shannon et al., 2008). This needs to be taken into account when designing nutrient supplementation programs, particularly with regard to messages developed to address this concern.

There were some limitations of this study.

- It was carried out during the winter, and, thus, we could not evaluate whether there may be seasonal differences in acceptability of supplements.
- There was little variability in the responses when we used the hedonic scale to ascertain the women's reactions to the organoleptic properties of the supplements. The homogeneity in responses may be due to social desirability bias or the reluctance of the respondents to give negative answers. Open-ended questions, together with hedonic scale questions, may be better able to capture the variation in preferences in terms of organoleptic properties and overall acceptability. Young et al. made similar recommendations based on their study of acceptability of several supplements among Mexican women (Young et al., 2010).

This study provided information that will be useful for the design and implementation of the next phase, a program effectiveness study. Because both supplements were acceptable, one programmatic option is to provide women with a choice of LNS-PLW-regular or LNS-PLW-cumin, or to alternate flavors each month. This might enhance long-term adherence by reducing monotony in the diet. Although selection of an acceptable supplement does not guarantee its use over the long term, a clear understanding of facilitators and barriers (e.g., fear of large babies from consumption of the supplement) to acceptability is helpful for developing educational messages and other aspects of program design, such as frequency of contact with front-line health workers.

C.2 LNS-IYC AND MNP-IYC TRIALS

The LNS-IYC and MNP-IYC were well accepted in this population of young Bangladeshi children and their caregivers, as indicated by the amount of the supplement the children consumed, the rating of its organoleptic properties by the caregivers, and their willingness to continue using the supplements. Based on our initial definition of acceptability as consumption of more than 50% of the supplement offered (lower limit of 95% CI), the two flavors of the LNS-IYC and the MNP-IYC were acceptable.

During the testing of the LNS-IYC, children consumed lower amounts of LNS-IYC-regular (as compared to the cardamom flavor) when this was tasted first, while they consumed more of the LNS-IYC-regular when the LNS-IYC-cardamom was tasted first. However, during the 2-week home-use phase, there was no difference in consumption by LNS-IYC flavor, which suggests that once the supplements are consumed more regularly, there is no specific preference for either of the two LNS-IYC flavors among children.

Almost all caregivers liked the color, odor, taste, and consistency of both of the LNS-IYC flavors. As mentioned above, the low occurrence of negative answers may relate to a desire to please the interviewer by providing positive comments. However, the high adherence (i.e., more than 90% consumed the recommended dose) observed during the use of the supplement at home, when contact with interviewers was less frequent, is in agreement with the caregivers' responses about the supplement's organoleptic characteristics. A few caregivers disliked the odor of the LNS supplement, but these complaints were evenly distributed between the two flavor groups. Provision of educational messages about the safety of the supplement, if the odor is unfamiliar, may be helpful to maintain adequate adherence.

Even though the MNP-IYC was supposed to be odorless and tasteless, some caregivers during the test-feeding phase stated that they did not like its odor and taste, and a few of them did not like its consistency either. In general, during the initial testing, the sensory characteristics of the MNP-IYC were less accepted than those of the LNS-IYC. However, results from the FGDs indicated that, after using the MNP-IYC for a longer time, PCGs accepted the supplement's sensory characteristics.

The overall ratings of acceptability of the two flavors of the LNS by the children (as reported by caregivers), both during the test-feeding and home-use phases, was the highest possible ("liked a lot"), and all caregivers were willing to continue using the supplement after the home-use phase. PCGs stated that they were happy to provide the supplement to their children and liked that it was ready to use. These findings likely reflect that the caregivers had a good experience using the supplements at home. Most caregivers followed the instruction of feeding the supplement twice a day. These results suggest that LNS-IYC provided in a programmatic context may be well received and used appropriately by mothers.

Acceptability of the MNP-IYC by the children was also high both during the test-feeding and home-use phases. Caregivers were willing to continue using it and followed the instructions regarding feeding frequency. Results from FGDs about the MNP-IYC supported these results. This suggests that MNP-IYC provided in a programmatic context targeted at young children may be easily accepted in this population.

During the home-use phase, the LNS-IYC and MNP-IYC were mostly mixed with rice when given to the children; this option was likely influenced by the procedures during the test-feeding, when mothers were asked to mix the supplement with rice. Caregivers also indicated that the supplements mixed with rice easily, which may have also encouraged them to continue giving the supplement with rice.

While using the LNS-IYC and MNP-IYC at home, a few caregivers reported health problems in the child; however, these perceived health problems were unlikely to be related to the LNS or MNP consumption, and did not increase with longer use of either supplement. Moreover, these perceptions of side effects did not seem to discourage the caregivers from continuing to give the supplement.

In general, results from FGDs support the acceptability of the LNS-IYC and MNP-IYC among caregivers as well as program staff. These results also indicate that participants attributed several health benefits to the use of the supplements.

These acceptability trials had some limitations. One relates to the incorrect crossover allocation of the LNS-IYC in the test-feeding trial, which meant that some of the participants tasted only one of the flavors. Nevertheless, when appropriate, we conducted further analysis using only the sample of subjects that were correctly assigned to the crossover design, and we observed similar results to those obtained using the whole sample. Another limitation was the lack of open-ended questions regarding sensory preferences, feeding practices, and overall acceptability, which could have elicited more varied responses in acceptability preferences (Young et al., 2010) and more information about the feasibility of adding these supplements into the daily diet of young children.

The findings from this acceptability trial indicated that the LNS-IYC and MNP-IYC were well accepted by the children and mothers, regardless of the flavor. This suggests that evaluation of their impact in a programmatic context will not be impeded by poor acceptance of these supplements.

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Tables and Figures

Table 1. LNS-PLW (both regular and cumin) Formulation

Nutrient	Unit	LNS-PLW
Dose	g	20
Energy	kcal	118
Protein	g	2.6
Fat	g	10
Linoleic acid	g	4.6
α-Linolenic acid	g	0.6
Calcium	mg	280
Copper	mg	4
Folate	µg	400
Iodine	µg	250
Iron	mg	20
Magnesium	mg	65
Manganese	mg	2.6
Niacin	mg	36
Pantothenic acid (B5)	mg	7
Phosphorous	mg	190
Potassium	mg	200
Riboflavin (B2)	mg	2.8
Selenium	µg	130
Thiamine (B1)	mg	2.8
Vitamin A	µg	800
Vitamin B12	µg	5.2
Vitamin B6	mg	3.8
Vitamin C	mg	100
Vitamin D	µg	10
Vitamin E	mg	20
Vitamin K	µg	45
Zinc	mg	30

Table 2. LNS-IYC (both regular and cardamom), Nutributter®, and MNP-IYC (Monimix®) Formulations

Nutrient	Unit	LNS-IYC	Nutributter®	MNP-IYC (Monimix®)
Dose/day	g	20	20	1
Energy	kcal	118	108	
Protein	g	2.6	2.56	
Fat	g	9.6	7.08	
Linoleic acid	g	4.46	1.29	
α-Linolenic acid	g	0.58	0.29	
Calcium	mg	280	100	
Copper	mg	0.34	0.2	
Folate	µg	150	80	160
Iodine	µg	90	90	
Iron	mg	9	9	12.5
Magnesium	mg	40	16	
Manganese	mg	1.2	0.08	
Niacin	mg	6	4	
Pantothenic acid (B5)	mg	2.0	1.8	
Phosphorous	mg	190	82.2	
Potassium	mg	200	152	
Riboflavin (B2)	mg	0.5	0.4	
Selenium	µg	20	10	
Thiamine (B1)	mg	0.5	0.3	
Vitamin A	µg	400	400	300
Vitamin B12	µg	0.9	0.5	
Vitamin B6	mg	0.5	0.3	
Vitamin C	mg	30	30	30
Vitamin D	µg	5		
Vitamin E	mg	6		
Vitamin K	µg	30		
Zinc	mg	8	4	5

Table 3. Socio-Demographic Characteristics of the PLW Participants (n=48)

Characteristic	Mean ± SD or n (%)
Pregnant	24 (50)
Lactating	24 (50)
Age (years)	23.3 ± 4.0
Religion	
Islam	42 (87.5)
Hindu	6 (12.5)
Education	
No education	8 (16.7)
1–5 years	13 (27.1)
6–9 years	19 (39.5)
10 years or more	8 (16.7)
Primary occupation	
Housewife	46 (95.8)
Nongovernment job	1 (2.1)
Day laborer	1 (2.1)

Table 4. Consumption and Organoleptic Property Ratings of the Supplements during the Test-Feeding Phase of LNS-PLW

		Test-feeding Day 1		Test-feeding Day 2	
		LNS-PLW-regular (n=24)	**LNS-PLW-cumin (n=24)**	**LNS-PLW-regular (n=24)**	**LNS-PLW-cumin (n=24)**
Consumption of test dose					
Percent consumed Mean ± SD 95% CI		 93.4 ± 18.1 86.2–100.1	 85.7 ± 26.4 75.2–96.3	 93.1 ± 12.2 88.2–97.9	 95.7 ± 7.1 92.9–98.6
Organoleptic property ratings					
Property	**Rating categories***	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Color	**1–3** **4** **5**	0 (0.0) 1 (4.2) 23 (95.8)	0 (0.0) 3 (12.5) 21 (87.5)	0 (0.0) 3 (12.5) 21 (87.5)	0 (0.0) 1 (4.2) 23 (95.8)
Odor	**1–3** **4** **5**	4 (16.7) 4 (16.7) 16 (66.7)	0 (0) 12 (50) 12 (50)	0 (0) 9 (37.5) 15 (62.5)	0 (0) 3 (12.5) 21 (87.5)
Taste	**1–3** **4** **5**	0 (0.0) 8 (33.3) 16 (66.7)	0 (0.0) 7 (29.2) 17 (70.8)	0 (0.0) 5 (20.8) 19 (79.2)	0 (0.0) 7 (29.2) 17 (70.8)
Consistency	**1–3** **4** **5**	0 (0.0) 1 (4.2) 23 (95.8)	0 (0.0) 5 (20.8) 19 (79.2)	0 (0.0) 4 (16.7) 20 (83.3)	0 (0.0) 2 (8.3) 22 (91.7)

* 1-3 = Disliked a lot, disliked a little, and neutral combined; 4 = Liked a little, 5 = Liked a lot

Table 5. Consumption of Supplements during the Home-Use Phase of LNS-PLW

	LNS-PLW-regular **Week 1, n=24** **Week 2, n=22** **Total n=46**	**LNS-PLW-cumin** **Week 1, n=24** **Week 2, n=23** **Total n=47**
Percent of recommended number of sachets consumed by PLW		
Mean ± SD	94.8 ± 10.1	95.3 ± 11.7
95% CI	90.6–99.0	90.6–100.1
How the supplement was consumed		
Mixed with rice, n (%)	41 (89.1)	39 (83.0)
Mixed with other food, n (%)	0 (0.0)	1 (2.1)
Eaten alone, n (%)	5 (10.1)	7 (14.9)
Preferred time of consumption		
Morning, n (%)	18 (39.1)	21 (44.7)
Noon, n (%)	16 (34.8)	18 (38.3)
Afternoon, n (%)	5 (10.9)	4 (8.5)
Night, n (%)	7 (15.2)	4 (8.5)
How often the supplement was finished		
Every time, n (%)	46 (100.0)	45 (95.7)
Almost every time, n (%)	0 (0.0)	2 (4.3)
Sharing the supplement with others		
Yes, n (%)	1 (2.2)	0 (0.0)
No, n (%)	45 (97.8)	47 (100.0)

Table 6. Socio-Demographic Characteristics of the IYC and PCG Participants (n=96)

Characteristic	LNS-IYC (n=48) Mean ± SD or n (%)	MNP-IYC (n=48) Mean ± SD or n (%)
Sex of child		
Male	23 (47.9)	28 (58.3)
Female	25 (52.1)	20 (41.7)
Caregiver of the child		
Mother	47 (97.9)	48 (100.0)
Other	1 (2.1)	0 (0.0)
Age of the child, months	16.2 ± 5.0	16.3 ± 5.0
Birth order of the child		
1	14 (29.2)	14 (29.2)
2	19 (39.6)	14 (29.2)
3	9 (18.8)	10 (20.8)
4	3 (6.2)	5 (10.4)
5 or more	3 (6.2)	5 (10.4)
Age of caregiver, years	25.0 ± 4.8	26.4 ± 5.0
Religion of caregiver		
Islam	44 (91.7)	43 (89.6)
Hindu	4 (8.3)	5 (10.4)
Education of caregiver		
No education	7 (14.6)	7 (14.6)
1–5 years	18 (37.5)	14 (29.2)
6–9 years	20 (41.7)	22 (45.8)
10 years or more	3 (6.2)	3 (10.4)
Caregiver's primary occupation		
Housewife	41 (85.4)	48 (100.0)
Day laborer	4 (8.3)	0 (0.0)
Business	1 (2.1)	0 (0.0)
Other	2 (4.2)	0 (0.0)

Table 7. Consumption and Organoleptic Property Ratings of the Supplements during the Test-Feeding Phase of the LNS-IYC and MNP-IYC

		Test-feeding Day 1			Test-feeding Day 2		
		LNS-IYC-regular (n=23)	**LNS-IYC-cardamom (n=25)**	**MNP-IYC (n=48)**	**LNS-IYC-regular (n=25)**	**LNS-IYC-cardamom (n=23)**	**MNP-IYC (n=48)**
Consumption of test dose							
Percent consumed Mean ± SD 95% CI		 66.3 ± 32.3 53.1–70.5	 80.7 ± 26.2 70.5–91.0	 74.8 ± 27.8 66.9–82.7	 82.4 ± 25.5 72.4–92.4	 82.6 ± 26.6 71.7–93.5	 79.9 ± 26.9 72.3–87.5
Organoleptic property ratings							
Property	**Rating categories***	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Color	**1–3** **4** **5**	0 (0.0) 1 (4.3) 22 (95.7)	0 (0.0) 6 (24.0) 19 (76.0)	1 (2.1) 27 (56.2) 20 (41.7)	0 (0.0) 1 (4.0) 24 (96.0)	0 (0.0) 2 (8.7) 21 (91.3)	1 (2.1) 23 (47.9) 24 (50.0)
Odor	**1–3** **4** **5**	2 (8.7) 2 (8.7) 19 (82.6)	2 (8.0) 3 (12.0) 20 (80.0)	9 (18.7) 22 (45.8) 17 (35.4)	1 (4.0) 5 (20.0) 19 (76.0)	1 (4.3) 4 (17.4) 18 (78.3)	6 (12.5) 27 (56.2) 15 (31.2)
Taste	**1–3** **4** **5**	1 (4.3) 5 (21.7) 17 (73.9)	0 (0.0) 4 (16.0) 21 (84.0)	8 (16.7) 23 (47.9) 17 (35.4)	0 (0.0) 4 (16.0) 21 (84.0)	0 (0.0) 2 (8.7) 21 (91.3)	3 (6.2) 26 (54.2) 19 (39.6)
Consistency	**1–3** **4** **5**	0 (0.0) 1 (4.3) 22 (95.7)	0 (0.0) 3 (12.0) 22 (88.0)	3 (6.2) 23 (47.9) 22 (45.8)	0 (0.0) 2 (8.0) 23 (92.0)	0 (0.0) 0 (0.0) 23 (100.0)	3 (6.2) 24 (50.0) 21 (43.8)

* 1–3 = Disliked a lot, disliked a little, and neutral combined; 4 = Liked a little, 5 = Liked a lot

Table 8. Consumption of Supplements during the Home-Use Trials of LNS-IYC and MNP-IYC

	LNS-IYC-regular **Week 1, n=25** **Week 2, n=25** **Total n=50**	**LNS-IYC-cardamom** **Week 1, n=22** **Week 2, n=23** **Total n=45**	**MNP-IYC** **Week 1, n=47** **Week 2, n=47** **Total n=94**
Percent of recommended number of sachets consumed by IYC			
Mean ± SD	93.4 ± 11.6	90.8 ± 18.9	95.7 ± 6.8
95% CI	88.9–98.0	83.0–98.4	93.7–97.6
How consumed			
Mixed with rice, n (%)	46 (92.0)	45 (100.0)	83 (88.3)
Mixed with other food, n (%)	3 (6.0)	0 (0.0)	11 (11.7)
Eaten alone, n (%)	1 (2.0)	0 (0.0)	0 (0.0)
Preferred time of consumption*			
Morning, n (%)	49 (98.0)	41 (91.1)	58 (61.7)
Noon, n (%)	17 (34.0)	19 (42.2)	27 (28.7)
Afternoon, n (%)	30 (60.0)	16 (35.6)	9 (9.6)
Night, n (%)	2 (4.0)	12 (26.7)	0 (0.0)
Frequency the supplement was finished			
Every time, n (%)	37 (74.0)	37 (82.2)	54 (57.4)
Almost every time, n (%)	10 (20.0)	5 (11.1)	37 (39.4)
Sometimes, n (%)	2 (4.0)	1 (2.2)	3 (3.2)
Never, n (%)	1 (2.0)	2 (4.4)	0 (0.0)
Sharing supplement with others			
Yes, n (%)	5 (10.0)	3 (6.7)	0 (0.0)
No, n (%)	45 (90.0)	42 (93.3)	94 (100.0)

* Total > 100% for the LNS-IYC groups due to multiple answers.

Figure 1. Flow Diagram Showing Number of Subjects for Enrollment, Allocation, Follow-Up, and Analysis for LNS-PLW

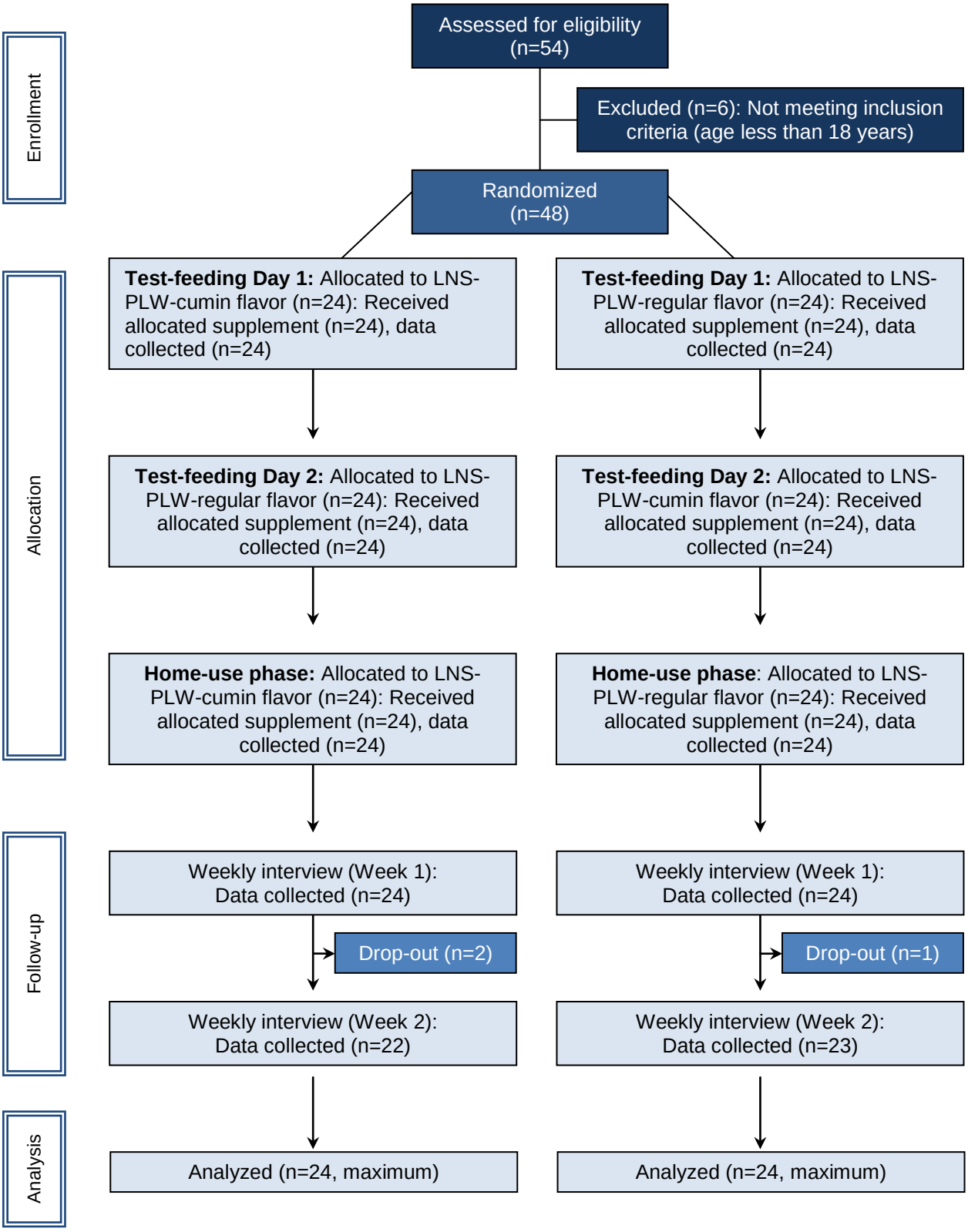


Figure 2. Flow Diagram Showing Number of Subjects for Enrollment, Allocation, Follow-Up, and Analysis for LNS-IYC

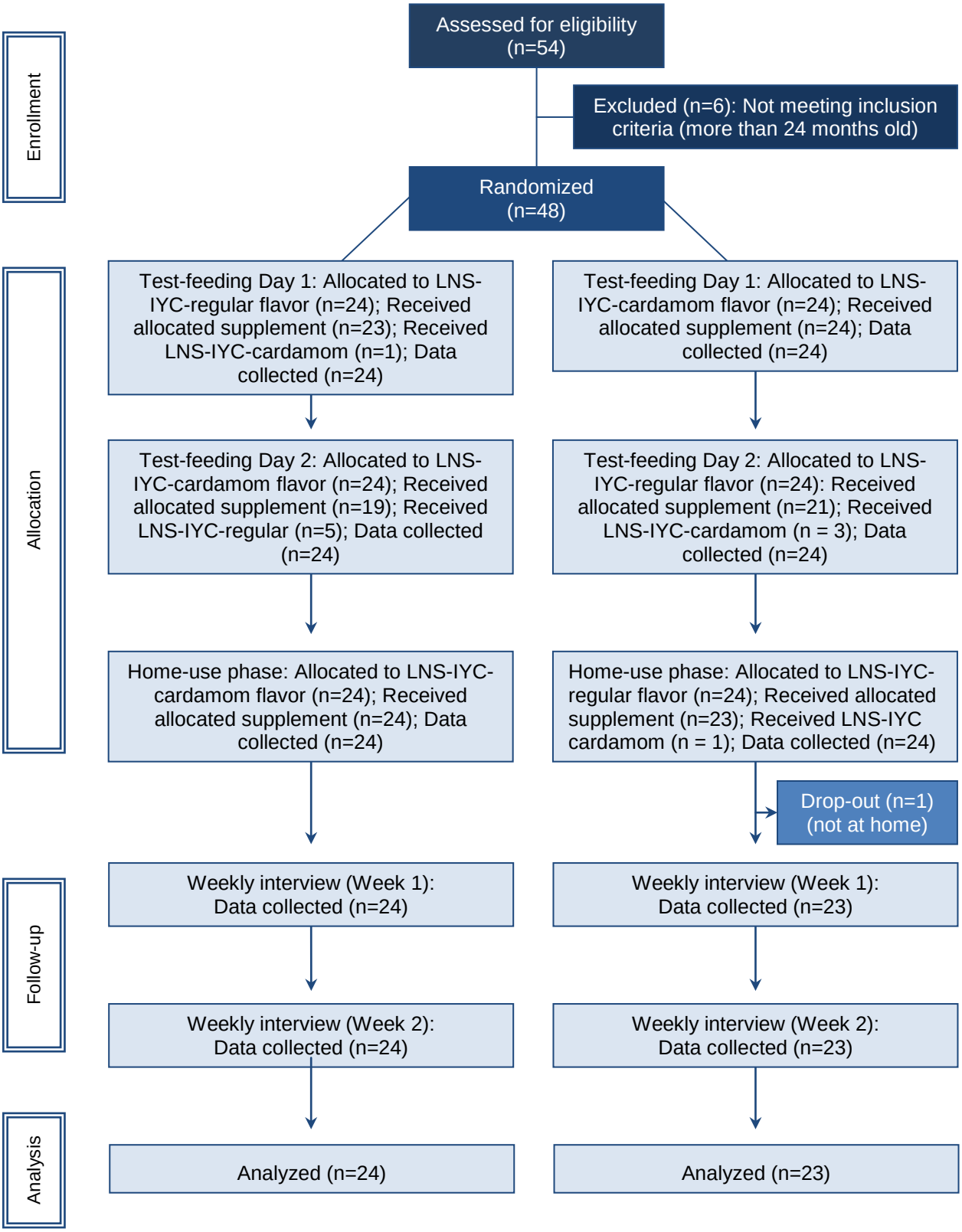


Figure 3. Flow Diagram Showing Number of Subjects for Enrollment, Allocation, Follow-Up, and Analysis of MNP-IYC

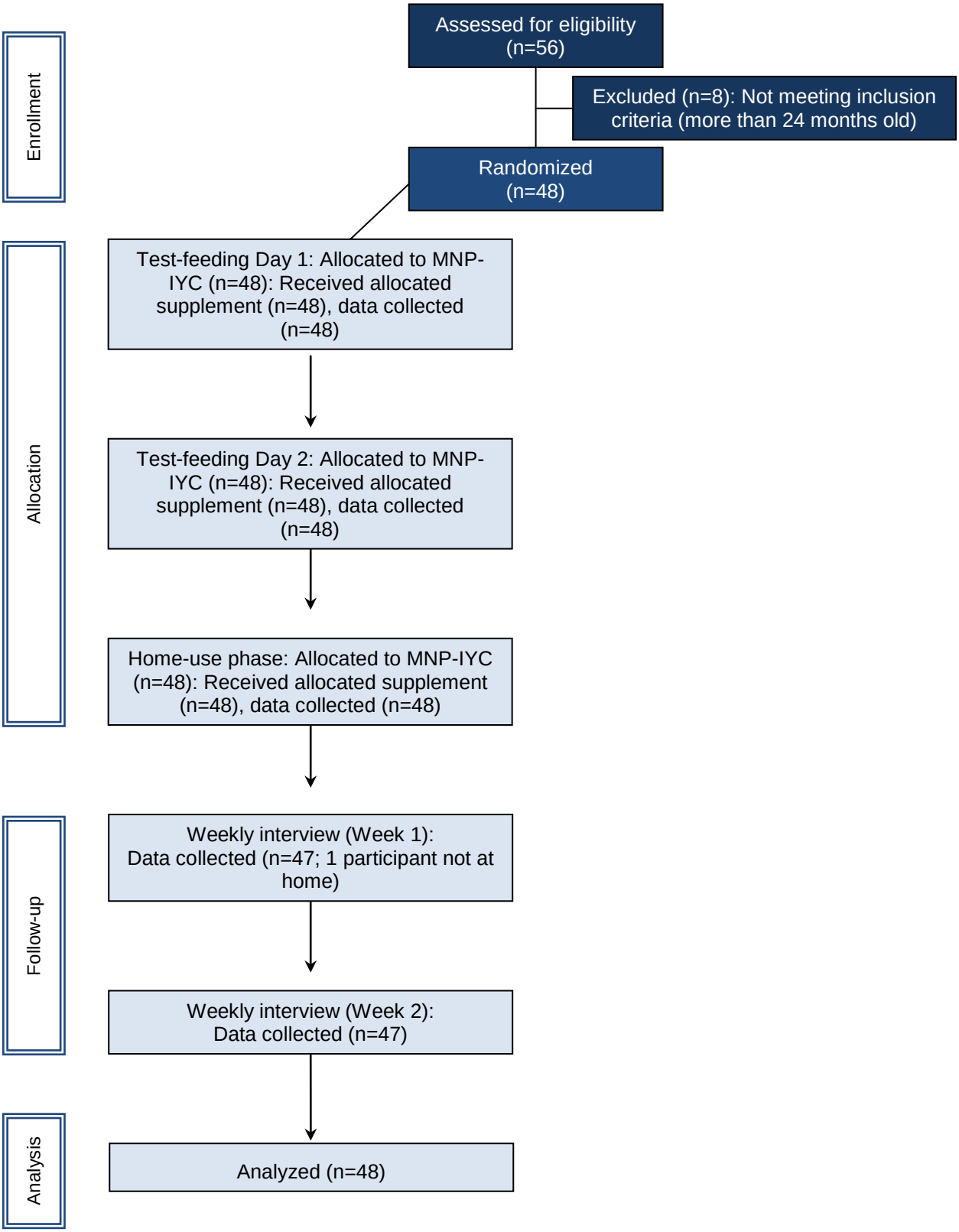


Figure 4. Overall Acceptability of the LNS-PLW during the Test-Feeding and Home-Use Phases

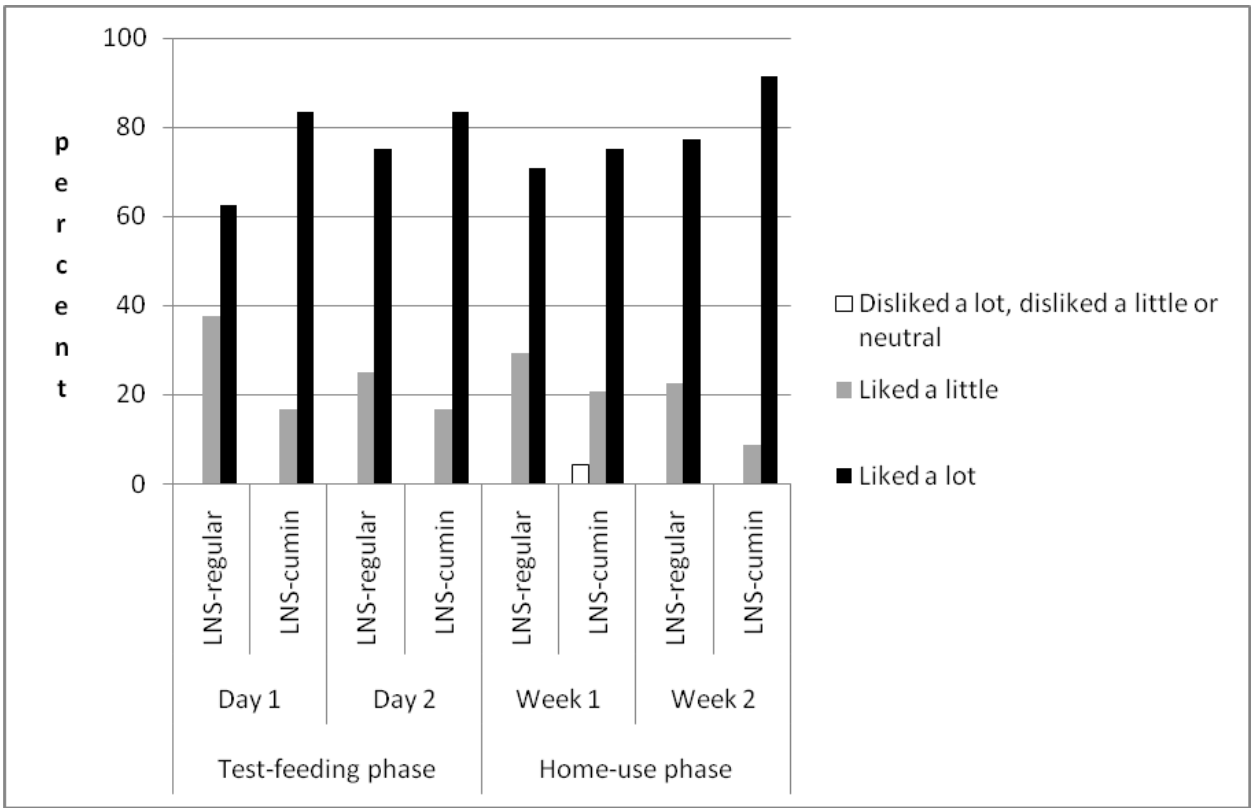
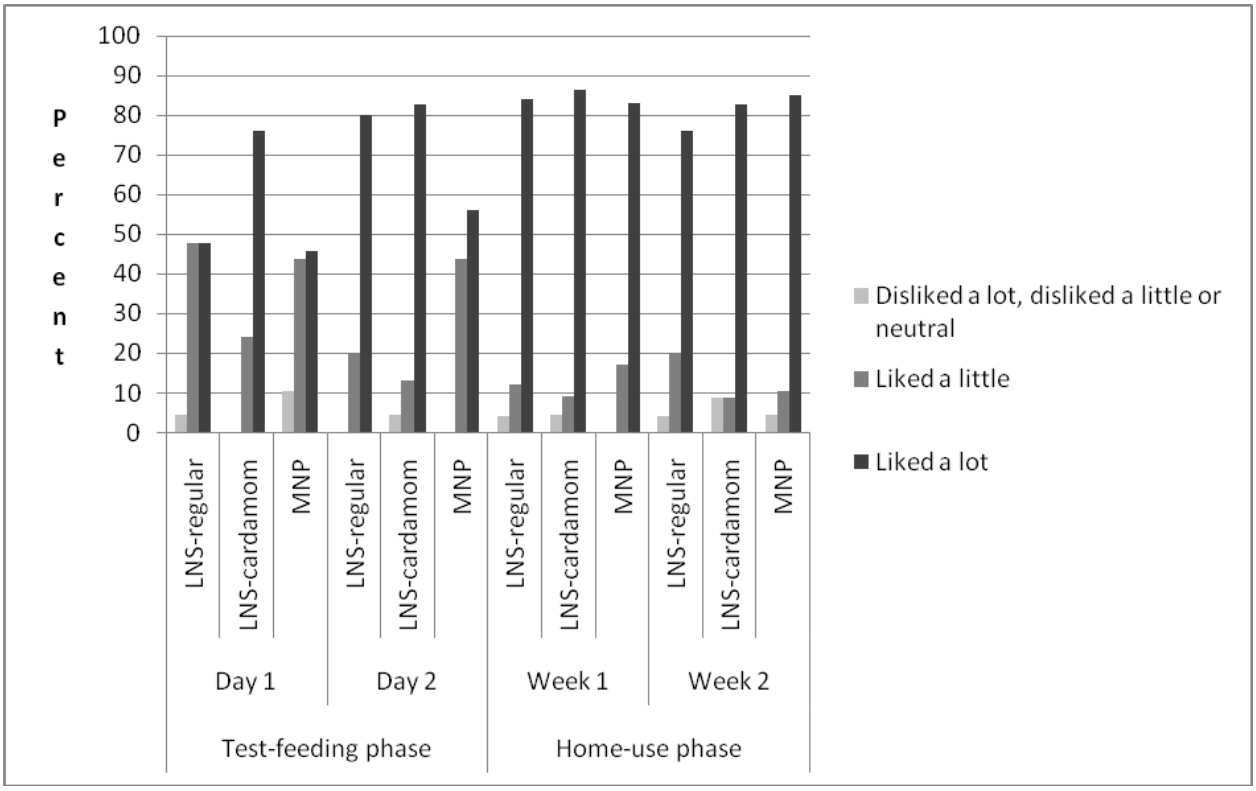


Figure 5. Overall Acceptability of the LNS-IYC and MNP-IYC during the Test-Feeding and Home-Use Phases



Appendix 1. Hedonic Scale

Dislike a lot	Dislike a little	Neither like nor dislike	Like a little	Like a lot
1	2	3	4	5

Part Two. Perceptions of PLW, Caregivers, and Health Program Staff about Malnutrition and Nutrient Supplements for PLW and IYC in Bangladesh

D. Materials and Methods

The methods for the FGDs were presented in Part 1 of this report. Additional goals of the FGDs beyond discussing the acceptability of the supplements were to:

- Identify ways to minimize intra-household sharing of LNS and MNP
- Explore strategies for "positioning" the product (e.g., to be used as a "special supplement" for IYC or for PLW) and possible delivery mechanisms
- Collect information to help develop simple, key messages on appropriate use of LNS-PLW and LNS-IYC and MNP for IYC to accompany delivery of the intervention

E. Results

E.1 STUDY PARTICIPANTS

Sixty-six community women (22 PLW, 22 mothers or PCGs from the LNS-IYC group, and 22 mothers or PCGs from the MNP-IYC group) took part in the FGDs. About half of the participants from the first two phases of the acceptability trials took part in FGDs. The details of socioeconomic and education status of the participants of the study were reported in Table 3 of Part 1.

In addition, 37 LAMB health workers (29 VHVs, 5 CHWs, and 3 CMWs) took part in four FGDs. The mean age of the program staff was 30.4 ± 4.5 years for VHVs and 44.7 ± 5.8 years for CHWs and CMWs. Seventeen VHVs were illiterate (they could only sign their name). All but one of the CHWs and CMWs had 12 or more years of education.

E.2 THEMES EMERGING FROM THE FGDS

Data analysis revealed two broad themes:

- Perceptions of malnutrition
- Opinions about the nutrition supplements

The "perceptions of malnutrition" theme includes the subthemes:

- Symptoms of malnutrition
- Causes of malnutrition
- Actions to be taken when malnutrition is identified

The other theme—"opinions about the nutrient supplement"—includes the subthemes:

- Perceived benefits of the supplements (results about this subtheme were described in Part 1)
- Organoleptic properties of the supplement (results about this subtheme were described in Part 1)
- Positioning the supplement and health education messages
- Delivery of the supplement
- Storing the supplement and prevention of sharing
- Community-level barriers related to the use of the supplement

E.2.1 Perceptions of Malnutrition

This section describes the subthemes under "perceptions of malnutrition." The subthemes are described for both PLW and IYC. For IYC, data from four FGDs (two for LNS-IYC and two for MNP-IYC) are combined.

Symptoms of Malnutrition for PLW

The symptoms of malnutrition in PLW mentioned by the caregivers included vertigo, low-grade pain or feeling of weakness in arms and feet, loss of appetite, blurring of vision, weakness, feeling unwell, sudden falls, frequent fever, inability to move around, lack of ability to digest food, breathlessness on exertion, inability to work, emaciation, difficulty in breathing, infection inside mouth, burning sensation in hands and feet, vomiting, and pain in the abdomen. One woman described the symptoms of malnutrition with practical examples:

> "For example, (a malnourished woman) gets exhausted when she tries to carry something in a pot; (she) becomes breathless."

The symptoms of malnutrition in PLW identified by LAMB staff are listed in Table 10. One VHV described the symptoms in her own words as follows:

> "It is easy to identify a malnourished pregnant woman. I told you earlier, the woman vomits. She does not have appetite and cannot eat. She suffers from vertigo."

Another VHV had a different perspective:

> "A malnourished pregnant woman can be detected by the largeness of her belly. If she is 5–6 months pregnant, she may look like a 2–3 months pregnant woman. A 2–3 months pregnant woman has a different appearance than a 5–6 months pregnant woman."

Symptoms of Malnutrition for IYC

The caregivers expressed their opinions on how to identify a malnourished child. They mentioned that malnourished children do not have an appetite; they do not eat and they suffer from indigestion; they become sick frequently; they are irritable and suffer from dysentery, diarrhea, pneumonia, headache, vomiting, fever, and *kurni* disease (essentially wasting, a condition that is perceived by the communities as a disease and that "makes arms and feet narrow"). Malnourished children take a long time to start walking; they have narrow arms and feet; they have a large head and a big tummy. Malnourished babies cannot sit; they do not walk or when they do, they walk slowly; they tumble when they try to walk or they cannot walk upright; they cannot talk even 2 years after birth; they do not play; and they do not smile. These children are weak or get exhausted easily; they look gloomy all the time and they do not grow well. The malnourished children have sunken eyes; the skin around their eyes is blackish. One woman explained:

> "(Malnourished children do) not want to eat, they become sick frequently; they do not have appetite. And, if you feed them something, they suffer from indigestion. They will have fever and their arms and feet will become narrow."

The LAMB staff also explained how a malnourished child can be detected (Table 9). One VHV described:

> "A malnourished child can be detected very easily. The child has large belly, sunken eyes, narrow hands and feet, and depressed chest."

Another VHV said:

> "(A malnourished child) can be detected by her color. Her legs are bent, chest is depressed. She does not have appetite, she cannot eat. She has no appetite and her mother cannot feed her even after a forceful try. Her hands and feet tremble. She cannot stand upright even after 1½ or 2 years."

Causes of Malnutrition in PLW

The participants reported various causes of malnutrition among PLW (Table 10). The participants also identified some cultural beliefs and practices that can be linked to malnutrition. The beliefs included:

- Fish causes loose stool
- Potato causes jaundice
- Vegetables may cause indigestion
- Beef can cause rash and skin infection in children

Some women mentioned that their husbands thought that eating a large amount of food can cause loose stool. Others talked about resistance from their mothers- and fathers-in-law to take medicine and more food during pregnancy due to the fear of having a large child. Many women described poverty as the root cause of malnutrition. One woman opined:

> "And, the cause of malnutrition is poverty. I cannot eat because I am poor. I can only eat if my husband can buy food. If my husband cannot buy food, how I can eat."

The LAMB staff reported various causes of malnutrition among PLW (Table 11). The causes included lack of food, diseases, and social factors. One VHV described the causes of malnutrition of pregnant mothers:

> "Mothers suffer from malnutrition because they do not get adequate rest. Every mother should rest at least 1 hour after she had her meal. There are families which do not allow mothers to rest. Because the father-in-law is there. The mother-in-law forces the mother to keep working. The mother cannot have food at meal time. All these result in malnutrition."

Another CHW describes the causes of malnutrition of lactating women:

> "The main cause of malnutrition of lactating women is that the mothers-in-law do not allow them to have all kinds of food. For example, vegetables; they do not allow mothers to consume vegetables. They think that the children will have loose stool if vegetables are eaten. And, the children will suffer; if he has umbilical infection, he will not get cured. Meaning, the women are deprived of nutritious food."

Causes of Malnutrition in IYC

The caregivers mentioned that the causes of child malnutrition are rooted in problems with both the mother and her child (Table 10). One woman said:

> "The cause of malnutrition is low birth weight. When my elder daughter was born, her weight was very low. Her weight was like the weight of a crow-baby. The people asked a lot of questions. I went to clinics and they said my child was malnourished. My daughter is 5 years old now but she did not get an admission to any school. She is stunted and weak. I had given her so many medicines since she was born, I cannot explain. She was malnourished when she was inside my womb; she came to the world as a malnourished child; she is suffering from malnutrition now; her nutrition gaps never fulfilled."

Another participant related that the child suffers from malnutrition due to the wrongdoings of the mother:

> "If I could feed my child well, he might not suffer from malnutrition. But, the child should be fed properly; I could not do that; I am busy with my own work; I am working, leaving my child alone. When I could find time, I fed him; it is my own fault that my child is malnourished. If I feed my child adequately, take care of him, he will never be ill, he will be healthy."

The LAMB staff opined that mothers and children are like dyads and if a mother suffers from malnutrition, it is likely that her child will be malnourished. A list of causes of malnutrition of IYC mentioned by the women is given in Table 11. The health staff described that, apart from food and illnesses, lack of proper breastfeeding practices and cleanliness are important factors contributing to child malnutrition. One VHV opined:

> "The children, who get additional food other that breast milk before they reach 6 months, will suffer from malnutrition. Others who are bottle fed or given *suji* (porridge) will also suffer."

Another VHV described:

> "I want to say about cleanliness. When the children are given complementary food and if the food contains *dhulabali* (dirt, dust, sand), the children will suffer from malnutrition. Malnutrition occurs due to lack of cleanliness."

Actions to Be Taken for PLW when Malnutrition Is Detected

The PLW stated that treatment for malnutrition from a doctor or a health facility is considered as the last option. If a woman is detected as malnourished during pregnancy or lactation, the family either does not do anything or considers self-care as the first option. The family may provide the women with more food and buy milk, fruits, eggs, fish, and meat that are considered nutritious food. The woman is also advised to take frequent meals. One participant said:

> "When the woman is malnourished, she should be given nutritious food; for example, vegetables, fruits, milk, eggs. These foods contain vitamins. The women should be given these foods all the time. If the woman does not eat all the food at a time, she should be given the same food after half an hour or 1 hour. If the woman can take food frequently, the mother and the child will not suffer from malnutrition."

The PLW also reported that sometimes the father-in-law or mother-in-law advises the woman to go to her parents' house when she is malnourished. At times, the women took "brown tablets" (iron tablets) to treat malnutrition and other medicines to reduce nausea and vomiting, which they identified as causes of malnutrition. When the family thought that self-care was not enough, they consulted traditional healers or homeopathic practitioners. These practitioners gave them holy water, sacred thread, amulets, and/or homeopathic medicines. If the symptoms were severe (the woman was unable to move or she had fever or was bedridden), the family took her to allopathic doctors in hospitals or private clinics.

The VHVs described that if PLW suffered from malnutrition, the first thing to be done is to improve her dietary consumption. They mentioned three types of foods that are necessary for each PLW: food for energy, food for maintenance of body, and food for preventing illnesses. They also gave examples of food items for each type. Foods for energy include rice, meat, banana, bread; foods for maintenance of body include lentils, oil, eggs, meat, and beans; and foods for preventing illnesses include fruits and vegetables. They suggested that if a PLW eats properly and takes adequate rest, she will not suffer from malnutrition. The VHVs stated that the PLW needed to visit a health care provider. The PLW would need a health check, have her blood pressure and weight measured, and take iron and folic acid regularly. The frequency of meals could also be increased from three to five times per day, for example. Other actions

that could be taken by the women included increased intake of water and improved personal hygiene. One VHV described:

> "(If a PLW suffers from malnutrition), we need to give her nutritious food. She needs to eat spinach, beans, carrots, pumpkin, etc. The frequency of meals should be five. She needs rest. If she takes rest, the child in the womb will be able to take nutrients from her blood using the umbilical cord."

They also pointed out that women should avoid frequent childbirth to prevent malnutrition. In the case of severe malnutrition, women should be taken to doctors, though they said that some women did not go to the doctor. One VHV expressed:

> "Though we tell them to go to doctors, they might see a homeopath. Visiting a traditional healer is rare nowadays. A lot of people went to the traditional healers in the earlier days."

On the other hand, the CHWs and CMWs described that the families went to spiritual healers at first and then to the *kobiraj* (a type of traditional healer primarily providing herbal treatment). If treatment from *kobiraj* failed, the next usual step was to see a homeopath. Once they found that the homeopath was unable to cure the mother, they went to the medically qualified health providers. They also gave a description of the treatment the PLW received from a spiritual healer or *kobiraj*. The spiritual healers usually gave them holy water. The PLW believe that holy water will remove the causes of malnutrition from their bodies. Sometimes the *kobiraj* also prepared medicines using the seeds of mangoes or blackberries along with hot oil and utters *mantra* (holy words). One CHW described:

> "We have a *kobiraj* in our area. He makes his pills using mango and blackberry seeds. The mangoes, which we eat. He collects those seeds and washes them. Then he grinds the seeds and makes small pills. He gives these pills for all kinds of illnesses. He also gives hot oil and utters *mantra*."

Like VHVs, CHWs suggested that PLW need proper food, rest, and care during pregnancy. They need safe delivery, especially when they suffer from malnutrition. After childbirth, the women need to adopt a family planning method. The CMWs and CHWs expressed that the mother-in-law and father-in-law in the family influence the diet consumed by PLW and, therefore, to treat malnutrition successfully, they need to be engaged, counseled, and educated.

Actions to Be Taken for IYC when Malnutrition Is Detected

The caregivers discussed various strategies to treat malnourished children. As a first step, the people try to give the child more nutritious food. They give him more milk; fish, including small fish; eggs; meat; vegetables; etc. They feed him *khichuri*, which is prepared from rice, lentils, and vegetables. Some women mentioned that *khichuri* should be cooked with seven ingredients, e.g., rice, lentil, potato, carrots, pointed gourd (*potol*), radish, and Malabar spinach (*pui shak*). They mentioned that pumpkin, leaves of gourd, taro (*kochu*) leaves, and beans can be added to *khichuri*. They also mentioned that they cook soft rice for their children. Some women suggested that the children should be fed frequently and if they did not want to eat, they should be force-fed. One woman stated:

> "When our children are malnourished, we do not do many things. We try to give them better food. The woman who has milk, she gives her child milk. If I have chicken eggs, I feed our child chicken eggs. I cook *khichuri*, soft rice and feed my child."

The other mentioned activities done at home to treat malnutrition could be grouped into two categories:

- Behaviors related to feeding and nutrition (feeding breast milk, buying vitamin supplements from local medicine shops; giving vitamin A capsules from the CHWs; giving formula milk and nutritious food from the market, e.g., Horlicks, which is an instant beverage mix promoted as a highly

nutritious food in Bangladesh and India)

- Care practices (doing physical exercise, massaging the children that cannot walk, helping the child walk, verbal communication with the child in a sweet voice, taking proper care of the child, massaging the child with oil before bath, doing household work after taking care of the child, clothing the child, putting him to sleep regularly, cleaning the child, taking care so that the child does not catch cold, and not allowing the child to be in dusty places)

The respondents also mentioned that when the symptoms of malnutrition get severe, they initially take the child to traditional healers (*kobiraj, mohonto*), spiritual healers (*hujur*), homeopaths, ayurvedic practitioners, and rural medical practitioners. The traditional healers explain that the child was attacked by an evil spirit and treat the child with holy water, sacred thread, amulets, and magic words (*jhar phuk*). One participant explained:

> "Suppose a child is malnourished, he is becoming thinner day by day; the people in the village say that the child has been attacked by evil spirits; the child will be cured if taken to a *mohonto*. Most of the people do not go to a doctor; they go to *mohonto* and *mohonto* cures the child with *jhar phuk*."

However, some of the caregivers were doubtful of the effectiveness of the treatment provided by the traditional healers, spiritual healers, and homeopaths. One participant said:

> "This (taking the child to traditional healers) is a superstition. The *mohonto* cannot cure a child (with malnutrition). We do not trust them. Many people believe that the children cannot walk because they are caught by *jeen* and *bhut* (evil spirits). The true thing is the child is not eating and becoming weak."

If the problems get more severe (the child does not walk and cannot sit and eat) and the child has symptoms of severe diseases (e.g., loose stool, vomiting, fever, and/or cough), they take the child to medical doctors. They mentioned that the doctors treat the child with medicine and vitamins and give some dietary advice. One mother described:

> "When the condition of my child is severe, I take him to a doctor. The doctor gave my child medicine to improve his appetite. He also advised to feed my child soft foods."

A few caregivers mentioned the LAMB's nutrition rehabilitation clinic as a place where they can go if their children have "narrow arms and feet." They think that narrowing of arms and feet is a symptom of severe malnutrition.

The LAMB health workers talked about different actions taken by the families when a child in the household was identified as malnourished. As a first step, the families give the children more food and, if the child is not cured, they go to the spiritual healers, traditional healers, homeopaths, and doctors, depending on the severity. Sometimes the children suffer from diarrhea and pneumonia as a consequence of malnutrition and they need to be taken to the doctors as well, and the doctors treat them accordingly. The health workers said that some children suffer from intestinal worms and they need to be treated, otherwise they would continue to suffer from malnutrition. The VHVs also mentioned some ways to detect the severity of malnutrition, including abrupt weight loss and yellowish coloring of the skin. They stated that exclusive breastfeeding until the child reaches 6 months could prevent malnutrition and that later on the children need *khichuri*. When the children are malnourished, they need an increased amount of complementary food, and they need to continue breastfeeding. Sometimes the children do not have an appetite and the VHVs advised the following local treatment:

> "There are children who do not have appetite. *Jaon* (a medicinal plant) can be boiled in water and then the water can be given to the child. The seed of Hortoki (*terminalia chebula*) can be crushed and mixed with rock salt and then given to the child. There will be a huge increase in appetite. I myself did it."

To treat child malnutrition, the CMWs and CHWs suggested a few other things. They said that misconceptions about malnutrition need to be addressed and treatment of malnutrition by unqualified health care providers should be avoided. The children need to be given anti-helminthic drugs and a vitamin A capsule every 6 months. They need immunization against common diseases. The children require a balanced diet too. They said that caregivers at home and at the health center should work together to treat malnutrition. According to one CHW:

> "There are two forms of care: at home and at the clinic. At home, the children should be given a nutritious and balanced diet. We will take care in the clinic. We will measure weight and do blood tests."

E.2.2 Opinions about the Nutrition Supplements

There were three types of supplements. The findings are grouped according to the supplement.

Positioning the Supplement and Health Education Messages (LNS-PLW)

The PLW gave their opinions about how to position the supplement. Nobody was in favor of promotion of the supplement as "medicine," and only a few said that they had no problems if the supplement was promoted as a "food" or "medicine." Almost all the women mentioned that the supplement should be promoted as a "special food," not as a "medicine." They opined that if the supplement was promoted as a "medicine," people would ask questions, since PLW should not take any medicine unless they suffer from a disease. The supplement would be more acceptable and people would ask fewer questions if it was promoted as a "special food." A few women mentioned that many people have misconceptions that medicines are not safe during pregnancy and that they can cause abortion. Another mentioned advantage of promoting the supplement as a "special food" was compliance. If the supplement is promoted as a "medicine," the compliance will be less because women might see a medicine as something taken irregularly (or that can be put off until the next day). Food, however, is consumed every day, which may make women consume the supplement more regularly. One woman said:

> "Nutritious food will be a better name for the supplement. If it is promoted as medicine, people may think they will not take the medicine today, they will take it the next day. If it is promoted as a food, they will eat it more regularly."

The women also reported that health education messages covering the importance of the prevention of malnutrition, the advantages of the use of supplements, and instructions for the use of supplements are required to convince them and other family members about the need for regular use of supplements. In their opinion, the health education messages should convey that:

- The supplement is nutritious and special for the mothers
- There are many malnourished children in Bangladesh
- There are many disabled children, too
- Healthy mothers and babies are required for the country

Similar to the opinions of the PLW, the VHVs wanted the supplements positioned as a special food instead of a medicine. They described their experience with iron tablets and said that most women are reluctant to take iron and folic acid tablets, because they are promoted as a medicine. They added that people have great trust in LAMB, so it would be beneficial if the LAMB logo was on the sachets. They argued that a medicine is usually taken for a limited period of time, and a food can be taken for a long period of time and needs to be consumed every day. One VHV explained:

> "If you call (the supplements) medicine, women will treat them as iron tablets. There are many women who do not take iron tablets. They can also ask questions, for example, why we are giving them medicine."

The health staff also suggested that only one type of message be promoted to each community so that the women in the community will not be confused.

The CHWs and CMWs argued that the health workers, including VHVs, should be trained so that they know everything (e.g., advantages and disadvantages) about the supplements and can answer any question. The health workers should also talk to fathers- and mothers-in-law and husbands and make them understand that the supplements are good for both mothers and children.

Positioning the Supplement and Health Education Messages (LNS-IYC)

The majority of the caregivers suggested that the supplement be promoted as a "special food," not as a "medicine," although a few of them felt that there would not be any problem if the supplement was promoted as a "medicine." The respondents that were in favor of naming the supplement a "special food" said that medicines are purchased from doctors and that the supplement was provided free of charge by non-doctors. The supplement was made from food ingredients and was mixed with other food to consume. They also felt that medicine is given to children when they are sick, whereas a food can be consumed by everyone all the time. They also said that some people are afraid of taking medicine and they would not like the name. Others said that people would be interested in trying a new food, but only a few would be willing to try a medicine. The people that were in favor of both "medicine" and "special food" said that, since the supplement was being provided by a LAMB hospital, "medicine" would also be appropriate. They also felt that the supplement saves people's lives by preventing diseases; therefore, medicine would also be suitable. One woman argued:

> "It (the supplement) is made from foods; therefore, it is not a medicine. Rice should be called rice and spinach should be called spinach. If you switch names, people will laugh at you. You have mixed all types of foods to prepare a special food and want to call it medicine. The people will not accept that."

The women also had some opinions about the health education messages. They said that health education messages were necessary to ensure compliance. They did not have specific suggestions for any messages, but felt that the community's inhabitants, especially women, should be informed of the pros and cons of the supplement. They stated that some people in the community would accept the supplement and some would not. Health education messages would be helpful in convincing some non-users. Some women suggested that other messages for improving child nutrition should be given along with the messages on the supplement. Others suggested that the supplement should be promoted as a means to prevent malnutrition, not as a means to cure malnutrition. The promotional messages should be similar to those health education messages used for immunization. One woman argued:

> "This food is not actually a medicine. That is what you told us. If this food is taken for a long time … meaning … (the children) are not suffering from malnutrition, (they) are growing naturally. This is the real proof. You are telling people if the malnourished children eat the supplement, their nutrition status will improve. We want a means so that the children do not become malnourished. Do you understand? For example, we immunize our children to prevent diseases; we do not immunize them when they (already) have the disease."

The VHVs from the areas where LNS-IYC was distributed also wanted the supplement to be promoted as a special food or as a special and nutritious food for children. One VHV argued:

> "We eat food every day, but we do not take medicine every day. The supplement should be named as special food not a medicine."

About the health education message, they opined that only one message should be promoted by all. They gave some examples of health education messages from family planning and health interventions in Bangladesh (e.g., "boy or girl, only two children is enough"). They suggested a message that translates as:

> "Nutrition is needed for all, especially for women and children. Let us fight malnutrition together."

The CHWs and CMWs also suggested some health education messages. One of them was:

> "We will not stop taking supplements; we will not suffer from malnutrition."

Positioning the Supplement and Health Education Messages (MNP-IYC)

All the respondents were in favor of naming the supplement as a "special food," and did not want to call the supplement a "medicine." They stated that if the supplements were known as medicine, children would be afraid. Moreover, medicine is consumed by everyone, but a "special food" means that the food is for a special group of people. One woman said:

> "(The supplement) needs to be named as *bishesh khabar* (special food) because the children benefit. It will be good if you name the supplement as *bishesh khabar*."

They suggested that the name of the supplement be *bachchader bishesh pushtikor khabar,* which translates as "special nutritious food for children." The FGD participants also liked Monimix®, which was the trade name of the supplement provided. They did not have any comments or suggestions for specific health education messages.

The VHVs, CHWs, and CMWs also agreed that the supplement should be promoted as a special food to increase compliance. They did not have any suggestions for health education messages. However, the CHWs and CMWs said that health education messages should be given to a group of people. They also suggested developing songs, rhymes, etc. about the supplements and conducting demonstrations for women about the use and storage of the supplements.

Delivery of the Supplement (LNS-PLW)

The respondents shared their viewpoints about the timing, amount, place, and person in charge of delivery of the supplements. There were different opinions. The suggested amount of supplement to be given at a time included a 7-day supply, a 10-day supply, a 14-day supply, and a 1-month supply. Some women feared that the supplements would be consumed by others (e.g., children) or would be wasted if more than a 7-day supply was given at one time. A majority of women were in favor of a monthly supply, though one woman argued:

> "If the supplement is given weekly, then the women will feel the demand. If a large amount is delivered, they will not be serious to consume the supplement."

The women also had different viewpoints about the time of delivery of the supplement. They preferred either morning or afternoon as the supplement delivery time. Some of the women reported that they were relatively free in the afternoon.

All of the women wanted the supplements to be delivered at home. Most of them wanted the research staff to deliver the supplements. Some of them mentioned LAMB CHWs as alternates to deliver the supplement. None of them mentioned VHVs as alternates to deliver the supplement. When the facilitators probed about VHVs, the women did not like the idea. One woman said:

> "The sister (data collector) who records our information will be serious about delivering the supplements. If the VHV is given the responsibility, she might be lazy. She might not be serious about timely delivery of the supplement. She can be lazy."

The VHVs had no preference about the person delivering the supplement. They said that they would be willing to take on the delivery responsibility if they are told to do so. They did not have any problem if CHWs or others deliver the supplements. They suggested that weekly delivery of the supplements would be more useful, indicating that if the supplements are delivered fortnightly or monthly, the women would not properly understand the supplement's importance.

Some of the CHWs and CMWs said that home delivery of the supplement is the best option, but all agreed that it would take a lot of their time. The alternate option was to have specific time, date, and place of the delivery of the supplements in each area. They cited their experience with mass distribution of anti-helminthic medicines or medicines for filaria. In those cases, home delivery of medicines did not produce a good result, as some women were not at home when the health workers visited them. They suggested that delivery of the supplement directly to the mothers of children that will consume the supplement is very important. They argued that if the women were not at home and the supplement was given to someone else in the household, the woman would not have the chance to talk to the health worker and ask questions. All this will have an impact on the use of the supplement. They also argued that people do not give importance to the things that they get free of charge. They agreed that there was a need for awareness raising and motivational campaigns.

The CHWs and CMWs also suggested that delivery of 1 month's supplement at a time was not a good idea. If the supplement was not given as a weekly or fortnightly supply, they believed that a lot of the supplements would be wasted. The CHWs themselves wanted to deliver the supplements with the help of VHVs. In the case of fortnightly delivery, they wanted the VHVs to pay weekly visits to the women who received the supplement.

Delivery of the Supplement (LNS-IYC)

The respondents opined that more sachets should be given to them. As the children take at least three meals per day, the daily dose should be three sachets for them. They suggested that the supplement should be delivered at home, because many people would not be willing to go to other places to get the supplement. However, some of the women said that they would be willing to collect the supplement from a specific place, because their children liked the supplement. One woman said:

> "As my child is eager to eat the supplement and (the supplement) is nutritious, I will have to collect it."

Most of the women wanted the supplement to be supplied to their house during the morning, though some mentioned that the supplement can be delivered at any time because they are home almost all the time. A majority of the women were in favor of a fortnightly supply. They feared that a monthly supply will be a lot for them to store and the supplements could be wasted. Some women stated that a weekly supply would be preferable.

The women wanted the supplement to be delivered at their home between 9am and 11am. Most of them are busy at noon, but said that the supplements could be delivered in the afternoon if morning delivery was impossible. The women wanted the research staff to deliver the supplements.

The VHVs suggested that home delivery of the supplement is better than other options because it will also allow them to monitor the use of the supplements. They pointed out that weekly or fortnightly distribution of the supplement would be better than monthly delivery. They did not rule out monthly delivery of the supplements, but said that the woman should be visited several times a month if monthly supplies were given. They also said the VHVs should deliver the supplements because they live close to the houses of the mothers that would get the supplements.

Delivery of the Supplement (MNP-IYC)

The majority of women were in favor of fortnightly delivery of the supplement. The other options mentioned by them were weekly, every 20 days, and every month. The participants opined that weekly or fortnightly supply will improve compliance. Most of the participants suggested that there be more supplement provided per day for the older children. The FGD participants opined that VHVs of LAMB should deliver the supplement, though they did not have problems with the research staff delivering the supplement.

> "(If the supplement was given weekly), the mothers will regularly feed the children. If you give 1 month or 2 months supply, there will be irregularity. If you give less amount (of supplement), the people will follow the instructions."

The VHVs opined that weekly or fortnightly delivery of the supplements would be better than monthly delivery. They suggested that the supplements could be delivered by the CHWs and that they would be able to help the CHWs deliver the supplements. They were also willing to visit the women weekly and to use a pictorial checklist to collect information about the use of the supplements. They said that either morning or afternoon is a suitable time for the delivery of the supplements.

Storing the Supplement and Prevention of Sharing (LNS-PLW)

Some of the women wanted to store the supplement in a refrigerator, though this is not required for this type of supplement. Many of them said that they would store the supplement in a cabinet, steel trunk, or cupboard. Some mentioned that they would keep the supplement in a drawer under lock and key. They also mentioned that the supplement would be kept in a dry place, which should be out of reach of the children. One participant explained:

> "The supplements should be kept in a place where the children cannot see. The place should not be wet and damp. The supplement should be kept in a dry place."

The women also linked storage of the supplements with ways to prevent their being shared. They pointed out that keeping the supplements in an appropriate place will reduce the chance of sharing with others, especially children. They said that they would be able to convince adults not to take the supplement and would tell them that the supplement should be consumed only by the person who was given the supplement. They also think that the instruction to eat one sachet of the supplement at a time will be helpful to prevent sharing. A participant described:

> "The supplement was given to me to eat the whole packet by one person. Therefore, it cannot be shared. If anyone else wants to eat, she will have to eat the whole packet. The supplement was delivered to me by my name. I will have to eat the supplement. Why should others eat (my supplement)?"

However, they thought it might be difficult to convince the children. During the acceptability study, they even gave wrong information about the supplements to their children to prevent sharing with them. One woman said:

> "I told my son, if you eat the supplements, you will suffer from loose stool. My daughter asked what kind of loose stool. Then she said OK, I will not eat the supplements."

The VHVs, CHWs, and CMWs explained that sharing might or might not be a problem in the case of PLW—they were unsure. However, they felt that the women would need to be convinced and motivated so that they do not share the supplements with others.

Storing the Supplement and Prevention of Sharing (LNS-IYC)

The women proposed a number of options to store the supplements and avoid sharing. They said that it would be difficult for them to convince other children in the household that they cannot have the supplement if the supplement is supposed to be given to only one child in that household. They thought that they could hide the supplements and that they would give other children alternate food (e.g., rice) if they wanted the supplement. They felt that if the supplements were left on a table and everyone could see them, the chances of sharing would increase. They also wanted to store the supplements in a glass jar, tin box, etc. so that insects could destroy the supplements. One woman stated:

> "If the other children want it (the supplement), I will have to hide the supplement from them so that they do not cry and remain silent."

The VHVs also shared their opinion about prevention of sharing of the supplements. They thought that sharing could be common and that the children should be fed the supplement under observation.

Storing the Supplement and Prevention of Sharing (MNP-IYC)

The women wanted to store the supplements in a place that was out of reach of the children. They suggested that the supplement should be kept in boxes so that insects and rodents could not destroy it. To prevent sharing of the supplement with other children, they suggested hiding it in a pitcher or under the mattress and feeding the supplements at a time when other children were not present. They stated that they would tell the other children not to eat the supplement. One woman explained:

> "(I will) keep the supplement carefully. I will keep the supplement inside the house so that the children cannot see (it), (so the children) cannot eat (it). Even if they want to eat (the supplement), we will not allow them (to do it). The supplement will be given only to the respective child."

To prevent sharing of the supplements, the VHVs proposed feeding under observation on each day. They also suggested that keeping daily records and that taking signatures from the PCGs on each day would be necessary to prevent sharing of the supplements. When they were probed regarding the feasibility of this approach, they responded that visiting the households would not take much of their time if the women mix the supplements with just a small quantity of food and eat the mixture of supplement and food before the consumption of the rest of the food. (In Bangladesh it is customary to mix the main dish [curry or lentils] with rice and consume the mixture. If the supplement was mixed with the entire quantity of rice and curry lentils, rather than a smaller portion only, the VHVs would have to stay longer in the household to observe the consumption of the entire food-LNS mixture.)

Community-Level Barriers related to the Use of the Supplement (LNS-PLW)

The participants shared a number of community characteristics that can be barriers to promotion of the supplements in the community, although most of the women said that there would be no barriers at the community level. Most of them did not anticipate any resistance from other NGOs working in the same areas. One woman said:

> "There will not be any barriers. In our village, people say that the supplements are good. The supplements will control malnutrition. It is beneficial for the mothers and the children. Others also wanted the supplement."

However, the participants also mentioned that there were some people that spread rumors and fear about the supplement. One woman shared:

> "Many people discouraged us (to take the supplement). They told us not to eat the supplement, as the supplements might be responsible for large babies. If the babies are large, childbirth will be difficult. A mother's life will be in danger."

Another woman described:

> "My husband told me that Bangladesh has a huge population, and the government planned to kill people by feeding the food (the supplement). The food (the supplement) will cause diseases, and people will suffer and die. The government is crazy."

The VHVs, CHWs, and CMWs suggested that everyone should get the supplement. The CHWs and CMWs said that if some women were excluded, they might be upset and later on decide not to visit LAMB for their health conditions.

Community-Level Barriers related to the Use of the Supplement (LNS-IYC)

The women did not see any barriers that would hinder the use of the supplement if the supplement was beneficial for the children. They had concerns that if the supplement was not provided to all the children in the community, some of the mothers would be unhappy. They suggested that the children should be checked regularly to see the effect of the supplement and that the community should be informed of the results. One woman argued:

> "The children who ate (the supplement) became healthy. Their appetite and nutrition status improved. Will you not check their vitamin status? You have given them (the supplement). How will we know if (the supplements) did good or bad? What is the benefit?"

The CHWs and CMWs said that if the supplements are given only to the rich people, there would be problems. The rich might think that they were already giving enough food to their children and that additional supplement was unnecessary. The others in the village might have questions as well. One CMW explained:

> "(If supplements are given to the rich children only) people in the village will say we are adding oil to our hair. The poor may think that they are excluded as they are helpless."

Community-Level Barriers related to the Use of the Supplement (MNP-IYC)

The participants mentioned that people in the community would not create any barrier as each child receiving the supplement benefited. One woman explained:

> "Everybody here fed their child (the supplement) and benefited. I hope nobody will create any barriers. All of us benefited; if there were problems (after eating the supplement), it would have been different."

However, they had concerns that some people in the village were "prejudiced" against the supplement, and that they will need to be convinced by sharing the experiences of people whose children benefited after eating the supplement. They also felt that many people in the community were disappointed that the supplements were not delivered to their children.

Some CHWs and CMWs pointed out that previous educational efforts had emphasized increased amount of already available food and that the delivery of a nutrient supplement conflicts with that message. They thought that the community would ask a lot of questions about the new product. They also opined that cooperation from the husbands of the PCGs was important. One VHV described:

> "One mother told me if there was any problem with the child after getting the supplement, she would stop giving the supplement to her child and wait until her husband was back. Once he was back, she would discuss the issue with him and decide on continuation of the supplement."

F. Conclusions

F.1 PERCEPTIONS OF MALNUTRITION

There is awareness and knowledge of physical and behavioral symptoms of malnutrition in all groups of participants. However, several of the symptoms listed by the participants refer to specific illnesses that may actually be a consequence of malnutrition, not symptoms of malnutrition itself.

Particularly in the case of pregnant women, the influence of the in-laws seems to be very important. As mentioned by the participants in different groups, this influence may be negative in that it prevents pregnant women from consuming nutritious food and taking proper care of themselves. Also, fear of having a large baby as a consequence of better nutrition seems to be present, which may need to be addressed through education before supplements will be properly used by pregnant women in this population.

A care-seeking chain for malnutrition treatment was identified. Sometimes this chain starts with self-care at home and in some cases with seeking care from a traditional healer. If the traditional healer is unable to “cure” the malnourished person, a homeopathic practitioner may be consulted. Apparently, only after the traditional healer and/or homeopathic practitioner fail to “cure” the malnourished person or when the problem is considered severe enough is the malnourished individual taken to a medical provider for appropriate care.

There is recognition that a malnourished person not only needs to increase consumption of nutritious foods, but also that appropriate caring practices are needed to help this person recover.

Among the more educated health staff (i.e., CHWs and CMWs), there was the notion that education is also necessary for improving the nutritional status of this population, and that the treatment of malnutrition should be a collaborative effort between the health provider and the families affected.

F.2 OPINIONS ABOUT THE NUTRIENT SUPPLEMENTS

Almost unanimously, the preference was to promote the supplement as a special food instead of a medicine. The two main reasons were that people would be less reluctant to try a new food than a new medicine and that it would encourage regular consumption, since foods are consumed regularly while medicines might not be.

Different opinions were voiced by members of the community and by health staff regarding health messages that should be associated with supplement distribution. While people from the community preferred to receive more information about the supplement (e.g., pros and cons of supplement use), the health staff indicated that providing more than one type of message may be confusing for the population.

Several delivery mechanisms were proposed. Pregnant women and caregivers preferred that the supplements be delivered to their homes, although some caregivers indicated that they were willing to pick it up somewhere else given the high acceptability by their children. The program staff had different opinions regarding who should deliver the supplement, although all (VHVs, CHWs, and CMWs) were willing to do it. It was indicated that although difficult, home delivery was possible. It was also suggested that specific dates and times for distribution of the supplements be set for each village, so that mothers could pick them up in their own community. In terms of the frequency of distribution, all groups indicated that a monthly distribution would not benefit adherence, and suggested weekly or fortnightly distribution instead.

Pregnant women and caregivers indicated that storing the supplement out of reach of children was necessary and would reduce sharing. Health staff suggested feeding the supplement under observation (by them) to make sure that it is eaten by the target person.

Potential barriers to the use of the supplements included misinformation in the community and spreading of such incorrect information, which would affect consumption. In addition, the preference that supplements be distributed to all pregnant women and children was indicated by caregivers and program staff. Moreover, involvement of husbands and in-laws in any education component related to the benefits of supplements was considered important to improve compliance. Finally, the need for a monitoring system to detect any potential negative effects due to the use of the supplements was expressed.

Tables

Table 9. Symptoms of Malnutrition in PLW and IYC Mentioned by Program Staff

Symptoms of malnutrition in PLW	Symptoms of malnutrition in IYC
Loss of appetite/unable to eat	Inadequate feeding
Loss of weight or unable to gain adequate weight	Loss of weight, thinness, skeleton-like appearance, narrow hands and feet, bent legs
Vertigo, nausea, vomiting, blurring of vision	Large belly
Unable to breastfeed the child	Indigestion
Unable to do household work	Unable to start walking/unable to stand upright at 1½ or 2 years of age
Weakness or generalized weakness	Unable to start talking at the appropriate age
Unable to move around or sit upright from a lying position	Cretinism
Indigestion, loose stool	Large/small head; thin buttocks
Anemia/pallor/lack of hemoglobin in blood	Unable to walk around
Sunken eyes	Loss of appetite
Breathlessness/feeling of discomfort on exertion	Sunken eyes, pallor, loose skin
Loose skin	Depressed chest
Swollen face	Frequent disease, e.g., diarrhea, pneumonia, fever, cough, runny nose, dysentery, worm infestation
	Trembling of feet while walking
	Depressed fontanelle
	Low weight for age
	Brown hair
	Accumulation of water in the body

Table 10. Causes of Malnutrition of PLW and IYC Mentioned by PLW and Caregivers

Causes of malnutrition in PLW	Causes of malnutrition in IYC
Childbearing or frequent childbearing Inability to take any kind of food or inability to take nutritious foods (e.g., fish, milk, meat, fruits, spinach) Unavailability of food Nausea and vomiting during pregnancy Loss of appetite during pregnancy Irregular meal time Prioritization of children for food Problems of internal organs Fever or feverish feeling Diseases, including pain in the abdomen and dysentery Heavy work (e.g., washing clothes) Breastfeeding during postpartum period Indigestion after eating leafy vegetables Poverty	Inadequate food intake by mothers during pregnancy, e.g., due to vomiting during pregnancy Hard work by mothers during pregnancy Low birth weight Inadequate breast milk Lack of exclusive breastfeeding during the first 6 months Lack of immunization Diseases, infections, fever, and indigestion of the children Lack of additional food at growing age of the child Lack of appetite Lack of regular meals, vitamins, right food in right amount Violence against women by in-laws or husband Poverty, inability of the father of the child to buy food Lack of education Lack of attention to female children by the family members Lack of time available for the mother to take care of the child due to other household work Lack of emotional support by the family members during pregnancy Poor understanding of the mothers and family members about how to raise a child Unsuccessful use of abortion medication Food adulteration, e.g., use of urea fertilizer to whiten rice

Table 11. Causes of Malnutrition in PLW and IYC Mentioned by Program Staff

Causes of malnutrition in PLW	Causes of malnutrition in IYC
Inadequate food intake/intake of low quality food	Maternal malnutrition
Violence by husband, mother-in-law, or father-in-law	Maternal illnesses
Multiple marriages of the husband	Low birth weight
Familial and social problems and stress	Lack of exclusive breastfeeding/breastfeeding
Early marriage, early childbearing, frequent child bearing	Not feeding colostrum
Lack of food in the household	Frequent illnesses (fever, diarrhea, pneumonia, tuberculosis)
Lack of education/illiteracy	Lack of immunity
Lack of knowledge about appropriate types/three types of food (energy-yielding, disease-preventing, and body-maintaining)	Lack of hygiene/lack of cleanliness
Morbidity, e.g., fistula	Worm infestation
Lack of rest	Inadequate knowledge about nutritious food
Irregular meals	Bottle feeding
Misconceptions about food/mothers-in-law do not allow to take all kinds of food	Poor quality of complementary food
Lack of antenatal care/childbirth at home	Continuation of breastfeeding after 6 months without giving complementary food
Prejudice	Lack of awareness about nutritious food
Lack of interest to take iron tablets for fear of large babies	Unsuccessful use of abortion medicines
Inadequate intake of iodized salt	High price of food items
Poverty	Lack of attention
	Lack of food
	Lack of proper immunization
	Lack of safe water
	Food taboos/prejudice
	Multiple children in the household
	Poverty