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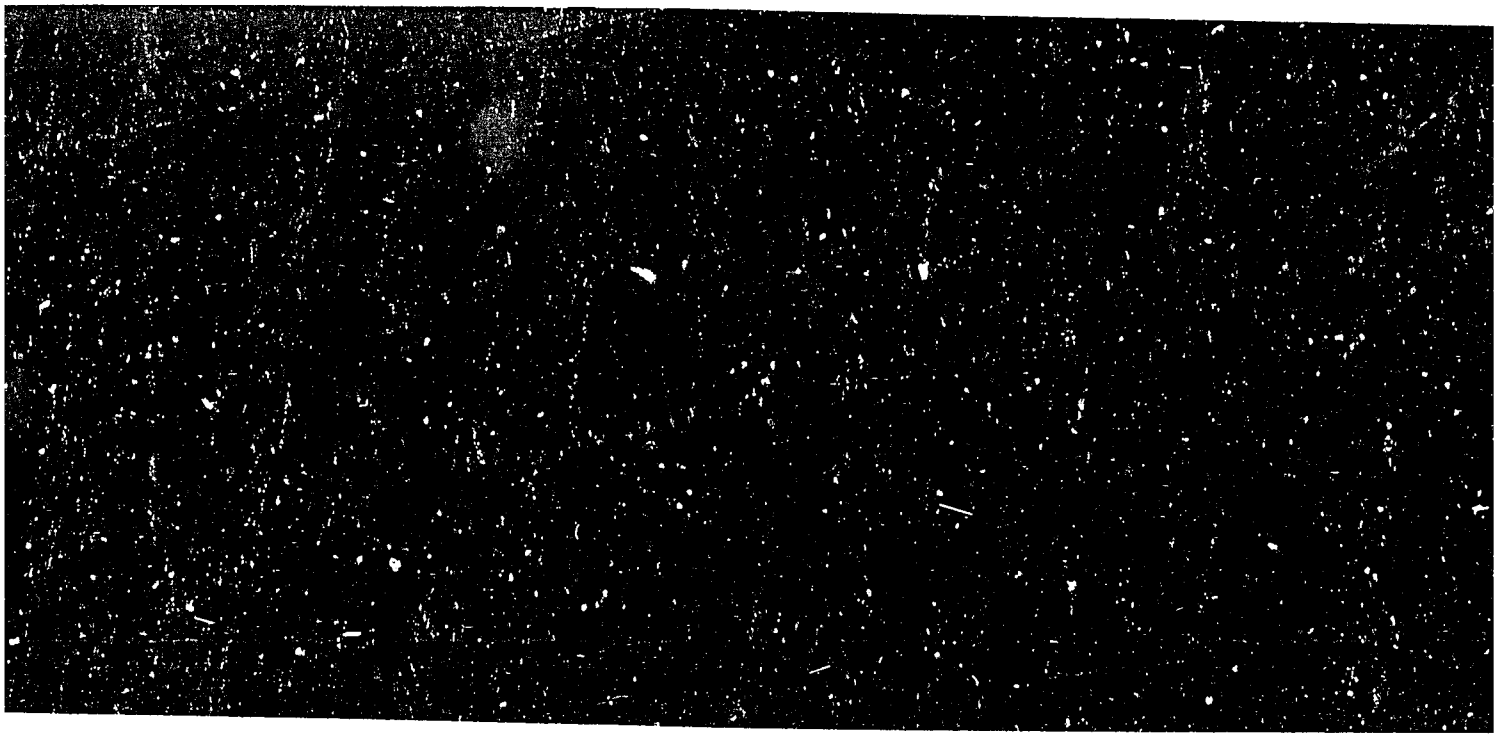
NUTRITION EDUCATION TO IMPROVE THE DIETS OF LACTATING MOTHERS AND WEANING-AGE CHILDREN: EVALUATION OF EFFECTIVENESS AND FOOD COSTS

An Experience From Bangladesh



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NUTRITION EDUCATION TO IMPROVE THE DIETS OF LACTATING MOTHERS AND WEANING-AGE CHILDREN: EVALUATION OF EFFECTIVENESS AND FOOD COSTS

An Experience From Bangladesh

by

Laurine V. Brown

Marian F. Zeitlin

May 1991

This is a publication
of the
Social Sector Policy Analysis Project
operated by the
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for the
United States Agency for International Development
Washington, D.C.

SUMMARY OF MAJOR FINDINGS
Nutrition Education to Improve the Diets of Lactating Mothers and Weaning-Age Children: Evaluation of Effectiveness and Food Costs
An Experience from Bangladesh

May 1991

by Laurine Brown and Marian Zeitlin

In rural Bangladesh a **Lactation Intervention** taught 48 families with breastfeeding mothers of infants under six months how to better the mother's diet in order to improve her milk supply and her health. A **Weaning Intervention** taught complementary feeding for 62 breastfed infants 6 to 12 months. Matched controls numbered 30 families for the mothers and 55 for the infants. The messages were developed by the community, and the approach to teaching was family-oriented, involving the mother, husband and mother-in-law. Local market prices were used to compute the costs of filling the nutrient "gaps" between the mothers' and children's intakes and their safe nutrient requirements.

The energy adequacy of the women's diets averaged about 64% of the FAO/WHO/UNU requirement at baseline and declined over eight months of study in both groups without significant differences attributable to intervention. Arm circumferences (AC) remained along the 5th percentile of standards. No differences were found between the treatment mothers' breastfed children and controls in average weight or AC.

The mother's energy gap was computed as the amount needed to maintain her weight and to support adequate lactation. To fill this gap using her existing diet would cost the family an additional 5.3 taka (US $0.17) which was 21% of the daily wage, and almost double the value of food that she was presently eating. The women conveyed frustration at their families' inability to afford the food needed to comply with the messages, despite careful promotion of low cost foods. Enlisting the support of the husband and other family members for the idea that the mother should eat more did not make it possible for her to receive a proportionately larger share of the inadequate family food supply.

By contrast, over five study months the children in the Weaning Intervention grew on average 0.41 SD, or about 410 gms, more in weight-for-age (WAZ) than the controls, and were about one-half kg heavier at the final measure. The weight-for-age of the treatment children held steady at 76% of the reference standard, while the controls dropped from 78% to 72%. The increase in percentage points of severe malnutrition (below -3 WAZ) was only 5% in the treatment group compared to 26% in the controls. Treatment children consumed a significantly greater percent of their ideal energy and protein requirements from complementary foods. The treatment children's growth and their intakes for energy and protein still lagged behind ideal standards. The affordable complementary foods were low in protein density, consisting mainly of cereal porridge with oil and brown sugar. Frequent infectious illness contributed to anorexia and to a decline in nutritional status with age.

The Weaning Intervention infants' energy gap (calculated against ideal intakes for well-nourished children), could be closed for less than one-third of the cost of improving the lactating mothers' diets, or about 8% of the daily wage. The gains achieved over these five critical weaning months, which did not close the gap, were accomplished for only 2% of the daily wage. Assuming other under-fives in the family would also share the complementary foods, the cost of the gains achieved might have increased to 6% of the daily wage.

Conclusions and Recommendations

- In an impoverished setting such as Bangladesh, attach nutrition education for improving women's diets to programs that make these improvements affordable, such as women's savings groups, income generating projects, agricultural production, home gardens, or subsidized or donated food programs.

- With or without other program supports, all families should be taught hygienic complementary feeding of simple, cheap, energy-enriched food to their breastfed infants after 5-6 months. In Bangladesh, the messages designed in village homes by this project have demonstrated the potential, and are being disseminated on a large scale by Bangladesh Rural Advancement Committee (BRAC). In other countries, similar village-level formative research should be conducted to design appropriate messages.

Next page: excerpts from "Give Me Food, Bastard" by Rafiq Azad, translated by Kabir Chowdhury in "Fifty Poems from Bangladesh", United Writers, Calcutta, 1977.

Give Me Food...

I am terribly hungry:
in the depth of my belly,
throughout the length and breadth of my body.
I feel, every moment,
fierce pangs of an all-devouring hunger.
Like summer corn-fields seared by drought
my body is ablase with the fire of hunger.

What I ask for is little. I want food.
I feel a burning fire in the pit of my stomach.
What I want is plain and simple:
I want rice. I don't care if it is cold or hot,
or if the grains are fine or red and coarse
like the rice doled out by ration shops.
I don't care as long as I get my plate-full of rice.
If I get two square meals a day,
I tell you,
I'll give up all other demands of mine....

If you can't satisfy this demand of mine,
things will go very wrong in your kingdom.
The hungry one does not know
what is right or wrong,
what is good or bad,
he does not know rules or statutes...
This simple hunger for food,
if allowed to grow and encompass everything,
can surely bring about a disastrous end...

Give me food...

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Laurine Brown, nutrition consultant, was responsible for the field implementation and data analysis of the project with consultation from Marian Zeitlin of Tufts University, who was principal investigator of the field project. Azmat Ahmad and Suaib Ahmed from Bangladesh Rural Advancement Committee (BRAC) were vital to the field implementation, under the expert guidance of Mustaque Chowdhury. The authors wish to thank Judy Brace of AED, Melanie Marlett of AID/PPC/PDPR, Nancy Pielemeier of AID/S&T/H, Linda Vogel of OIH, Karen Nurick of AID/ANE/TR, and Mary Lee McIntyre and Collette Chabbott of PRO/AID Bangladesh for their advocacy, technical, and administrative support. Nasreen Huq, Gretchen Berggren, Bea Rogers, Leisa Weld, Stanley Gershoff, Karen Peterson, Helen Armstrong, Georgia Guldan, Nesar Ahmed, Michael Levitan, Fred Zerfas, and Wahed Islam provided valuable and insightful technical and editorial comments on the document. We are also grateful to Sobita Datta for expert nutritional advice during the field work, Bob Houser for guidance on the analysis, in addition to all the BRAC staff, Fazle Abed, director of BRAC, Halida Khondaker, former BRAC medical director, the BRAC coders, and the village workers and families that made the project work.

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APPENDIX I. FLASH CARD VISUAL AIDS FOR WEANING INTERVENTION

-- EXECUTIVE SUMMARY --
NUTRITION EDUCATION TO IMPROVE THE DIETS OF LACTATING MOTHERS AND WEANING-AGE CHILDREN: EVALUATION OF EFFECTIVENESS AND FOOD COSTS

An Experience from Bangladesh

DESCRIPTION OF PROJECT

This study evaluates the successes and barriers to the effectiveness of family-oriented nutrition education for two target groups in rural Bangladesh - lactating mothers and children of weaning age - with emphasis on food costs.

From January to December 1987, Bangladesh Rural Advancement Committee[a] (BRAC) and Tufts University conducted a joint nutrition education intervention in rural Bangladesh. Persuasive and practical nutrition messages were developed by the community, and disseminated to mothers of target infants, and their families, through village volunteers. Two sets of messages were tested to prevent growth faltering of infants: (1) the **Lactation Intervention** taught families with breastfeeding mothers of infants under six months how to better the mother's diet in order to improve her milk supply and her health; and (2) the **Weaning Intervention** taught complementary feeding for breastfed infants 6 to 12 months.

For each intervention, ten hired village workers tested and refined the messages in their own homes. Next, they trained volunteer mothers with infants in the target age ranges, and these volunteers disseminated the messages to other village mothers. Separate samples were selected for each campaign, along with age and season matched controls (from a distant site). All mothers in both interventions breastfed throughout the trials.

The Lactation Intervention followed 78 mothers (48 treatment, 30 control) from February through November 1987. Seventy-six percent of these infants were under 6 months at recruitment, with the remainder between 6-11 months. The Weaning Intervention started in May, after the Lactation Intervention was underway, and followed 117 children ages 4-14 months at baseline (62 treatment, 55 control) through November. Census data collected by BRAC at the beginning of the study assisted field workers in identifying sample families with children in the target age range who also had other families with children in the specified age group living nearby (to disseminate the educational messages to). Monthly dietary, anthropometric and morbidity data were collected on all sample children and mothers. Local market food prices were also collected each month.

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[a] Bangladesh Rural Advancement Committee (BRAC) is a local non-governmental organization (NGO) founded, directed, and staffed by Bangladeshis. From its initial efforts to help resettle refugees in 1972 after the War of Liberation from Pakistan, BRAC has assisted large numbers of landless and powerless poor to expand their political and economic involvment. Initial activities focused on rural development, and have diversified to include health, education, and credit programs. BRAC has been described as a prototype for NGOs, continually redefining the state of the art for NGO development (Korten 1989).

The approach to teaching was family-oriented, involving the mother, husband and mother-in-law. This approach appealed to the family's desire for strong, healthy children, and recognized the fact that a Bangladeshi mother has limited control over her own food portions.

The messages for lactating mothers encouraged breastfeeding mothers to eat an extra serving of all foods they already ate at meals, increase fluid intake, use good hygiene practices, and to offer both breasts to the baby at each feed. Education to improve the diets of young children included in-home demonstrations of "snack-type" recipes (for example, an energy-enriched cereal food *Chop Chop*), and techniques to enrich foods from the family pot with energy (for example adding oil and molasses), protein (adding milk, fish, or lentil flour), and vegetables or fruits in season. The messages stressed food hygiene. They encouraged continued breastfeeding in addition to frequent and persistent feeding of new foods, using an analogy between human babies and baby chicks who need to peck for food all day.

MAJOR FINDINGS

LACTATION INTERVENTION

Evaluation of the Lactation Intervention yielded inconclusive results. Figure 1 shows the calorie intakes of the mothers. In both groups, the energy adequacy of the womens' diets averaged about 64% of the FAO/UNU/WHO requirement (WHO, 1985) at baseline and declined over the study period. These levels (Manjrekar et al, 1985; Hira et al, 1988; Zeitlin et al 1989) and seasonal trends (Huffman et al, 1985; Chowdhury, 1987; Zeitlin et al, 1989; Torres et al, 1990) were consistent with the findings of other researchers from similar samples. At the midpoint, three months into the education program, the differences between treatment and control groups, both in energy intake, and in deterioration in adequacy, were not statistically significant[b]. At this point, motivation was high and a change would have been expected.

By the end of the study, eight months after the baseline measure, the declining adequacy of the mothers' diets was significantly less (i.e better) for the treatment group than the controls. However, severe flooding and other confounding events occured between the midpoint and this final measurement. Therefore, the endpoint difference between the groups cannot be attributed to the education program with full confidence.

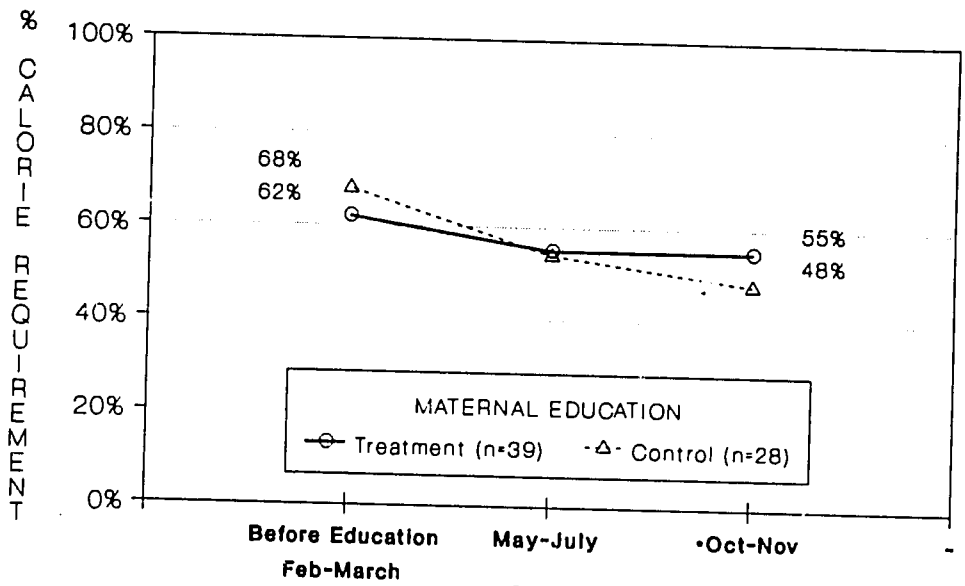
In both treatment and control groups, the energy adequacy of the mother's diet was significantly associated with her child's growth (weight gain) and nutritional status (weight-for-age and arm circumference or AC), as well as her own nutritional status (AC). This suggests that if barriers to improving women's diets can be overcome, both the nutritional status of women, and their breastfeeding children will improve. In addition, the mothers' years of formal education were positively correlated with the adequacy of her diet (controlling for wealth) and her AC at baseline.

The women were extremely lean with average AC measures approximating the 5th percentile of international standards (Frisancho, 1981). The AC of the women did not decline over the 8 months despite a decline in energy intake. This suggests either the mothers reduced activity, that AC is not a sensitive measure of short-term

[b] Throughout this report statistical significance is defined as $p<.05$.

Fig 1. ENERGY ADEQUACY OF LACTATING MOTHERS' DIETS

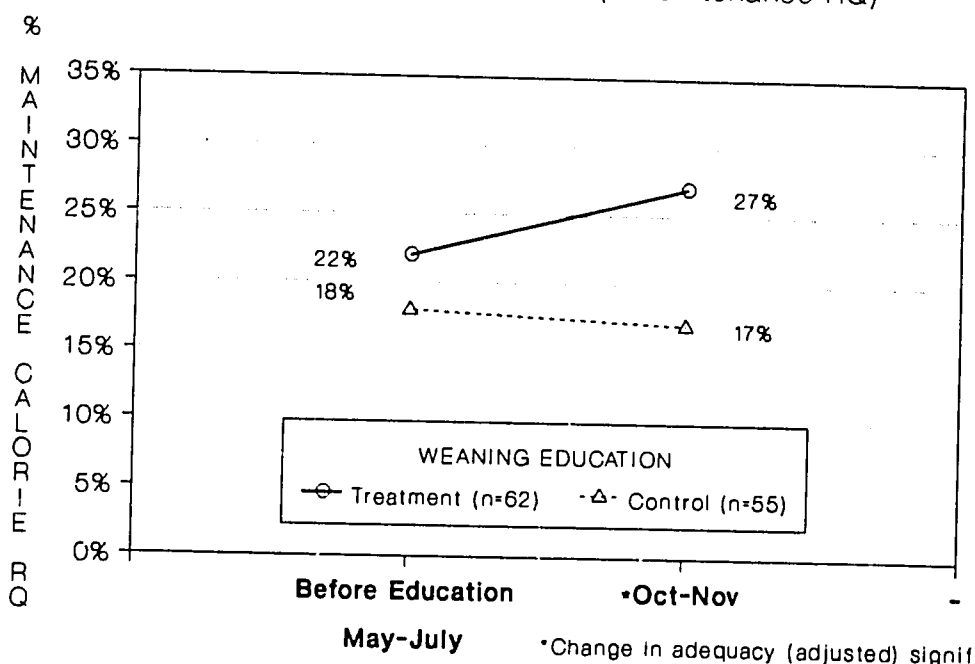
Before and After Nutrition Education



*Change in adequacy from Feb-Mar to Oct-Nov significantly better for treatment than controls (adjusted for confounders)

Fig 2. ENERGY ADEQUACY OF CHILD DIETS

When Family Members Receive Weaning Food Education (%Maintenance RQ)



*Change in adequacy (adjusted) significantly better for treatment than control
Ave age: Before-8mos, Oct/Nov-13mos

Breastmilk estimates not included

change in these lean rural women, or that breastmilk production declined. The decline could have been greater for the controls who did not receive extra encouragement to breastfeed. No significant differences in growth rates or changes in AC were found between children whose mothers received maternal education and those who did not, suggesting that breastmilk production, and intake by the infants, was not increased.

The nutritional adequacy of the women's diets was strikingly poor, reaching an average over all seasons of only 56% of their requirement for energy, 60% for protein, and 29% for vitamin A. Dietary iron levels were adequate; however, the iron may be poorly absorbed. Prior validation of the dietary recall instrument found no tendancy for the recall to underestimate observed intakes (Rizvi et al, 1984).

The families conveyed overwhelming frustration at their inability to afford the food needed to comply with the messages for mothers, despite the project's careful promotion of low cost foods. The study spanned the hot-dry, and monsoon seasons, when hunger is greatest in a year with unusually severe flooding. While families liked being the recipients of information that might keep their child healthy, and women generally wanted to eat more food, they had little means to do so. The breastfeeding mothers felt that if they increased their own share of the food, they would need to increase the share given to all family members. Enlisting the support of the husband and others for the idea that the mother should eat more at meals did not make her feel that she could take more than she served to them.

WEANING INTERVENTION

The children whose mothers received education on appropriate weaning foods and practices grew significantly better than the controls. After adjusting for baseline nutritional status, age, morbidity, wealth, and mother's education, the treatment children had grown, on average, 0.41 standard deviations (SD) more in weight-for-age (WAZ), or about 410 gms, than the controls over the five month period. Figure 3 illustrates the unadjusted weight gain (in kg) for the treatment and control children relative to the cutoff for moderate malnutrition[c]. Adjusting for the above factors, the final weights of the treatment children were, on average, .46 SD greater than those of controls. This translates to an approximate difference of one-half kg.

Over the five months, the (adjusted) percentage of the reference median weight-for-age (WAPM) of the treatment children held steady at 76%, while the controls dropped from 78% to 72%. Moreover, significantly fewer treatment than control children became severely malnourished during this time. The increase in percentage points of severe malnutrition (below -3 WAZ) was only 5% in the treatment group compared to 26% in the controls. In addition to treatment group, factors found to contribute to the variability in final WAZ were initial WAZ, diarrhea, respiratory illness, age of child, and wealth. Sex of the child was not significant in predicting the nutritional status or growth of these very young children.

Findings from analysis of child arm circumference were similar to those for weight. While there were no significant differences between treatment and control children at baseline, treatment children had significantly larger AC measurements after the education. The increase from the baseline to the final measurement was also significantly greater for treatment children than controls.

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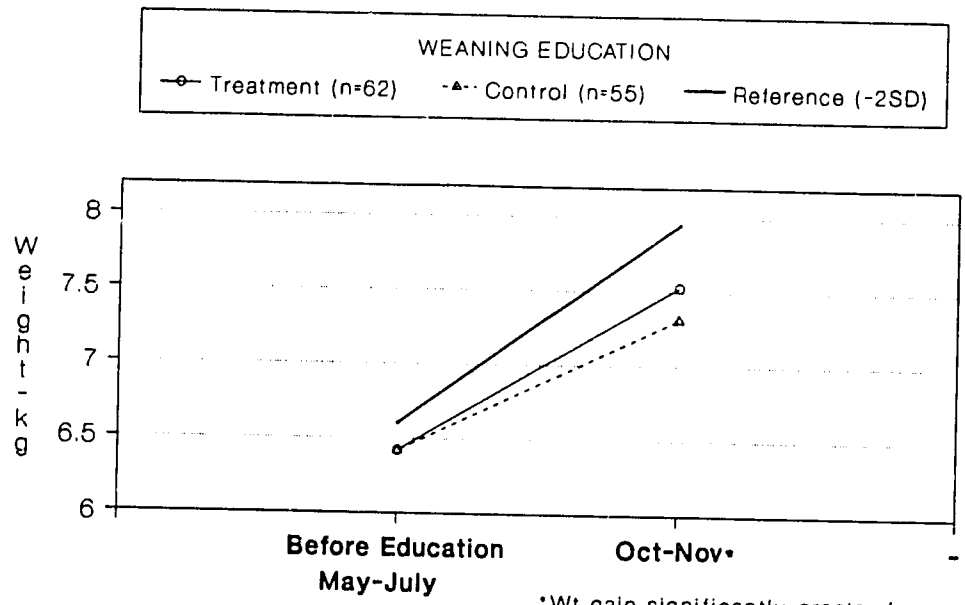
[c] Moderate malnutrition is defined as less than 2 standard deviations (SD) below the median weight of the reference population for the child's age and sex (Carlson and Wardlaw, 1990).

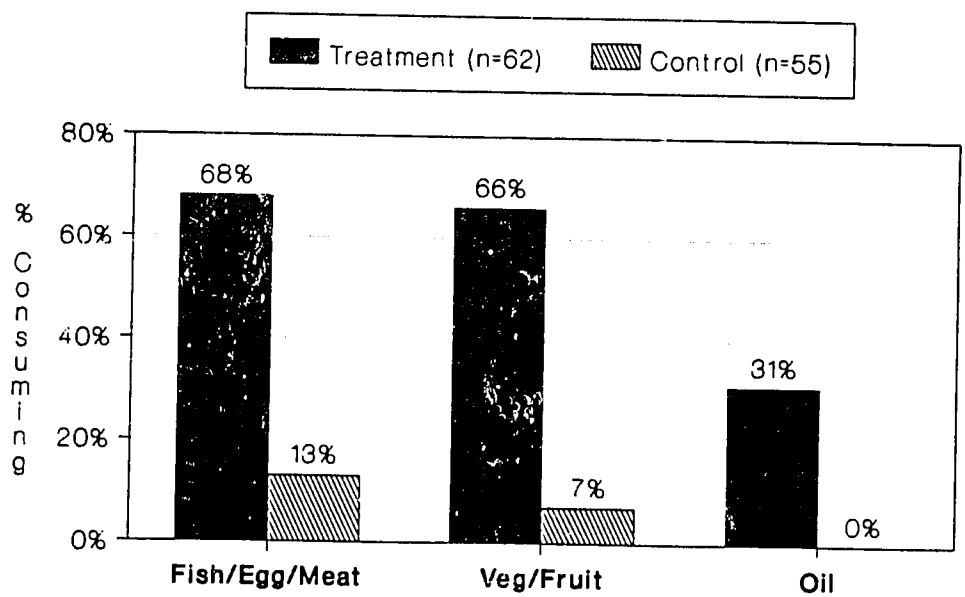
Fig 3. WEIGHT GAIN IN CHILDREN
When Family Members Receive Weaning Food Education



Average child age May-July 8 mos, Oct-Nov 13 mos. 100% children breastfeeding.

*Wt gain significantly greater for treatment. After adjusting for confounders, final wt of treatment 0.46 kg more.

Fig 4. CONSUMPTION OF SELECTED FOODS
by Weaning-Age Children from Households Receiving Weaning Food Education



Average age 13 months
100% children breastfeeding

After education, treatment children also consumed a significantly greater percent of their estimated ideal energy and protein requirements from complementary foods, adjusting for the effects of child age, wealth, mother's education, morbidity, sex, and initial nutrient adequacy. Figure 2 compares the change in energy adequacy from complementary foods, based on maintenance growth needs for both groups. Controlling for wealth (and other factors), mother's education was a significant determinant for the ideal energy and protein adequacy of the child's complementary food intake at the final measure. Both the sex of the child and agricultural wealth were significant in predicting protein intake at the final measure but not calories. Interestingly, female children fared better that male children for protein intake. The treatment diets had a significantly higher percent of protein from animal sources (mainly milk and fish) than the controls at the final measure. There were no significant sex differences in the quality of protein consumed.

Figure 4 illustrates the marked differences in the number of children in the treatment group, compared with controls, consuming animal foods (not including milk), vegetables and fruit, and oil at the final measure. All of these foods were encouraged through the weaning messages.

While a treatment effect was apparent, the children's growth and their intakes for energy and protein (including estimates for breastmilk) still lagged behind ideal standards. According to their mothers' reports and informal field observations, they frequently refused or failed to finish the foods offered to them. Frequent infectious illness contributed to this anorexia. High morbidity rates and a decline in nutritional status characterize both the hot/dry and the rainy seasons (Brown et al, 1982b). Superimposed on these already difficult conditions was severe flooding, which infiltrated the homes, fields, and markets. Seasonal food shortages, poverty, and limited time of the mothers to prepare food and attentively feed their infants further constrained their compliance with nutrition messages.

FOOD COSTS

Local market prices were used to compute the costs of filling the nutrient "gap" between the mothers' and children's intakes and their safe nutrient requirements (WHO, 1985; NRC, 1989; Appendix B and C). Costs to fill the nutrient gaps were computed for energy, protein, vitamin A, and iron. The mothers' computation used the market value of the same mix foods they were eating, while the children's used the project's complementary feeding recipes. Since consumer prices have continued to rise since the study in 1987, the actual costs presented will need to be adjusted for inflation[d]. However, the relative comparisons between costs for mothers and children remain the same.

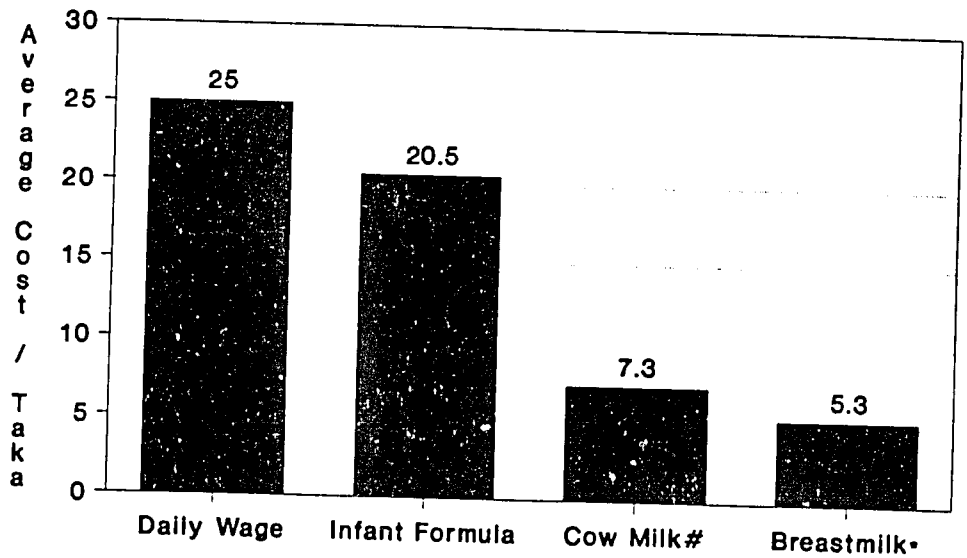
Costs for Lactating Mothers

To improve her energy intake so that she could produce an adequate amount of milk for her young child and remain healthy and active, a lactating Bangladesh woman would need to **spend an additional 5.3 *taka* (U.S.$0.17) which was 21% of the daily wage[e], and almost double the value of food that she was presently eating.**

[d] Since 1987, consumer prices in Bangladesh have risen about 9-10% per year (EIU, 1991a). The devastating cylone of April 30, 1991 may further inflate consumer prices and decrease real wages.

[e] The average daily wage during the study period was 25 taka, or U.S. $0.82 (field notes from study). The average exchange rate during the study period in 1987 was 30.5 taka = 1 US dollar. The value of the taka has continued to fall relative to the U.S. dollar. The exchange rate on April 8, 1991 was 34.5 taka = 1 US dollar (EIU, 1991a).

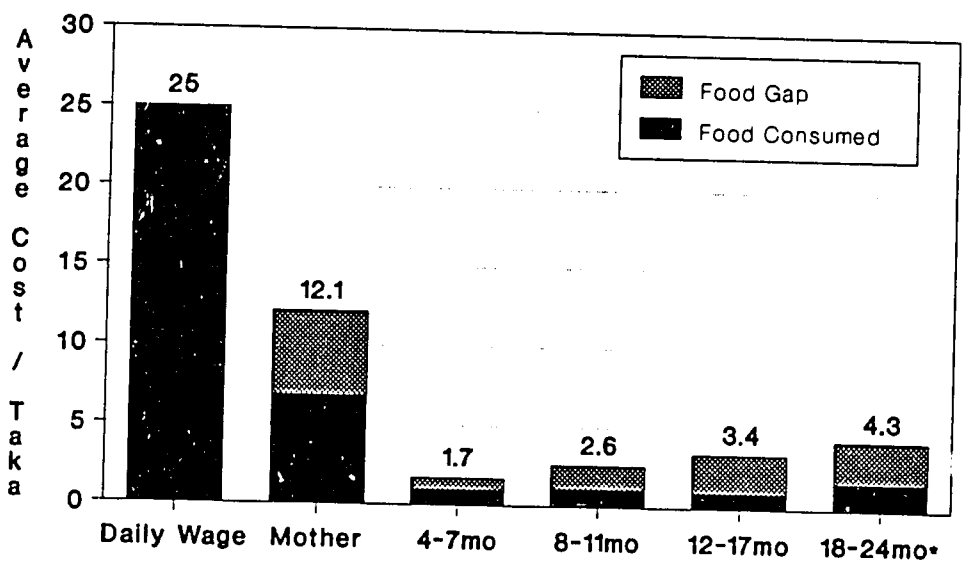
Fig 5. DAILY COST OF PROVIDING INFANT FORMULA, COW MILK#, OR BREASTMILK* COMPARED WITH DAILY WAGE IN BANGLADESH



#Cow milk, alone, is not an adequate breastmilk substitute.

*Breastmilk based on additional food costs to improve lactating mother's diet. Costs computed for child 0-6 months.

Fig 6. COST OF ENERGY ADEQUATE DIET FOR LACTATING MOTHERS AND BREASTFED CHILDREN IN BANGLADESH



Costs based on 78 women over 8 mos & 61 control breastfed infants over 5 mos.
*21-24mo data from control site in 1986.

Cost of breastmilk not included.

In actuality, the costs would be much greater than this, since, if a woman increased her own intake, she would have had to increase the share given to other family members.

If wheat were substituted entirely for rice, the nutritional needs of the mother could be met for much less - only half a *taka* more than the value of the diet she was already consuming. While wheat was eaten during hungry times, however, cultural and personal food preferences competed with financial barriers. The more desirable diet - rice with fish, in addition to vegetables - cost over 57% more per day than the cheapest wheat-based diet[f].

Despite the financial barriers to improving the lactating mothers' diets, breastfeeding provided cost savings over breastmilk alternatives. Feeding cow's milk[g] costs nearly one and a half times, and infant formula four times, the cost of providing the additional food needed to improve the lactating mother's diet (Figure 5). The high costs of breastmilk subsititutes underscore the great need to find development models that will reduce the economic barriers to improving women's diets.

The protein needs for the mothers could be met for slightly less additional money than for calories, though the amount needed was still unaffordably high. For vitamin A, if all of the calorie needs were met with the traditional diet, the vitamin A requirement would not be met. However, if greater quantities of dark green leafy vegetables, which are available most of the year, were included in the traditional diet the mother's vitamin A requirement could be met for less than half a *taka* or 2% of the daily wage (assuming an adequate amount of fat is available for absorption).

Costs for Weaning-Age Children

Economics was not as great an obstacle for improving infants' diets. In the Bangladesh context, **the breastfeeding infants' diets could be improved for less than one-third of the cost of improving the lactating mothers' diets, or about 1-2 *taka* per day (5-8% of the daily wage).** These estimates are computed against ideal intakes for well-nourished children. Figure 6 illustrates the differences between mothers and children. Assuming other children in the family would also need to be given an increased share of food, the food costs might increase to 23% of the daily wage. Thus, the cost of improving the diets of all under-fives in the family would about the same as the cost of improving the mother's diet alone.

An examination of the "additional" costs imposed by each message developed for the Lactation and Weaning Interventions, in terms of fuel and time, revealed that messages with low food costs can have poor compliance when additional costs are high.

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[f] Most of the wheat in this rice-growing country is imported (usually donated). While a switch to a wheat-based diet may be financially beneficial in the short-term for poor households, in the long-term this shift may be detrimental to the economy by increasing reliance on foreign assistance, and disrupting the local agricultural practices.

[g] Note: cow's milk, alone, is not a nutritionally adequate substitute for breastmilk.

CONCLUSIONS AND RECOMMENDATIONS

The findings from this study lead us to concude that the nutrition education given to lactating mothers to improve their diets, in this culturally restrictive and economically deprived setting, had limited measureable impact on their nutritional status and that of their breastfeeding children. By contrast, culturally appropriate and feasible complementary messages for breastfed infants after 5-6 months resulted in behavioral change and improved weight gain of children.

Financial barriers were a great constraint for the women in improving their own diets (with the possible exception of vitamin A). However, economics was not as great an obstacle for improving the infants' diets. In the Bangladesh context, the breastfeeding infant's energy gap could be closed for less than one-third of the cost of improving the lactating mother's diet, or about 8% of the daily wage. This difference becomes even greater if the costs to increase the share of food given to other family members, which would be a cultural necessity, are estimated. The gains achieved in the Weaning Intervention for the children over the five month critical weaning period, which did not close their ideal gap, were accomplished for only 2% of the daily wage. Assuming other under-fives in the family also shared the complementary foods, the costs of the gains achieved might have increased to 6% of the daily wage.

In addition to economics, cultural beliefs and practices may have hindered compliance to nutrition messages for mothers more than for the children. The Weaning Intervention successfully promoted a convenience snack food for children. However, the messages developed by the community for mothers lacked a comparable snack food, focusing primarily on increasing the number of meals and amounts consumed at meals. With hindsight, the snack approach might have been a more culturally feasible way for the women to unobtrusively increase their food intake, though the financial barrier would still be present. Although the specific nutrient needs and cultural taboos may differ slightly, these conclusions can be generalized to all women of childbearing age, including adolescents and pregnant women.

If the severe financial barriers to compliance are addressed, we believe it will be possible to improve women's diets through nutrition education. In the presence of an increase in purchasing or food producing power additional testing would still be needed to adapt the educational messages to the new circumstances.

MAJOR POLICY RECOMMENDATIONS

- In an impoverished setting such as Bangladesh, **attach nutrition education for improving women's diets to programs that make these improvements affordable,** such as women's savings groups, income generating programs, agricultural production, home gardens, or subsidized or donated food programs. Nutrition education should not be given to women in isolation of these supports.

- With or without other program supports, **encourage hygienic complementary feeding of simple, cheap, energy-enriched food in breastfed infants after 5-6 months.** In Bangladesh, the messages designed in village homes by this project have demonstrated the potential, and BRAC has gone on to implement them on a large scale. In other countries, similar village-level formative research should be conducted to design appropriate messages.

ADDITIONAL RECOMMENDATIONS

- **Explore village-based vs wide-scale production of time- and fuel- saving infant foods** (similar to *Chop Chop* or *Satu*), **using community-based message design procedures similar to the one in this project.** Examples include quick cooking cereal bases combining subsidized grains and lentil flours to which oil, sugar, vegetables, milk powder and other foods can be added in the preparation. Explore low cost options for "finger foods" that the transitioning child can successfully self-feed.

- **Explore snack foods preparations for women.**

- **Improve diets with donated grains if an effective vehicle for dissemination can be found.** For example, in BRAC areas, grains can be distributed to children in non-formal primary schools with demonstrated recipes for preparation. It would be be expected that some of the food would be shared with other family members.

- **Design strategies to help caretakers deal with infant feeding problems.** Of high priority should be programs to prevent and treat infectious illness, as well as micronutrient supplements if needed. Combine handwashing and hygiene messages with feeding messages.

- **Train** village-level health and nutrition workers **to demonstrate food preparation methods and to model expected behaviors**, rather than simply verbally teach the education messages.

- **Engage fathers and other family members in the issues of intrafamily food distribution.** It is our assessment in Bangladesh, both informally and through the analysis, that all household members suffer from lack of adequate food. Reducing the food portions of other household members to increase the woman's portion may do more harm, psychologically, than good for the woman whose sole responsibility is to care for her family. Instead, means to improve the diets of the entire family are needed.

PART 1
INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Attempts to improve the nutritional status of women and children through education confront many obstacles in an impoverished setting such as Bangladesh. Some argue that such efforts are futile if a family's economic condition is such that it cannot even meet basic needs. However, other interpretations suggest education enables the recipient to make the best of a difficult situation. This study evaluates the successes and barriers to the effectiveness of nutrition education for two target groups - lactating mothers and children of weaning age.

From January to December 1987, a joint nutrition education intervention with Tufts University and Bangladesh Rural Advancement Committee (BRAC) was conducted in rural Bangladesh[1]. Persuasive and practical nutrition messages were developed by the community and disseminated to mothers of target infants, and their families, through village volunteers. Two sets of messages were tested to prevent growth faltering of infants: (1) the Lactation Intervention taught families with breastfeeding infants under six months how to better the mother's diet in order to improve her milk supply and her health; and (2) the Weaning Intervention taught complementary feeding for breastfed infants 6 to 12 months.

The approach to teaching was family-oriented. In addition to the grandmothers, who exert considerable control over their households, the fathers of the children were targeted and enlisted in improving the diets of their infants and their wives. Separate samples were selected for each campaign, along with age- and season-matched controls. The impact of the first set, messages for lactating mothers, is presented for the first time in this report. Preliminary findings from evaluation of the second set of messages were presented in a previous report to USAID (Brown and Zeitlin, 1989), and the intervention has been further evaluated in this report.

Despite extreme poverty, and reportedly strong cultural traditions surrounding infant feeding, the field findings of the Weaning Intervention suggested that education, in the absence of other interventions, was successful in changing the

[1] Bangladesh Rural Advancement Committee (BRAC) is a local non-governmental organization (NGO) founded, directed, and staffed by Bangladeshis. From its initial efforts to help resettle refugees after the War of Liberation from Pakistan in 1970, BRAC has assisted large numbers of landless and powerless poor to expand their political and economic involvment. Initial activities focused on rural development, and have diversified to include health, education, and credit programs. BRAC has been described as a prototype for NGOs, continually redefining the state of the art for NGO development (Korten 1989).

infant feeding practices of the traditional village women. A follow-up survey in March 1988 further validated these assumptions (Ahmad and Ahmed, 1989; Appendix G). Moreover, rather than feeling that they were being asked to do the impossible, mothers of the target children, most of whom had no formal education, expressed their gratitude to be the recipients of messages that could potentially benefit the health of their infants.

The project was conducted on the assumption that any additional food would improve growth after age 5 to 6 months. An evaluation of the effects of the additional foods on the infants was essential, to help confirm whether the additional food was beneficial in promoting growth, as has been illustrated under better conditions.

The dietary messages designed to improve the diets of the lactating mothers (Lactation Intervention), produced mixed field results. In general the mothers wished to eat more during lactation. Local food beliefs and taboos placed far fewer constraints on women's food intake during lactation than during pregnancy. Yet, despite the project's careful consideration for recommending low cost traditional foods, field observations suggested that financial barriers limited the lactating mothers' ability to comply with messages to improve their own diets.

Interest in "Safe Motherhood" (Herz and Measham, 1987), has helped to focus policy makers on the need to complement child survival efforts with interventions to improve the nutritional status of women. Our field observations raise concerns that, in the absence of economic assistance - for example in the form of income generating projects or food supplements - nutrition education messages given to lactating (and pregnant) mothers may be financially unachievable and therefore may do more harm than good. We surmise that economics was not the greatest barrier to compliance for the infant feeding messages, however.

1.1.1 Hypotheses

This report evaluates the impact of nutrition education messages for lactating women compared to those developed for infants, and discusses the extent to which unaffordable food costs restrict improvements in maternal diets as compared to infant diets. Specific hypotheses to be tested follow:

1. Nutrition education is effective in changing the complementary feeding practices of traditional rural Bangladeshi women and in improving the nutrient adequacy of the diets and the growth of their older infants. However, due to extreme poverty combined with the food costs imposed by the nutrition messages, education, alone, cannot significantly improve the nutrient adequacy of maternal diets.

2. The changes in nutrient adequacy of the diets of lactating mothers in response to education will be significantly less than the changes in nutrient adequacy of the diets of infants receiving education to promote complementary foods.

3. For breastfeeding infants, the growth impact of nutrition education to improve the diets of their lactating mothers will be less than the impact of nutrition education to improve the complementary foods given to the infants.

1.2 THE NUTRITION PROBLEM IN BANGLADESH

Bangladesh is a country with a myriad of obstacles to achieving good child health - extreme poverty with seasonal food shortages, overpopulation, poor sanitation, limited food preservation technologies existing in a tropical climate, a nearly nonexistent health infrastructure, low status of women combined with extremely low levels of education, annual flooding and other catastrophic natural events - to name a few. As we write Bangladesh is coping with, yet, another natural disaster from which it will, again, try to rebuild - this time a devastating hurricane killing hundreds of thousands, and ruining crops, homes, roads and futures.

Per capita GNP is only 170 dollars, with 86 percent of the people living under the poverty line (UNICEF, 1991). Estimates of unemployment range from 23 to 42 percent. "The country's climate and terrain mean that adverse weather, usually in the form of heavy flooding, constantly threatens to disrupt plans and make targets unattainable. Losses of both food and cash crops are a common occurrence, seriously disrupting the entire economy...the constraints to economic development are severe, the opportunities for diversifying the economic base are limited and, faced with a perennial trade deficit, the country relies very heavily on aid assistance." Landlessness has been increasing (EIU, 1991).

Despite the considerable emphasis on education since independence from Pakistan in 1971, the literacy rate is only about 33 percent (EIU, 1991). While enrollment in primary schools is increasing, eighty percent of women have never been to school and cannot read, write or understand numbers at a functional level (UNICEF, 1991). These facts translate to a devastating impact on maternal and child health.

Widespread maternal undernutrition in Bangladesh extends to unborn children, and the vicious cycle of chronic nutritional deprivation entraps each successive generation. Over one-quarter of all infants are born with low birth weight (UNICEF, 1991) to mothers who produce, on average, less breastmilk than well nourished women (Brown et al, 1982;, Brown et al, 1986; Huffman et al, 1980).

Childhood malnutrition and mortality rates are among the highest in the world (UNICEF, 1991). Nine million (56%) of the children under five are chronically undernourished (BBS, 1987). Eight percent of children, or 1.3 million, between 6 months and 5 years are acutely malnourished (BBS, 1987). About 116 out of every 1000 children born die before their first birthday. Of those surviving the first year, 68 per thousand live births will die before the age of 5 (UNICEF, 1991). In addition, 30,000 children are permanently blinded each year due to vitamin A deficiency (HKI, 1985).

As in other developing countries, Bangladeshi children grow well in weight in the first few months. But before 4-6 months weight gains falter relative to international standards (Brown et al, 1986a; Israel and Tighe, 1983; BBS, 1987). One study documents 90% of rural girls and boys to be below normal weight (the National Center for Health Statistics [NCHS] 5th percentile) by 8 and 15 months, respectively (Brown et al, 1982a). Some of this deficit is due to feeding practices.

There is a great unmet need for programs aimed at addressing malnutrition in Bangladeshi children. While the government of Bangladesh has documented in its *Second* and *Third Five-Year Plan* a commitment to making primary health care (including nutrition) accessible to all "by the year 2000", service implementation remains dismal. Government workers are poorly supervised and, for the most part,

non-productive (BRAC, 1990). Health facilities lack medicines and contraceptives, and are often not respected or utilized by the people. With the exception of vitamin A capsule distribution, virtually no nutrition activities are successfully implemented through the government system. Discouragingly few of the objectives of The Third Five Year Plan (1985/86-1989-90) look likely to be met (EIU, 1991).

Partially as a result of the inefficient government health system, there is a large presence of non-governmental organizations (NGOs) - both indigenous and international - with health and nutrition projects in Bangladesh. Most work on a small scale, however, some, such as Bangladesh Rural Advancement Committee (BRAC) and CARE, cover large areas.

Unfortunately, most of the NGO efforts in nutrition are largely unrecognized by other agencies working in the field, and are rarely evaluated. Nutrition activities often take the back burner relative to other activities, and tend to ignore the true limitations of the recipients. Far too frequently, the design of nutrition programs does not take into account the desperate poverty of the households, the poor sanitary conditions, and the frequent bouts of child illness which restrain growth and reduce child appetite. These shortfalls in planning limit the potential impact of nutrition education.

1.2.1 Infant and Child Feeding Practices

Nearly 100% of newborn infants are breastfed in rural areas, and breastfeeding continues through the second, and into the third year of life. Children cling to their mothers throughout the day and night, suckling up to 12-20 times. Over 75% of mothers breastfeed beyond 2 and 1/2 years. The major reason for discontinuing breastfeeding in the first year is death of the infant, and in the second year, pregnancy (Huffman et al, 1980). Breastmilk provides the bulk of energy, protein, and vitamin A to children under 3. However, the quantities the undernourished mothers can produce are grossly insufficient to meet the needs of the child over 4-6 months (Brown, 1982; Brown et al, 1986).

Complementary feeding does not make up for the nutrient deficit. Traditionally, Bangladeshi women do not persistently encourage their infants to eat other foods until about 18 months (Guldan, 1988; BRAC, 1989). Beliefs about foods causing "stomach problems", or other undesirable conditions, are part of the reason for the limitation by mothers (Rizvi, 1979), in addition to limited time to feed due to heavy domestic work schedules. Indeed, the poor sanitary conditions present a constant health hazard to children, and the chance of contracting diarrhea may be heightened by the feeding of contaminated weaning foods. Self-limitation by the infants is another important reason for inadequate consumption of foods, likely a result of anorexia due to high infection rates (Molla et al, 1983), and possibly a result of satiety from frequent suckling at the breast (Guldan, 1988).

Unlike other Asian and African countries, Bangladesh has no traditional weaning mixtures. Only small amounts of liquid and solid foods are offered in the first year of life, often when the mother feels her milk is "not enough". Introduction of foods is not based on age criteria (except religious "initiations" that involve introduction of foods at a certain age [Rizvi, 1979]), as few village women keep track of ages of their children. The first food offered is usually diluted cow's milk (powdered, condensed, or fresh) or a cereal gruel, made from wheat, rice, or barley flour sweetened with sugar. As the child's oral-motor skills improve, finger foods, such as bananas, biscuits, and chapatis (flattened bread), are fed. Foods from the family

meal - rice, and to a small extent, curries (if not too spicy) - are offered in small amounts before one year of age, and become more important in the second and third year of life.

Foods offered are appropriate for children, yet are lacking in variety and essential nutrients, particularly energy, protein, and vitamin A. Vegetables, such as those high in vitamin A, fish, and lentils are rarely given to children. There is some evidence of male favoritism in feeding practices (BRAC, 1989; Chen et al, 1981).

1.2.2 Maternal Nutrition

Few studies have provided adequate data and trends on maternal nutritional status in Bangladesh. The little information available, however, highlights the devastating condition of these women.

Bangladesh is one of three countries in the world where women have shorter life expectancy than men (World Bank, 1989). The overall poor maternal nutrition status is worsened by seasonal food scarcity and frequent pregnancies. Huffman (1985) found the nutrition and health status of Bangladesh women declined with increasing parity, suggesting the women were using up their own body stores for pregnancy and lactation. Supporting these observations, a national survey found pregnant and lactating women consumed only 70% of their energy requirement and 65% of their estimated protein requirement (Ahmad and Hassan, 1986).

Brown (1982) measured breastmilk outputs of rural women and found, though outputs were remarkable in relation to the nutritional status of the women, they were less than those of well-nourished women. Outputs were insufficient to meet the estimated growth needs of the infants after the first few months.

Numerous cultural food practices compound the nutrition problem. Food is scarce and poverty extreme, and in Bangladesh, despite tremendous nutritional needs of the (often pregnant and lactating) women, men and children eat first, and the woman eats the remaining food, if any (Rizvi, 1979; Brown, May 1987). Women have no control over the food budget - the men buy and sell food in the market. Adding to the powerless role of the woman, the newlywed goes to live with the husband's family, often a less supportive environment than the woman's own home. On the basis of 20 indicators related to health, marriage, children, education, employment, and social equality, the overall status of women in Bangladesh has been rated lowest in the world (Population Crisis Committee, 1988). Few women receive any schooling, though the rates for men are also very low.

A woman's day is consumed with cooking, collecting firewood and water, cleaning, and caring for children and elders. "Her contribution often is unrecognized because it is unpriced (difficult to value) and invisible (consumed immediately)" (World Bank, 1989). With increasing landlessness the role of women is changing dramatically, with women being forced out of the homes to find work (World Bank, 1989).

To break the cycle of malnutrition in women and children in this country, significant steps must be made, not only in health and nutrition, but in other social and economic sectors.

Discussing nutrition messages with village women...

...and village men.

PART 2
METHODS

2.1 FIELD METHODOLOGY

2.1.1 Site Selection and Intervention Design

The Lactation Intervention and Weaning Intervention were conducted in a rural non BRAC site in the Manikganj District of Bangladesh (see map in Appendix A). Message development to improve the diets of the lactating mothers began in February 1987, and the women were followed through November 1987[2]. Weaning food message development began in May 1987, with the final follow-up in November 1987[3]. Figure 1 summarizes the timeline, sample sizes, data collected and methodology for message development and dissemination.

The intervention site, in the Gopinatpur Union, covered five villages with a total population of approximately 12,003 with 2,219 households[4]. The control site, about one hour away (by foot in the dry season, and by boat in the rainy season) incorporated five villages in the two unions of Ramkrishnapur and Boira. These sites were originally selected for phase 1 of this project, which developed and tested sanitation messages. Selection was based on: location, with both areas being isolated from transportation networks; similarities in occupation, lifestyle and food availability of the families; and lack of other development programs in the communities. Both sites were located in the low lying deltaic plains about 100 kilometers northwest of the capital city, Dhaka, and on the banks of the great Padma (Ganges) River. Road conditions were poor, and the villages had no electricity.

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[2] The first anthropometric measurements on controls in the Lactation Intervention were obtained during the last few days of January 1987, however, for simplicity the baseline will be referred to as beginning in February.

[3] A few sample children were recruited the last few days in April 1987 for the Weaning Intervention, however, for simplicity the baseline will be referred to as beginning in May.

[4] Intervention area population figures were collected by BRAC using a house-to-house demographic survey conducted in September to November 1986. Demographic information was not collected on all families in the designated control area. A sample of 150 families with children 0-24 months was identified by house-to-house survey in January 1987 (50 in each age cagegory: 0-5 months, 6-11 months, and 12-24 months) and demographic information collected on these 150 households.

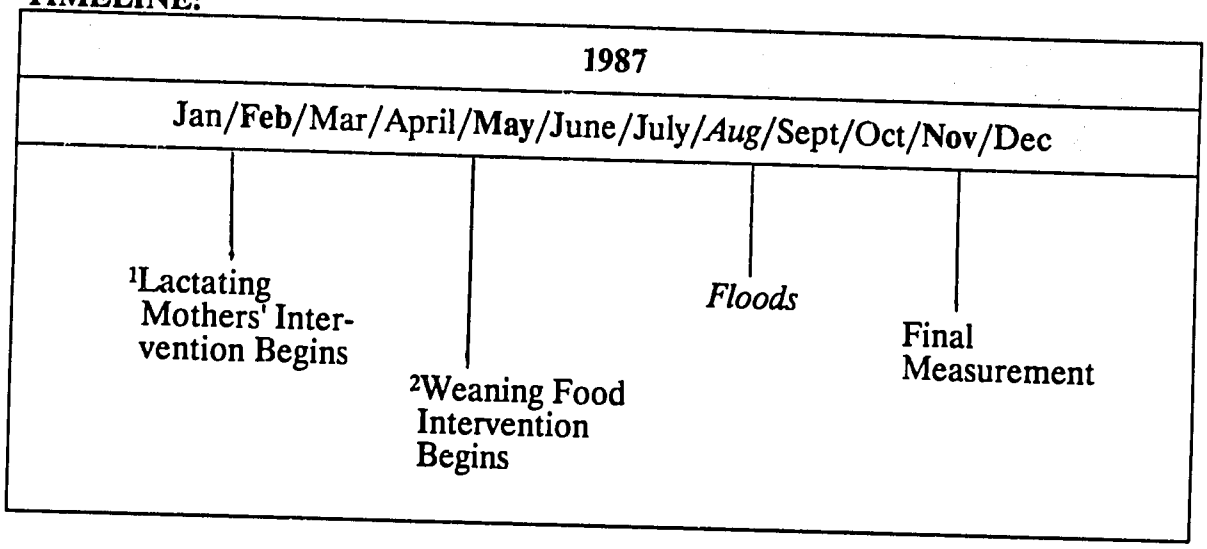
FIGURE 1

SUMMARY OF BANGLADESH FIELD PROJECT: DEVELOPMENT OF MESSAGES TO IMPROVE THE DIETS OF LACTATING MOTHERS AND CHILDREN OF WEANING AGE

TARGET GROUPS AND SAMPLE SIZE

- **Lactating Mothers & their Breastfed Children**[1]
  (48 treatment, 30 controls)
- **Children of Weaning Age**[2]
  (71 treatment, 67 controls)

TIMELINE:



DATA COLLECTED

Baseline:
-census (demographic and SES information)

Monthly:
-child weights
-child arm circumference
-mother arm circumference
-dietary (24 hour recall)
-child morbidity
-market food prices

METHODOLOGY

3 levels of message development and testing (in home):

Paid Health Worker
↓
Volunteer Mother
↓
Community Mother

The original sample for the Lactation Intervention consisted of 78 mothers - 48 treatment and 30 controls. The children of these mothers ranged from 0-12 months at the time of recruitment with 80% under the age of 6 months. All mothers were breastfeeding throughout the study.

The original sample for the Weaning Intervention consisted of 138 children - 71 treatment and 67 controls - between the ages of 4-14 months at the time of recruitment. Of these children, 132 had some follow-up dietary and anthropometry information. It was decided that children whose mothers had received education to improve their own diets should not be included in the Weaning Intervention. However, since finding children in the narrow target age range (6-12 months) living in close proximity to other children of the same age greatly limited the sample size, 10 mothers from the Lactation Intervention were allowed to enter the Weaning Intervention. The 30 control children from the Lactation Intervention were also included as controls for the Weaning Intervention. All children were breastfeeding throughout the study.

2.1.2 Message Development and Dissemination

The interventions, field methodology, and measurement instruments used are described in detail elsewhere (Brown et al, 1988). Briefly, field staff, hired by Bangladesh Rural Advancement Committee (BRAC), consisted of eight paid village workers (VWs) - five female and three male - and one male supervisor. All VWs were from the local villages, thus knew the sample community well. Technical support was provided by a nutritionist from Tufts University, Ms. Laurine Brown, a social anthropologist from BRAC, Dr. Azmat Ahmad, and by the research specialist from Tufts, Dr. Marian Zeitlin.

Preliminary behavior change messages for each theme - improving lactating mothers' diets and improving complementary feeding practices for young children - were initially developed in brainstorming sessions by the village and technical staff in response to a community-based nutritional needs assessment and problem diagnosis. The village workers preferred "catchy" phrases, considering them to be "shundor" (beautiful), a valued virtue in Bangladesh culture. In addition, messages were developed with four basic concepts in mind: they needed to be 1) do-able; 2) specific; 3) motivating; and 4) memorable. Teaching analogies were used and care was taken to select the most economically feasible messages[5].

Messages to improve the diets of breastfeeding mothers encouraged the mothers to eat an extra serving of all foods she already ate at meals, increase fluid intake, use good hygiene practices, and to offer both breasts to the baby when breastfeeding (see Figure 2). Since a Bangladeshi mother has limited control over her own food portions, her husband and mother-in-law were also included in the teaching.

Messages to improve the diets of young children included in-home demonstrations of "snack-type" recipes (for example, an energy-enriched cereal food *Chop Chop*),

[5] A change in expectations of learning was necessary during the first message trial, improvement of lactating mothers' diets. Initially, the workers tried to teach the mothers to repeat, verbatim, the beautiful, rhythmic messages. In doing so, the focus was on memorization, not actual practice of the content of the message. The dilemma was that the "shundor" (beautiful) messages were motivating and memorable, however, the mother would often focus on learning the poetic words, not on practicing the message. On discussion with the village workers, it was decided mothers should only be expected to repeat the "sense" of the message, and not the poetry in totality, and messages were simplified. For the weaning food theme, less "catchy sounding" messages were developed to attempt to discourage memorization of the words.

FIGURE 2.
NUTRITION MESSAGES
FOR
LACTATING MOTHERS IN BANGLADESH

MOTIVATIONAL

1. Mother's milk is the best milk for baby. Baby should not be bottlefed because it may cause illness.

2. If mother has much milk, baby will be very happy.

INCREASING FOOD AND LIQUID INTAKE

3. Eat large amounts of all kinds of foods and you will produce much milk, and your baby will receive much milk.

   Eat 3 plates of rice with 5 handfuls of rice per plate, OR 3-4 *ruti* (flat bread) 3 times a day, WITH 2 handfuls of dark greens/ vegetables, small fish or *dal* (lentils), and you will have much breastmilk.

4. Daily, drink 8 or more glasses or water, and you will produce much milk.

SANITATION AND HYGIENE

5. Before eating, wash hands, dishes, and spoons very well with tubewell water so they will be free of dirt and germs.

CORRECT BREASTFEEDING TECHNIQUE

6. When baby feeds on both breasts, he drinks much milk. Let the baby, himself, stop the feeding.

Messages developed and tested by BRAC in behavioral trials in Zhitka, Manikganj District, Bangladesh, 1987. Education was done through active participation on home-visits by BRAC workers and volunteer mothers. Translated from original Bangla version.

FIGURE 3.

COMPLEMENTARY FEEDING MESSAGES FOR INFANTS AND YOUNG CHILDREN IN BANGLADESH

INTRODUCTION OF FOODS AND FREQUENCY

1. A baby should be breastfed until 2 years of age, and from 5 months should be given other food to keep him or her healthy.

2. If you want to habituate your baby to other foods, give 2-3 small spoons (small amounts), 2-3 times daily of soft food. Slowly and gradually increase the amount as the baby adjusts.

   Soft foods include wheat or rice flour gruels, banana, potato, sweet potato, softened biscuits, and bread. To make the food soft and keep germ free, use boiled water.

3. Just as the baby chicken pecks all day on food, so should your baby be given food - small amounts and frequently.

4. Let the baby eat as much as he wishes. Be attentive to him or her, and never force.

VARIETY AND ENERGY DENSITY OF FOOD

5. *Chop Chop* is good for a 5 month and older baby. Give it 4 times daily to make your baby strong:

   2 handfuls (closed fist) wheat or rice flour
   1 handful molasses or sugar
   2 small spoons oil
   1 *poa* (about 120 ml) milk or tubewell water
   Cook until it becomes a soft, jelly consistency.

   Special *Chop Chop (Shushada)*:

   Make 1/2 seer (1/2 kg) peanut or lentil flour. Store along with 1 seer whole wheat flour. Occasionally dry in sunlight or heat (to prevent spoiling).

   2 handfuls wheat flour
   1 handful peanut or lentil flour
   1 handful molasses (or sugar) OR dark greens & other vegetable
   2 small spoons oil
   4 *chotak* (about 240 ml) water or milk, if available
   Cook as above recipe, until soft, jelly-like consistency.

6. In a 7 month baby, if you want to protect from disease, give Mishowkow (mixed food) 4 times daily.

   (A) If possible, cook Mishowkow separately for the baby in the morning and afternoon:

   2 clean handfuls rice, wheat/rice flour, potato/sweet potato
   If you have, add 1 handful lentils or egg
   Some dark leafy greens and other vegetables cut very fine
   2 small spoons oil
   Add 1/2 *seer* (1/2 liter) water and cook until soft.

   Then feed to your baby. For a small baby, mash the food with a clean hand before feeding.

   (B) Mishowkow can be made with 4 kinds of already cooked foods:

   2 handfuls rice, potato, or sweet potato
   1 handful dark leafy greens and other vegetables
   If you have some, add small fish, lentils, or an egg
   With a clean hand, mash and add 2 small spoons oil.

7. When fruits are in season, feed the mashed pulp or juice to your baby.

8. If you want your baby to be strong, add 1 small spoon of oil or molasses to his or her food.

9. Whatever you cook for your family, give some to your baby.

SANITATION AND HYGIENE

10. Before cooking and eating, wash your hands, utensils, and spoons with tubewell water, and soap or ash, so that they will be free of dirt and germs. If the baby does not eat all the food, cover the food to protect from bugs and dust and, a little later, again feed it to the baby.

FEEDING DURING ILLNESS

11. When baby is sick, to help him or her get better, feed him soft foods many times throughout the day.

Messages developed and tested by BRAC in behavioral trials in Zhitka, Manikganj District, Bangladesh, 1987. Education was done through demonstration on home-visits by BRAC workers and volunteer mothers. Translated from original Bangla into English.

and techniques to enrich foods from the family pot with energy (for example adding oil and molasses), protein (adding milk, fish, or legume flour), and the addition of vegetables or fruits in season (see Figure 3). Hygienic preparation of foods was stressed. Mothers were encouraged to continue breastfeeding in addition to frequently and persistently feeding new foods; for this, an analogy was used between human babies and baby chicks who need to peck for food all day.

The messages were then tested and revised through modelling and practice in three stages: 1) by paid village workers (VWs); 2) by volunteer mothers (VMs); and finally 3) by community mothers (CMs). In the first stage of the trials, hired village workers tried the messages in their own homes. Here the feasibility of the behaviors demanded in the messages was tested, and impractical messages modified. When the village workers felt comfortable with the messages, they recruited and trained volunteer mothers with children in the target age range - under 6 months for the Lactation Intervention, and between 6-12 months for the Weaning Intervention. Since it was difficult to find enough mothers with children in the narrow target age range living in close proximity to the volunteer mothers, mothers with children outside the target age range were allowed to enter the study. In the third stage, these volunteer mothers disseminated the messages to other village mothers (referred to as community mothers or CMs) with children in the target age range.

Teaching (or bargaining) was done by the female village workers in the homes of the sample mother or child, on an individual basis (including the mother and other caretakers), although groups of people would often gather in interest. Male workers met with the male household members (sample woman's husband or sample child's father). Teaching was participatory, through active demonstration, when possible. The workers used bargaining and persuasion to motivate mothers to practice the messages. Colorful flash cards aided the workers in stimulating discussions with volunteer mothers. Copies are attached in Appendix H and I.

Each of the five female VWs taught three VMs, visiting several times per week, for 1-2 months. Each VM taught approximately three to four CMs. Teaching of the CMs by the VMs was often informal - the mothers would gossip while fetching water or during leisure time. The hired workers would visit CMs occasionally to ask what they had learned from the VMs, and to monitor the response to the messages.

At the end of the project, messages were synthesized and modified based on observations and outcomes during the intervention (Figures 2 and 3).

2.1.3 Data Collection and Survey Instruments

Workers received training in anthropometric measurement - child weight, mother and child arm circumference - using methods developed by Zerfas (1985), dietary recall techniques (using a 24-hour recall instrument developed by Zeitlin et al, 1984), interviewing techniques, and maternal and child nutrition. Training was ongoing, and incorporated participatory techniques, using role modelling and small group discussion.

All households were visited monthly by the VWs for collection of anthropometric, dietary, and morbidity data, however, serious flooding interfered with data collection during August and September[6]. Baseline values of the above data were collected prior to the intervention, along with socioeconomic information on all

[6] Sample questionnaires and recording forms are included in another report (Brown and Zeitlin, 1988).

sample households. Child weight was measured with a portable Salter scale, which was regularly checked with a constant weight. Mother and child arm circumference measurements were taken using the TALC (Teaching Aids at Low Cost) tape. The monthly 24-hour recall of the mother's or child's food intake was recorded on a pre-tested instrument containing common Bangladeshi foods (Zeitlin et al, 1984, Rizvi et al, 1984). Child morbidity data consisted of mother's recall of the type of illness and approximate number of days the child was sick with the illness during the month.

Food prices for staple and seasonal foods were collected once a month, from April - November 1987, in two villages in the treatment area - Zhitka, which had a daily market, and Bhadurpur, which had a market twice a week. Prices for February and March were estimated from prices in April and from market surveys conducted in several other BRAC sites during that time.

Extensive field notes describing visits to sample homes were kept by all village workers. This information provided a rich source of descriptive information on the intervention process.

2.2 DATA PREPARATION AND ANALYSIS

The impact of each education program was evaluated based on changes in "pre-" and "post-" education indicators for dietary adequacy and nutritional status. For both the Lactation Intervention and the Weaning Intervention, improvements in dietary adequacy and nutritional status for those receiving the education were compared with controls (matched by child age and season) after adjusting for any baseline differences between the groups. Table 1 summarizes the months when baseline data was obtained for the Lactation Intervention and the Weaning Intervention and the months selected as endpoints ("post-education") for each evaluation. Table E1 in Appendix E summarizes the sample sizes of children and mothers for whom data were available for each indicator.

The analysis of the five-month-long Weaning Intervention had a single post-education endpoint. The analysis of the eight-month-long Lactation Intervention used both a midpoint and an endpoint. The midpoint evaluation was useful for several reasons: 1) the flooding in August would likely have had a greater direct impact on the mother's dietary intake than the weaning infant's diet; thus, it was felt important to evaluate the impact of the program before the confounding effects of the flood; 2) as her breastfeeding infant got older, the likelihood that enhancement in the mother's diet would result in improvements in the nutritional status of her infant was reduced, since the older child would also need more additional foods; evaluating at the midpoint when the average age of the children was only seven months reduced this problem.

Indicators used for dietary adequacy and nutritional status, and the statistical tests used to evaluate the outcomes, are described in more detail in the following sections.

TABLE 1. EVALUATING THE IMPACT OF THE LACTATION AND WEANING INTERVENTIONS: "PRE-" AND "POST EDUCATION" INDICATORS USED TO DETERMINE DIFFERENCES IN OUTCOMES BETWEEN TREATMENT AND CONTROLS

LACTATING MOTHERS' INTERVENTION	1987		
	BASELINE* "pre-education" Feb/Mar	MIDPOINT "post-education" May/June/July	FINAL "post-education" Oct/Nov
ANTHROPOMETRY# -Mother & child AC child weight	First measure available	Child wt: Last measure available (AC not available)	Last measure available
MOTHER DIETARY§ -24 hour recall	First measure available	Average of 3 measures	Average of 2 measures

WEANING FOOD INTERVENTION	1987	
	BASELINE* "pre-education" May/June/July	FINAL "post-education" Oct/Nov
ANTHROPOMETRY# -Child weight, AC	First measure available	Last measure available
CHILD DIETARY§ -24 hour recall	First measure available	Average of 3 measures

** Due to the rolling recruitment of the sample for each education trial, the "pre-education" indicators span a 3 month time period. For each individual, the first measurement was taken before receiving education. As not all children (or mothers) had all measurements, the months contributing to the averages differed slightly from child to child (or mother to mother).*

 # The first anthropometric measure available for the individual was the "pre-education" indicator. For the "post-education" indicators, if the measurement for last month specified was not available, the measurement from the previous month was used.

§ The first dietary recall available on each individual was taken as the "pre-education" measure. For the "post-education" dietary indicators, all measurements available during the months indicated were averaged since daily food intakes are highly variable, to strengthen the accuracy of the indicator in measuring "usual" food intake. At baseline, since only one dietary measurement was taken before education trials began, the following month of measurements could not be averaged without confounding the results.

2.2.1 Variable Construction

Anthropometry

For the Lactation Intervention, the changes in women's mid upper arm circumference (AC) measurements were evaluated from the baseline to the final endpoint. Women's AC was not evaluated at the midpoint since a large number of measurements were missing.

For the Weaning Intervention the children's weights, converted to z-scores (WAZ) according to the National Center for Health Statistics (NCHS) and World Health Organization (WHO) standards for age and sex (WHO, 1983), were used for statistical comparisons. Actual weights, and percent of median weight-for age (WAPM), using the same standards, were displayed for descriptive purposes.

For the 59 (29 treatment, 30 control) infants of the women in the Lactation Intervention who were under 6 months at the time of recruitment, child weights were evaluated as above for the Weaning Intervention. Arm circumference measurements were collected monthly on all children of mothers in this study, including 19 over the age of 6 months at the time of recruitment, who were not included in the weighing. Since adequate standards were not available for arm circumference of children under one year, the raw values were used, and age and sex of the children were controlled for in the analyses.

Dietary Adequacy

Energy, protein, fat, vitamin A, and iron intakes of the infants and mothers were computed from the monthly 24 hour recalls using Bangladesh food composition tables (Darnton-Hill et al, 1988), and U.S. Department of Agriculture (Adams, 1975) tables. As 100% of the sample infants were breastfeeding throughout the study, and test weighings for breastmilk output were not feasible, the amount of breastmilk consumed at each age was estimated from research on a comparable Bangladeshi sample (Brown et al, 1982; Brown et al, 1986; see Appendix C for rationale and estimates).

Energy, protein, vitamin A, and iron were expressed as absolute intakes, and as a percent of the international recommendations (WHO, 1985; NRC, 1989; see Appendix B and C for detailed description of standards used). As all the mothers lactated throughout the study, additional dietary requirements for lactation were based on the age of her breastfeeding child, and on international recommendations (WHO, 1985; Indian Council of Medical Research, 1981). All dietary values for infants were determined both with, and without, breastmilk estimates.

Because of generally high infection rates in Bangladesh children beginning in the second half of the first year of life, an additional factor was added to the protein requirement for children over 5 months (Scrimshaw and Zeitlin, personal communication 1989; Rand et al, 1984; see Appendix C for description). A modification was made for foods of low protein quality, consumed by both mothers and children (WHO, 1985; see Appendix B and C for adjustment).

Since most of the village children weighed far less than the international norm, "maintenance" requirements for energy and protein were first computed, multiplying the child's age-specific requirements (per kilogram [kg] of body weight) by his or her actual weight. These estimates should provide sufficient energy and protein to maintain a (healthy) child's present growth percentile (or WAZ), but would not be sufficient for catch-up growth, and would underestimate the real needs of undernourished children. Additionally, they may not be sufficient to meet the additional requirements associated with frequent infections. Therefore, "ideal" requirements were also determined, using the median weight for the child's chronological age and sex (NCHS 50th percentile values, WHO [1983]) in place of actual weights.

Pre- and post-intervention variables were created for the above adequacies. Since daily dietary intakes had high variability, the midpoint and final dietary variables were created by averaging, as indicated in Table 1.

Nutrient "gaps" were computed, for each observation, on both the sample mothers and the sample children. The "gap" is the difference between the requirement, and the amount of the nutrient consumed by the mother or the child. For children, since two requirements were determined for calories and protein, two nutrient gaps were computed, one to fill the "maintenance" calorie and protein needs, and one to fill the "ideal" needs for these nutrients.

Morbidity

The mother's recall of her child's illness prevalence (recorded monthly) was used as a control variable for children in the Weaning Intervention, and the infants of the mothers in the Lactation Intervention. The illnesses were grouped into: 1) water loosing illness (diarrhea, dysentery, vomiting); 2) respiratory and oral infections (cold, cough, throat or mouth infections); 3) fever; 4) measles; and 5) other (skin or eye infections, and other minor illness). Combining all the available observations illness prevalence was computed as the mean percent of days/month the child was sick with the illness category. These variables were used in analysis of covariance (ANCOVA) to control for the effects of morbidity on child growth and food intake.

Socioeconomic Indicators

Many socioeconomic (SES) indicators were collected at baseline, such as mother's education, housing type, land, source of drinking water, and possessions. Scales for traditional wealth, agricultural wealth, and modernization/ education were created for each household, replicating the model derived from factor analysis by a previous study at the same sites (Guldan, 1988) (see Appendix D). Acceptable internal consistencies of the scales were confirmed using SPSSX's[7] Reliability Program with Cronbach's Alpha.

In the traditional wealth and agricultural wealth scales, items were assigned monetary values, according to their local market prices, added together, logged and then expressed per capita. A general wealth scale combined both the traditional and agricultural wealth scales. The modernization/education scale, which was not monetized, consisted of the possession of radios, watches, soap, and the years of education for the mother and the household head.

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[7] SPSSX Version 3.11 (and in the final stages 4.0) running on VAX 8550 operating on VMS, SPSS Inc, 44 N. Michigan Ave, Chicago, IL 60611.

Market Food Prices

The monthly monetary value for foods eaten by the mothers in the Lactation Intervention and children in the Weaning Intervention was determined by converting the price in local currency (*taka*) for the raw market units to the price per kg of the edible portion[8]. Average waste from the foods, as purchased, was determined from the Bangladesh Food Composition Tables (Darnton-Hill et al, 1988). Since fish prices varied considerably from one variety to the other, a weighted price, based on actual consumption each month was determined. Lotus 1-2-3 software[9] was used to aid in food price computations.

The monetary value of the mothers' and children's diets was determined by computing the market price (per kg of edible portion) by the amount consumed by the individual. Although this is not the actual amount spent by the family for the food of the sample mother or child, it is a measure of the potential cost of the diet, if all food were to be purchased in the market that month. A comparison of these estimates of food values was made with a sample of 11 households on which actual weekly food expenditures were obtained during the month of April. The estimates were very similar (see Part 6 for results).

The costs to fill the nutrient "gap" for mothers were computed individually for each mother using the actual value of the foods she consumed that month. The costs to fill the nutrient gap for children, who were consuming a very small number of foods, were determined using several common weaning foods, including foods promoted through the education program: *Chop Chop* (basic, with milk, or with lentils) *Mishowkow* (with lentils, egg or fish), cow's milk only, infant formula, and the average value of the lactating mother's diets from the other sample. The cost to fill the nutrient gap for vitamin A was also determined using green leafy vegetables. To explore differences in food costs by child age, the 6 monthly observations were combined into one cross-sectional file, and children of each age (in months) were studied regardless of season.

For each intervention, cost estimates for treatment and controls were combined to form one sample of mothers (Lactation Intervention) and one of children (Weaning Intervention). Differences in costs for women are compared descriptively with those for children.

2.2.2 Statistical Methods

For all comparisons, treatments and controls were matched by the child's age (or in the Lactation Intervention by the age of the mother's child) during the same season. Analysis of covariance (ANCOVA) was used to determine the impact of the education intervention on changes in nutrient adequacy for mothers and children, and changes in nutritional status. The baseline and endpoint variables, and the changes in the measure over the study period (relative to baseline), were used as dependent variables.

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[8] During the study period in 1987, the exchange rate was approximately 30.5 Bangladesh taka = 1 US dollar.

[9] Lotus 1-2-3, Version 2.2, Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142.

Adjusted mean values were calculated for treatment and controls for anthropometrics, and dietary variables, controlling for wealth, mother's education, morbidity, child age and sex, mother's age, and baseline nutritional status or nutrient intake. T-tests, Pearson correlations, and partial correlations were used in preliminary analyses to explore significant group differences in baseline and final nutritional status, dietary adequacy, and morbidity. The McNemar non-parametric test for changes from pre- to post-intervention was used to determine the significance of changes in the number of severely undernourished children in each treatment group. Crosstabulations, with the chi-square test of significance, were used to compare differences in nutritional status categories (WAZ categories) between the control and treatment groups.

SPSSX was used for statistical analysis. Throughout this report, statistical significance is defined as $p<.05$.

2.2.3 Sample Sizes at Follow-up

For the Weaning Intervention, all 138 children were included in the preliminary analysis, 132 (71 treatment, 61 control) of whom had some follow-up dietary or anthropometric data. In the final analysis, 21 children were excluded due to either missing baseline or final measurements. All 78 women (48 treatment, 30 control) in the Lactation Intervention were included in the preliminary analysis. Table E1 in Appendix E summarizes the sample size used in the final analysis for each independent variable.

Missing data was primarily due to the child or mother being absent on follow-up visits (for example visiting maternal relatives), or the family's out-migration. In addition, one treatment child in the Lactation Intervention died from an acute illness early in the study. For both interventions, there were no significant differences between those children or mothers included, and excluded, on the basis of mother and/or child nutritional status, dietary intakes or SES variables.

For the sake of consistency, the results presented for the Weaning Intervention are based on the smaller sample of 117 (62 treatment, 55 control), ranging in age from 4-14 months at baseline to 9-18 months at the final measurement. The results of the Lactation Intervention are presented for the sample having all measurements for each indicator as shown in Appendix E, Table E1.

PART 3
SOCIOECONOMIC CHARACTERISTICS OF HOUSEHOLDS IN LACTATION AND WEANING INTERVENTIONS

Socioeconomic (SES) characteristics of the treatment and control families in both the Lactation Intervention and the Weaning Intervention are summarized in Tables 2 and 3. The interventions were conducted in the same site for both campaigns, and the controls were selected from the same site, thus the demographics of the treatment and control families in both samples would be expected to be similar.

The average age of the women to whom the education was targeted in both samples was approximately 28 years. The mothers in both samples had an average of 3 children, and nearly all of the mothers were married. The average number of household members was slightly higher for the treatment sample (Table 2).

The number of Moslems and Hindus varied in the two sites - with more Hindus at the control site than at the treatment.

Mothers' literacy rates ranged from only 8% to 29%. More mothers in the Lactation Intervention had received any schooling than in the Weaning Intervention. In the Weaning Intervention, more control mothers were educated, while in the Lactation Intervention the opposite was true, though the differences were not statistically significant in either sample (Table 2). The same trend in education rates was found for the head of the household. Since the household heads were, in most cases, male, the literacy levels were generally higher than for the mothers, though well over half were illiterate.

In both samples, a higher percent of control households were landless (Table 3). This was due to the fact a number of families in the control area once owned land which was submerged by the ever-changing Padma (Ganges) River. Possession of animals and animal sheds was also higher for treatment households, again, consistent with the differences in land-holdings (Appendix D, Table D2).

The primary source of income was farming in the treatment, and government service jobs were the main source of income in the control area, highlighting the difference in landholdings between the sites. The control area also was closer to government health and administrative offices. Other sources of income were similar for both groups - agricultural or other skilled day labor, small business, fishing, boating, and other jobs such as traditional folk healing.

(Artwork by village boy, Pintu)

(Embroidery design by Surayla)

In Bangladesh, men sow and harvest crops. Women process crops at home.

TABLE 2. DEMOGRAPHIC INFORMATION
TREATMENT AND CONTROL DIFFERENCES FOR LACTATION AND WEANING INTERVENTIONS

MATERNAL AND HOUSEHOLD HEAD CHARACTERISTICS	LACTATING MOTHERS SAMPLE			WEANING FOOD SAMPLE		
	TREATMENT n=48	CONTROL n=30		TREATMENT n=62	CONTROL n=55	
	mean	mean	signif#	mean	mean	signif#
Mother's Age (yrs)	28	26	NS	28	28	NS
Household Head Age (yrs)	42	39	NS	44	37	**
Household Members	7	6	NS	7	6	***
Mother's Number of Children	3	3	NS	3	3	NS
Household Head Yrs in Village	37	12	***	41	15	**
Mother's Yrs in Village	11	8	***	13	9	***
	percent	percent	signif#	percent	percent	signif#
MOTHER'S EDUCATION						
No Schooling	71%	77%	NS	92%	84%	NS
Some Primary (<5 yrs)	4%	0%		3%	2%	
Completed Primary (5 yrs)	17%	13%		3%	9%	
Some Secondary (6-11+ yrs)	8%	10%		2%	5%	
HOUSEHOLD HEAD EDUCATION						
No Schooling	52%	63%	NS	79%	71%	*
Some Primary (<5 yrs)	10%	3%		9%	4%	
Completed Primary (5 yrs)	21%	3%		8%	5%	
Some Secondary (6-11+ yrs)	17%	27%		3%	20%	
Missing	0%	3%		0%	0%	
MOTHER'S LITERACY IN BENGALI						
No	71%	77%	NS	92%	86%	NS
Yes	29%	23%		8%	4%	
HOUSEHOLD HEAD'S LITERACY						
No	54%	67%	NS	79%	73%	NS
Yes	46%	33%		21%	27%	
RELIGION						
Moslem	85%	47%	***	94%	53%	***
Hindu	15%	53%		6%	47%	
MOTHER'S MARITAL STATUS						
Married	85%	100%	NS	96%	100%	NS
Unmarried	0%	0%		2%	0%	
Lost Husband	0%	0%		2%	0%	
MOTHER'S RELATION TO HEAD OF HOUSEHOLD						
Wife	73%	87%	NS	69%	93%	
Son's Wife	19%	13%		21%	7%	
Brother's Wife	4%	0%		6%	0%	
Daughter	2%	0%		2%	0%	
Household Head	2%	0%		2%	0%	

p-values were calculated from t-tests with continuous variables and x^2 tests with catagorical variables.
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, NS (not significant) $p>0.05$

TABLE 3. HOUSEHOLD WEALTH INDICATORS
TREATMENT AND CONTROL DIFFERENCES FOR LACTATION AND WEANING INTERVENTIONS

HOUSEHOLD CHARACTERISTICS	LACTATING MOTHERS SAMPLE			WEANING FOOD SAMPLE		
	TREATMENT n=48	CONTROL n=30		TREATMENT n=62	CONTROL n=55	
	percent	percent	signif#	percent	percent	signif#
HOUSE OWNERSHIP						
Owns House and Lot	98%	60%	***	98%	64%	***
Owns House, Other's Lot	2%	40%		2%	36%	
HOUSING STRUCTURE						
All Tin	17%	17%	NS	5%	16%	NS
Tin Roof Only	62%	63%		82%	71%	
All Thatch or Straw	21%	20%		13%	13%	
LAND OWNERSHIP (PAKI)§						
Landless	42%	93%	***	47%	91%	***
1-3 Paki	23%	3%		13%	4%	
4-6 Paki	12%	0%		14%	0%	
7-12 Paki	8%	3%		18%	5%	
12+ Paki	15%	0%		8%	0%	
SOLVENCY						
Deficit	4%	7%	NS	5%	5%	NS
Somehow Maintains	38%	63%		39%	58%	
Solvent through Year	44%	27%		43%	33%	
Surplus	15%	3%		13%	4%	
DRINKING WATER SOURCE						
Tubewell	98%	97%	NS	100%	98%	NS
Ringwell	2%	3%		0%	2%	
LATRINE						
Cement	6%	0%	NS	3%	2%	NS
Bamboo or Other	90%	90%		94%	93%	
None	4%	10%		3%	5%	
MAJOR SOURCE OF INCOME						
Farmer	33%	0%	NS	34%	7%	
Agriculture/Skilled Day Laborer	19%	20%		21%	20%	
Fisherman	6%	10%		5%	11%	
Service Holder	17%	30%		11%	22%	
Business	15%	20%		16%	20%	
Boatman	4%	7%		6%	5%	
Income from Outside	0%	3%		0%	2%	
Other	2%	7%		5%	11%	
Missing/Unknown	4%	3%		2%	2%	

p-values were calculated from t-tests with continuous variables and x^2 tests with catagorical variables.
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, NS (not significant) $p>0.05$
§ 1 Paki=0.33 Acre

A greater percent of the treatment families than controls reported to be solvent or in surplus, annually, for both the Lactation Intervention and the Weaning Interventions.

The traditional homesteads consisted of one or more thatch, jute, bamboo, or tin huts, surrounding an earthen courtyard. The huts generally functioned as bedrooms, but sometimes served as kitchens, animal sheds, or grain storage sheds. Tin houses more efficiently protected from rain leakage and other adverse weather conditions, however, they were considerably more expensive to build. In both samples, significantly more treatment families owned the lot their house was built on. In the control area, some of the land was provided by the government for homesteads

Almost all households claimed to use tubewell water for drinking, with the exception of a few households who obtained water from ringwells. The majority of households had crude latrines made of wooden or bamboo platforms perched over either ground or water.

Possession of various household belongings, or traditional wealth indicators is listed in Appendix D, Table D2. Possession of "modern" items, such as radios and watches was similar for treatment and control households in the weaning food sample. More households in the lactating mothers sample possessed these modern items, with treatments having more than controls, although the combined modernization scale suggests the differences are not statistically significant (Appendix D, Table D1). On average, about 3 times more treatment than control families (48-63% vs 13-17%) owned soap which could reflect the influence of the hygiene intervention carried out previously at the treatment site. However, the low figures reported for soap possession for the control area are inconsistent with reports from the same site the previous year, where 45% claimed to have soap (Guldan, 1988).

Table D1 in Appendix D compares the scores for treatment and control for the agricultural and traditional wealth scales, in addition to the modernization scale. For both interventions, there were significant differences in agricultural wealth between treatment and control families, but not for traditional wealth or modernization.

PART 4
LACTATION INTERVENTION: EVALUATION OF IMPACT

Summary of Findings - The energy adequacy of the 48 treatment and 30 control women's diets averaged about 64% of requirements at baseline and declined over the study period. These levels and seasonal trends were consistent with the findings of other researchers from similar samples. At the midpoint, three months into the education program, the differences between treatment and control groups, both in energy intake, and in deterioration in adequacy, were not statistically significant. At this point, motivation was high and a change would have been expected. By the end of the study, eight months after the baseline measure, the declining adequacy of the mothers' diets was significantly less (i.e., better) for the treatment group than the controls. However, severe flooding and other confounding events occured between the midpoint and this final measurement. Therefore, the endpoint difference between the groups cannot be attributed to the education program with full confidence.

The nutritional adequacy of the women's diets was strikingly poor, reaching an average over all seasons of only 56% of their requirement for energy, 60% for protein, and 29% for vitamin A. Dietary iron levels were adequate, however, the iron may be poorly absorbed.

In both treatment and control groups, the energy adequacy of the mother's diet was significantly associated with her child's growth (weight gain) and nutritional status (weight-for-age and arm circumference or AC), as well as her own nutritional status (AC). This suggests that if barriers to improving women's diets can be overcome, both the nutritional status of women, and their breastfeeding children will improve. In addition, the mothers' years of formal education were positively correlated with the adequacy of her diet (controlling for wealth) and her AC at baseline. The women were extremely lean with average AC measures approximating the 5th percentile of international standards. The AC of the women did not decline over the 8 months despite a decline in energy intake, suggesting either the mothers reduced activity, that AC is not a sensitive measure of short-term change in these lean rural women, or that breastmilk production declined. No significant differences in growth rates or changes in AC were found between children whose mothers received maternal education and those who did not, suggesting that breastmilk production, and intake by the infants, was not increased.

The families conveyed overwhelming frustration at their inability to afford the food needed to comply with the messages for mothers, despite the project's careful promotion of low cost foods. The study spanned the hot-dry, and monsoon seasons, when hunger is greatest in a year with unusually severe flooding. While families liked being the recipients of information that might keep their child healthy, and women generally wanted to eat more food, they had little means to do so. The breastfeeding mothers felt that if they increased their own share of the food, they would need to increase the share given to all family members. Enlisting the support of the husband and others for the idea that the mother should eat more at meals did not make her feel that she could take more than she served to them.

4.1 FINDINGS OF INTERVENTION TO IMPROVE DIETS OF LACTATING MOTHERS

The following sections report the findings from the evaluation of the Lactation Intervention conducted in rural Bangladesh from February-November 1987. The discussion section interprets the findings in the context of the Bangladesh and other poor countries. Part 6 reviews the food cost barriers to the households of the nutrition education messages disseminated through this intervention.

4.1.1 Changes in Dietary Adequacy for Lactating Mothers

Energy Adequacy at Baseline

At baseline, mothers in the control group were consuming significantly more calories than mothers in the treatment group (p=.001, Appendix E, Table E2). Apart from group differences, other factors predicting the energy adequacy of a mother's diet at this time, were the age of her child, and her years of schooling.

The majority of controls were recruited during the beginning of February, which was shortly after the major rice harvest. Due to the ongoing enrollment in the education program, the majority of treatment mothers entered the study during March. The fact that March was generally a less plentiful month, with greater food scarcity, higher food prices, and little work available, could account for some of the group differences (Brown, May 1987).

For both groups, however, the energy adequacy of the women's diets was very poor, compared with the amount the mothers would need to produce an adequate amount of breastmilk for their infants, and to lead an active, healthy life. On average mothers were consuming less than two-thirds of their estimated needs.

Baseline to Midpoint: Energy Adequacy

The dietary energy adequacy of both groups declined from the baseline in February-March to the first endpoint (midpoint) which was approximately 3 months into the education program. The weather had become increasingly hot, humid, and rainy from Feb-March to May-July, and a seasonal decline in total food intake might be expected (Brown, May 1987).

While the decline in dietary energy adequacy was greater for the controls, the differences were not statistically significant, after controlling for other important factors (p=.806, Appendix E, Table E2). Baseline energy adequacy, the child's age, and the mother's years of education were all significant in determining the change in energy adequacy of the diets of the mothers over the hot season. Controlling for these factors, the (adjusted) decline in adequacy was about 10 percent of the calorie requirement for both groups (9.5 controls, 9.9 treatment). Neither agricultural or traditional wealth were significant in predicting the change.

Baseline to Final: Energy Adequacy

The energy adequacy of the mothers' diets continued to decline from May-July and the final measure in October-November. This was, on average, 8 months after the baseline measure. The decline from baseline was significantly worse (larger) for the

controls than the treatment mothers. After controlling for the age of the mother's child and the baseline caloric adequacy of her diet, the (adjusted) decline was 15.5 percent for the controls compared with a decline of 10.1 percent of the requirement for treatment mothers. This difference was statistically significant (p=.001, Appendix E, Table E2). The (estimated) decline in the mother's breastmilk production over the 8 months (based on the age of her child as described previously) was not significant in predicting the decline in the her energy intake.

Figure 4 illustrates the trend in dietary adequacy between the mothers who received education, and those who did not.

Severe flooding occurred in both areas between the midpoint to the final measure, which may have confounded the final results. **While nutrition education may have prevented the mothers in the treatment group from suffering the sharp decline in dietary adequacy noted in the controls, it cannot be concluded the difference was due, entirely, to the intervention effect.**

4.1.2 Quality of the Mothers' Diets - General Characteristics

Of the 4 major nutrients evaluated - calories, protein, vitamin A, and iron - vitamin A was the most deficient nutrient (see Figure 5). Although the high prevalence of vitamin A deficiency disorders in Bangladesh (e.g. blindness) support these findings (HKI, 1985), the values should be interpreted with caution. No good data are available on the vitamin A content of Bangladesh fish, a common food in the women's diets. In this analysis fish were assumed to have no vitamin A or carotene, thus, the levels in the diet may be underestimated. Even so, fish are consumed in small quantities.

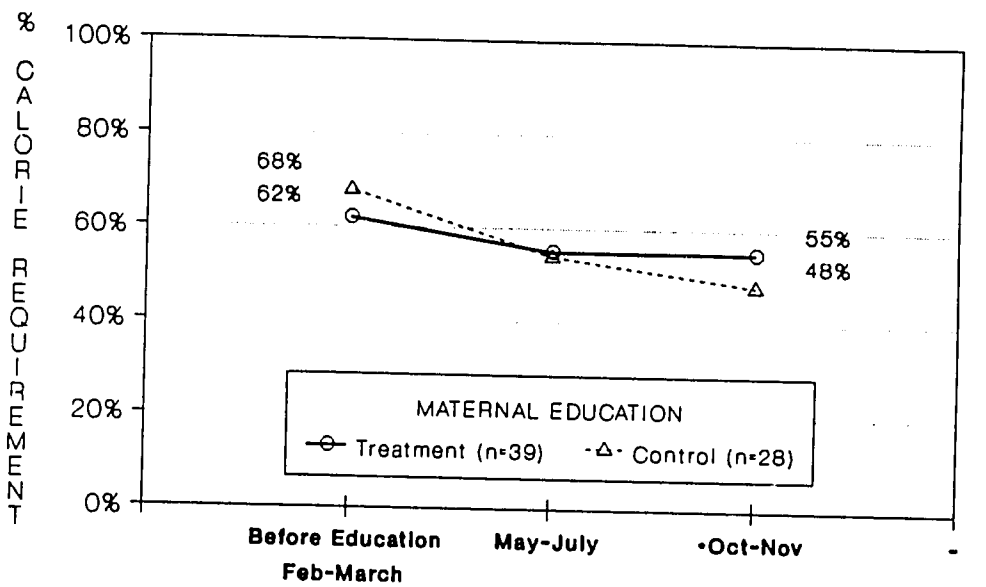
Adding to the bleak picture of vitamin A adequacy is the extremely low fat content of the diet. Dietary fat is thought to be essential for absorption of carotene and vitamin A from the diet. Only 5% of the calories consumed in the high bulk diet of the mothers were from fat (Figure 6). This compares with a contribution of over one-third in developed countries (NRC, 1989). Vitamin A consumption was highest during the midpoint (May-July), a time when carotene rich foods, such as mangoes were in season, and many dark green leafy vegetables were plentiful and cheap. The increase in consumption from the baseline to the midpoint was significantly greater for the treatment mothers than for the controls, however at the final measure the change in consumption for the two groups was not significantly different. In October-November the after-effects of destruction of home gardens by the floods reduced the supply of vitamin A-rich dark green leafy vegetables.

The iron content of the diets of the women, was found to be more than adequate over all the seasons, based on a requirement level of 15 milligrams (mg) per day (NRC, 1989; see Appendix B). In addition to food sources analyzed in this study, the drinking water, often obtained from iron tubewells, may have provided additional iron, although the absorption of this form of iron may be low.

Trends in protein consumption paralleled trends in calorie consumption. In general, protein adequacy of the diet was slightly better than energy adequacy of the diet, even after adjusting for the low protein quality of the diet. However, with such inadequate levels of energy intake, it is difficult to interpret protein adequacy levels. At low levels of energy intake, protein may be used to meet energy needs rather than for body building and repair functions (WHO, 1985).

Fig 4. ENERGY ADEQUACY OF LACTATING MOTHERS' DIETS

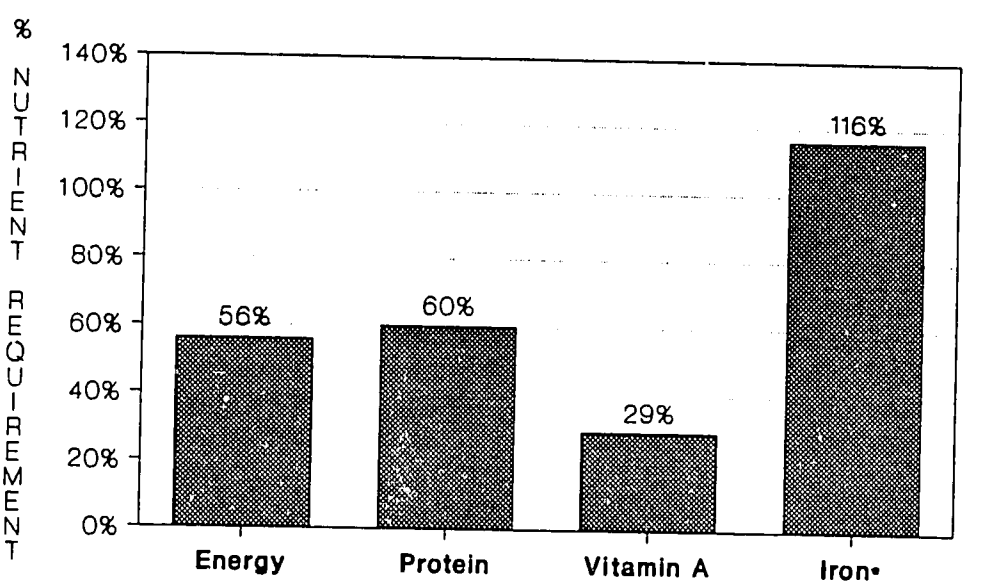
Before and After Nutrition Education



*Change in adequacy from Feb-Mar to Oct-Nov significantly better for treatment than controls (adjusted for confounders)

Fig 5. NUTRIENT ADEQUACY OF LACTATING MOTHERS' DIETS

Energy, Protein, Vitamin A, Iron



*Iron in the women's diets may be poorly absorbed.

Monthly averages from Feb-Nov 1987 for lactating mothers with children of under age 2 years.

Figure 7 illustrates the contribution of each food group to the total calories in the mothers' diets, during each of the 3 seasons observed. Grains, including rice and wheat, constituted a strikingly high percentage of the dietary calories - over 75%. The rest came from vegetables, with small contributions from fruits, fish and other animal foods, lentils, and oil. The proportion from grain was highest during the months of April-July and October-November. In this area of Bangladesh, the proportion of grain contributed by wheat usually increases during the hot, dry months, particularly March and April, when wheat is distributed in food-for-work programs. This phenomenon was highlighted in the study done the previous year in the same site (Zeitlin et al, 1989)

Figure 8 illustrates the percent of women consuming selected foods during each of the 3 seasons, excluding, grains, vegetables, and oil which are consumed daily by almost all women. It is important to remember in interpreting this figure that February-March consists of only one dietary observation, May-July averages a maximum of 3 dietary recalls (one each month), and October-November averages 2 observations. Thus, the likelihood of observing a mother consuming a food on only one observation, would, of course, be lower than on two or three observations. Keeping this in mind, the consumption of fish increased in October-November, when rivers were swollen from the rains. The number of mothers consuming lentils increased during May-July, but in February-March and October-November, less than 30% of the women consumed lentils on the days observed. Consumption of dark leafy greens also increased in May-July when greens were more plentiful and cheaper. Consumption of milk and other animal foods, such as eggs or chicken, was extremely low at any observation. Consumption of fruits increased during May-July; however, even in-season fruits (for example, mangoes) were considered expensive, and only one-third of the women consumed fruits on the days observed.

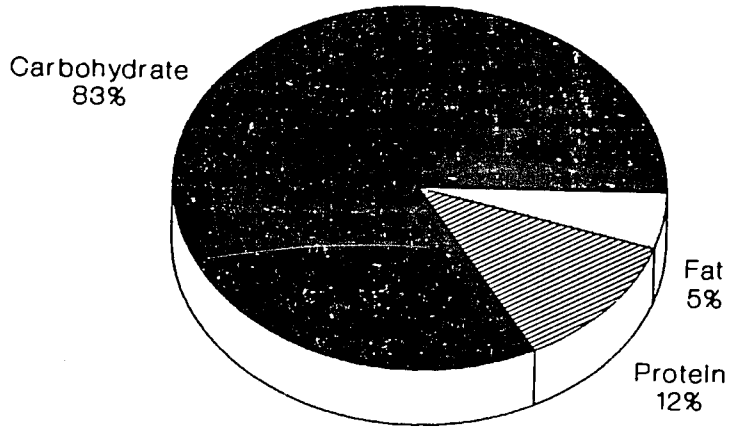
4.1.3 Changes in Nutritional Status

Mothers' Arm Circumference

The nutritional status of the mothers in the treatment and control group was similar before education, as suggested by the mothers' mid upper arm circumference (AC) measurements. The average measurement for both groups approximated the 5th percentile of the reference standard (Frisancho, 1981), highlighting the lean state of the lactating mothers at a time, shortly after giving birth, when fat reserves are most needed. Treatment mothers had a slightly larger arm circumference than controls, but the difference is not statistically significant, nor likely to be biologically significant. The difference between the two groups becomes even smaller - treatment 22.8 centimeters (cm), controls 22.4 cm - after adjusting for other factors that predicted the mother's arm size in this sample: mother's age, her child's age, mother's education, and her initial calorie consumption. Neither traditional wealth, nor agricultural wealth were significant in predicting mother's baseline arm circumference.

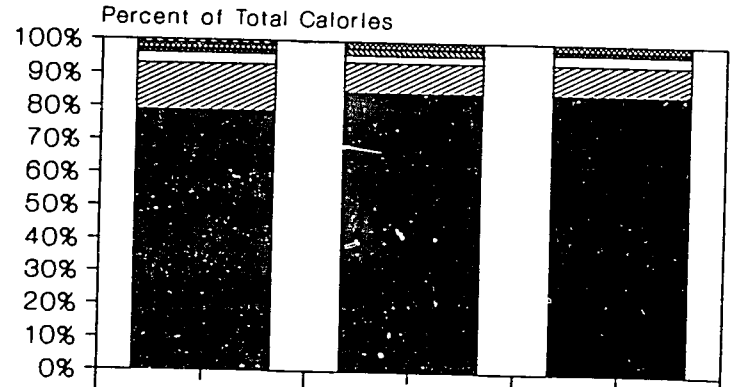
Over the 8 months of the study, the arm circumference measurements remained stable, and in the control group, increased slightly. The difference between the change in the two groups is slightly significant ($p=.026$) only after controlling for the mothers' calorie consumption over the 8 months, initial arm circumference, and agricultural wealth. The (adjusted) increase was of 0.1 cm for treatment mothers vs 0.6 cm for controls. This difference is likely not functionally significant. Figure 9 illustrates the change relative to the reference standards.

Fig 6. Distribution of Calories in Lactating Mothers' Diets
(% Calories from Protein, Fat, CHO)



Average for February-November 1987 for both treatment and control mothers

Fig 7. Percent of Calories from Food Groups in Diets of Lactating Mothers by Season

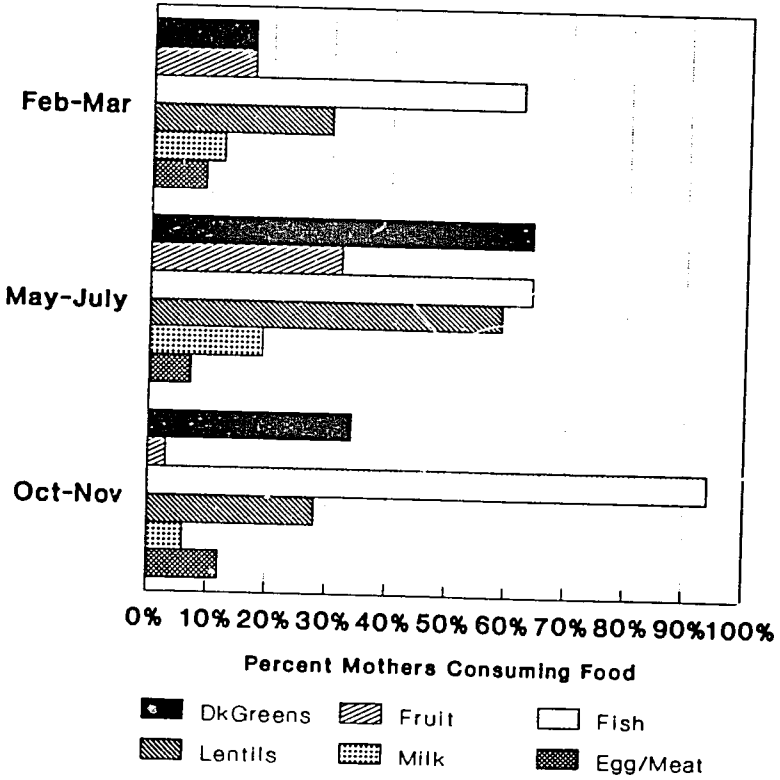


	Feb-Mar	April-July	Oct-Nov
Sugar	1%	0%	0%
Oil	2%	2%	2%
Lentil	1%	2%	1%
Animal	3%	2%	3%
Veg&Frt	14%	9%	9%
Grain	79%	85%	85%

Grain, Veg&Frt, Animal, Lentil, Oil, Sugar

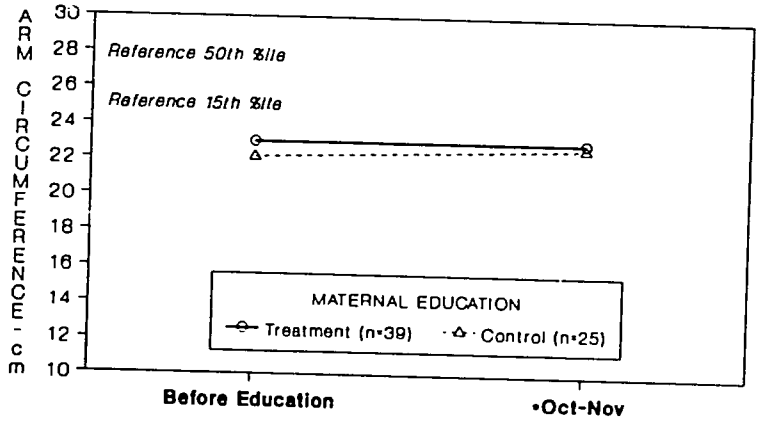
Treatment & control mothers combined

Fig 8. Seasonal Variation in Consumption of Selected Foods by Lactating Mothers
(Dark Greens, Fruit, & Protein Foods)



Treatment and control mothers combined

Fig 9. MOTHERS' ARM CIRCUMFERENCE (AC)
Comparison by Season
Before & After Education



*Change in arm circumference (adjusted for confounders) was: Treatment +0.1cm, Control +0.6

Looking at both treatment and control women together: **the more calories the individual mother consumed on average over the year, the larger her final arm circumference, and the greater the increase (or the smaller the decrease) in her arm circumference from baseline to final measurement** (Appendix E, Table E3).

Child Weight and Arm Circumference

As described in Part 2, children in the lactating mothers' group who were under 6 months at the time of recruitment were weighed on a monthly basis to determine if dietary changes of their mothers affected their growth. Arm circumference measurements were taken on the breastfeeding children of all sample mothers. There were no significant differences in nutritional status at baseline - measured either in weights (translated to weight-for-age z-score, WAZ) or arm circumference (AC) - between the children whose mothers received nutrition education, and those who did not. Similarly there were no significant differences in change in nutritional status of the young children between the two groups. The nutritional status of both groups deteriorated over the study period, which is consistent with the growth trend observed in Bangladeshi children during the first two years of life (BBS, 1987; Brown et al, 1982; Brown et al, 1986a; BBS, 1987).

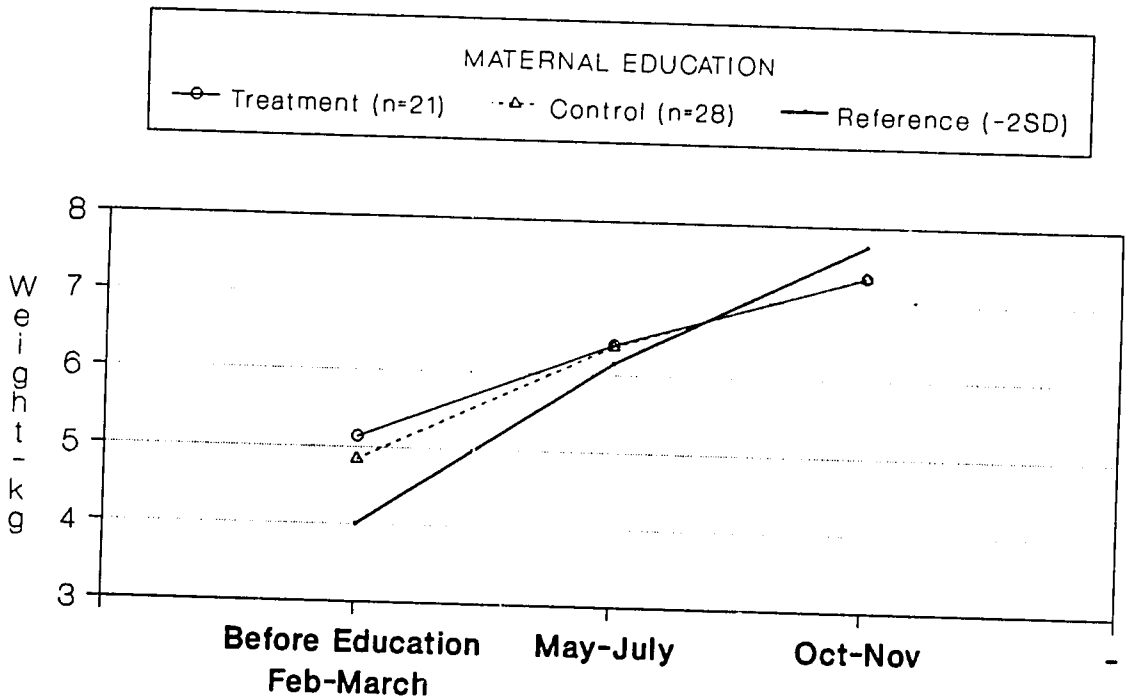
The 49 children who had all 3 weight measurements were, on average, 3 months (range 0-6) at baseline, 7 months (range 3-12) at midpoint, and 12 months (range 8-17) at the final measure. The adequacy of their weight (WAZ) declined by approximately 0.9 standard deviation units from baseline to the midpoint, and by 1.4 standard deviation units from the baseline to final measure (Appendix E, Table E4). Of the 49 children present for all 3 observations, only 6% of the children were moderately malnourished at baseline, using the cutoff of -2 SD recommended by UNICEF. By the midpoint, over half (51%) the children were moderately malnourished, and by the final measure nearly two thirds (71%) of the children were below the cutoff for moderate malnutrition.

Figure 10 illustrates the actual weight gain for treatment and control children relative to the cutoff for moderate malnutrition for the reference population (averaging males and females). Figure 11 illustrates the decline in adequacy of weight (WAPM) for the children using percent of the reference median weight for each child's age and sex (see also Appendix E, Table E5).

Though no treatment group differences were apparent, **the caloric adequacy of the mother's diet was significantly related her child's nutritional status** (measured by the child's WAZ or the child's AC). Other factors that were significant in determining the weights (WAZ) of the children at the final measure, relative to their baseline nutritional status were: child's complementary food intake, and diarrhea prevalence. Sex of the child was a more significant predictor of child weight-for-age at baseline (i.e., in the 3 month child) than at the final measure (average age 12 months), with male children faring slightly better than females. Female children, however, showed less deterioration in weight-for-age (less decline in WAZ) over the study period than males. At the final measure, where the average age was 12 months, no significant sex differences were apparent in nutritional status (WAZ), after controlling for the effects of child age, initial nutritional status, and the mother's and child's calorie intake (Appendix E, Table E4).

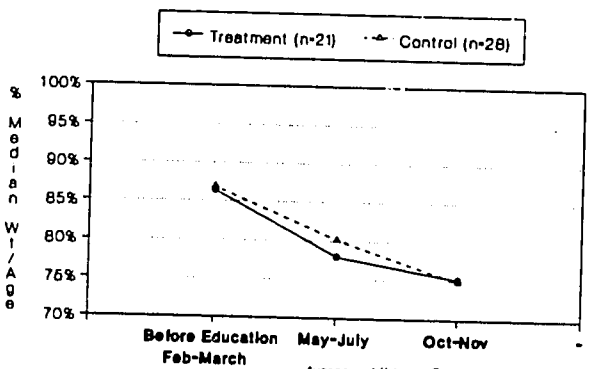
For arm circumference (AC), which includes a larger sample of children, there were no significant gender differences at baseline, after controlling for age and wealth (average age 4 months). However by the final measure sex differences were

Fig 10. WEIGHT GAIN IN CHILDREN OF MOTHERS RECEIVING MATERNAL NUTRITION EDUCATION



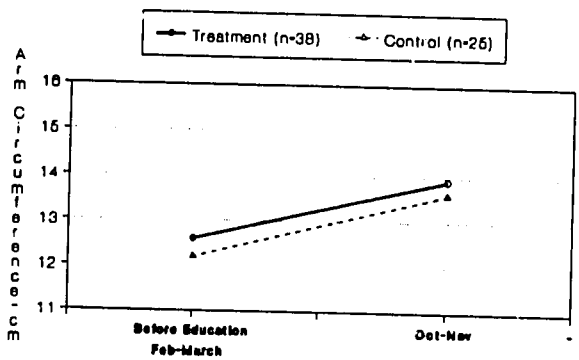
Average child age Feb-Mar 3mos, May-July 7 mos, Oct-Nov 12 mos. 100% children breastfeeding.

Fig 11. WEIGHT ADEQUACY IN CHILDREN OF MOTHERS RECEIVING MATERNAL NUTRITION EDUCATION



Average child age Feb-Mar 3mos, May-July 7 mos, Oct-Nov 12 mos 100% children breastfeeding

Fig 12. ARM CIRCUMFERENCE IN CHILDREN OF MOTHERS RECEIVING MATERNAL NUTRITION EDUCATION



Average child age Feb-Mar 4mos, Oct-Nov 13 mos. Treatment group slighty older. Group differences not significant.

apparent with males having larger AC's. This is to be expected with AC, since unlike weights, the measures are not standardized against a norm for age and sex. At the final measure, **aside from male and female differences, only the adequacy of the mothers diet over the study period was predictive of the child's arm circumference.** Figure 12 illustrates the change in arm circumference over time for both treatment and control children. The average circumference for the treatment group was slightly (though not significantly) higher than the controls simply as an artifact of the slightly older age in this sample.

Adjusting for the effects of baseline arm circumference (AC), child age, sex, adequacy of the mother's diet, and the time span from baseline to final, the AC of treatment children increased 1.6 cm, and controls 1.0 cm. The differences between the two groups are not statistically significant (Appendix E, Table E6).

There were no significant differences between treatment and controls in the total number of children who were severely malnourished (below -3 WAZ) at the baseline, midpoint, and final measure. Similarly, there were no significant differences between groups in changes in WAZ categories (Appendix E, Table E7). However, while there was a significant increase in the number of control children who became severely malnourished from baseline to final ($p=.016$), the increase was not significant for treatment group ($p=.500$) (Appendix E, Tables E8 and E9).

4.2 DISCUSSION

The findings from this evaluation highlight the poor nutritional status and diets of the rural mothers in Bangladesh. The limited measurable impact of carefully developed education messages on women's dietary practices, combined with the concerns raised during the implementation phase, suggest the need to evaluate the barriers carefully. Before evaluating the constraints, however, some explanation on the extremely poor diets of the women, and the decline over the study is needed.

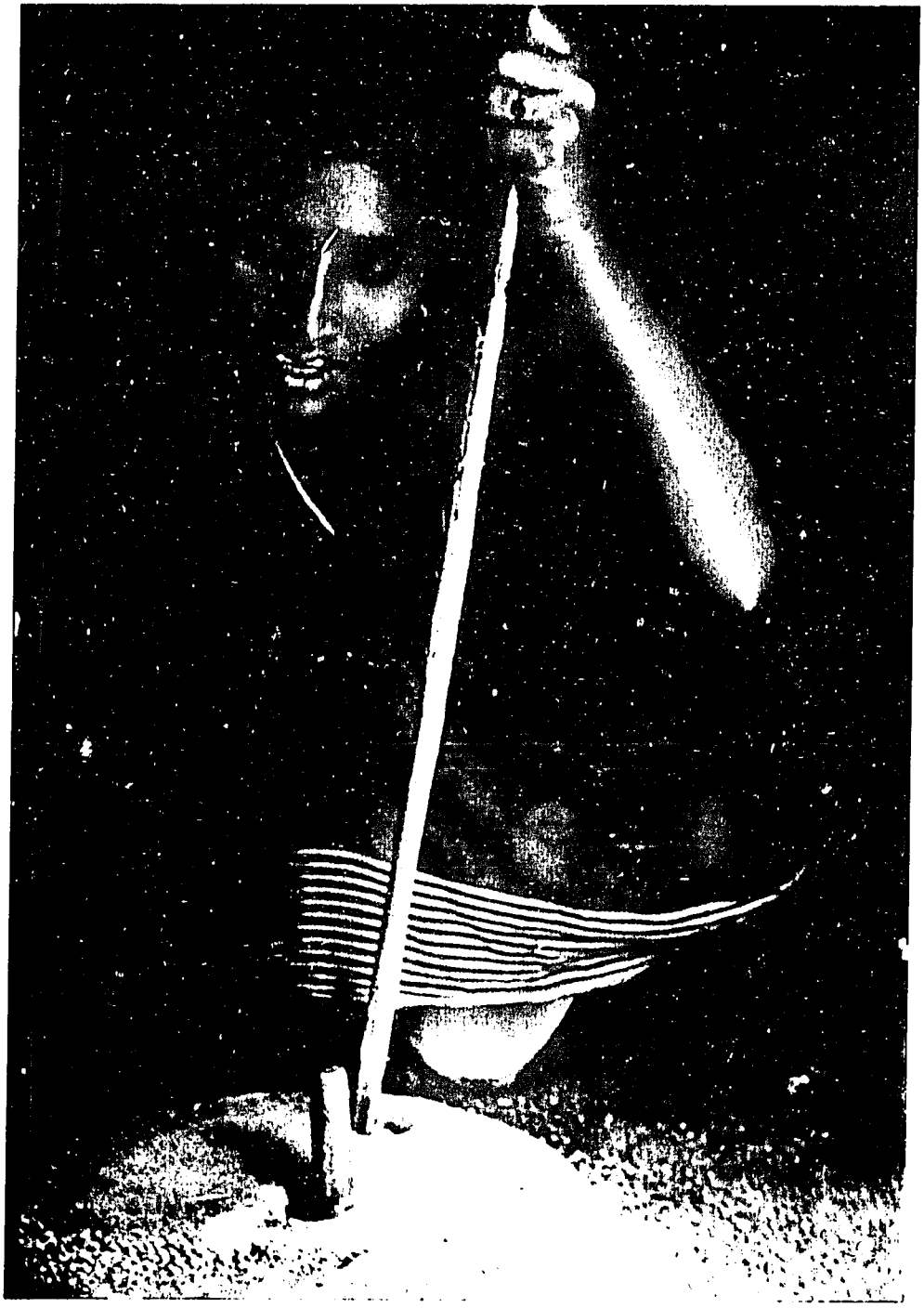
4.2.1 Extremely Poor Diets for Women

Nutrient adequacy of the lactating mothers' diets was strikingly poor over all seasons (with particularly regard to energy, protein, and vitamin A).

Energy

The women fell over 1000 kilocalories (kcals) short of what they would need to produce an adequate amount of breastmilk for their children, and lead and active, healthy life. With such a deficient energy intake, one questions how the mothers could function at the level they did; alternatively, the appropriateness of the requirement must be called into question.

Several explanations support the appropriateness of the energy requirement and the accuracy of the dietary recalls, though not fully. First, it is apparent from the growth of their breastfeeding children, that the mothers *were not* producing sufficient amounts of milk to support normal child growth. An adjustment of 500 kcals was added to the non-lactating requirement for all mothers (rationale described in Part 2 and Appendix B). This provision appears justified to enable the women to produce an "adequate" breastmilk quantity and quality for the growing infants. However, since the mothers were very likely *not* producing an adequate level of breastmilk, their additional energy need may, in actuality, have been less. It is



important to keep in mind that the potentially lower actual requirement for these women is a result of their inability to consume enough food to produce an adequate amount of milk for their infants, not a result of healthy adapting to lower levels of food intake.

Secondly, at such a deficient level of energy intake, the mothers were likely not as active as they would otherwise be. In deducing the energy requirement, a conservative estimate of their basal metabolic needs was first made, using a reference 40.4 kg woman as a standard (see Appendix B). This may be a slight underestimation of the women's actual weights, resulting in a more conservative estimate of energy needs (women from the same study area averaged 41 kg the previous year) To this basal requirement an estimate of energy expenditure was added. The daily activities of the rural Bangladeshi woman were broken down into tasks and a calorie requirement estimated for each task, based on FAO/WHO/UNU guidelines (WHO, 1985). Women who were not consuming an adequate amount of energy likely curtailed their activities (when they could), and rested more frequently. A study on healthy lactating Dutch women with a lactation energy cost of 650 kcals/day at nine weeks postpartum, achieved the additional calories primarily through eating more, but also through reducing activity and tissue mobilization (van Raaij et al, 1991). Some have suggested the WHO metabolic constants may overestimate actual energy expenditure in small individuals (Henderickx et al, 1990). Indian women were able to perform 15 work tasks at a lower cost than men primarily because they are smaller (Edmundson and Edmundson, 1989), although the researchers hypothesize social processes also enabled these women on a "low plane of nutrition" to maintain a high level of productivity.

In addition to the above explanations, one cannot exclude the possibility that actual food consumption was underestimated by the 24 hour recall. Both under- and overestimations are potential errors with the recall method (Willet, 1990). All attempts were made to obtain an accurate estimate of intake - field workers were experienced and well trained in probing for additional foods and quantities, and coming from the study village, had close rapport with the village women. The recall dietary instrument had been pre-tested and validated in rural Bangladesh (Zeitlin et al, 1984; Rizvi et al, 1984), and the workers had a full year's experience prior to this study in using the instrument. The validation checks comparing observed and reported intakes found only small discrepancies - well under 50 kcals, suggesting the instrument is relatively accurate at measuring actual intake on the day observed (Rizvi et al, 1984). This is likely due to the monotony and simplicity of the traditional Bangladesh diet, and may not be the case in a country with a more varied and complex diet, such as Indonesia.

In the previous year's study in the same site, (which used the same field workers and methodology), the average monthly energy intakes of the women over the entire study period were virtually the same as with this study - 1306 kcals compared with 1354 kcals in this study - suggesting consistency and quality control with the data collection. Other studies on impoverished women in India have found similarly low energy intakes (Manjrekar et al, 1985; Hira et al, 1988).

Even if the recall was accurate at determining intake on the day measured, the question of this approximating "usual" intake arises. In a society such as Bangladesh where the diet is simple, monotonous, and relatively homogeneous, and poverty is widespread, this may be less of a concern, however, than in a more developed country (Rizvi et al, 1984), although some researchers disagree (Torres et al, 1990).

Averaging several daily recalls (one per month), as was done in this study, helps to further strengthen the reliability of the instrument for predicting usual intake.

Since the food intake of infants is determined by their fluctuating appetite (and often finicky eating behaviors), variations in caretakers and their time and attentiveness to feeding, in addition to food availability in the household, this instrument may be less accurate for the children than the mothers at predicting the "usual" intake of the children.

It is also possible these women have adapted, somewhat, to a chronic low level of food intake. Whether this survival mechanism *supports* or *compromises* health is an ongoing question. While the Bangladesh women have by no means adapted entirely health-fully - as their nutritional status, and that of their breastfeeding children remains poor, and morbidity and mortality levels are high - they may have been able to maximize utilization of what little food was consumed. Our findings are consistent with the lower one-third of the U.S. distribution of healthy women reported by Trembly et al (1991). Using careful seven day food records, "small eaters" were found to consume over 900 calories a day less than "big eaters" (1488 kcals vs 2393 kcals) at similar levels of activity and nutritional status (fatness). This suggests much is still not understood about metabolism.

Protein

Since energy intake was extremely limiting, it is difficult to interpret the functional implications of the low protein intake. At low levels of calorie intake protein will be used to meet energy needs, rather than for body building and repair functions (WHO, 1985). A recent study suggests that even lactating women on energy adequate diets consuming less than 1 gram (gm) of protein per kg body weight were in negative nitrogen balance (Children's Nutrition Research Center, 1990). The women in this sample were consuming well under this (64 gm/kg adjusted for low protein quality).

Decline in Food Intake for Women

In addition to their generally poor diet, the decline in calorie consumption for the lactating women noted over the study period requires some interpretation. Two explanations are likely. The first is a seasonal explanation. The baseline measure was taken during a more plentiful, cooler season. The midpoint in May-July spanned the hot, rainy period. This narrative by a villager eludes to the daily struggles of this season:

> *"Ashar and Shraban (Bangladesh months) are the rainy season. Now the communication is disturbed by heavy rainfall. The (people's) daily life is interrupted and they have to be confined within their houses, day after day. Now the movement of snakes and other insects increases. Sometimes the heavy rainfall causes floods which throw the men into the ditch of sorrow and suffering. (The people) suffer from fever and other diseases."*
>
> (Moksedul Alan, 1987)

The final measure in October-November characterized a post-monsoon, pre-harvest situation when the nutritional status of women has been found in other studies to be lowest (Huffman, 1985; Chowdhury, 1987). To make the situation more difficult, August and September brought severe floods to both sites, submerging rooftops in some homes, and halting all ground transport. Food production, distribution, and

consumption was affected. The final measurement was taken 2-3 months after this crisis, when families were still struggling to repair their damages.

Longitudinal studies available for Bangladesh have primarily looked at anthropometric indicators of change in women, rather than changes in dietary intakes. This is likely due to the complexity of collecting and analyzing dietary data. The few reliable longitudinal studies available have eluded to similar trends as observed in this study, yet also introduce year to year monthly variations (Zeitlin et al, 1989; Torres et al, 1990).

Analyzing dietary recalls collected in 1978-79, Torres and colleagues (1990) found energy intakes of women in rural Bangladesh to be lowest in July, August, September, and November, consistent with this study's findings. Dietary intakes of women from the same control and intervention site as this study, followed from January to July the previous year (1986), showed a slight decline in energy intake from February-March to May-July. Yet, energy consumption peaked in April and June, in addition to March (Zeitlin et al, 1989). The average consumption month to month differed by only 100 kcals or less for the whole sample of 370 mothers, whereas this study of 78 women found an average difference of over 250 kcals between the 2 seasons. Wheat (poor man's staple) constituted a greater share of the total calories during March-June than during January-February, in both the 1986 and 1987 samples. Wheat was distributed in food-for-work (e.g. road building) programs during these months. However, possibly due to differences in levels of employment in food-for-work each year by the samples, along with annual differences in preceding harvest, the calorie deficit was not supplemented as well in the 1987 sample.

The second explanation for the decline in calorie consumption over the 8 months is that, as the children were getting older and were starting to consume more of other foods, the mothers may have produced less breastmilk and adjusted their food intake accordingly. The fact that the estimates of the decline in the mother's breastmilk (based on her child's age) were not significant in determining the decline in calories, suggests individual variation in mothers milk production not related to the child's age. The best country estimates of breastmilk production by Bangladesh mothers suggest a steady increase in breastmilk volume from the child's birth to 5 months, and a slow decline thereafter until 18 months, after which there is a sharp decline (Brown et al, 1982; Brown et al, 1986; see also Appendix C, Table C1 for the estimates used in this study). Eighteen months is the age at which mothers traditionally begin to assertively feed additional foods to the child.

If a reduction in breastmilk production occurred in the treatment and control women, their actual energy needs may have declined from the baseline to final measure. However, if the women decreased their energy consumption as a natural response to a decline in actual need, it is difficult to understand how they could do so voluntarily given how deficient their diets already were. The fact that the Bangladesh culture has many anecdotes of ways to stave off hunger - chewing betel nut and *pan* to numb hunger pangs, spicing up foods with hot chilies to do the same, sticking to rice in tough times since it is best at "filling up the stomach" - suggests the women have learned over the years to cope with hunger. Also, children's demand for breastmilk, and hence their ability to stimulate its production by sucking may have been reduced by their high levels of morbidity, and lower activity levels caused by malnutrition.

Stable Arm Circumference

Despite their low food intake, the women do not appear to be using up their own limited body stores of fat, as suggested by their stable arm circumference measure (AC). The stable nutritional status, in light of the declining calorie intake is suggestive of two phenomenon: 1) mothers reduced activity during the hot, rainy season; 2) mothers produced less breastmilk. The reduction in breastmilk production may have been greater for the controls if this explanation is true, although the decline was not detectable in the growth (change in WAZ or AC) of their breastfeeding children.

An alternate explanation is that changes in arm circumference may not be a sensitive indicator in women to changes in dietary adequacy and its functional effects on nutritional status[10]. In such a lean state, changes in fatness levels may not be detectable using AC as an indicator. In addition, despite care taken in standardizing worker measurements (using techniques developed by Zerfas [1985]), measurement errors cannot be ruled out.

Other studies have suggested that the nutritional status of mothers, measured by weight or arm circumference, does not decline over the lactation period (Huffman et al, 1980; Zeitlin et al, 1989b; Chowdhury 1987). Huffman et al (1980) found that women breastfeeding their children from 1.5 to 3 years postpartum appear to maintain body weight, suggesting this may be due to metabolic adaptation caused by the lactation process, or the probable low quantities of milk produced. Chowdhury (1987) reported that in the first year postpartum, women's arm circumference did not decline, however weights of the women did, suggesting either differences in change of body composition or that AC may not be as sensitive as weight to changes in nutritional status. However, he also found seasonal differences, with the leanest period being August-October, and concluded that the postpartum deterioration in nutritional status was most likely due to season.

The average woman's AC was near the 5th percentile of the reference population (Frisancho, 1981) in this study. Estimates of body mass index from a study the previous year, imply that most of these women have very low fat reserves to call on (mean of 18), with 13% being in what would be classified in developed country terms as an "anorexic condition"[11] (Zeitlin et al, 1989b). In any case, this further supports the argument that these mothers, limited by their food intakes, are compromising production of breastmilk quantities for their older infants, in addition to conserving activity, when possible.

In an analysis spanning 2.5 years (1976-78), Huffman et al (1985) described seasonal and annual gains or deficits in maternal weight corresponding to variations in prices, wages, and rice availability. In general, women gained weight between November and February, had a slight loss from February to April, gained through July, and had substantial losses from July to October during both years. During this 4 month period preceding harvest of the major rice crop, *aman* (harvested November-January), food availability was somewhat limited, rice prices rising, and wages falling. This period corresponds to the months of lowest energy intake for the

[10] Despite notable advances in the used of AC for screening for severe malnutrition in children, AC is not recommended as a monitoring tool. In growing children (ages 1-5 years), the reasoning is that AC remains constant while weight increases (Nutrition Communication Project, 1989). The usefulness of the indicator as a monitoring tool for nutritional status in adults, specifically lean women, is not entirely clear.

[11] A body mass index of less than 16 is defined here as anorexic.

women in the Lactation Intervention. The authors noted that the deficit occurring February through April, was only observed one year, and they suggested this deficit was dependent on the quality of the preceding *aman* crop. This may also explain the small difference in monthly trends from February to April 1987 noted during the Lactation Intervention compared with energy intakes of women studied the previous year.

Participation in agriculture may also confound the interpretation of AC as an indicator of nutritional status. When agricultural wealth was controlled for in the analysis, differences between treatment and control mothers' final AC and change from baseline to final, became more significant (p=.026). Significantly more treatment families were involved in agricultural activities. While women do not work in the fields in this culture, they do process the food after the harvest. This heavy labor may have kept their arm muscles larger, despite a decline in energy intake, although, since activity levels were not measured, only assumptions can be drawn.

While it would have been desirable to have more measures of nutritional status in the mothers - for example weights and heights - and triceps skinfold thickness, we designed the intervention with a low cost assessment measure. Our finding that women's AC did not decline despite a decline in energy intake suggests more research should be done on the use of this indicator for rapid assessment in lean women.

Iron Adequate Diets Amidst Reports of Anemia

The sufficient levels of iron consumed by the women in this study demand further interpretation, given the fact that other studies have alluded to a very high prevalence of anemia (the majority assumed to be iron deficiency) in Bangladeshi women of childbearing age (Chowdhury, 1987; Huffman et al, 1985). Chowdhury (1987) reported nearly one tenth of non-pregnant women in Bangladesh suffered from severe anemia (hematocrit < 30%). Hematocrit levels averaged 34%. Huffman et al (1985) found 6-11% of non-pregnant women to be severely anemic, with the highest levels found during the month of October.

Anemia prevalence was not determined in the sample mothers, but would be expected to be comparable to levels reported for lactating women living under similar conditions. Several explanations for the high prevalence of anemia despite this study's findings of adequate dietary iron are plausible - poor absorption, increased requirement (for example due to hookworm), or increased metabolic needs. Most of the iron in the diet is from grain and vegetable sources, which is thought to be poorly absorbed (less than 5% - [NRC, 1989]). Mothers in this study consumed very little animal foods, and rarely, if ever, consumed red meats which are thought to provide the most available source of iron. Although the daily iron requirement for mothers, 15 mg, takes the low biologic availability of iron in some foods into consideration (NRC, 1989), increased iron demands in these Bangladeshi women from frequent pregnancies and frequent infections (e.g hookworm), combined with the extremely poor bio-availability of the iron in the diet may increase their iron requirement above levels used in this study. Some have suggested a requirement of 26-56 mg/day for (non-lactating, non-pregant) women consuming a diet with low iron bio-availability. This compares with 6.5-14 mg/day recommended for those consuming a diet with high bio-availability (INAC, 1981). If

the higher level of requirement is used, the women in this study consumed only 67-31% of their iron requirement (excluding iron from tubewell water and other non-foods).

Vitamin A

The Lactation Intervention found some improvement in the vitamin A content of the treatment women's diets relative to the controls immediately after the education (midpoint). This increase could well be a program effect, although the differences in the treatment and control areas, with treatment families having more land to grow greens and other vegetables, cannot be ruled out. No significant differences were found at the final measure - however, the floods in August and September destroyed many of the home gardens, reducing the supply of greens in October and November. The high prices of greens during these months confirm the low availability of good sources of vitamin A (see Table 12 in Part 6).

The estimates of dietary adequacy in this study assume that the carotene and vitamin A in the foods consumed will be absorbed. However, since dietary fat is thought to be necessary for absorption of the nutrient (HKI, 1990), this assumption may be partially incorrect for the women, given the extremely low fat content of the diets. Along with increasing the vitamin A content of the diet, fat may need to be increased. As mentioned previously, these findings should be interpreted with caution due to the limited data base for vitamin A content of some foods.

4.2.2 Constraints for Mothers and their Families

"When we have the food, we eat it, when we don't, we don't!". Despite the fact that low cost foods were encouraged in the messages, this was a common response of the rural mothers when asked if they were able to eat the amounts of the foods suggested in the messages. From the beginning of the program, the mothers were not ignorant of the fact that when they ate "good food" they had more breastmilk. *"But where will we get the food?"*, they asked. Women knew that in order to increase their own share of food, they would have to increase the share given to others in the family. Suggestions to eat more animal foods provoked immediate reactions. Encouraging consumption of foods considered unattainable (for example, animal foods) fed into the belief that good health was only attainable by the wealthy. It is not surprising that the most well liked message was *"drink 8 or more glasses of water a day and you will have more milk."* This was one thing the women could do to help their child that cost no money.

Realizing the woman's powerless role in food purchasing and food allocation within the household, we decided our efforts to increase her awareness of what she should be eating might produce more frustration than good unless we could reach the controller of the food budget, her husband. Conversations with the husbands suggested there was no "fat" in the budget for food: *"We are poor and cannot afford more food."* In fact, of a sampling of households interviewed, weekly food expenditures were already greater than weekly income. When asked how this was possible, most men revealed they were constantly taking out loans from neighbors, and, if possible, from banks (Brown, May 1987).

Attempts to bring the husbands into the educational process met with mixed results. Many felt positive about receiving education, saying it is good for their child's health, something everyone is concerned about. The majority however, were not

willing to teach other men, outside of informal discussions at the market or mosque, because of work demands.

Indeed, their work frequently took them away from the home. One month into the educational campaign, nearly half of the fathers were absent, having relocated temporarily to a new district for work. Some of the men were not receptive to receiving nutrition education about their wives, stating *"this is not our function - it is the father's duty to make the income and bring the food. It is the mother's duty to care for the child and inform the father of the child's needs* (for example, when the child is sick and needs medicine)."

However, the majority responded saying *"we know we should give food three times a day but we are poor and not always able."* They agreed to give food to their wives when they had it. Even though a greater portion of the food may go to the men in the household, most of the men were very thin themselves, suggesting they were also getting less than their required level of energy and other nutrients.

In addition to the husbands, we found directing educational efforts to mothers-in-law and sisters-in-law resulted in more support for the often powerless mother. In some cases, however, mothers-in-law resisted the teachings or resented the project being directed at their daughters-in law, and it was apparent the control issues were an extension of ongoing interfacial conflicts. For example, one mother-in-law refused to let the village worker weigh her grandchild. It was found she had no strong beliefs against weighing, but felt the worker should provide her with something (like money or food). Further investigation into the problem, revealed that the father of the baby, her son, was mentally ill and unable to work. The mother-in-law frequently took out the frustrations of her son's condition and their impoverished situation on her daughter-in-law.

4.2.3 Snacks vs Meals Approach to Improving Women's Nutrition

Interestingly, the messages developed in these community-based trials promoted the traditional "three-meals-a-day approach" to improving the women's diets. Alternately, as will be discussed in the following sections, community trials for weaning infants led to messages that promoted snack-type foods. Possibly the reality that many times during the year the women could only consume two meals a day led women to develop an ideal goal of three-meals-a-day for themselves. However, encouraging women to eat more food at meal times challenged cultural norms, especially when food was scarce. Women had been taught all their lives to be self-sacrificing, and always ate last. Although snacking was generally infrequent among the women we studied, snacks did not carry the same taboos as meals. With hindsight, a "snack approach" to education for women may have confronted fewer cultural barriers.

PART 5
WEANING INTERVENTION: EVALUATION OF IMPACT

Summary of Findings - The 62 children whose mothers received education on appropriate weaning foods and practices grew significantly better than 55 age- and season-matched controls. After adjusting for baseline nutritional status, age, morbidity, wealth, and mother's education, the treatment children had grown, on average, 0.41 standard deviations (SD) in weight-for-age (WAZ), or about 410 gms more than the controls over the five month period. Adjusting for the above factors, the final weights of the treatment children children were .46 SD greater (about .5 kg) than controls.

Over the five months, the (adjusted) percentage of the reference median weight-for-age (WAPM) of the treatment children held steady at 76%, while the controls dropped from 78% to 72%. Moreover, significantly fewer treatment than control children became severely malnourished during this time. The increase in percentage points of severe malnutrition (below -3 WAZ) was only 5% in the treatment group compared to 26% in the controls. In addition to treatment group, factors found to contribute to the variability in final WAZ were initial WAZ, diarrhea, respiratory illness, age of child, and wealth. Sex of the child was not significant in predicting the nutritional status or growth of these very young children. Significance levels from analysis of child arm circumference were similar to those for weight.

After education, treatment children also consumed a significantly greater percent of their estimated ideal energy and protein requirements from complementary foods, adjusting for the effects of child age, wealth, mother's education, morbidity, sex, and initial nutrient adequacy. Both the sex of the child and agricultural wealth were significant in predicting protein intake at the final measure but not calories. Interestingly, female children fared better that male children for protein intake. The treatment diets had a significantly higher percent of protein from animal sources (mainly milk and fish) than the controls at the final measure. There were no significant sex differences in the quality of protein consumed.

While a treatment effect was apparent, the children's growth and their intakes for energy and protein (including estimates for breastmilk) still lagged behind ideal standards. According to their mothers' reports and informal field observations, they frequently refused or failed to finish the foods offered to them. Frequent infectious illness contributed to this anorexia. High morbidity rates and a decline in nutritional status characterize both the hot/dry and the rainy seasons (Brown et al, 1982b). Superimposed on these already difficult conditions was severe flooding, which infiltrated the homes, fields, and markets. Seasonal food shortages, poverty, and limited time of the mothers to prepare food and attentively feed their infants further constrained their compliance with nutrition messages.

Cooking and feeding complementary foods.

5.1 FINDINGS OF THE INTERVENTION TO IMPROVE THE DIETS OF WEANING-AGE CHILDREN

The following sections report the findings from the evaluation of the Weaning Intervention, conducted in rural Bangladesh May-November 1987. The discussion section compares the findings with other studies on similar populations. The food costs of the messages are reported in Part 6.

5.1.1 Growth Effects

Average Growth Rates

While the nutritional status of the treatment and control children was similar at baseline, the growth of the treatment children was significantly better than the controls, over the study period. This finding held up even when controlling for age, sex, morbidity, season, wealth, and household education differences in the two groups.

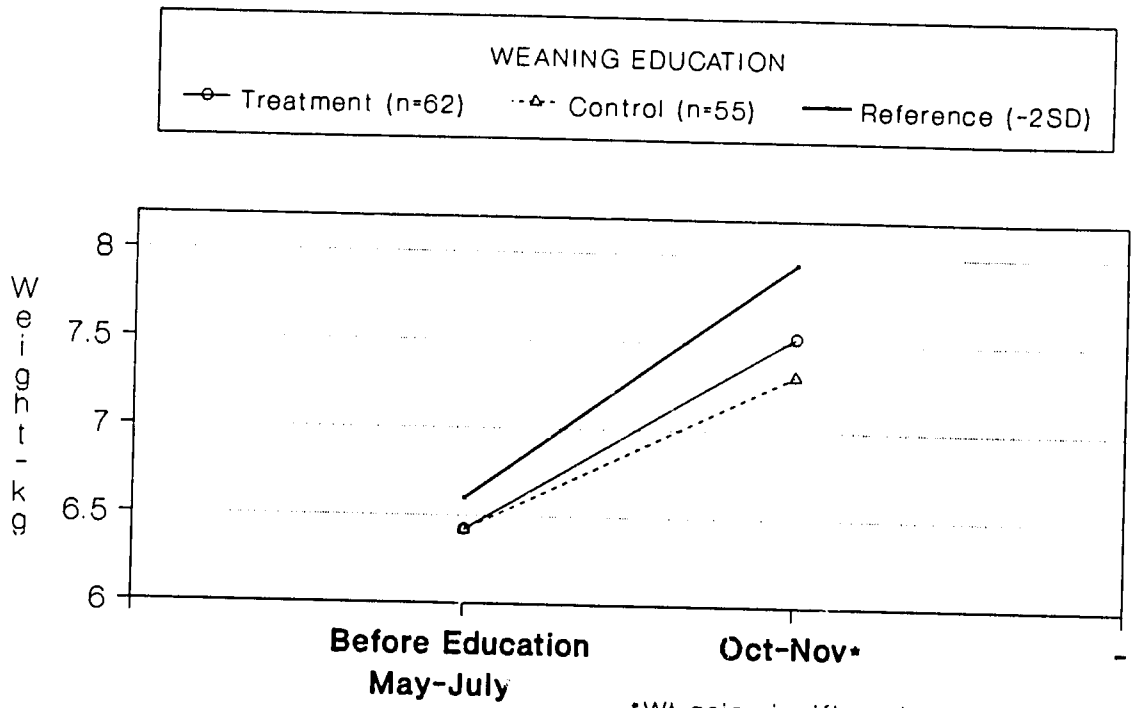
The mean baseline weight (expressed as weight-for-age SD units or WAZ) was slightly, but not significantly better for controls than treatment (-1.94 vs -2.12). The average age for both groups at baseline was 8 months with a range of 4-14 months. It is clear that when recruited, the average child was already considered moderately malnourished.

Rates of growth over the following 5 months were significantly different for treatment children and controls ($p<.0001$; Appendix E, Table E10). Adjusting for initial weight (WAZ), age, morbidity, wealth, and maternal education, the average weight-for-age of the controls dropped -0.63 SD units but for treatment children declined by only -0.22 SD units of weight (Appendix E, Table E10). Thus, the children whose mothers received education on weaning practices grew nearly half a standard deviation unit (0.41 SD) better than the controls, which translates to an improvement in growth of about 410 gms over 5 months in this age group. Also, the adjusted final mean weight-for-age (WAZ) of the treatment group was nearly half a standard deviation unit better than the controls; i.e., treatment children were approximately half a kg heavier. This difference is statistically significant ($p<.0001$; Appendix E, Table E10). Thus, this intervention prevented further deviation from reference growth standards in the treatment children.

Figure 14 illustrates the decline in weight-for-age percent median for the controls compared with the relatively stable nutritional status of treatment children. The (adjusted) percentage of reference median weight-for-age (WAPM) of the treatment children held steady at 76% while the controls dropped from 78% to 72% (Apppendix E, Table E11).

Figure 13 illustrates the actual weight gain for the treatment and control children relative to the cutoff for moderate malnutrition (less than 2 SD below the reference population). The unadjusted values are illustrated for simplicity, however, they do not fully illustrate the magnitude of the differences between the groups, as described above. Controlling for child sex, age, morbidity, family wealth, mother's education, the differences between the groups become greater. Over the 5 months, the average rate of weight gain (unadjusted) for treatment children was 1.18 kg (7.9 gm/day), but only 0.89 kg (5.6 gm/day) for the controls. These rates represent 89% and 63%, respectively, of expected growth for children with a starting age of 8 months and an ending age of 13 months growing two standard deviations below the median of

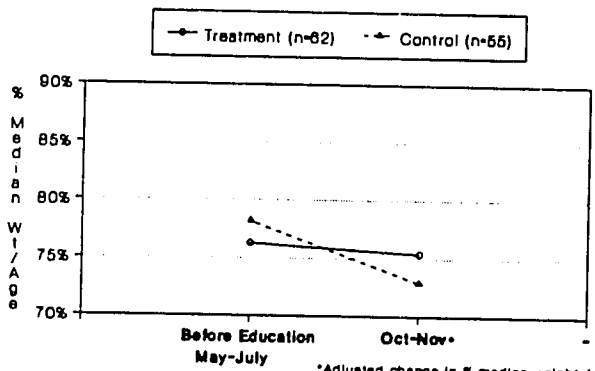
Fig 13. WEIGHT GAIN IN CHILDREN
When Family Members Receive Weaning Food Education



Average child age May-July 8 mos, Oct-Nov 13 mos. 100% children breastfeeding.

*Wt gain significantly greater for treatment. After adjusting for confounders, final wt of treatment 0.46 kg more.

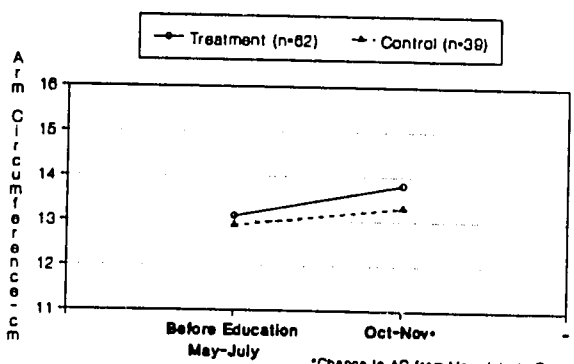
Fig 14. WEIGHT ADEQUACY IN CHILDREN
When Family Members Receive Weaning Food Education



Average child age May-July 8 mos, Oct-Nov 13 mos. 100% children breastfeeding.

*Adjusted change in % median weight-for-age -0.8% for treatment, -5.4% for controls. Group differences significant.

Fig 15. ARM CIRCUMFERENCE IN CHILDREN
When Family Members Receive Weaning Food Education



Average child age May-July 9 mos, Oct-Nov 13 mos. 100% children breastfeeding.

*Change in AC from May-July to Oct-Nov significantly better for treatment than controls (adjusting for confounders).

international (WHO, 1985) standards (a more achievable standard than the reference median in this setting).

Change in Arm Circumference

Treatment group differences for changes in arm circumference (AC) were consistent with findings for weight gain (WAZ). At baseline, there were no significant differences between the AC of treatment and control children, after controlling for child age, sex, wealth, and mother's education. However at the final measure, controlling for the above factors in addition to baseline AC, morbidity and food intake, treatment children had significantly larger AC measurements than controls (p=.014). The increase in AC from the baseline to final measure was also significantly better for the treatment children (p=.014) with treatment children increasing .8 cm and controls only .3 cm (Appendix E, Table E12). Figure 15 illustrates the unadjusted AC values for treatment and control children at the baseline and final measurement. As with weight, the magnitude of the differences between the two groups becomes greater after controlling for the effects of child age, sex, morbidity, family wealth, and mother's education.

Prevention of Severe Malnutrition

While the nutrition messages in this study were designed for community-wide dissemination, and not for rehabilitation of the severely undernourished child, a major purpose of education of this nature is to prevent severe clinical malnutrition, and, hence, to improve child survival. Thus, we must look at the impact of the program on preventing severe malnutrition.

The control group had a significant increase (p<.0001) in the number of children severely undernourished[12], while the treatment children did not (p=.508) (Appendix E, Table E13). Similarly, there was a significantly greater (p=.001) number of control children with worsening nutritional status (WAZ categories of malnutrition) than treatment children (Appendix E, Table E14). The increase in percentage points of severe malnutrition (WAZ < -3SD) was only 5% in the treatment group compared to 26% in the controls. As Figure 16 illustrates, initially the treatment group had more severely undernourished children (16%) than controls (9%) though the difference is not statistically significant. In the end, more control children were severely undernourished (35%) than treatment children (21%), however, this difference is not statistically significant.

Morbidity

Illness rates demonstrated seasonal trends. Diarrheal rates were reported to be highest during the hot dry months at the beginning of the study and through the rainy season, encompassing May through September. Record floods, which prevented data collection during the middle of the study period, and the limited sensitivity of the monthly recall, confounded our ability to determine if diarrheal rates increased with an increase in complementary foods. Respiratory and fever rates were highest in the last three months of the study (during and just after monsoons). Reported incidence of skin disease, scabies or rashes of unknown cause, was highest in the hot, dry months for the treatment group, though was very

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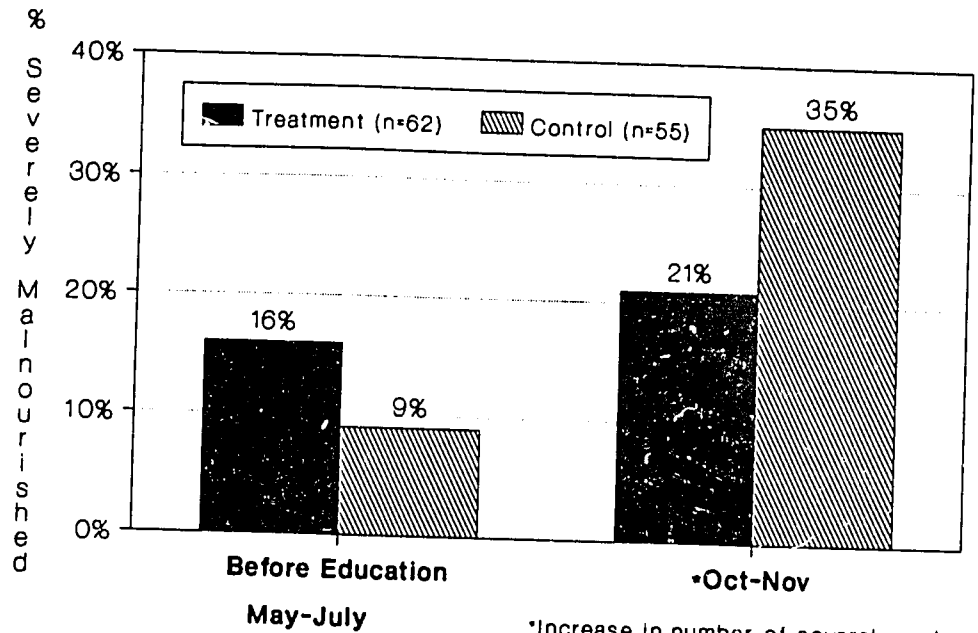
[12] Severe malnutrition is defined here using the UNICEF cutoff of 3 standard deviations below the international reference for the child's weight-for-age and sex (Carlson and Wardlaw, 1990).

Fig 16. SEVERE MALNUTRITION

Before and After Weaning Food Education
(Weight-for-Age Z-Score < -3SD)

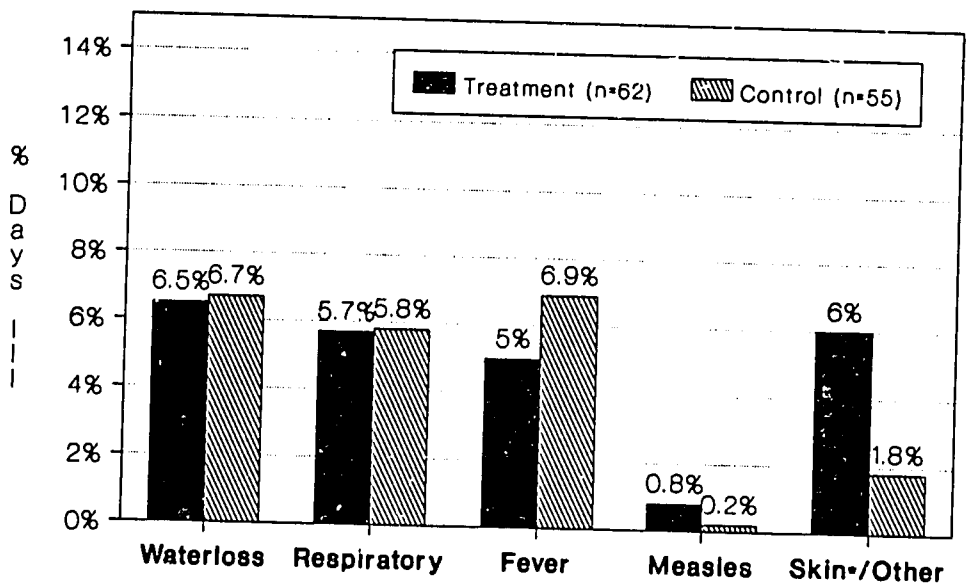


Ave age: Before-8mos, Oct/Nov-13mos

*Increase in number of severely malnourished children significant for controls, but not for treatment.

Fig 17. CHILD ILLNESS

Percent of Days Reported to be Ill
from May-November



Age range 4-18 months

*Significant difference between control and treatment children.

low at this time for controls. Well over half the children in both groups had at least one episode of diarrhea, respiratory illness, or fever during the 5 months observed.

The number of days each child was sick per month with each type of illness was similar for treatment and control children over the study period, with the exception of skin disease, which was significantly ($p=.008$) higher in the treatment group. Figure 17 illustrates the average monthly prevalence (% of days sick/month) of the illnesses. Of each of 3 major illness categories - gastrointestinal (diarrhea, dysentery, or vomiting), respiratory, and fever - children were sick on average 5-7% of the days/month over the 5 months studied (or 1.5 to 2 days/month).

5.1.2 Dietary Adequacy

While average baseline energy and protein intakes showed no significant differences between treatment and controls, intakes following nutrition education were significantly higher ($p<.0001$) for the treatment group.

Baseline Energy Adequacy

All (100%) of the sample were breastfeeding throughout the study. In addition, at baseline, almost three quarters (68% treatment, 73% control) were eating other foods on the day of recall. These foods consisted of diluted milk or cereal porridges sweetened with sugar, pieces of soft fruit, or bites of family foods (e.g. rice, flat bread); the average age at that time was 8 months (range 4-14 months). Protein foods other than milk - such as eggs, meat, fish or legumes - were rarely given.

The variety of food given, and the number of children consuming each food, was similar in both groups before the education, with the exception of a higher percent of treatment children receiving added sugar on the day of recall.

The energy adequacy of the diets was also similar for both groups, and, even when the age-specific breastmilk intakes were averaged in, were inadequate to support normal growth. Approximately 20% of the child's total calories were provided by complementary food and the remaining 80% were from breastmilk. Appendix E, Tables E15 and E16 summarize the caloric adequacies of the complementary food for both the maintenance and ideal requirements. Table E17 summarizes the adequacies of the diet including breastmilk (estimates).

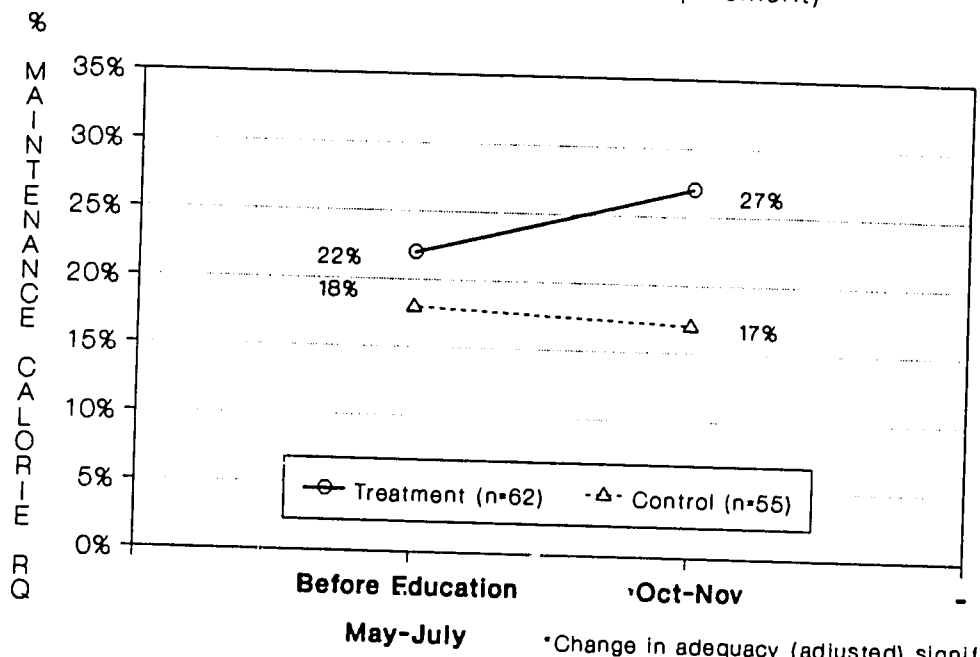
With these low intakes, the activity levels of the children would be minimized, nutritional status would continue to decline. In the previous years' sample, delays in the child's motor development were greater with increasing malnutrition (Zeitlin et al, 1989b).

Final Energy Adequacy

The energy adequacy of the complementary food in the treatment group improved, as shown in Figure 18 from initial to final measurement. In contrast, the energy adequacy of the diets of the control group actually decreased from baseline. The changes between the two groups were significantly different ($p<.0001$). In addition, treatment children were consuming a significantly greater percent of their energy requirement from complementary food, at final measurement, than the controls ($p<.0001$). This difference was significant even after controlling for child age, morbidity, wealth, mother's education, and initial calorie adequacy from

Fig 18. ENERGY ADEQUACY OF CHILD DIETS

Before and After Weaning Food Education
(Percent Maintenance Requirement)

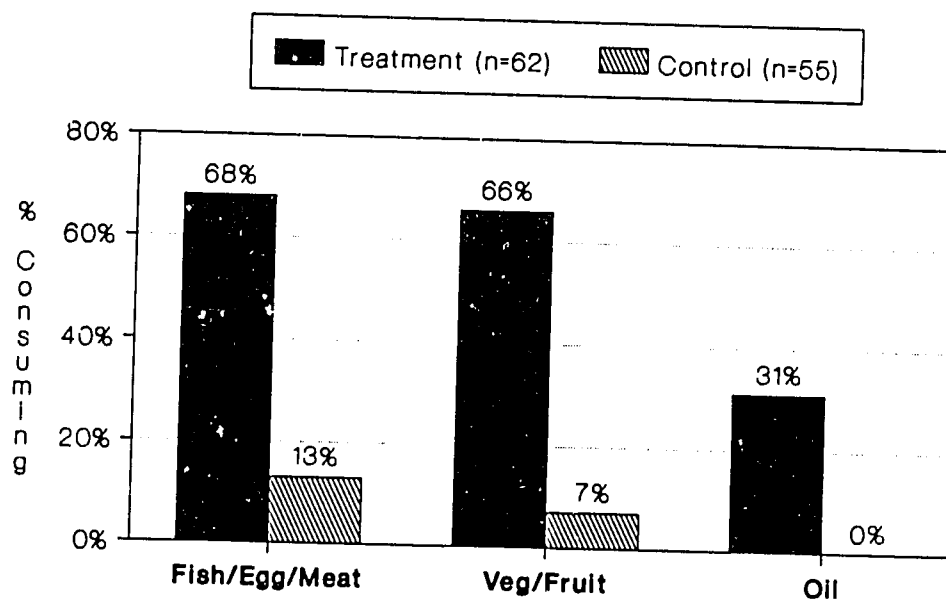


Breastmilk estimates not included

*Change in adequacy (adjusted) significantly better for treatment than control
Ave age: Before-8mos, Oct/Nov-13mos

Fig 19. CONSUMPTION OF SELECTED FOODS

by Weaning-Age Children from Households
Receiving Weaning Food Education



Average age 13 months
100% children breastfeeding

complementary foods (Appendix E, Tables E15 and E16). Sex of the child was not significant in the analysis for energy adequacy.

The extra food consumed did not entirely compensate for the increased total energy requirement and the decrease in (estimated) breastmilk intake as the child grew older. Therefore the energy adequacy of the total diet (including breastmilk) decreased for both groups over the study period. The decline was much less for the treatments than the controls, and the total ideal energy adequacy of the diet (including breastmilk) was significantly greater ($p<.0001$) after the intervention, for treatment children compared with controls (74% vs 65% of maintenance) (Appendix E, Table E17).

While the changes in raw calories do not control for different requirements with varying ages, they do put food consumption in concrete, realistic terms. Treatment children consumed, on average, 65 kcals/day (unadjusted) more from complementary food after the intervention than before, increasing daily intake from 132 kcals at baseline to 197 kcals post-education. The control group increased their daily consumption of complementary foods, on average, by only 9 kcals, from 115 kcals to 124 kcals. When the age-specific breastmilk estimates are included, the treatment group increased their intake by 39 total kcals/day, from 511 to 550 kcals. The control group actually decreased their total intake by 19 kcals/day, from 492 kcals to 473 kcals. Thus, overall, not controlling for age or requirement, the treatment group consumed approximately 75 kcals more per day after education than the controls, with or without breastmilk estimates. This extra amount is equal to, for example, 2 small spoons of oil, one regular handful of rice, or one medium size banana.

To compare with other similar studies, it is helpful to express the total intake in kcals/kg. A study of rural Bangladeshi children 5-30 months, which did test weighings of breastmilk, in addition to measuring complementary food intakes, found the average total energy intakes to be 63-71 kcals/kg/day and protein intakes to be 1.2-1.5 gm/kg/day (Brown et al, 1982). At final measurement, with a mean age of 13 months (ranging from 9-18 months), treatment children in our sample were consuming approximately 73 kcals/kg/day (including breastmilk estimates) and the controls only 65 kcals/kg/day (for a total of 550 vs 473 absolute kcals/day). Protein intake was 1.39 gm/kg/day for treatment and 1.12 gm/kg/day for controls. Thus, our reported intakes were similar to the above sample, with the mean of the treatment group being on the higher end, and that of the control group on the lower end of the range.

Another study in Bangladesh reported that intakes of 86.5 kcals/kg/day and 1.48 gm protein/kg/day in younger infants (under 9 months) were associated with maintaining weight gain comparable to the reference population, but didn't permit recovery from existing relative weight deficits (Brown et al, 1986a). Intakes below this amount were associated with poor growth, relative to the reference population (negative change in z-score). Our study sample was slightly older, thus the requirement per kg might be slightly less. Still, these data are consistent with our finding, that intakes of treatment children in the range of 73 kcals/kg/day and 1.39 gm protein/kg/day were not quite sufficient to maintain normal growth rates, resulting in a slight decline in weight-for-age (-0.22 in WAZ over 5 months).

Final Protein Adequacy

Protein adequacy followed the same trend, for treatment and control groups, as that described for energy. While baseline intakes were similar, the final protein adequacy from complementary food was significantly greater for the treatment group than controls ($p<.0001$) (Appendix E, Table E18).

The protein adequacy provided by complementary food improved in the treatment group from initial to final, while the adequacy declined for the control group. The decline in protein for the controls was primarily due to the change in composition of weaning food offered to the younger child (average age 8 months) compared with the older child (average 13 months). Fewer children in the control group were fed cow's milk at final measurement than at baseline, though the same trend was not observed in the treatment group. This decline in intake of cow's milk was compounded by an increased absolute protein requirement for the older child. The increase in children eating other high quality protein foods did not compensate for the increased absolute requirement with increasing age.

Mother's education, agricultural wealth, the child's age and sex were significant in predicting ideal protein adequacy of the diet at the final measure (Appendix E, Table E18). Interestingly, female children fared better than male children.

As with energy, the protein adequacy of the total diet (breastmilk and food) declined in both groups, due to the decrease in (estimated) breastmilk quantity, as the child grew older. However, the protein gap was much less for the treatment group. The protein adequacy of the diet, including food and breastmilk, was significantly ($p<.0001$) greater after the intervention, for treatment than controls (62% vs 53% maintenance) (Appendix E, Table E19).

While the absolute protein intake is not useful for statistical comparisons, since it does not control for different requirements at various ages, it is useful for descriptive purposes. Treatment children consumed, on average, 3.7 gm of protein from complementary foods at baseline, with a slight increase to 4.6 gm at final measure. Control children decreased their total consumption of protein, from 3.0 to 2.5 gm/day for the reasons described above for protein adequacy. When breastmilk estimates are added, the trend is similar, with treatment children increasing their consumption of total protein (from 9.9 gm to 10.4 gm), and control children actually decreasing their total consumption (from 9.2 gm to 8.2 gm).

Final Protein Quality

The percent of good quality protein in the complementary food offered decreased from initial to final measurement, due, primarily, to the decrease in cow or goat milk consumed, as the children grew older. The decrease was less for the treatment group. The final contribution of good quality protein was significantly higher ($p=.008$) for the treatment children (30% of the protein) than controls (22%). Adjusting for the child's age, sex, family wealth, mother's education, and other factors, the differences between the groups become greater (Appendix E, Table 20). There were no sex differences in the quality of protein consumed by the children. Since not all of the control children consumed complementary foods, when breastmilk estimates were included, the (unadjusted) ratio of good quality protein in the diet was higher for controls (85% of the protein) than for treatment children (74% of the protein), although the total protein was lower for the control group

than the treatment group. It is important to note, that the ratio of good quality protein is still very high, consisting of over three quarters of the protein consumed.

Distribution of Final Calories

The percent of calories in the complementary food provided by fat declined in both groups, primarily due to the decrease in consumption of cow or goat milk. The decrease was much more marked in the controls, (decrease from 20% to 9% of the calories) than for the treatment group who were adding oil to the infant's food (decrease from 17% to 14%). The percent of calories from protein remained the same in the treatment group (11%) but declined (from 11% to 9%) in the controls. Over two thirds of the treatment children were consuming small fish at final measurement compared to only 13% of the controls. In addition, more children in the treatment group were consuming milk at the final measure.

Adding breastmilk estimates, the contributions of carbohydrate, protein, and fat to the total energy of the diet change very little from pre- to post-measurements. At final measurement, they were 57% carbohydrate, 7-8% protein, and 35-36% fat.

Vitamin A adequacy of the complementary foods declined from baseline to final for both groups, primarily due to a lower intake of milk in the older infant. The adequacy was higher for the treatment than the control group at both points. However, neither the differences nor the change from baseline to final were statistically significant. At the final measure, the diets of the treatment children provided 6% of the vitamin A requirement, and for controls 4%. With breastmilk estimates, the vitamin A adequacy of the diet improves to providing about 70% of the requirement for both groups.

Percent of Children Eating Complementary Food

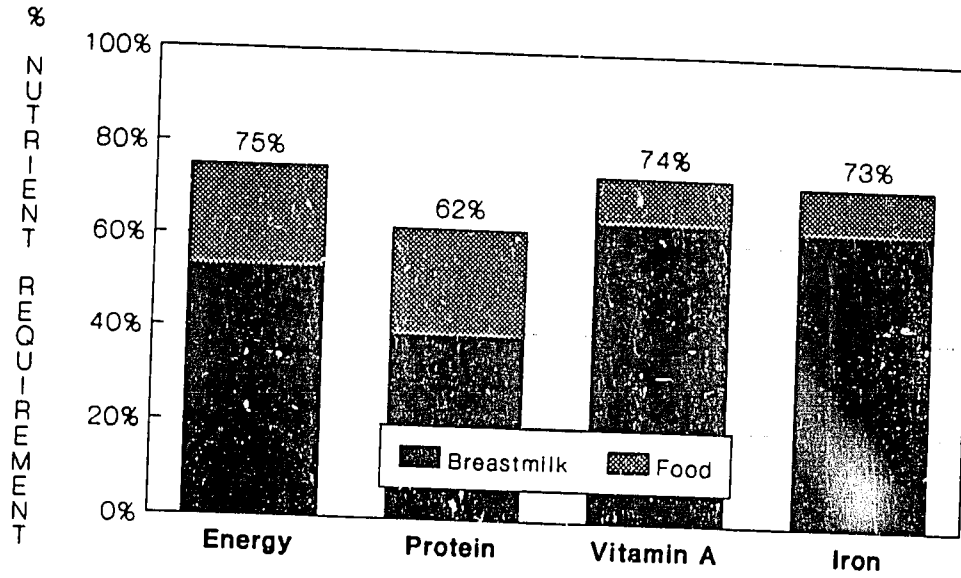
At the final measurement, 100% of the treatment group and 86% of the control group consumed complementary food, on 24-hour recall. The average age was 13 months for both groups. Approximately one-third of the calories in treatment children compared to one-fourth in the controls were provided by complementary food.

The quality of the diet also varied, with treatment children consuming a greater variety of food. Although a greater percent of treatment children were consuming all of the food groups, the biggest differences observed were in the percent eating fish, vegetables, and oil (see Figure 19). Sixty eight percent of treatment children vs only 13% of controls were consuming fish and small amounts of animal protein solid foods. Traditional customs discourage feeding fish to young children, due to fear of small bones, and the belief that eating fish causes worms. The nutrition messages encouraged addition of small amounts of hygienically prepared fish in the children's diets.

Two thirds of the treatment children compared with only 7% of the controls were consuming fruit or vegetables at the final measure, also a nutrition message. One-third of the treatment children were receiving added oil to their diet, while none of the controls were. Oil is commonly reported to give babies stomach problems, so it is not traditionally given. This message - to add oil to any food the baby consumes - was well received by mothers because it was easy to do, and required very little time. A more thorough discussion of the messages will follow below and in Part 6).

Fig 20. NUTRIENT ADEQUACY FOR DIETS OF WEANING AGE CHILDREN IN BANGLADESH*

Breastmilk & Food



Monthly averages from May-November 1987. Children ages 7-20mo (average 11mo); n=132

*Based on nutrient requirement to maintain child's present growth rate. 100% are breastfed. Breastmilk estimated.

Figure 20 illustrates the adequacy of the weaning child's diet (based on energy needs for maintenance growth), averaged over all of the observations. This figure averages the adequacies for both groups simply to compare the relative adequacies for energy, protein, vitamin A, and iron. Breastmilk continues to contribute the greatest share of all nutrients for the child under age 2 years.

5.2 DISCUSSION

The findings from this analysis are very encouraging, given that the growth impacts of supplementary feeding programs and nutrition education programs have generally been very modest, and that nutrition education projects in the Sub-continent have tended to encounter resistance to changing feeding practices for children below the age of one year.

Our findings suggest that nutrition messages - if developed and marketed through appropriate cultural means and channels - have the demonstrated potential for changing infant feeding practices, even in a conservative culture where poverty is extreme.

The other important finding is that increased consumption of hygienically prepared, energy-enriched weaning food, after age 5-6 months, did not result in a negative impact on infant growth (weight gain), as would have been the case if the additional food were highly contaminated with diarrheal causing micro-organisms, or if large amounts of breastmilk were displaced by the poorer nutrient quality foods. Thus, encouragement of "safe" weaning food is likely to be beneficial, rather than harmful after 5-6 months, in breastfed infants, even if the supplement is low in protein density. The effects on growth in height, however, are not known.

5.2.1 Growth Effects

The size and nature of the estimated growth impacts that characterize this project are similar to those of weaning foods projects in Indonesia (Zeitlin et al, 1984) and in the Dominican Republic (USAID, 1988), in which messages were designed using village level concept testing. These projects have achieved mean improvements in weight-for-age on the order of half a standard deviation, and reductions of about half in percentage of severely malnourished children.

In our sample, adjusting for SES, morbidity, age, and initial nutritional status the magnitude of difference (between the weight gain for the groups) was nearly half a standard deviation unit (.41 SD) for weight-for-age. A z-score change of 0 illustrates maintenance growth (i.e., maintaining the same distance in standard deviation units from the reference median). The treatment children in our sample maintained a nearly normal growth rate, with only a -.22 SD (adjusted) change over an average of 5 months. However, control children changed -.63 SD (adjusted) over the same time period, thus deviating to a much greater degree from international standards.

It is interesting that significant sex differences in growth or female discrimination in complementary feeding were not observed in this study. Other studies have reported sex biases in feeding, and higher rates of malnutrition in female children in Bangladesh (Chen et al, 1981; BBS, 1987; BRAC, 1989). The discrepancy may be due to the younger age of the children in this study, as some have suggested sex differentials may be more predominant after age 18 months. Observations from the previous year suggest mothers introduced food significantly earlier to girls, reflecting

a less strict following of taboos to earlier feeding (Zeitlin et al, 1985). This liberal feeding may have a positive effect on female infants' growth, counterbalancing other practices (such as less medical attention) that may negatively affect growth.

5.2.2 Energy and Protein Adequacy

While both groups showed similar baseline complementary food intakes, at the final measurement children in the treatment group were eating significantly more complementary food than the controls, and a greater variety, resulting in a significantly greater intake of energy and protein. The improvement relative to baseline was also significant.

In addition to more total protein from complementary food, treatment children also consumed a greater ratio of good quality protein to poor quality protein. This suggests that, overall, the children were not entirely replacing breastmilk with complementary food.

Reporting bias is a possible confounder in evaluating any education program. Efforts were made to reduce reporting bias during the study, and to validate dietary reports by the mothers. The hired workers made unannounced visits to households (of course, villagers did not have phones for "call ahead" appointments!) and asked to see the foods the mother said she prepared for the child. There were always other family members around, who would validate the mothers' reports. Also, all of the workers were from the local village and were trusted by the sample mothers; they could not easily be deceived since they often lived within close proximity and, given the open air atmosphere of the rural village environment, often knew the internal affairs and limitations of the households. The village workers were regularly supervised on their home visits to sample family homes by the field supervisor and the nutritionist, and ongoing, informal training on interviewing skills occurred weekly. In addition, unannounced visits were made to random sample households by the field supervisor and nutritionist to monitor the acceptance and practice of the messages, and cross check data collected by the village workers. Field observations verified that many of the mothers were practicing the messages. The frequency and extent varied from individual to individual and time to time.

5.2.3 Breastmilk Replacement and Nutrient Needs

Did the increased consumption of complementary food cause a decreased intake of breastmilk? The actual breastmilk consumption in our study is an unknown quantity, with the potential for high individual variability. Measuring breastmilk outputs would have interfered with the purpose of our project, thus we have used the best available estimates (see Part 2 and Appendix C). It is likely that the children who consumed the most complementary food decreased their breastmilk intake somewhat, as other studies suggest this happens to some degree (Pasricha, 1973). However, since growth rates were better overall for the treatment children, it is unlikely the complementary food substituted detrimentally for breastmilk. Studies of breastmilk outputs in developing countries, where infants suckle frequently support this hypothesis (Pasricha, 1973; Khan, 1984; Whitehead, 1985). For example, in a metabolic setting in India, where breastmilk test weighings were done, children who were encouraged to consume the "bulky" home diet decreased their intake of breastmilk, but the intake from complementary foods more than compensated for the decline (Pasricha, 1973). Observational data in Bangladesh suggests that older infants and young children who consume more complementary food, in addition to breastmilk, have better growth than those solely breastfed,

despite an increase in diarrhea in those eating more complementary food (K. Brown, personal communication, unpublished data, 1989).

What is the decline in the amount of energy and protein received from breastmilk as the children get older, and what quantities of complementary food would be needed (assuming constant breastmilk intake) to compensate for this? Estimates of breastmilk intakes done by test weighing from other studies in Bangladesh where children were consuming complementary food, suggest that the amounts declined from 632 gm/day in the first year to 563 gm/day in children 12-17 months (Brown et al, 1982). This is a difference of approximately 40 kcals and 0.69 gm of protein/day. In our sample, the treatment children increased their intake of complementary food from baseline (mean age 8 months) to final (mean age 13 months) by 65 kcals/day, which is greater than the (estimated) decrease from breastmilk. Control children only consumed 9 kcals/day more at final measurement than at baseline, which does not compensate for the (estimated) decline in breastmilk energy and protein. The daily protein intake increased in treatment children by 1 gm, which, adjusting for the poorer protein quality, still makes up for the (estimated) loss from breastmilk. The control group, however, consumed less protein from complementary food at the final measure than at baseline (decrease of 0.55 gm). The mothers may have reached their limit of milk production, prior to the introduction of more solid food, since the reason for offering the additional food was often because she felt her milk was "not enough". With the young children continuing to suckle frequently, the complementary food likely provided "extra", rather than "replacement" (though we can only assume this). It is important to add that the nutrition education messages encouraged continued and frequent breastfeeding for the health of the children.

Given the positive acceptance of breastmilk as an ideal food for infants and young children in rural Bangladesh, it appears there is little danger (at this time) of complete, or even major, substitution by a lower quality food in infants under one and probably two years of age. Limited options resulting from extreme poverty and the high cost of infant formula or milk (see Part 6) almost necessitate breastfeeding and are likely causes for the wide practice and extended duration of breastfeeding in Bangladesh. The danger of the substitution effect may be greater in countries where children do not suckle constantly throughout the day - for example, if mothers work out of the home - or where poverty is not so extreme, alternative feedings are more affordable, and breastmilk not as highly regarded.

5.2.4 Protein Quality

Is there need for concern about the amount of poor quality protein in the complementary foods that were affordable to the families? Assuming breastmilk still constituted 75% of the diet (by energy content), the ratio of good quality protein to poor quality was still very high. The total "amount" of all nutrients was inadequate, however, the "ratio" of nutrients was acceptable. Mothers were willing to give starch-based weaning foods, however, in the recipe trials, foods that incorporated animal foods met with resistance, reportedly due to the cost (see Part 6). We concluded that, while not ideal, it was more beneficial to encourage "energy rich, protein poor" complementary foods in breastfed infants than to recommend foods families can't afford, and can't offer on a daily basis.

It is important to stress that this starchy diet would, clearly, not support normal growth without breastmilk (or an appropriate substitute). Since both protein and energy intakes were insufficient to meet requirements, in our sample, we were unable to determine, separately, the limitation of low total protein or protein quality

diet on the infant growth rates. In addition, the effects of the additional complementary food on the growth in stature of the children is not known.

5.2.5 Weaning Food Contamination

Contamination of weaning foods - resulting from poor sanitation and hygiene combined with rapid bacterial growth in stored foods - is a major concern in a tropical environment with no refrigeration (Rowland et al, 1978; Black et al, 1982; Guldan, 1988), and could negate the benefits of the additional nutrients consumed from the food. We observed no differences in diarrheal prevalence rates in treatment and control children. However, due to the limitations in our monthly morbidity data, we cannot conclude whether the increase in complementary food caused an increase in diarrhea. It is likely there was some increase in mild diarrhea in those consuming more complementary food (Manjrekar, 1985). However, diarrhea is negatively related to growth outcomes, as was also found in our sample. Since the treatment children grew, on average, better than the controls, it is not likely the losses from diarrhea were greater for the treatments. Good hygiene was stressed with all of the nutrition messages; thus, it is possible the food was prepared in a more sanitary manner in the treatment group, and the failure to see an increase in diarrhea rates was real.

While we cannot conclude the additional energy and protein from the complementary food resulted in improved growth in the treatment children, it is likely the effect was not negative, since the growth of the treatment group was better.

5.2.6 Messages

What messages were most accepted by the village mothers? Field observations suggested - and the analysis confirmed - that many of the mothers were practicing the feeding messages, though not all of the women, not all of the messages, and not all of the time. Mothers in the treatment group gave "more" of foods that are traditionally given, feeding their infants more intentionally and energetically. In addition, with persuasion they were willing to add small amounts of oil, fish, and vegetables or fruit to the child's diet. All these foods (except fruit) are not often encouraged in children of this age due to certain cultural beliefs (Brown et al, 1988; Rizvi, 1979).

Mothers perceived their infants to be consuming "snacks", (i.e., foods that "didn't count"), thus the messages for this age group did not confront meal time taboos as with the messages for lactating mothers (Part 4). Individual mothers held beliefs about what foods should and shouldn't be given to their child, as any "good mother" would, wanting to do the best for her child. But, our experience was that food taboos for the children were not always as steadfast as focus groups suggested. If the mother had evidence that a food would improve her child's health, and would not be harmful, (for example, with oil in this study) she was often willing to overcome her stated belief (assuming it met other important criteria, such as low cost and preparation time).

The most "well-liked", and most frequently implemented messages, were those that required little time and money. For example, over 30% of the mothers in the treatment site added a small spoon of "energy rich" oil to the child's food - be it rice or cereal gruel. The messages that encountered the most resistance were those that required more time and money, for example, a *kichuri* dish (mixture of rice,

VM with healthy daughter two years after Weaning Intervention.

Severely malnourished child. The Weaning Intervention prevented severe malnutrition. Nutrition education, however, could not fully overcome the anorexia of frequent illness.

vegetables, oil, and fish/egg/milk, if available) which took 30-45 minutes to cook. A follow-up survey conducted by a separate research staff in March 1988 revealed the messages were still persuasive and memorable (Ahmed and Ahmed, 1989, Appendix G).

Most mothers were not willing, or able, to cook separately for the baby on a daily basis, due to time and fuel constraints. One of the more successful transitional foods encouraged in the messages, *Chop Chop* - an inexpensive, energy enriched cereal gruel - required very little preparation time, and used ingredients that were often on hand, thus was frequently offered. Still, mothers would prepare this food only once, or at the most, twice a day. If milk were added for enrichment (in families that could afford it), and if the mixture (even without milk) was stored for any period of time, the food could breed potentially harmful micro-organisms and result in diarrhea (Black et al, 1982; Rowland et al, 1978). Food contamination was a concern with the messages.

Reasons for mothers' failure to prepare the weaning foods on a daily basis (in addition to time and fuel limitations) included the refusal of the child to accept the food readily and lack of ingredients in the house. Mothers had to be taught that a baby must adjust to the new food and will not immediately accept it with vigor; they must let the child experience the new sensation and try repeatedly until the child is familiar with the taste and texture, and has developed the oral skills to eat the food.

This cautious approach to feeding is difficult to sort out. On the one hand, limiting the quantities of foods given to the child may be a protective practice given the potential hazards of unsanitary weaning foods. On the other hand, with food being scarce, and infants being finicky, clumsy eaters, the caretakers may take the first cue from the resistant child as a statement that the next attempted spoonful (or fingerful) may be hurled to the ground.

5.2.7 Food Refusal and Morbidity

One of the most common reasons reported for not giving more complementary food was because "the child refused". One budget conscious father, impatient with the time often needed for normal child feeding development, got very angry at the BRAC field worker when he agreed to purchase the ingredients for *Chop Chop*, only to have the infant spit it out. The reality of child development, unfortunately, is that no matter how nutritious, tasty, and appropriate a food, one can never guarantee a child will eat it[13].

While normal interactive feeding behaviors have been observed between Bangladesh infants and mothers (Zeitlin et al, 1987; in addition to informal field observations during this study), it remains a puzzle why the children do not "demand" and consume sufficient quantities of food to sustain normal growth, as healthy children are expected to. Granted, some of the inadequate intake was due to the limited attentiveness of individual caretakers to feeding, due to time constraints, demands of other children, or social/interactional dysfunction. However, the frequent acute infectious episodes, and the chronic underlying illnesses probably accounted for a major part of the energy deficit (Martorell and Yarbrough, 1983).

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[13] Food prepared, however, never went to waste. As would be expected in poverty conditions, if the baby did not eat it all it was quickly distributed among other hungry mouths in the family.

On sick days, children in developing countries are reported to consume at least 20-30% less calories from complementary food[14] (Molla et al, 1983; Martorell and Yarbrough, 1983; Hoyle et al, 1980). This effect is not overcome by intensive educational efforts to encourage the caretaker to feed the child more food, even in controlled environments (Molla et al, 1983). Cultural beliefs about withholding feeding during illness, such as is practiced in Bangladesh, exacerbate the energy deficit. Thus the gap in expected and actual growth widens. The high morbidity with its increased metabolic costs and anorexia, places an ever-present limitation on the potential success of nutrition education messages. Programs to prevent and control infections in young children are likely to create a more positive feeding environment, with better food intakes, improved growth, and more effective compliance to nutrition education.

Some may argue that the differences observed in child growth, in our sample, are not "dramatic" enough to warrant nutrition education programs. By no means do we intend to sell nutrition education messages as the magic ticket to child health. Neither was our project designed to test the "maximum potential impact" of a nutrition education program on change in feeding practices and infant growth. Rather, the purpose of the project was to develop and test nutrition messages that had the "potential" for behavior change, and the "potential" for a positive impact on child health, given the many existing constraints in rural Bangladesh. The trials occurred during the seasons of poor growth and high morbidity (Brown et al, 1982a), with extreme flooding superimposed on already difficult conditions. Only education (no food supplements) was given. The education was disseminated through volunteers. Poverty and poor sanitary conditions were daily barriers. Given these limitations, we argue that to find any difference in the treatment and control groups is remarkable.

While we don't negate the desperate need for other development and health programs to continue, we feel nutrition education can play an important role in the health of the weaning-age child. Our findings suggest, if appropriate messages are marketed through the appropriate channels, a change in infant feeding practices and improved growth of infants is possible, despite impoverished conditions. Part 6 will explore the food costs of these messages and improvements.

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[14] Intakes of breastmilk may not decrease (Hoyle et al, 1980).

Man bartering bananas at village market.

PART 6
FOOD COSTS

Poverty is a major barrier to good nutrition. However, we hypothesize that efforts to improve the nutritional well-being of mothers may be hindered by poverty more than efforts to improve the nutritional status of children, at least in the Bangladesh setting. This section will explore the financial barriers to complying with the nutrition messages for lactating mothers (Lactation Intervention) compared with messages for feeding young children (Weaning Intervention) in the Bangladeshi context. In the first part of this section, treatment and control groups are combined for both the lactating mothers sample and the weaning-age children sample, to allow descriptive comparisons between costs for mothers and young children.

The cost estimates are based on market food prices during the study period in 1987. Since 1987, consumer prices in Bangladesh have risen about 9-10% per year (EIU, 1991a)[15]. The present disaster that Bangladesh is coping with may further inflate consumer prices, and decrease real wages. While the relative costs comparisons between mothers and children should be the same today as in 1987, the reader is reminded the actual food costs quoted in this report will be higher.

6.1 MONETARY VALUE OF DIET

6.1.1 Lactating Mothers

The monetary value of the mothers' diets from February through November 1987 averaged 6.8 *taka* per day (U.S. $0.22), with a range of 4.0 to 11.6 *taka*. This translates to **27% of the income for a daily wage earner**[16]. The market value of the diet was approximately 0.5 *taka* for every 100 kcals consumed, and 2.5 *taka* for every 10 gm of protein (adjusted for the low quality of the protein). In general the more food consumed by the mother, the more expensive the food. In other words, mothers who consumed more calories were also obtaining those calories from more desirable and costly foods (for example, fish, lentils) rather than the less expensive "filler" foods (wheat, rice).

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[15] The value of the taka relative to the U.S. dollar has continued to fall also. The exchange rate on April 8, 1991 (before the disastrous hurricane of April 30) was 34.5 taka = 1 US dollar (EIU, 1991a).

[16] The average daily wage during the study period was 25 taka, or U.S. $0.82 (field notes from study collected by interviews with daily laborers).

Figure 21 illustrates a breakdown by food groups of the market value (averaged over all the seasons) for the average daily diet of the mothers compared with the contribution of each food group to the total energy content. Grain contributed much more to the energy content of the diet than to the cost, but still constituted the major food expenditure. Since animal foods were expensive relative to their energy content, they constituted a greater percent of the market value than of the total energy content.

Comparison of Estimated Food Costs with Actual Food Expenditures

A comparison of the estimated food costs (based on consumption and market value of the foods), with actual weekly expenditures for the household, was made for a sample of 11 mothers (from the treatment group) for which household expenditures were obtained during the month of April. Food expenditures, measured at the household level, were divided by the number of household members, to give a crude estimate of average expenditures per capita.

Figures 22 and 23 compare the breakdown of costs for the 11 households by food groups using household expenditures vs the estimated market value of the mothers' diets. The market value of the mothers' diets, based on a direct measure of their reported consumption in April and the contribution of each food group to the cost, was very similar to the actual per capita expenditures for the same families during the month of April. At a glance, the two charts suggest that women are not discriminated against, at least in terms of the *proportion* of foods consumed, compared with the household diet.

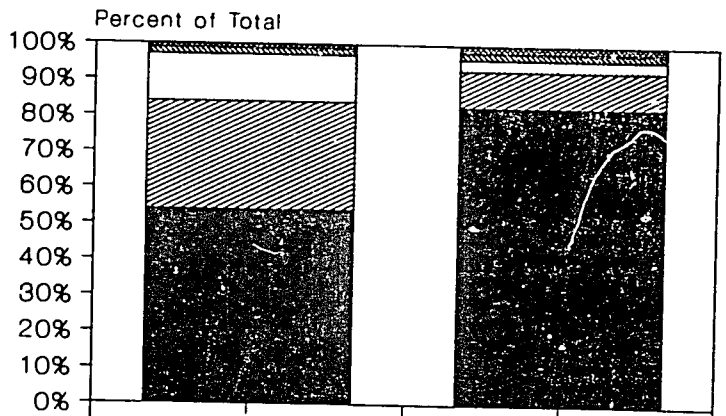
The main difference between the actual expenditures for the household, and the estimated market value of the sample mothers' diets was for vegetables: they accounted for 27% of the value of the mothers' diets, but only 13% of the weekly food expenditures for the family. Since most rural Bangladeshi households grow vegetables around their homes, they likely consumed some home grown vegetables.

Oil consumption may also have been underestimated in the dietary recall, suggested by comparing the value of what mothers reported eating (1% of the market value of their diets) compared with the food expenditures for the same households (3% of the household weekly expenditure). However, the low levels of oil reported (5% of the total dietary energy) are consistent with other studies on lactating women in Bangladesh (Brown et al, 1990). In fact, in a sample of urban Bangladesh women consuming 1.7% to 7.8% of their dietary energy from fat, fat intakes reported by dietary recall were *greater* than the levels actually observed (Brown et al, 1990). Thus, it is likely the oil comsumption in this study was not underestimated by much, if indeed at all.

6.1.2 Children of Weaning Age

The monetary value of the diets of children (treatment and controls) in the Weaning Intervention averaged only 1.3 *taka* per day (U.S. $0.04) from May-July to October-November. This is **less than 20% of the value of the mothers' diets, or 5% of the daily wage.** Without the intervention effect (i.e., only controls), the average value of the complementary food was 1.2 *taka* per day over the 5 months. The breakdown of the market value of the diet changed from the baseline measure to the final measure, due to dietary changes related to the ages of the children, and, in part, as a result of the intervention (see Figure 24 for figures for non-intervened children).

Fig 21. Lactating Mothers' Diets: Contribution of Food Groups to Total Market Cost (taka) and Energy.

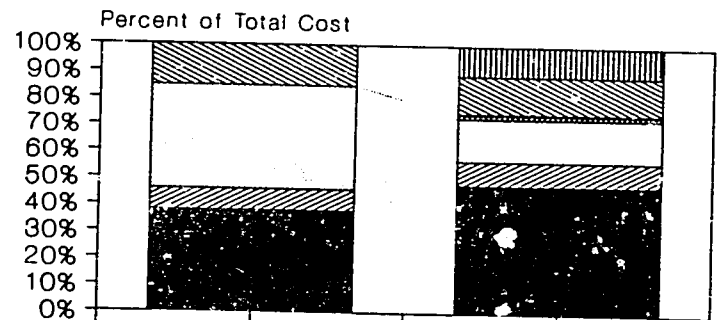


	Food Cost	Diet Energy
Oil	1%	2%
Lentil	2%	2%
Animal	13%	3%
Veg&Frt	30%	10%
Grain	54%	83%

Grain, Veg&Frt, Animal, Lentil, Oil

Averages for 8 observations Feb-Nov 1987
Treatment and control mothers combined

Fig 24. Changing Diet of Infants: Percent of Total Cost by Food Group - Baseline and Final -

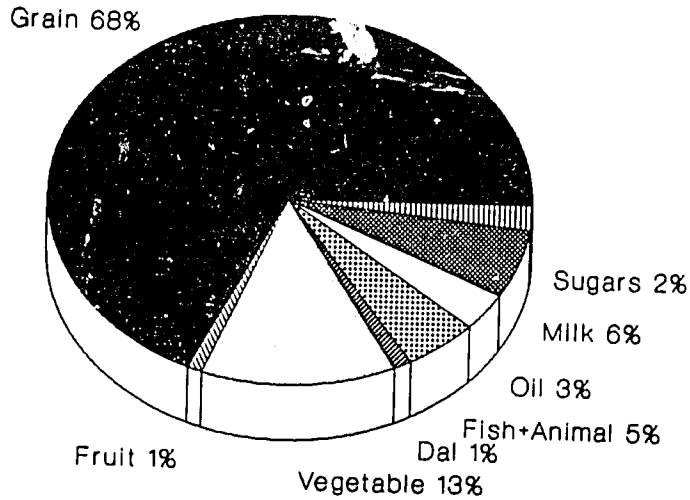


	May-July (8mo)	Oct-Nov (13mo)
Fish/Egg	0%	11%
Sugar	15%	14%
Oil	0%	2%
Lentil	0%	0%
Milk	39%	16%
Vg&Ft	8%	9%
Grain	38%	48%

Grain, Vg&Ft, Milk, Lentil, Oil, Sugar, Fish/Egg

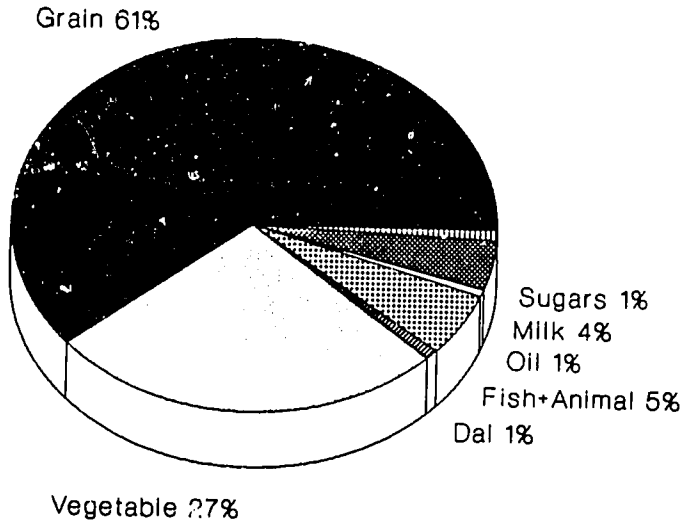
Treatment & control combined. 100% breastfeeding. Breastmilk cost not estimated.

FIGURE 22.
WEEKLY HOUSEHOLD FOOD EXPENDITURES
Percent of Total Food Expenditures



Household food expenditures reported for 11 households in intervention area (April/May 1987)

FIGURE 23
MARKET VALUE OF DAILY DIET FOR MOTHERS
Percent of Total Food Cost



Cost of foods consumed (24-hour dietary recall) computed from market prices and averaged for 11 mothers, April/May 1987.

Supplemental cow's milk constituted a greater share of the market value of the diet in May-July, when the average age was 8 months, than in October-November. While milk shares declined, the monetary share for other animal foods, primarily fish, increased. The increase observed for fish was likely a result of the nutrition messages, as consumption increased only in the treatment group (Part 5).

The total value of the complementary foods was similar for children ages 4-17 months, about 1.2 *taka*/day for treatment and control children, and about 1.0 *taka*/day for controls, alone (Table 8 for controls). Surprisingly, non-intervened children of ages 12-17 consumed the same amount of additional food (calories) as children 8-11 months. While children 4-7 months consumed one-third fewer calories from additional foods than children 8-17 months, they consumed a greater share of milk, a more expensive food. It is important to point out that additional foods still provided less than one-third of the calories in these young children's diets. Breastmilk constituted the remaining two-thirds.

To determine the costs of complementary foods for children 18-24 months, older children from the same control site studied one year earlier were evaluated (Zeitlin et al, 1989). Children have been observed to be more assertively fed the family diet after age 18 months (Guldan 1988). Complementary food intakes increased in the children ages 18-24 months, as evidenced in Table 8. The costs of the (insufficient) complementary food for the children at the end of the critical weaning period (18-24 months) are not quite double the costs for the youngest children (4-7 months).

One might argue that a cost factor for breastmilk needs to be added to the total cost of the infants' diets. This is an indirect cost estimate, with the mother consuming the food in order to produce the breastmilk. The daily cost of improving the lactating women's diets from their deficient levels to levels necessary for adequate milk production was approximately 5.3 *taka* (based on diets of the women in the Lactation Intervention). Of this amount, 2.5 *taka* would be required for lactation, and 2.8 *taka* would be needed to bring the women's diets (whether lactating or non-lactating) up to adequate levels. Thus, the additional "cost for lactation" for infants with undernourished mothers can be estimated to be about 5.3 *taka* per day.

It is useful to compare this cost to that of providing milk supplements to the infant, in place of breastmilk. An average Bangladeshi child age 0 to 6 months growing between the 5th to 10th percentile on international growth charts (see following section on standards for nutrient adequacy) requires about 475 kcals/day (WHO, 1985; see also Appendix C). Theoretically, if a woman consumed an adequate diet, she would be able to produce a milk supply sufficient to support growth for her infant under 4-6 months[17], at least along this percentile. The average price for this amount of cow's milk[18] was 7.3 *taka*. Infant formula (Lactogen) would have cost 20.5 *taka* for 475 kcals (see Figure 25). Thus, feeding cow's milk costs the family almost one and a half times, and infant formula nearly four times the amount required to improve the mother's diet for adequate lactation[19]. This represents 29% and 82%, respectively, of the daily wage. The costs for breastfeeding would also

[17] This assumes the woman consumes adequate fluids, is in generally good health and rested, allows adequate time for her child to suckle, offers both breasts, has a generally healthy child with a good suck... and all the other essential components of adequate lactation.

[18] Note, however, that cow's milk, alone, is not a nutritionally adequate substitute for breastmilk.

[19] These estimates only consider direct food costs. Other costs to consider with bottlefeeding are nipples and bottles. For both, the costs required to improve the diets of other children and adults in the family would need to be factored in to the total costs.

benefit the mother's health, in addition to the child's. These estimates are similar to those found in other developing countries (Center to Prevent Childhood Malnutrition, 1990).

Food Costs for Improved Growth in Treatment Children

The question arises: "What did the improved growth in the treatment children cost the family, in terms of food?". Table 4 shows the average *taka* value of the complementary foods (not including breastmilk "costs") consumed by the treatment and control children. The cost of the treatment children's diet increased after the weaning education by only 1% of the daily wage, while the cost of the control diet actually declined[20]. The costs were significantly higher for the treatment children's diets after the education (final) than the controls, although the costs were still low relative to the value of the mothers' diets (4-6% of the daily wage vs 27% for mothers).

The daily cost of the treatment children's diets increased .56 *taka* more than the controls from baseline to final. The treatment children gained on average 410 gm more than the controls over the five months observed (Part 5). **Thus, the improved weight gain in the treatment children of 410 gm over a five month critical weaning period came at an additional food cost to the family of .56 taka per day, or 2% of the daily wage.**

Table 4. Average Daily Cost of Weaning-Age Child's Complementary Food at Baseline and Final Measure

	- DAILY FOOD COST -		
Measure	**Treatment** mean (SD)	**Control** mean (SD)	Significance of Group Differences[21]
Baseline	1.08 *taka*	1.16 *taka*	NS
Final	1.44	0.96	*
Change	+.36	-.20	*

Additional daily cost increase for treatment children: .56 *taka*

Additional complementary food cost per day for improved growth during the critical weaning period:

- **additional cost of 2% of the daily wage**
- **for 410 gm improvement in weight gain**
- **over 5 critical weaning months**

[20] The decline in estimated food cost from baseline to final for the controls was partly due to a decrease in milk consumption as the child got older.

[21] Significance determined by t-test. NS=not significant (p>.05), * = p<.05.

6.2 COSTS TO FILL THE NUTRIENT GAP

6.2.1 What is the Nutrient Gap?

The nutrient "gap" is defined here as the difference between the mother's and children's food intakes and their safe nutrient requirements (WHO, 1985; NRC 1989; Appendix B and C). Local market food prices were used to compute the costs for filling these nutrient gaps for mothers and children for four nutrients: energy, protein, vitamin A, and iron. These estimated costs provide us with information on the economic feasibility for rural households of improving the diets of women and children. The costs to fill the gap for mothers were computed using the market value of the same mix of foods they were already eating. The cost computation to fill the nutrient gaps for children used several common weaning foods, including the project's complementary feeding recipes.

A descriptive comparison is made below between costs to fill the gaps for mothers (Lactation Intervention) vs costs for children (Weaning Intervention). The purpose of this analysis is to determine costs barriers for the average Bangladeshi mother or child under normal rural conditions, i.e., without an intervention effect. Since a treatment effect was found in the Weaning Intervention (children whose mothers received weaning education consumed significantly more food), these children may not be considered "average" after the education. The costs to fill their remaining nutrient gaps may be lower than the "average" rural child of the same age, since they were consuming more food than the average (i.e., control) children as a result of the intervention. Therefore, treatment children in the Weaning Intervention were excluded from the computation of costs to fill the nutrient gaps.

Since no treatment effect was attributed to the intervention for the mothers (Lactation Intervention), both groups might be assumed to be representative of the average lactating rural woman in Bangladesh. Thus, the treatment and control groups are combined for the analysis of costs to fill the nutrient gaps for mothers.

A Note on the Standards for Nutrient Adequacy

A discussion of the energy and protein requirements used in computing the calorie (and protein) gaps for mothers and children is warranted, since the levels selected can greatly influence the cost estimates to close the gaps, and thus, are crucial to the policy conclusions.

A great deal of consideration on the part of the authors went into selecting the appropriate nutrient goals, particularly for growing children. The requirement needed to be realistic, given the poor present condition of children in Bangladesh. However, the food costs required to meet the "maintenance" requirement (based on the children's actual weight - see Appendix C) would maintain the children in their current moderately undernourished state. Even though the short-term Weaning Intervention did not quite achieve this maintenance level of intake or growth in the treatment children, this requirement seemed too low, because it underestimates the food costs to maintain a well-nourished (heavier) child.

The "ideal" requirement (based on an international reference child growing at the 50th percentile - see Appendix C) seemed far too optimistic a goal for the next generation of rural Bangladeshi infants, given that the average child in this study

was below the 3rd percentile on the reference growth chart (about -2.5 SD from reference median weight at an average age of 11 months), and that the average child is thought to be well below the 50th percentile at birth[22]. Costs to fill this gap would greatly overestimate achievable goals for child growth in Bangladesh.

Therefore we compromised on a requirement based on the following rationale. The weights of the youngest children in the weaning sample (4-7 months) were between the 5th and 10th percentile on the NCHS reference standards (WHO, 1983) for age and sex (-1.5 SD from the median). Since this is the age at which weaning foods should first be introduced, maintaining growth along this curve is a realistic goal (though very optimistic, and, as yet unachieved). Therefore, the costs to fill the energy (and protein) gap between what the children were consuming, and what they would need to grow on this curve are illustrated in the discussion of costs.

The women's energy (and protein) requirement was estimated using a conservative weight for a moderately active rural Bangladeshi reference woman, with an additional 500 kcals for lactation. The discussions in Part 4 and Appendix B describe in detail the rationale for this standard, and the argument also applies to estimating the costs to fill this gap. Our computations are based on the assumption that intakes of energy and protein at this level would prevent further deterioration in the woman's nutritional status, while enabling her to produce an adequate amount of breastmilk. This intake would not enable her to improve her already malnourished state; however, it would likely be sufficient to support her during lactation as well as during pregnancy (WHO, 1985; Appendix B). The food costs for the women, then, would support inter-generational improvements (in her lactating or unborn child), while maintaining the women in their present state of health.

An important distinction between children and adult women supports the rationale for these requirement levels. Under normal conditions, children are growing, whereas adults are in a static state. Children under age 2 years, as those in this study, still have the capacity to recover from past nutritional insults, with some exceptions. While women can gain fatness and can recover from micronutrient deficiencies, their stature and brain capacity cannot recover from past nutritional insults. Thus, a maintenance-level nutrient goal for the women (which, incidently, is far from what they achieved in this study), and a compromise between a maintenance and ideal goal for young children, are justified.

6.2.2 Mothers

The nutrient adequacy of the mothers' diets, the nutrient gap remaining, and the estimated amount of money (in *taka*) the family would need to fill the gap are summarized in Table 5. Costs to fill the gaps for energy, protein, vitamin A, and iron were computed for each individual mother, and were based on the monthly market value of the foods she ate, averaged over the 8 observations. The cost estimates to fill the nutrient gap assume she would eat the same mix of foods she was already eating.

Energy

To meet her energy requirement using the same low cost diet she was already consuming, **the mother would need to spend an additional 5.3 taka (21% of the daily**

[22] Unfortunately, little accurate data is available on birth weights of Bangladeshi children. The majority of children are born at home, and rarely come into contact with medical services where their weights would be recorded.

TABLE 5. LACTATING MOTHERS
NUTRIENT ADEQUACY OF DIETS AND DAILY COSTS TO FILL THE NUTRIENT GAPS

DIETARY INTAKE AND ADEQUACY	CALORIES	PROTEIN(^)	VITAMIN A	IRON (+)
Nutrient Requirement/day (#)	2405 kcal	46-41 gm	3600-3900 IU	15 mg
Daily Food Intake:	1354 kcal	39 gm 26 gm (adj)	1072 IU	17 mg
Adequacy of Diet (% of requirement)	56 %	60 %	29 %	116 %
Daily Nutrient Gap	1051 kcal	17 gm	2545 IU	ADEQUATE
VALUE OF FOOD CONSUMED (*)	6.8 taka ---------->			
COSTS TO FILL NUTRIENT GAP (**)	CALORIES	PROTEIN(^)	VITAMIN A	
-With Mother's Same Diet (**)	5.3 taka	4.4 taka	16.1 taka	
-With Dark Leafy Greens	NA	NA	0.4 taka	
TOTAL COST FOR ADEQUATE DIET	12 taka	11 taka	23 taka (w/same diet) 7 taka (w/greens)	

Note: Reported figures are averages of a sample of 78 lactating Bangladesh women followed monthly from Feb/Mar-November 1987. Ages of their breastfeeding children ranged from 0 - 12 months at the beginning of the study period, to 8 - 18 months at the end.

(#) Calorie requirements are calculated based on average woman's weight of 40.4 kg and moderate activity, using WHO guidelines. 500 additional calories added for lactation. Protein & vitamin A requirements based on the age of the mother's breastfeeding child.

(^) Protein adequacy of diet was adjusted for low protein quality according to WHO guidelines.

(+) Iron in the diet may be poorly absorbed.

(*) Food costs based on monthly market prices in Zhitka, Manikganj District, Bangladesh, during the study period. In reality some foods may have been produced at home. 30.5 Bangladesh taka = 1 US$.

(**) The average diet consumed by the mothers as a breakdown of % of calories was:
83% Grain, 10% Veg, 1% Fruit, 2% Lentil, 3% Fish/Milk/Egg/Meat, 2% Oil, <1% Sugars
By cost the % of the total market value of the diet was:
54% Grain, 27% Veg, 3% Fruit, 2% Lentil, 13% Fish/Milk/Egg/Meat, 1% Oil, <1% Sugars

TABLE 6. DAILY FOOD COST (TAKA) OF ADEQUATE DIET PROMOTED IN NUTRITION MESSAGES FOR LACTATING MOTHERS* - BY MONTH

FOODS	AMOUNT FOR EACH MEAL	NUMBER MEALS PER DAY
Rice	6 handfuls	3 times per day
- or Ruti (flat bread)	- 5 (50 gm each)	
Dark Leafy Greens	1 spoon (35 gm)	
Potato	1 spoon (35 gm)	
Fish	2 fingerfuls (15gm each)	
- or Dal	- 2 spoons (80ml each)	
Oil for curry	2 spoons (4ml each)	
Chili	1 (2gm each)	

FOOD COMBINATION	COST (TAKA)*									
	F/Mar	April	May	June	July	August	Sept	Oct	Nov	AVER
TOTAL COST (TAKA) PER DAY										
-Rice,greens,potato,fish,oil:	11.7	11.7	10.7	8.8	11.9	13.1	13.6	11.7	12.6	11.8
-Rice,greens,potato,dal,oil:	9.5	9.5	8.1	7.8	9.3	10.7	10.8	10.6	11.0	9.7
-Ruti,greens,potato,fish,oil:	10.2	10.2	10.1	8.4	11.7	11.2	7.5	6.7	7.4	9.3
-Ruti,greens,potato,dal,oil:	7.9	7.9	7.5	7.4	9.1	8.7	4.7	5.6	5.9	7.2
COST (TAKA) PER 100 CALORIES										
-Rice,greens,potato,fish,oil:	0.51	0.51	0.46	0.38	0.51	0.57	0.59	0.50	0.55	0.51
-Rice,greens,potato,dal,oil:	0.38	0.38	0.33	0.32	0.38	0.44	0.44	0.43	0.45	0.39
-Ruti,greens,potato,fish,oil:	0.44	0.44	0.44	0.36	0.50	0.48	0.32	0.29	0.32	0.40
-Ruti,greens,potato,dal,oil:	0.32	0.32	0.30	0.30	0.37	0.35	0.19	0.22	0.24	0.29

** Food costs based on monthly market prices in Zhitka, Manikganj District, Bangladesh during the study period. 30.5 Bangladesh taka = 1 US$.*

wage), or almost double the value of food that she is presently eating. In actuality, however, the costs would be much greater than this. If a woman increases her food intake, she often must also increase the share given to other family members. Assuming a minimum family of three, consisting of the woman, her husband (1 adult equivalent), and a young child (1/3 adult equivalent), the cost of improving the woman's diet would need to be increased by a minimum factor of 2.3 for a total additional 12 *taka* (or 50% of the daily wage). The average family size of sample mothers is 6-7, however, so the additional cost of food to be shared would be much higher.

Table 6 illustrates several combinations of foods promoted through the nutrition messages that would meet the lactating women's requirement for all four nutrients - calories, protein, vitamin A and iron. These quantities would provide 100% of the lactating women's energy, protein, vitamin A, and iron needs. The market value of each diet is presented from February-March (the first market prices available) through November. Wheat flour is the cheapest staple, the price kept artificially low due to distribution through food-for-work schemes. The combination of wheat (in the form of *ruti* or unleavened bread), dark leafy greens, potatoes, lentils (*dal*), and a small amount of chili and oil can meet the nutritional needs of the mother for less than half a *taka* per day more than the value of the diet she is already consuming. However, while wheat will be eaten during hungry times, it is considered a poor man's food. Bangladeshis believe a meal of rice leaves them with a "feeling of satisfaction and fullness" that wheat cannot provide. Thus, cultural and personal food preferences compete with financial barriers. The more desirable diet - rice with fish, in addition to vegetables - costs over 57% more per day than the cheapest diet (see Table 6)[23].

Protein

In general, if the adult calorie needs are met, the protein needs will likely be met. As Table 5 shows, the protein needs for the mothers can be met for slightly less additional money than for calories, though the amount needed is still high. These estimates take into account the low protein quality of the diet.

Vitamin A

The vitamin A adequacy of the mothers' diets was the lowest of all the nutrients studied. **Even if all of the calorie needs were met with the traditional diet, the vitamin A requirement would not be met. However, using dark green leafy vegetables, which are available year round, the vitamin A requirement could be met for less than half a *taka* per day (2% of the daily wage).** This assumes an adequate amount of fat is available for absorption and utilization of the nutrient. While the average price over the year is low, prices and abundance (in addition to preference) of leafy greens however, vary by season, as was found in this study (see Table 12) and in an earlier study on vitamin A availability (Zeitlin and Megawangi, 1989).

Iron

As noted previously, the mothers' diets contained an adequate amount of iron to meet estimated requirements. Increasing the energy adequacy of the diets, would

[23] Most of the wheat in this rice-growing country is imported (usually donated). While a switch to a wheat-based diet may be financially beneficial in the short-term for poor households, in the long-term this shift may be detrimental to the economy by increasing reliance on foreign assistance, and disrupting the local agricultural practices.

further increase the iron adequacy. Given the finding that dietary iron is not limiting, using the requirement level of 15 mg/day (NRC, 1989; Appendix B), other factors - such as poor bioavailability of the dietary iron, increased iron losses in the women, and infections - need to be considered to address the high prevalence of anemia among women of child-bearing age in Bangladesh (see Part 4 for discussion on this). The true requirement of these women may be higher than recommended levels.

6.2.3 Children

Energy and Protein

Table 7 illustrates the adequacy of the diets of the control children in the Weaning Intervention (including estimates for breastmilk), and presents the costs to fill the nutrient gap for the non-intervened children using a variety of different foods. The average age over the 6 observations was 11 months (range 4-20 months). As a reminder, the food consumption of the weaning-age children was measured monthly by 24-hour recall and averaged over the 6 observations; the breastmilk quantity was estimated using country standards for each month of age; and the food costs were based on average local prices over the study period.

By feeding *Chop Chop*, one of the weaning foods promoted through the messages, the child's energy requirement could be met for about one *taka*. This is only 5% of the average daily wage for agricultural laborers, or 23% of the additional cost to meet the mothers' energy needs. **Adding a small amount of lentils or milk to the mixture increases the cost by only a small amount, and improves the protein adequacy** (and with milk, the vitamin A adequacy), **bringing the cost to 25-36% of the cost of improving the mother's diet (or 8% of the daily wage)**. Assuming other children in the family would also need to be given an increased share of food, the food costs might increase to 23% of the daily wage.

Mishowkow, a mixed weaning food with a more lumpy texture than the pudding-like consistency of *Chop Chop* is appropriate as a transitional food for the child (beginning at approximately 7 months of age). The cost is slightly higher than *Chop Chop* due to the greater variety of foods, but if lentils or ground fish are consumed, the cost to fill the calorie and protein gap is under 2.5 *taka*. This is still under half of the cost to meet the calorie requirement for lactating mothers. Use of eggs in this mixture is more expensive. (A breakdown of the nutrient contents of *Chop Chop* and *Mishowkow* can be found in Appendix F, Tables F1 and F2).

If cow's milk alone is used to fill the nutrient gap, the costs are considerably higher. Infant formula, is extremely expensive, and would be affordable only for the wealthiest of households.

Providing the food from the family diet[24] to the child would cost about the same as providing *Chop Chop* or *Mishowkow*, since the ingredients are similar. Family food would need to be mashed to the appropriate texture for the infant before feeding. One important limitation of these foods, however, with the exception of rice, is that they often contain an intolerable amount of hot spices for the sensitive palate of the infant.

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[24] The average costs of the family diet were based on the average costs of the foods consumed by the women in the Lactation Intervention.

TABLE 7. WEANING-AGE CONTROL CHILDREN
NUTRIENT ADEQUACY OF DIETS AND DAILY COSTS TO FILL THE NUTRIENT GAPS FOR GROWTH AT 1.5 STANDARD DEVIATION BELOW THE MEDIAN OF THE REFERENCE POPULATION (#)

DIETARY INTAKE AND ADEQUACY	CALORIES	PROTEIN(^)	VITAMIN A	IRON (+)
Nutrient Requirement/Day (#) (based child -1.5 SD reference wt)	811 kcal	16.3 gm	833-1000 IU ave: 924 IU	5-10 mg ave: 9.5 mg
Daily Dietary Intake: -Food -Breastmilk (estimate) -Food & Breastmilk	 124 kcal 360 kcal 484 kcal	 3.0 gm 5.4 gm 8.9 gm 8.4 adj gm	 78 IU 590 IU 668 IU	 0.6 mg 5.9 mg 6.5 mg
Adequacy of Diet w/Breastmilk (% of requirement)	60 %	52 %	73 %	70 %
Daily Nutrient Gap	327 kcal	7.9 gm	256 IU	3.0 mg
VALUE OF FOOD CONSUMED (*)	1.2 taka	---------->		
COSTS TO FILL NUTRIENT GAP (*)	CALORIES	PROTEIN(^)	VITAMIN A	IRON (+)
Chop Chop -*Flour,molasses/sugar,oil:* -*Flour,molasses/sugar,oil,lentils:* -*Flour,molasses/sugar,oil,milk:*	 1.2 taka 1.3 taka 1.9 taka	 2.9 taka 1.9 taka 2.7 taka	 NA NA 4.3 taka	 1.0 taka 0.9 taka 1.7 taka
Mishowkow (pre-cooked) -*Rice,lentils,greens,oil:* -*Rice,egg,greens,oil:* -*Rice,fish,greens,oil:*	 1.5 taka 3.2 taka 2.6 taka	 2.4 taka 3.1 taka 2.3 taka	 0.2 taka 0.3 taka 0.3 taka	 0.4 taka 0.8 taka 0.6 taka
Family Diet	1.6 taka	2.0 taka	1.6 taka	1.2 taka
Cow's Milk (fresh) Infant Formula (Lactogen)	5.0 taka 14.2 taka	2.5 taka 15.4 taka	2.1 taka 3.5 taka	15.5 taka 13.0 taka
Dark Leafy Greens	NA	NA	< 0.1 taka	0.1 taka

Note: Reported figures are averages of a sample of 61 Bangladeshi control children followed monthly from May-Nov 1987. Average age was 11 months (range: 4-14 mos at first measure, 9-20 mos at final). Average weight 6.9 kg (ave range: 5.7-9.1kg). 100% of the children were breastfeeding throughout the study - breastmilk intakes were estimated based on the best country data available for children living in rural areas. All figures are rounded averages so may not add perfectly.

(#) Calorie and protein requirements are calculated based on the child growing at 1.5 SD below the median weight of NCHS/WHO reference for the child's age & sex (ave 11mo, 8.05kg). This is between the 5th to 10th percentile on growth charts of the international reference.

(^) Protein content of food was adjusted for low protein quality according to WHO guidelines

(+) Iron in the diet may be poorly absorbed.

(*) Food costs based on monthly market prices in Zhitka, Manikganj District, Bangladesh, during the study period. 30.5 Bangladesh taka = 1 US$.

Vitamin A and Iron

Chop Chop is not a good source of vitamin A. Attempts to encourage mothers to add green leafy vegetables to the mixture met with a lot of resistance, since the mixture is a "sweet" food. If the sugar were left out of the recipe, the **vitamin A content of the mixture could be increased by adding dark greens for less than one-tenth of a *taka* per day, or less than 1% of the daily wage.** Feeding of greens to young infants met with some resistance among mothers in the Weaning Intervention, as greens were thought difficult to digest by infants. Resistance decreased however, after mothers participated in a demonstration of chopping, cooking, and feeding the mixture to their child without any detrimental side effects.

Mishowkow is a good source of vitamin A if dark green leafy vegetables are added to the recipe. If a sufficient amount of the food is given to meet the child's energy requirement, the child's vitamin A needs, in addition to the iron needs will be met.

Costs to Fill the Energy Gap by Age Groups

Table 8 breaks down the estimated energy gap and costs for filling the gap for the average child with selected infant foods by age category: 4-7 months, 8-11 months and 12-17 months, and 18-24 months. The data for children 18-24 months were obtained from a sample of older children from the same control site during the previous year (Zeitlin et al, 1989). Inclusion of this age group enables us to look at the costs to fill the energy gap for all age groups during the critical weaning period 6-24 months.

Naturally, the estimated costs to fill the energy gap increase with increasing age of the child, since the reference child gets taller and heavier, and the estimated breastmilk intake declines (Brown et al, 1982). Also, as noted previously, the average Bangladeshi child under 18 months consumes very small quantities of complementary food. In our study, the quantities of foods consumed by the control child 12-17 months were not much greater than those of children 8-11 months. The estimated calorie gap for a child 12-17 months is over three times that of a child age 4-7 months, and the costs to fill the gap are triple. Since children 18-24 months are consuming considerably more food than children 12-17 months, the costs to fill the remaining energy gap remain relatively stable.

Figure 26 illustrates the costs of the lactating women's diets, and the costs to fill their energy gap, compared with the same figures for young children. As in Table 8, control children from the previous year were included to show the full spectrum of potential costs to families to fill the nutrient gap for their children during the critical weaning period 6-24 months. For the children under 18 months, the cost of providing *Chop Chop* cooked with milk was used to compute the costs of filling the nutrient gap. For children 18-24 months, an average of the cost of providing *Chop Chop* with milk and the family diet was used. The costs are illustrated relative to the daily wage at that time. This figure does not depict the costs of the additional food that would be necessary to feed the rest of the family members. The food "costs" of the breastmilk are reflected in the requirement for the mothers, since she bears the burden of depleting her own body stores if she does not consume the additional foods required to breastfeed her child.

It is evident that improving the weaning-age child's diet is financially much more feasible than improving the diet of the lactating mothers. While the costs increase for the older children, they are still considerably lower than the costs for mothers. A

TABLE 8. WEANING-AGE CONTROL CHILDREN BY AGE GROUP
ENERGY ADEQUACY OF DIETS AND DAILY COSTS TO FILL THE ENERGY GAP

ENERGY INTAKE AND ADEQUACY PER DAY	AGE GROUP			
	4-7 mos	8-11 mos	12-17 mos	18-24 mos(§)
Average age of children observed: Sample Size	(6 mos) n = 32	(10 mos) n = 87	(13 mos) n = 99	(20 mos) n = 344
Calorie Requirement/Day (#)	591 kcal	756 kcal	893 kcal	1019 kcal
Daily Calories Consumed:				
- Food	73 kcal	125 kcal	130 kcal	260 kcal
- Breastmilk	389 kcal	369 kcal	344 kcal	304 kcal
TOTAL: Food & Breastmilk	462 kcal	494 kcal	474 kcal	564 kcal
Adequacy of Diet w/Breastmilk (% of requirement)	78 %	65 %	53 %	55 %
Daily Calorie Gap	129 kcal	262 kcal	419 kcal	454 kcal
VALUE OF FOOD CONSUMED (*)	1.0 taka	1.1 taka	1.0 taka	1.7 taka
COSTS TO FILL ENERGY GAP (*)				
Chop Chop				
-Flour,molasses/sugar,oil:	0.5 taka	1.0 taka	1.5 taka	1.7 taka
-Flour,molasses/sugar,oil,lentils:	0.5 taka	1.1 taka	1.7 taka	1.9 taka
-Flour,molasses/sugar,oil,milk:	0.7 taka	1.5 taka	2.4 taka	2.6 taka
Mishowkow				
-Rice,lentils,greens,oil:	0.6 taka	1.2 taka	2.0 taka	2.1 taka
-Rice,egg,greens,oil:	1.3 taka	2.6 taka	4.1 taka	4.5 taka
-Rice,fish,greens,oil:	1.0 taka	2.0 taka	3.3 taka	3.5 taka
Family Diet	0.6 taka	1.3 taka	2.1 taka	2.3 taka
Cow's Milk (fresh)	2.0 taka	4.0 taka	6.4 taka	6.9 taka
Infant Formula (Lactogen)	5.6 taka	11.3 taka	18.1 taka	19.7 taka

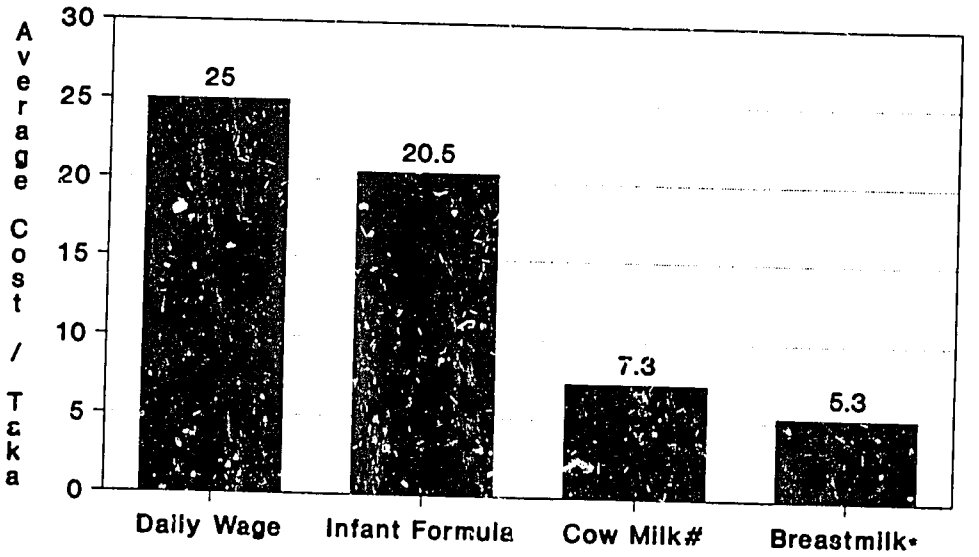
Note: Reported figures for children 4-17 months are averages of 224 total observations 61 Bangladeshi control children followed monthly from May-Nov 1987. Monthly observations were combined to form 1 cross-sectional file allowing study of different age groups. Season not controlled for with this method. 100% children breastfeeding throughout the study - intakes were estimated based on the best country data available for children living in rural areas.

(§) Data for children ages 18-24 months obtained from control breastfed children in the same site during the previous year. Bangladeshi children are more assertively fed after age 18 months, so the remaining costs to fill the gap are about the same as for the child under 18 months. Costs for the foods consumed based on average costs of the family diet and diets of children 12-17 months.

(#) Calorie requirement based on the child growing at 1.5 SD below the median weight of NCHS/WHO reference for the child's age and sex. This is between the 5th to 10th percentile on growth charts of the international reference.

(*) Food costs based on monthly market prices in Zhitka, Manikganj District, Bangladesh during the study period. 30.5 Bangadesh taka = 1 US$.

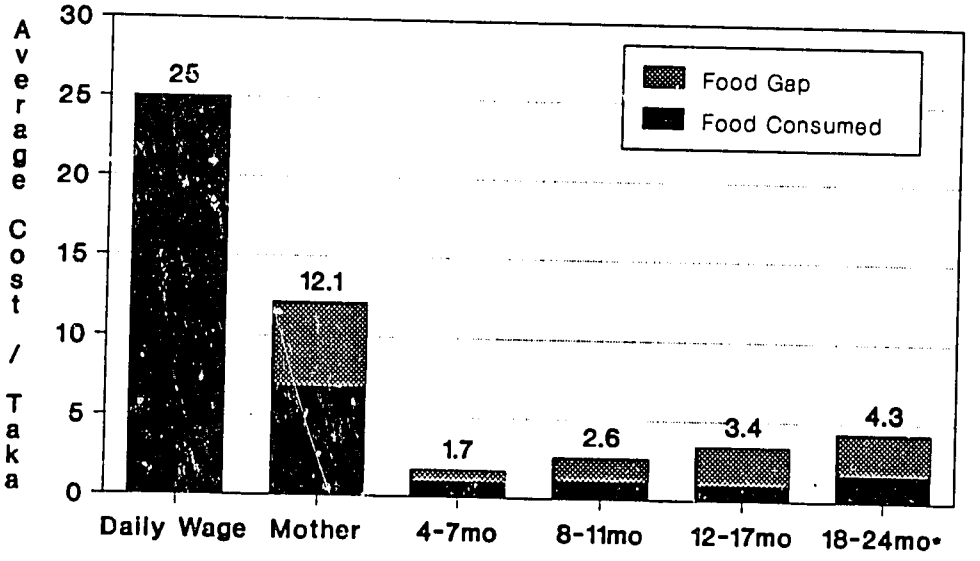
Fig 25. DAILY COST OF PROVIDING INFANT FORMULA, COW MILK#, OR BREASTMILK* COMPARED WITH DAILY WAGE IN BANGLADESH



#Cow milk, alone, is not an adequate breastmilk substitute.

*Breastmilk based on additional food costs to improve lactating mother's diet Costs computed for child 0-6 months.

Fig 26. COST OF ENERGY ADEQUATE DIET FOR LACTATING MOTHERS AND BREASTFED CHILDREN IN BANGLADESH



Costs based on 78 women over 8 mos & 61 control breastfed infants over 5 mos.
*21-24mo data from control site in 1986.

Cost of breastmilk not included.

daily wage earner would need to allocate an additional 21% of his income to improve his lactating wife's diet, but the costs of improving his young breastfed child's diet during the critical weaning period require an additional 3%-6% of his income for the child under 12 months, and 10% for the child 12-24 months. As the child approaches the end of the weaning period, the costs to fill the nutrient gap, above and beyond what families normally provide, stabilize. The additional costs required for children are not negligible for very poor families, but they are much more within a family's means than improving the women's diets, especially when the costs to increase the share given to other family members are included.

6.3 COSTS OF THE NUTRITION MESSAGES: FOOD, FUEL AND TIME

Efforts to increase compliance with messages designed to improve nutritional well-being of mothers and children must address costs of the behaviors demanded of the recipients. The costs can be divided into 3 categories: 1) financial costs for the food, 2) fuel costs for preparation of the foods, and 3) time costs. The previous sections bring reality to the high financial cost of complying with some nutrition messages in the Bangladesh context, particularly for mothers. However, a message may require no additional money, but be labor intensive, and thus, still meet with resistance.

Table 9 ranks the "additional" costs imposed by the nutrition messages tested in the Lactation Intervention. Table 10 does the same for the messages tested in the Weaning Intervention. The additional costs imposed by the messages (in terms of food, fuel, and time) are over and above what women in this sample, based on field observations, practice normally for themselves, and for their children. For example, a mother may already feed her child frequently. Thus to comply with a message to feed a simple food frequently may not require "additional" time for her, despite the fact the daily task requires a considerable amount of time. In another setting, the baseline behaviors may differ, thus the costs - time, fuel, and of course food - would also differ.

The column of "other barriers" on Tables 9 and 10 is by no means an exhaustive list, but highlights a few of the major obstacles to compliance, even if food, fuel, and time costs are low.

6.3.1 Mothers

Field interviews with mothers suggested the most well liked message in the Lactation Intervention was the encouragement to drink 8 or more glasses of water each day (message #4, Table 9). A look at the "additional costs" rating supports the reasons why: compliance required no additional money, no fuel, and only a very small amount of additional time in this setting where drinking water is plentiful. In an environment where water supplies are extremely limited, such as parts of Sub-Saharan Africa, this message may meet with more resistance.

As women in Bangladesh generally feel breastmilk is good for their infants, and continue to breastfeed well into the second and third year, messages #1 and #2, which were, primarily motivational, met with little resistance.

The only message that met with considerable resistance was #3, the crucial message that encouraged the mother to increase her own food intake. The estimated food costs were considerable for this message, as eluded to earlier, ranging from an

TABLE 9. LACTATION INTERVENTION: ADDITIONAL DAILY FOOD, FUEL, AND TIME COSTS OF NUTRITION MESSAGES TO IMPROVE THE DIETS OF LACTATING MOTHERS IN BANGLADESH

MESSAGE	ADDITIONAL COSTS OF MESSAGE			OTHER BARRIERS
	FOOD (taka)	FUEL	TIME	
MOTIVATIONAL				
1) Mother's milk is best; don't bottle-feed.	60-85% savings over bottle-feeding(#)	None	None	Motivation Mother's health
2) If mother has much milk, baby will be happy.	None	None	None	Motivation Mother's health
INCREASING FOOD AND LIQUIDS				
3) Eat large amounts food: 3 plates rice (or 3-5 ruti) w/5-6 handfuls rice, 2 handfuls greens/veg, fish or lentil. (Total cost=7-12 taka)	High: 3-6 taka Minimum cost if also increase family members' food=12 taka(*)	Low	Low	Cultural taboos Intra-family food distribution - need additional food for other family members. Food preferences
4) Drink 8+ glasses water daily.	None	None	Low	Distant water source or limited supply.
SANITATION AND HYGIENE				
5) Before eating wash hands & utensils in tubewell water.	None	None	Medium	Motivation Limited water supply
BREASTFEEDING TECHNIQUE				
6) Offer baby both breasts; Let baby stop the feeding.	None	None	Low-Med	Motivation

Note: Food costs based on average monthly market prices in Zhitka, Manikganj District, Bangladesh, during the study period. 30.5 Bangladesh taka = 1 US$

(#)Theoretically a mother would need to consume 500 calories to produce 400 calories of breastmilk. The average cost the additional calories in the mother's diet = 2.5 taka. Cow's milk averaged 6.1 taka/400 cals, and infant formula averaged 17.3 taka/400 cals. Thus, breastmilk (based on the cost of the mother's diet) provides a 60% savings over cow's milk, and an 85% savings over infant formula.

(*)If a woman increases her food intake, she often must also increase the share given to other family members. Assuming a minimum family of 3, including her husband (1 adult equivalent) and a young child (1/3 adult equivalent). Thus the cost of improving her diet must be increased by a factor of 2.3. The average family size, however, in the Zhitka sample is 6-7, so the additional cost of food to be shared, in reality, would be much higher.

additional 3 to 6 *taka*, depending on whether the low or moderate cost diet was selected. Table 6 presents monthly variations in costs per day and per 100 calories for 4 variations on this message. In Bangladesh, as in many cultures, there is considerable resistance to the idea that the woman should eat more food. Eating only after the rest of the family has eaten is customary, and restricting food intake is considered virtuous. These customs are drilled into the young girl beginning in infancy. In addition, as mentioned previously, if a woman increases her food intake, she must also increase the amount given to other family members. Thus, the cost of complying with message #3 is even greater, in reality, than the cost of simply increasing the mother's amount of food.

6.3.2 Children

Table 10 illustrates the estimated costs for the weaning food messages for children. Table 11 presents monthly variations in costs for 100 calories of selected infant foods, including those promoted through the Weaning Intervention.

Based on field observations, one of the most well liked messages for the weaning-age children was the analogy made for feeding a baby frequently, just like a baby chicken feeds (#3). Chickens are a desirable asset in the Bangladeshi culture, and mothers understood the association between frequent pecking and growth. Compliance with the message cost essentially no additional money, and demanded only a small amount of additional time, above what mothers were already doing.

The message suggesting mothers add a small amount of oil to any food given to the baby was also well accepted (#8). Initially there was some resistance due to a belief that the oil might upset the child's stomach, in addition to a feeling that oil was expensive. After mothers saw other infants eating foods with oil and having no side effects, and, after they were convinced that the cost of oil was the same as for rice (for the same amount of energy) they were willing to comply with the message regularly. Aside from the need to confront the cultural beliefs, this message posed little additional costs, either in money, fuel, or time.

Messages to prepare weaning food mixtures demanded more money, fuel, and time, thus resistance was higher. Discussions with the children's caretakers during the intervention, suggested that time and fuel were as great or greater barriers than food cost. Although *Chop Chop* and *Mishowkow* were well liked foods for young children, *Chop Chop* was prepared more often for several very logical reasons. The basic recipe for *Chop Chop* used less costly ingredients than *Mishowkow*, and was generally less expensive for the same amount of calories (see Table 11)[25]. *Mishowkow*, (or using the general name, *kichuri*) if prepared from raw ingredients, required a considerable amount of preparation time and fuel. If precooked foods (i.e., foods from the family pot) were used, the time required for preparation and the fuel costs were much less; however, spiciness or *jol* of the family foods was a problem.

Fruit, especially bananas, was a desirable food to give to children. However, unless the family had a fruit bearing tree, fruit was rarely given. The market cost of the fruit illustrates why (see Table 12). Bananas were twice as expensive as milk for the

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[25] The average cost for 100 calories of Chop Chop variations ranged from .3 to .6 taka. Mishowkow ranged from .4 to 1.0 taka for 100 calories. Note: in Table 10 the total costs for one recipe are similar simply because of the selected quantity used for each preparation.

TABLE 10. WEANING INTERVENTION: ADDITIONAL DAILY FOOD, FUEL, AND TIME COSTS OF NUTRITION MESSAGES TO IMPROVE THE DIETS OF WEANING AGE CHILDREN IN BANGLADESH.

MESSAGE	ADDITIONAL COSTS OF MESSAGE			OTHER BARRIERS
	FOOD (taka)	FUEL	TIME	
INTRODUCTION OF FOODS AND FREQUENCY 1) Breastfeed baby until 2 yrs; from 5 months give other food.	Lactation cost for mother = 2½ taka	None-Low	None-Low	Motivation Mother's health
2) Give 2-3 small spoons soft food 2-3 x/day - gradually increase.	Low: ½ taka	None-Low	Low-Med	Motivation Food taboos
3) Like a chick, feed baby frequently. like a baby chicken.	Low	None-Low	Low-Med	Season workload
4) Let baby eat as much as wants. Be attentive but don't force.	Low-Med	None-Low	Low-Med	Cultural taboos Child sickness
VARIETY & ENERGY DENSITY OF FOOD 5) Feed Chop Chop to 5 month or older baby - 4 times/day. -flour,molasses,oil,(lentil/milk):	1 recipe = 1-2 taka(#)	Low	Low-Med	Cultural taboos Child refusal
6) Feed Mishowkow to a 7 month or older baby, 4 times/day. -From raw ingredients: *(rice,lentils/egg,greens,oil)*	1 recipe = ½- 2 taka(#)	High	Med-High	Cultural taboos Child refusal
-Pre-cooked: *(rice,lentils/egg/fish,greens,oil)*	1 recipe = ½- 2 taka(#)	None	Low-Med	
7) In season, feed fruit pulp or juice. (ex:small banana, mango, papaya)	½ - 1½ taka(#)	None	Low	Availability & cost very seasonal
8) Add 1 small spoon oil or or molasses to baby's food.	3 spoons = ½ taka(#)	None	Low	Cultural taboos
9) Whatever you cook for family, give some to your baby.	Low-Med ½ - 3 taka(#)	None	Low	Cultural taboos
SANITATION & HYGIENE 10) Before cooking & eating, wash hands, & utensils w/tubewell water, soap/ash. Cover food.	None	None	Medium	Motivation & beliefs Limited water supply
FEEDING & ILLNESS 11) When baby is sick, feed soft food many times throughout day.	Same as normal diet	None-Med	High	Cultural taboos Motivation & patience Child refusal

Note: Food costs based on average market prices in Zhitka, Manikganj District, Bangadesh during the study. 30.5 Bangladesh taka = 1 US$

(#)If a mother feeds her infant more, or special foods, she often must increase the share given to her other children. Assuming there was a minimum of 1 other child, the cost of improving the infant's diet must be doubled. Mothers in the Zhitka study had an average of 3 children, so the cost of improving the infant's diet should be tripled.

TABLE 11. SELECTED BANGLADESH WEANING FOODS - MARKET COST BY MONTH (PER 100 CALORIES)

FOOD	COST (TAKA) PER 100 CALORIES									
	F/Mar	April	May	June	July	August	Sept	Oct	Nov	AVER
WEANING MIXTURES										
Chop Chop - Basic										
- moderate (sugar, average flours)	0.35	0.35	0.34	0.34	0.40	0.41	0.39	0.39	0.39	0.37
- cheaper (molasses, course flour)	0.28	0.28	0.27	0.25	0.34	0.34	0.33	0.32	0.36	0.31
Chop Chop w/Milk										
- moderate (sugar, average flours)	0.51	0.51	0.53	0.50	0.60	0.56	0.60	0.70	0.63	0.57
- cheaper (molasses, course flour)	0.45	0.45	0.47	0.43	0.56	0.50	0.54	0.64	0.61	0.52
Chop Chop w/Lentils										
- moderate (sugar, average flours)	0.38	0.38	0.37	0.37	0.43	0.43	0.43	0.43	0.43	0.41
- cheaper (molasses, course flour)	0.33	0.33	0.31	0.30	0.38	0.38	0.38	0.37	0.41	0.35
Mishowkow, from raw ingredients										
- Rice,lentils,greens,oil	0.39	0.39	0.36	0.34	0.41	0.44	0.45	0.48	0.51	0.42
- Rice,egg,greens,oil	0.75	0.75	0.88	0.86	0.91	0.80	1.10	0.98	1.00	0.89
Mishowkow, pre-cooked										
- Rice,lentils,greens,oil	0.41	0.41	0.37	0.35	0.45	0.48	0.50	0.60	0.63	0.47
- Rice,egg,greens,oil	0.81	0.81	0.95	0.92	1.01	0.87	1.21	1.14	1.17	0.99
- Rice,fish,greens,oil	0.74	0.74	0.74	0.53	0.82	0.83	0.90	0.81	0.91	0.78
OTHER FOODS										
Oil (average of 3)	0.32	0.32	0.36	0.32	0.36	0.37	0.36	0.37	0.38	0.35
Sugar	0.54	0.54	0.48	0.51	0.65	0.70	0.65	0.65	0.65	0.59
Molasses	0.43	0.43	0.34	0.34	0.57	0.57	0.51	0.51	0.68	0.49
Cow Milk	1.28	1.28	1.44	1.28	1.60	1.28	1.60	2.24	1.79	1.53
Banana (average)	4.22	4.22	4.22	2.39	2.75	2.75	2.75	3.67	3.67	3.40

Note: Food costs based on 1987 monthly market prices in Zhitka & Bhadurpur, Bangladesh.
30.5 Bangladesh taka = 1 US$.

same amount of energy. Other costs, in terms of time and fuel, were negligible, however, as bananas and other fruits come "ready-to-eat" as purchased.

6.4 MARKET FOOD PRICES

In many developing countries seasonality determines food availability and food prices. Bangladesh is no exception, as market surveys from the study area illustrate.

Table 12 compares the local market prices from March to November 1987 of over 100 common foods. Prices are illustrated by cost per 100 kcals. Tables F3 and F4 in Appendix F illustrate the prices in units as sold in the market, and in common units of kg for the edible portion. As mentioned earlier, consumer food prices in Bangladesh have increased about 9-10% per year since 1987.

Since foods as purchased from the market vary considerably in amount of waste, water content, and nutrient content, the price by weight does not always provide an accurate ranking of foods as low or high cost sources of nutrients. For example, in Bangladesh, an error is frequently made in comparing the affordability of potatoes with rice. Since the market price (by weight) of potatoes is much less than the market price of rice, and in fact during certain months rice is more than twice the price, potatoes are assumed to be an inexpensive substitute for rice (Appendix F, Tables F3 and F4). In fact, the opposite is true since a high proportion of the weight of raw potatoes is water (Table 12). With regard to energy supply, potatoes are a more expensive source than rice.

This example illustrates the need for program planners to look at the prices of foods by their nutrient contents to prevent erroneous recommendations on low cost food purchasing for poor households.

6.4.1 Monthly Price Fluctuations

The foods found to vary most in availability were fruits and vegetables[26]. Due to this, the largest price swings were observed in these foods. The average rice price varied by about 11 percent over the 9 months recorded, with the highest price observed during the floods (August). Prices for wheat flour increased during the monsoon months, but did not rise sharply during the floods. A likely explanation for this is that wheat supply was kept high during the floods through distribution by various agencies for food relief.

Seasonal fluctuations in food prices are likely to be more harmful for the poor than the better off in a society (Pinstrup-Andersen, 1990). For the poor, food and other basic needs occupy a larger budget share, and when food prices increase, there is less opportunity to shift expenditures from other commodities to food. Relatively small changes in the price of food staples may affect the ability of poor consumers to

[26] In interpreting the market price data, it is important to keep in mind that a number of different varieties of each food - such as rice, pulses, fish, bananas - are often available in the rural markets. For example, on the same day the cost of a "hali" (four) of a "preferred" banana (shobi kola) was 6 taka, a common banana (modna kola) was 2.5 taka, while a banana full of seeds in each bite (bichi kola) cost only 1 taka for four. Similarly, the quality of the foods may vary considerably, affecting the price from vendor to vendor. Since the purpose of this analysis was to get a rough estimate of the market costs of various foods and the economic feasibility of nutrition messages for rural households, an average price was taken for each food group. The reader is reminded that prices and price changes for certain varieties of each food may vary from those observed in the average price.

What a man brings home from the market....

...determines the family diet.

TABLE 12. BANGLADESH MARKET SURVEY (1987) - MONTHLY FOOD PRICES* PER 100 CALORIES

FOOD	PRICE (TAKA) PER 100 CALORIES*										
	F/Mar	April	May	June	July	August	Sept	Oct	Nov	Aver	% Rice Price
	---------- taka per 100 calories ----------										
MILK											
Barley Water	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	251 %
Condensed Milk (Full)	1.02	1.02	1.10	1.10	1.10	1.17	1.17	1.17	1.17	1.11	361 %
Condensed Milk (Skim)	1.23	1.23	1.32	1.32	1.32	1.42	1.42	1.42	1.42	1.34	436 %
Powder Milk (Full)	1.86	1.86	1.86	1.86	1.92	1.92	1.92	1.92	2.02	1.90	619 %
Powder Milk (Skim)	2.59	2.59	2.59	2.59	2.66	2.66	2.66	2.66	2.80	2.65	859 %
Fresh Milk	1.28	1.28	1.44	1.28	1.60	1.28	1.60	2.24	1.79	1.53	497 %
STAPLES											
Rice	0.34	0.34	0.28	0.26	0.29	0.37	0.34	0.28	0.29	0.31	100 %
Jai (Rice)	0.34	0.34	0.28	0.26	0.29	0.37	0.34	0.28	0.29	0.31	100 %
Atar Jai	0.25	0.25	0.24	0.24	0.28	0.26	0.26	0.25	0.25	0.25	82 %
Ruti/Chapati (Refined Flour)	0.30	0.30	0.29	0.30	0.34	0.30	0.30	0.30	0.30	0.31	99 %
Ruti/Chapati (Brown Flour)	0.19	0.19	0.19	0.17	0.22	0.21	0.22	0.19	0.19	0.20	64 %
Ruti/Chapati (Average)	0.25	0.25	0.24	0.24	0.28	0.26	0.26	0.25	0.25	0.25	82 %
Sapri	0.25	0.25	0.24	0.24	0.28	0.26	0.26	0.25	0.25	0.25	82 %
Pitha	0.34	0.34	0.28	0.26	0.29	0.37	0.34	0.28	0.29	0.31	100 %
Potato (Alo)	0.52	0.52	0.52	0.58	0.78	0.78	1.04	1.04	1.04	0.76	246 %
Sweet Potato (Misti Alo)	0.28	0.28	0.18	0.18	0.28	0.37				0.26	85 %
Chirra (Flattened Rice)	0.46	0.46	0.50	0.37	0.37	0.43	0.43	0.43	0.43	0.43	141 %
Muri (Puffed Rice)	0.60	0.60	0.60	0.60	0.60	0.73	0.60	0.60	0.60	0.62	201 %
Kichuri w/Veg	0.34	0.34	0.29	0.28	0.32	0.38	0.36	0.32	0.33	0.33	107 %
Kichuri w/o Veg	0.38	0.38	0.34	0.33	0.36	0.42	0.40	0.36	0.37	0.37	121 %
Biscuit (average sweet & salt)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	177 %
VEGETABLES											
Potato (Alo)	0.52	0.52	0.52	0.58	0.78	0.78	1.04	1.04	1.04	0.76	246 %
Arum (Kachu)		1.17			1.15	1.18		1.15	1.15	1.16	377 %
String Beans (Sim/Barbati)	2.07	0.97						3.04	3.87	2.49	809 %
Cabbage/Radish (PKapi/Mula)	1.28	2.13						4.26	4.43	3.03	984 %
Leafy Greens (Sak)	0.91	0.91	0.61	0.52	1.22	1.22	1.52	2.65	2.92	1.39	450 %
Snake Gourd (Chichinga)		3.95	4.19	3.64	2.43		6.19	5.64		4.34	1410 %
Eggplant (Begun)	1.86	1.86	3.10	2.48	2.48	3.10	9.29	9.91	5.76	4.42	1437 %
Okra (Dherosh)			2.37	2.37	2.37	2.37				2.37	770 %
Ridge Gourd (Jhinga)		1.31	1.31	2.18	1.74	2.18	5.22	5.22	4.05	2.90	942 %
Bitter Gourd (Korolla)		1.97	1.18	1.58		3.15				1.97	640 %
Caulif/Radish/SGourd/Cuke	0.77	1.32	2.96	1.82		2.05		4.56	4.65	2.59	842 %
Pumpkin/Ridge Gourd/Okra		0.96	2.04	2.38	2.30	2.42	4.22	4.22	4.11	2.83	920 %
Eggplant (Begun)	1.86	1.86	3.10	2.48	2.48	3.10	9.29	9.91	5.76	4.42	1437 %
Ash Gourd/Amaranth/Beans	2.28	2.28	1.87	0.46	1.96	1.96	4.56	3.78	6.70	2.87	933 %
Arum Tuber (Kachu Muki)		0.70	0.61	0.44	0.35	0.22	0.22	0.26	0.22	0.38	122 %
Bottle Gourd (Lao)	0.28	0.28	0.43					0.91	0.91	0.56	183 %
Tomato	1.87	1.87	2.68							2.14	696 %
Chili (Kacha Marich)	3.78	3.78	3.45	3.45	3.02	4.31	4.85	4.85	3.78	3.92	1273 %
PROTEIN											
Fish (average of 28 kinds)	4.78	4.78	5.85	4.23	4.83	4.33	4.56	3.80	4.03	4.58	1487 %
Fish (weighted by consumpt)	3.61	3.61	3.91	2.26	4.03	3.82	4.36	2.56	3.13	3.48	1130 %
Chicken Egg	2.44	2.44	3.25	3.25	3.25	2.44	4.06	3.25	3.25	3.07	996 %
Duck Egg	1.35	1.35	1.35	2.07	2.07	1.55	2.59	2.07	1.55	1.77	575 %
Beef/Mutton	3.21	3.21	3.21	3.21	2.81	2.81	4.81	5.21	4.81	3.70	1201 %
Chicken/Pigeon	4.22	4.22	3.70	3.17	3.17	4.22	7.39	7.39	6.34	4.87	1582 %
Pulse (Dal; average of 5 kinds)	0.51	0.51	0.49	0.49	0.55	0.54	0.59	0.57	0.61	0.54	175 %
Oil (average of 3 kinds)	0.32	0.32	0.36	0.32	0.36	0.37	0.36	0.37	0.38	0.35	114 %

(continued)

(Table 12, continued)

FOOD	PRICE (TAKA) PER 100 CALORIES										
	F/Mar	April	May	June	July	August	Sept	Oct	Nov	Aver	% Rice Price
	---------- taka per 100 calories ----------										
FRUIT											
Banana (Kola)	4.22	4.22	4.22	2.39	2.75	2.75	2.75	3.67	3.67	3.40	1106 %
Mango (Am)			3.52	2.57	1.93	1.93				2.49	808 %
Jackfruit (Katal)			4.34	3.47	5.21	6.94				4.99	1622 %
Borai	0.53	0.53								0.53	172 %
Guava (Peara)	2.20	2.20	2.54		3.38	1.69	2.54	2.11	1.69	2.29	745 %
Pineapple (Anarosh)			1.59	1.59	0.79	1.06		1.06		1.22	395 %
Papaya (Pepe)		2.55	6.35	6.35	5.08	2.54	7.62	9.52	5.08	5.64	1831 %
Starfruit (Kamranga)			1.20		20.00	12.00	4.00			9.30	3021 %
Orange (Komola)		23.14	17.36						11.57	17.36	5638 %
ADDITIONAL FOODS											
Sugar	0.54	0.54	0.48	0.51	0.65	0.70	0.65	0.65	0.65	0.59	193 %
Molasses	0.43	0.43	0.34	0.34	0.57	0.57	0.51	0.51	0.68	0.49	159 %
Liquid Molasses	0.43	0.43	0.34	0.34	0.57	0.57	0.51	0.51	0.68	0.49	159 %
Date or Cane Juice	2.92				3.24				3.24	3.14	1019 %
Jilapi (Sweet)	0.62	0.55	0.66	0.60	0.77	0.77	0.88	0.88	0.99	0.75	243 %
Shazna (Horseradish)	2.15	1.29	0.86	0.86						1.29	419 %
Satu	0.21	0.21	0.21	0.21	0.19	0.18	0.18			0.20	64 %
Melon (Bangee)		10.00	1.40	1.40						4.27	1386 %
Sagu	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	241 %
Suji (Seminola)	0.37	0.37	0.37	0.37	0.43	0.43	0.43	0.40	0.43	0.40	130 %
Barley	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	251 %
Wheat Flour (Refined)	0.31	0.31	0.29	0.31	0.34	0.31	0.31	0.31	0.31	0.31	101 %
Wheat Flour (Brown)	0.19	0.19	0.19	0.17	0.22	0.20	0.22	0.19	0.19	0.20	63 %
Wheat Flour (average)	0.25	0.25	0.24	0.24	0.28	0.26	0.26	0.25	0.25	0.25	62 %
Rice Flour	0.34	0.34	0.28	0.26	0.29	0.37	0.34	0.28	0.31	0.31	101 %
Naru (Coconut Sweet)	0.41	0.41	0.49	0.49	0.47	0.49	0.62	0.62	0.72	0.52	170 %
Candy	1.21	1.21	1.21	1.21	1.08	1.48	1.48	1.48	1.21	1.29	418 %
Chanachur (Trail Mix)	0.33	0.28	0.28	0.30	0.32	0.32	0.37	0.37	0.37	0.33	106 %
Banana Flower (Vadail)	2.77	3.32							3.32	3.14	1019 %
Mishty (Sweet)	1.81	2.01	2.01	2.01	1.81	1.81	2.42	2.42	2.42	2.08	676 %
Lactogen (Infant Formula)	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	1408 %
Wood Apple (Bel)		2.29	1.83							2.06	670 %
Jackfruit Seed (Katal Bichi)			0.50	0.40	0.60	0.80				0.57	187 %
Chop Chop (Refined Flour)	0.38	0.38	0.37	0.37	0.43	0.44	0.42	0.42	0.42	0.40	131 %
Chop Chop (Brown Flour)	0.32	0.32	0.31	0.30	0.37	0.38	0.37	0.36	0.36	0.35	112 %
Chop Chop (Average)	0.35	0.35	0.34	0.34	0.40	0.41	0.40	0.39	0.39	0.37	122 %
Sugar Water (Shorbot)	0.54	0.54	0.49	0.51	0.65	0.70	0.65	0.65	0.65	0.60	194 %
Onions											
Onion Fry (Piaz Torkari)	1.32	1.32	1.33	1.73	2.73	2.07	4.70	3.39	0.11	2.08	675 %
Green Coconut (Gab)	0.63	0.76			0.70					0.70	226 %
Green Banana (Kacha Kola)	1.87	2.08	1.66	1.66						1.82	591 %

Note: Food prices based on 1987 monthly market prices in Zhitka & Bhadurpur, Manikganj District, Bangladesh.

* 30.5 Bangladesh taka = 1 US$

meet nutritional requirements. The price of rice jumped 33 percent from May to August. In this society, where over half of the family food budget is spent on rice, a 33 percent increase in price would mean approximately a 17 percent increase needed in food expenditures. As the diets were already highly grain based, with very little animal food and little room for substituting less expensive foods, the only alternative for these desperately poor households was to limit the amount of food they purchased that day or week. When times were rough, which was all too often, many villagers ate only rice and salt.

With food price increases in rice, the poorer households likely purchased cheaper varieties of rice or substituted wheat; an increase was observed in the proportion of wheat in the women's diets, compared with rice, during these months. However, when unemployment is high, even this substitution cannot provide enough of a cushion to ensure an adequate diet.

It is also possible that some households had stocks of grain and vegetables, and thus did not need to purchase all the foods in the market. Having food stocks is most typical of the large landowners, of whom there were very few in this sample.

PART 7
DISCUSSION

7.1 DISCUSSION OF FINDINGS

The results of the cost analysis help to validate the concerns of strong economic barriers raised during the field implementation of education to improve lactating mothers' diets. For a woman to consume an adequate diet using low cost foods, she would need to nearly double her food budget, at an additional cost of 21% of the daily wage. In reality, these costs would be much greater as she would also need to increase the allocation of food to other household members. In the Bangladesh context, the breastfeeding infant's diet could be improved with a "low cost" weaning food for about one-third of the additional cost for improving a lactating woman's diet, or less than 8% of the daily wage.

Financial barriers were present for the children also - even 1-2 *taka* is not a negligible sum. However, given the lower average cost, and the fact that fewer family members' diets would also need to be supplemented, the financial barrier for infants is more feasible to, at least partially, overcome. The gains achieved for the treatment children in the Weaning Intervention, which were notably still less than ideal, were accomplished for only 2% of the daily wage more than what controls spent. Assuming other under-fives were also fed more, the additional cost to the family may have been 6% of the daily wage.

7.1.1 Not Enough Food to Go Around

"OK, if you want me to eat more food, give it to me!"....the frustrated response of the poor mothers to education to improve their own diets highlights the magnitude of their powerless condition.

The financial constraints for the mothers to comply with nutrition education messages aimed at improving their diets (with the possible exception of vitamin A) should be of great concern to program planners. Most of the women in this study wanted to improve the quantity and quality of their diets, but felt helpless to do so, given the economic, seasonal, and cultural constraints. While it is possible the education program helped women prevent the severe decline in dietary adequacy that was seen in the controls over the hungry season and after the flood, the difference cannot be solely attributed to the intervention.

The cost estimates of the messages for mothers document the financial obstacles to compliance that were apparent from the beginning of the education intervention.

Indeed, improving the woman's diet so that she could produce an adequate amount of milk for her young child and remain healthy and active, would *double her food costs*. While the woman, who eats last in the Bangladesh household, may be getting less than her "fair share" of the family food, one glance at the extreme leanness of the men in the household, and the poor nutritional status of the children suggests that *no one* was getting an adequate nutritional allotment. To take food from the husband would put the bread-winner (or more appropriately, rice-winner) in even worse shape to earn income for the family. To take from the children would have a devastating effect on their growth, and the future of the household. To impose a burden of taking from others in the household for her own health is to further increase the anxiety of the woman, whose sole duty is to nurture her family.

Improving her child's diet is likely to be more feasible for a Bangladesh woman than improving her own diet for several reasons: 1) she has more control over her child's diet; 2) investing in her child is valued in this society, whereas investing in herself is not culturally acceptable - for example, it is more acceptable for a woman to ask her husband to purchase additional foods for the baby than to purchase additional foods for herself; and 3) since breastmilk provides the bulk of the young child's diet, only small amounts of additional foods are necessary. The costs for children are not inconsequential, however, and the cost of filling the energy gap for the children increases considerably in the second year (and thereafter), when breastmilk intake likely declines.

In reality, if the woman increases her share of the food, she must also increase the share to other family members. In a *minimum* household of one child and 2 adults, this would impose an "additional" financial burden equal to half a daily wage earners pay. To increase the share given to her infant, assuming she would also have to increase the share given to her other children, would cost less than 15-23% of a daily wage.

The woman's food intake appeared more affected than the infant's by the seasonal availability and prices of food. The majority of the Bangladesh infant's diet was breastmilk, so only a small additional amount of food needed to be supplied by complementary foods.

Traditional adult diets are already about as low cost as possible (with the exception of substitution of wheat for rice), with over 80 percent of the calories from grain, and little or no animal foods. Education to change food choices for women in order increase food consumption will likely be futile. The only exception to this is if donated wheat (the price kept artificially low due to subsidization) were substituted for rice. Some of this substitution is taking place in poor households, already, but the acceptance is gradual, and rice is still the preferred food. The other drawback to this approach is the effect on agriculture in this predominantly rice growing country, and further dependence on food aid.

7.1.2 Growth Effect of the Weaning Intervention vs No Growth Effect of the Lactation Intervention

The lack of a detectable (significant) growth difference between treatment and control infants in the Lactation Intervention strengthens the conclusion that the Weaning Intervention had a positive impact on child weight gain. Treatment children in both interventions were from the same site, as were controls. Had the flooding during the monsoon season exerted a differential impact on the young infants from each area, the treatment children in both the Lactation Intervention

and the Weaning Intervention would have been expected to grow significantly better than the controls. This was not the case.

Findings from the Weaning Intervention suggests a realistic goal for a nutrition education program in an impoverished setting such as Bangladesh. Given in isolation, without addressing the economic, environmental, political, and social barriers, nutrition education may prevent a worsening in nutritional status, but will likely not be adequate for the child to achieve an international ideal. For example, for infants, weaning food education may soften the sharp deterioration in nutritional status seen from 4-6 months of age to 2 years, but may not promote catch-up growth to international norms. In other words, the realistic achievements, for education alone, would be more on the order of maintenance than "catch-up", unless the socioeconomic conditions are improved. The growth effects observed in this study (resulting in approximately .5 kg improvement in weight gain over 5 critical weaning months) are similar to findings from Indonesia where nutrition education was conducted in isolation of other interventions (Berg, 1987). On a large scale, when education is integrated with other programs the effect on child growth is likely to be greater than with education alone, examples of which include Narangwal Integrated Nutrition and Health Care, the Tamil Nadu Integrated Nutrition Project (TINP) and the Community-based Programs for Child Survival and Development in Iringa, Tanzania (Huffman and Steel, 1989).

7.1.3 Lack of Comparable "Snack" Food for the Mothers

Although the costs of complying with the nutrition messages to improve their own diets were often beyond the poor village woman's financial resources, economics were by no means the only barrier. Financial constraints were superimposed on limitations defined by culture. A deeper look into the cultural beliefs and practices around eating offers a further explanation as to why the messages designed for children in this study may have been more culturally feasible than the messages designed for mothers.

In Bangladesh, as in many Asian countries with rice-based diets, a person feels they have not eaten if they have not consumed a rice meal. One high level Bangladesh government official recalled spending a month in New York City, and after several days of McDonald's Big Macs and french fries, began combing the streets for a plate of rice to satisfy his psychological craving (Brown, May 1987).

In this study, village workers received considerable training to probe carefully in their questioning of sample women for all foods consumed during the 24-hour recalls, since snack foods were often not spontaneously recalled[27]. Similarly for children, by probing and observation we found the widely held perception that children were not fed until well into the second year of life was not an accurate description of practice. While they were not assertively fed a family rice meal until about 18 months (Zeitlin, 1987), bits and pieces of a variety of appropriate weaning foods were offered starting around 4-6 months. The prevailing perception was that unless the food was rice, it didn't "count". In part this may stem from the feeling, embedded in the culture through many years of consuming large quantities of rice, that no other food provides the satiety of a rice meal.

Many of the weaning food messages promoted "snack type" foods...foods that could be eaten outside of a meal, and, that hence essentially "didn't count". Because the

[27] Even with careful recall few women in this study were found to consume foods outside of meals.

process of designing the messages was conducted by the community, the trials automatically came out with recipes that fulfilled not only cultural criteria, but also other critical criteria that we may never succeed in isolating. One of the most popular weaning foods was *Chop Chop* which was a flour-based cooked cereal enriched with sugar, oil, and sometimes milk or lentil flour. Food preparation time was minimal, and the food did not challenge the complicated cultural "meal" taboos.

On the contrary, the messages for women, also designed by the community, focused primarily on increasing foods eaten at meals, thus they confronted the self-sacrificing cultural taboos ingrained in the women from childhood about limiting their food intake at meals so that others in the family could eat. A snack food comparable to that promoted for the infants did not evolve from the community trials, thus was not tested.

Why didn't the snack approach for women emerge naturally, as it did for the children? Possibly because snacking is not as common for women, while, in general, all foods given to children under about 18 months are considered snacks (i.e., "don't count"). In addition, the financial barriers to improving women's diets are the same whether promoted through snacks or meals.

Recent work by other organizations in Bangladesh, suggests the snack approach to improving nutrition for women holds promise in addressing cultural barriers. Save the Children USA (SAVE) in Bangladesh is perfecting the technique for preparing a snack food, *Satu*, similar in ingredients to *Chop Chop* (Dr. Amin, personal communication, 1990). Wheat and lentil flour are combined and toasted, forming a pre-cooked cereal base. This dry homemade mixture can be safely stored for several weeks, limiting labor for the mothers. The food was originally developed as a low cost convenience cereal for infants, to which water or milk (in addition to oil, vegetables, sugar) could be added. However, SAVE discovered mothers enjoyed the toasted dry mixture and would occasionally grab a handful for themselves (G. Berggren personal communication, 1991). In a society where few snack foods are available, affordable, and non-perishable, *Satu* offers a promising means of improving women's nutritional status.

Of course, care must be taken, in promoting such foods, to maintain the food for the young infants. In addition, the financial barriers must be addressed, as with the meal-approach.

7.1.4 Participatory Education

An important element of the Lactation and Weaning Intervention was the participatory nature of the education, and the involvement of the recipients of the education in the development of the messages.

While both Interventions used the same educational approach, the weaning food messages demanded more active participation by recipients, for example, through the preparation of special recipes, than those developed for mothers. The messages developed for the women encouraged "more" of what the women were already doing. Workers discussed food amounts, and when appropriate, used foods and utensils in the homes for a visual illustration of the dialogue.

Perhaps if the messages for women had demanded more active participation, such as preparation of a convenience snack food, the behaviors may have been more memorable and compliance greater. However, this optimistic assumption presumes

complying with the message would be feasible - low cost, low labor, and culturally acceptable - which is a continuing challenge. Filling the nutrient gap with a snack food, however, would still likely have been prohibitive for the mothers without income support or donated foods.

7.1.5 Economics of Breastmilk vs Substitutes

Since nearly 100 percent of rural women in Bangladesh breastfeed their children (Huffman et al, 1980), and breastmilk is generally considered best for children, a strong argument of the advantages of breastmilk over formula or cow's milk need not be made here. However, advocacy is greatly needed to address the poor diets and nutritional status of the lactating women, in part so that they can adequately breastfeed.

While we have found that improving a woman's diet may be beyond her financial means, we also estimated that providing the woman with the additional calories necessary for lactation would provide a considerable savings to the household over using a breastmilk substitute. **Feeding cow's milk would cost nearly one and a half times, and infant formula about four times, the cost of providing the additional food needed for lactation to the mother**[28]. This finding supports the need to penetrate the financial barriers to improving women's diets.

7.1.6 Women's Education and Health

The finding that a woman's exposure to formal education, even after controlling for wealth, was a significant predictor of the nutritional adequacy of her diet (energy intake), and in the Weaning Intervention, was predictive of the children's nutritional status and weight gain requires special mention. The link between maternal education and child health has been highlighted in a number of countries, including Bangladesh, and to a lesser extent the link with education and maternal health has been described (Caldwell, 1979; Chowdhury, 1982; Cochrane, et al 1980; Hobcroft et al, 1984; Bhuiya et al, 1986; Caldwell, 1986; Ware, 1986; Guldan, 1988). Unlike income improvements, schooling may affect attitudes and tastes, in addition to productivity (Behrman and Wolfe, 1984).

Bairagi (1980) found that literate mothers used a higher family income to the greater benefit of their children's nutritional status than illiterate mothers. Guldan (1988), studying women from the same site in Bangladesh as this study, consistently found significant differences in child feeding and hygiene practices of women with varying levels of formal education. In general, women with any education had more positive practices - for example more attentive feeding of their child, cleaner homes and clothing, and more hygienic food preparation. However, not all the differences were interpreted as positive - for example, they breastfed the children less frequently and terminated the feeding more often. Barrera (1991) suggests that more educated Filipino women are able to provide wholesome substitutes to breastmilk without production ill effects.

Huffman et al (1985) found the education level of Bangladeshi women was positively associated with their own height, weight, and hematocrit. Women with education have been reported to have fewer and more spaced children (Kasarda et al, 1986; Jain and Nag, 1986). This, alone, can have a considerable impact on their

[28] These cost estimates take only food costs into consideration. The estimate for improving the mother's diet is based on the market value of the diets of the women in the Lactation Intervention. See Part 6 for more discussion on this.

own health by reducing the economically unachievable nutrition demands placed on them through frequent child-bearing.

While the specifics of the relationships between education and health still need to be teased out (Behrman and Wolfe, 1987), promoting access to education for women deprived of even the most basic exposure still holds strong promise for many as a pathway to better maternal and child health.

7.1.7 The Money Problem: Potential for Women's Income Generation & Savings Groups

There is some evidence, through the program of Save the Children USA (SAVE) in Bangladesh, and anecdotally from other NGOs, that the participation of women in savings groups has a positive effect on their child's growth (Berggren and Sternin, 1988). The effect is likely due to empowerment of the women, the information exchange of the group forum, as well as the income generation. Through these forums, well designed nutrition education efforts are likely to have a multiplier effect in improving child nutritional status.

Income generating programs and women's savings groups, such as those through SAVE, BRAC, or Grameen Bank, can potentially reduce the economic barriers for women to improve their own diets. However, experience with SAVE suggests that **this benefit does not naturally occur**. Many of the village women in SAVE's impact area, having achieved a substantial savings over the years, don't know what to spend the money on. (G. Berggren, personal communication, 1991). Bangladeshi women are taught throughout their lives to be self sacrificing, and they would not spontaneously spend money on themselves. **For income generating and savings programs to be successful in improving women's diets, specific, carefully developed guidelines on how the money can be spent wisely must be offered in conjunction with the programs.**

7.1.8 Vitamin A - Potential for Closing the Gap

Since the maternal dietary adequacy for vitamin A was estimated to be extremely poor in this study, and vitamin A deficiency diseases so common in Bangladesh, vitamin A deserves special attention. In the short term, vitamin A capsules are being distributed in many areas. However, for the long term, improving the amount of affordable vitamin A-rich foods available to the households is a realistic, feasible goal.

Closing the vitamin A gap for the women should be economically feasible for most Bangladeshi women and children if dark green leafy vegetables, or *shak* (considered a "poor man's food") are consumed. Only very small amounts of dark greens are needed to meet the requirement. Even when prices are highest, the cost for women to meet the requirement is only 4% of the average daily wage, and well under that for children. Dark greens of various varieties are generally available year round, though market prices fluctuate seasonally. During certain months - specifically October and November during the year studied - the high market prices may still present a barrier to poor households. While nothing may be able to be done about the unexpected catastrophic seasonal losses suffered during certain years, efforts can be focused on improving the overall supply and consumption year round. Since vitamin A is stored in the body, ensuring adequate consumption of the nutrient during more plentiful seasons may help to protect against unforeseeable, yet seemingly frequent, seasonal crop failures.

Our field observations suggest most households grow such vegetables in home gardens. Even those with little land will grow a "roof garden" using vine vegetables. Zeitlin and Megawangi (1989) found large differences in home grown greens by season in Bangladesh. Despite the fact that the intervention had only marginal success in improving the vitamin A adequacy of the diet, we believe, with more focused education and provisions to meet the relatively low costs, vitamin A consumption can be successfully increased for women and children. The critical issue for improving consumption may be whether greens are *free*. BRAC is currently conducting an home gardening intervention to promote the growth and consumption of vitamin A and carotene rich vegetables and fruits (Nasreen Huq, BRAC, personal communication, 1990). This will further reduce the seasonal economic barriers to correcting vitamin A deficiency.

The low fat content of the women's diets may hinder absorption of the nutrient. However, the extent to which this occurs is not known. The overall fat intake of the breastfeeding children's diets should be sufficient to allow adequate absorption of carotene and vitamin A. The greater challenge with infant diets is persuading mothers that consumption of dark greens will not be harmful to the child. The Weaning Intervention, which used in-home demonstration and persuasion by neighboring village mothers, suggests this is possible. The effects of potential toxins in some leaves may need to be monitored with increasing use for children.

7.2 INCORPORATION OF LESSONS LEARNED INTO BRAC'S PROGRAM

Lessons learned from the educational interventions are timely for BRAC as they launch into a new "Women's Health and Development Program" (WHDP). This three year initiative (1991-1993) is designed to provide a packet of interventions to reduce maternal and infant and child mortality rates while developing the capacity to sustain the results. A major thrust will be to combine health activities with the components of education, rural development and credit to improve the health of those most vulnerable (BRAC, 1990a).

Nutrition education will be an important element of this program. Nutrition education to address the needs of children under age 2 has been ongoing for the past few years through BRAC's child survival program, with the largest focus occurring during growth monitoring sessions. Health education efforts have not yet focused specifically on women. This study confirms the need to complement educational messages to improve women's diets with programs that enhance economic well being at the household level. Programs may be combined with women's savings or credit plans, or home gardening for vitamin A. **Program funds should not be channeled to nutrition education campaigns conducted in isolation of these supports for women.**

This study also confirms the beneficial relationship that a woman's exposure to education has on health (hers and her child's), which argues for the value of efforts such as BRAC's non-formal primary education program (NFPE). This innovative program offers an alternative to poor children (especially girls) who have been by-passed by the government school system. The three-year curriculum provides the basic education needed for rural Bangladeshi life, and holds promise for the future generation of mothers. BRAC has observed an information spread of concepts taught the children at school, to their homes, and is considering strengthening a curriculum on nutrition. These schools can be important vehicles for simple

nutrition messages, including cooking demonstrations, preparation of snack foods, gardening interventions, promotion of vitamin A-rich foods, and hygiene.

In BRAC's proposed WHDP, young girls ages 14-17 years will be provided with educational opportunities on safe motherhood. The same concepts described above for the younger children can be emphasized for the adolescent girls. The financial obstacles for the school-age children and adolescent girls to consuming larger quantities of food at home will remain obstacles to their families, as the costs of improving the lactating mothers diets did in this study. Building up the children's human capital and teaching them marketable skills may help whittle away some of the economic barriers to improving diets in the long-run.

A follow-up field visit to Bangladesh by Laurine Brown, project consultant, was scheduled for January 1991 to review the research findings and program implications with BRAC and local organizations. Unfortunately, the trip was cancelled due to unrest in the country in response to developments in the Persian Gulf War.

BRAC NFPE village school.

PART 8
CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The findings from this study lead us to concude that the nutrition education given to lactating mothers to improve their diets, in this culturally restrictive and economically deprived setting, had limited measureable impact on their nutritional status and that of their breastfeeding children. By contrast, culturally appropriate and feasible complementary messages for breastfed infants after 5-6 months resulted in behavioral change and improved weight gain of children.

Financial barriers were a great constraint for the women in improving their own diets (with the possible exception of vitamin A). However, economics was not as great an obstacle for improving the infants' diets. In the Bangladesh context, the breastfeeding infant's energy gap, could be closed for less than one-third of the cost of improving the lactating mother's diet, or about 8% of the daily wage. This difference becomes even greater if the costs to increase the share of food given to other family members, which would be a cultural necessity, are estimated. The gains achieved in the Weaning Intervention for the children over the five month critical weaning period, which did not close their ideal gap, were accomplished for only 2% of the daily wage. Assuming other under-fives in the family also shared the complementary foods, the costs of the gains achieved might have increased to 6% of the daily wage.

In addition to economics, cultural beliefs and practices may have hindered compliance to nutrition messages for mothers more than for the children. The Weaning Intervention successfully promoted a convenience snack food for children. However, the messages developed by the community for mothers lacked a comparable snack food, focusing primarily on increasing the number of meals and amounts consumed at meals. With hindsight, the snack approach might have been a more culturally feasible way for the women to unobtrusively increase their food intake, though the financial barrier would still be present. Although the specific nutrient needs and cultural taboos may differ slightly, these conclusions can be generalized to all women of childbearing age, including adolescents and pregnant women.

If the severe financial barriers to compliance are addressed, we believe it will be possible to improve women's diets through nutrition education. In the presence of an increase in purchasing or food producing power, additional testing would still be needed to adapt the educational messages to the new circumstances.

MAJOR POLICY RECOMMENDATIONS

- In an impoverished setting such as Bangladesh, **attach nutrition education for improving women's diets to programs that make these improvements affordable**, such as women's savings groups, income generating projects, agricultural production, home gardens, or subsidized or donated food programs. Nutrition education should not be given to women in isolation of these supports.

- With or without other program supports, **encourage hygienic complementary feeding of simple, cheap, energy-enriched food in breastfed infants after 5-6 months.** In Bangladesh, the messages designed in village homes by this project have demonstrated the potential, and BRAC has gone on to implement them on a large scale. In other countries, similar village-level formative research should be conducted to design appropriate messages.

ADDITIONAL RECOMMENDATIONS

- **Explore village-based vs wide-scale production of time- and fuel- saving infant foods** (similar to *Chop Chop* or *Satu*), **using community-based message design procedures similar to the one in this project.** Examples include quick cooking cereal bases combining subsidized grains and lentil flours to which oil, sugar, vegetables, milk powder and other foods can be added in the preparation. Explore low cost options for "finger foods" that the transitioning child can successfully self-feed.

- **Explore snack foods preparations for women.**

- **Improve diets with donated grains if an effective vehicle for dissemination can be found.** For example, in BRAC areas, grains can be distributed to children in non-formal primary schools with demonstrated recipes for preparation. It would be be expected that some of the food would be shared with other family members.

- **Design strategies to help caretakers deal with infant feeding problems.** Of high priority should be programs to prevent and treat infectious illness, as well as micronutrient supplements if needed. Combine handwashing and hygiene messages with feeding messages.

- **Train** village-level health and nutrition workers **to demonstrate food preparation methods and to model expected behaviors**, rather than simply verbally teach the education messages.

- **Engage fathers and other family members in the issues of intrafamily food distribution.** It is our assessment in Bangladesh, both informally and through the analysis, that all household members suffer from lack of adequate food. Reducing the food portions of other household members to increase the woman's portion may do more harm, psychologically, than good for the woman whose sole responsibility is to care for her family. Instead, means to improve the diets of the entire family are needed.

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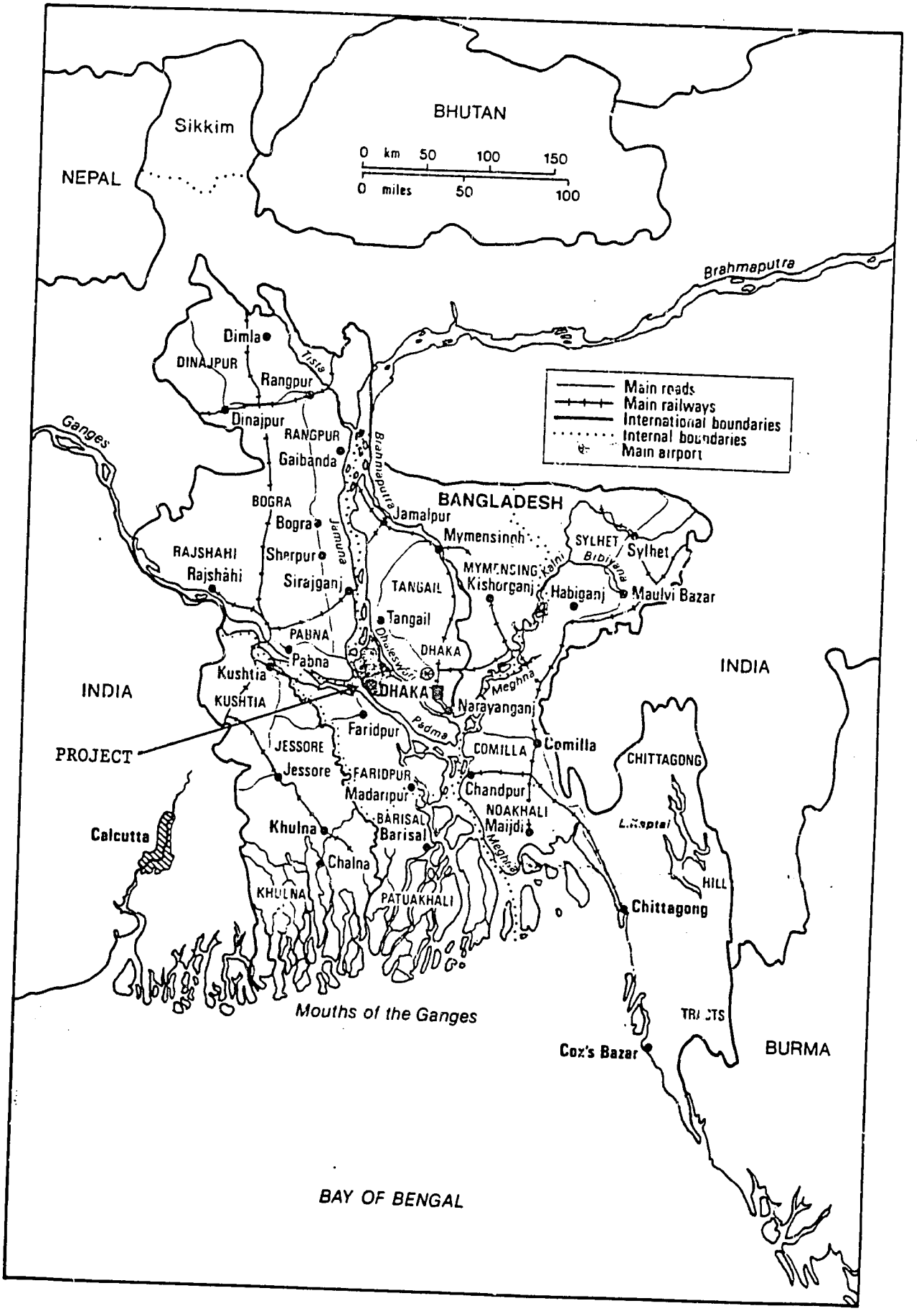
APPENDIX A
MAP OF BANGLADESH AND PROJECT SITE

Bangladesh - Map and Project Site



APPENDIX B
ESTIMATION OF NUTRIENT REQUIREMENTS FOR LACTATING MOTHERS IN BANGLADESH

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APPENDIX B.

ESTIMATION OF NUTRIENT REQUIREMENTS FOR LACTATING MOTHERS IN BANGLADESH

Guidelines and rationale used in Lactation Intervention to compute breastfeeding mothers' nutrient requirements and nutrient adequacy. Requirements computed: Calories, protein, iron, and vitamin A.

(by Laurine Brown, July 1990)

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ENERGY REQUIREMENT

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SUMMARY:

ENERGY REQUIREMENT (RQ) = RQ for non-lactating woman (BMR + activity) + factor for lactation

= 1905 kcals + 500 kcals
= 2405 kcals/day

1. ENERGY REQUIREMENT FOR NON-LACTATING WOMAN

The basal metabolic rate can be computed from Table 5, pg 71, WHO 1985, using a woman's weight (see Table B1 below. Note: A formula which includes *height and weight* in Annex 1, pg 178, WHO 1985, gives about the same results). The energy requirement for the non-lactating woman is not computed here with added standard deviations (Indian references).

Table B1. BASAL METABOLIC RATE (BMR) + ACTIVITY NEEDS:

AGE (yr)	% OF SAMPLE	BMR* x (40.4kg/45kg)	(#) x ACTIVITY	TOTAL
10-18	(1.3%)	12.2W + 746 = **1239**/1295}		= **2180**/2279
18-30	(65.4%)	14.7W + 496 = **1089**/1158}	x 1.76	= **1916**/2037
30-60	(33.3%)	8.7W + 829 = **1180**/1220}		= **2076**/2148
WEIGHTED AVERAGE:		= **1121**/1180 kcals/d		= **1973**/2077 kcals/d
			x 1.7	= **1906**/2006 kcals/d

* Average weight and height of the Bangladeshi female (in Huffman et al 1985) is 40.4 kg (+4.6 SD = 45 kg), and 147.9 cm (+5.2 SD). 40.4 kg was selected in this study as the average weight. Thus the BMR + activity is 1906 kcals/day.

\# Activity level for rural Indian woman is BMR X 1.76 (Table 14, pg 78, WHO 1985). Moderate activity for a woman (Table 15, pg 78, WHO 1985) is 1.64 X BMR. In this study, Table 14 was adapted below to arrive at an activity level of 1.7 X BMR:

	HOURS	*TIME*	*KCALS*
BED 1.0 X BMR	8	33%	370
OCCUPATIONAL ACTIVITIES -HOUSEWORK, FOOD PREP, GATHER WATER, CROP PROCESSING 2.7 X BMR	7	29%	878
DISCRETIONARY ACTIVITIES 2.5 X BMR	2	28%	234
RESIDUAL TIME 1.4 X BMR	7	29%	*455*

TOTAL = 1.73 (or 1.7) x BMR (1121 kcals) = *1906 kcals/day*

Weighting the estimated requirements by the distribution of age of women in the Lactation Intervention, the requirement for the non-lactating woman is 1906 kcals/day (rounded to **1905 kcals/day).**

2. ADDITIONAL ENERGY NEEDS FOR LACTATION

Additional energy needs for lactation depend on the milk output of the woman. Milk output, in turn, depends on the age of her child, and other factors (such as nutritional status, weight gain in pregnancy). Attempts were made to be consistent with the assumptions made for the breastmilk intakes estimated for the infants studied (see Appendix C for estimation of breastmilk volumes for the Weaning Intervention).

WHO (1985) recommends 500 additional kcals for lactation. This is based on an estimated breastmilk volume of 750 ml/day in the first 6 months and 600 ml/day in the second 6 months (in a healthy woman). 650-700 kcals is recommended the first 6 months if the gestational gain is abnormal. Using WHO formulas (WHO 1985, Table 19, pg 88) and the estimated breastmilk volumes for the rural Bangladesh woman (Table B2, column 2 or Appendix C), the amount of calories and protein the mothers require to produce these volumes (though inadequate) were computed. Table B2 is a worksheet summarizing the comparison of the WHO samples and the Bangladesh sample. The Indian references recommend 500-550 kcals in the first 6 months, 400 kcals in the second 6 months. (The Indian reference woman is 45 kg in these computations, and the non-lactating energy requirement is estimated to be 2200 kcals/day [ICMR 1981]).

For this study, it was concluded to add 500 kcals for the first 12 months of lactation. Since breastmilk volume is stable in Bangladesh the second year, the requirement was kept at 500 kcals/day.

Adding the lactation requirement to that of the non-lactating woman **the estimated energy requirement for the lactating rural Bangladeshi women:** 1905 + 500 = **2405 kcals/day.**

Table B2. Comparison of Breastmilk (BM) Volumes used by WHO (1985) for Computing Energy and Protein Requirements for Lactation with Breastmilk Volumes and Nutrient Requirements Estimated for a Rural Bangladeshi Woman (see Appendix C).

Child Age *(mo)*	WHO BM vol (WHO Tb 19 pg 88)	Bangladesh^ BM vol (Appendix C)	ENERGY RQ based on B'desh BM volmue* *(vol x .875)*	WHO ENERGY RQ	PROTEIN RQ based on B'desh BM volume# *(1mo: vol x.0186)* *(2mo: vol x.0165)*	WHO PRO RQ *+2SD*
0mo	719ml	559ml	489kcals	5	10.4gm	
1	795	566	495	0	9.3	
2	848	599	524	0	9.9	
3	822	632	553		10.4	
4		634	555	K	10.4	
5		645	564	C	10.6	16 gm
6	600	621	543	A	10.2	
7		645	564	L	10.6	
8		628	550		10.3	
9		618	541	R	10.2	
10		600	525	E	9.9	
11		582	509	C	9.6	
			(ave 534kcals	O		
			1st 12mo)	M		12 gm
12-17	550	563	493	M	9.3	
18-23		501	438	E	8.3	11 gm
24+		368	322	N	6.1	
				D		

* Breastmilk (BM) volume x .7 cal/100ml x 80% conversion. (WHO 1985, Tab 19, p88)
\# Breastmilk (BM) volume x 1.3 g protein/100ml (for 1 month child) x 70% conversion. (WHO, Tab 20, p89)
x 1.15 g/100ml (if child age > 1 month) x 70% conversion.

BANGLADESH BREASTMILK NUTRIENT COMPOSITION PER 100 GRAMS (Brown et al, Am J Clin Nutr 36:878-889, 1982):

61 KCALS
1.0 gm PROTEIN
3.0 gm FAT
7.5 gm CHO
1.0 mg IRON
30 mcgm RET EQ (100 IU VITA)

^Breastmilk volumes adapted from the following references (see Appendix C):

1. Brown, K., R. Black, S. Becker, S. Nahar, J. Sawyer. 'Consumption of Food Nutrients by Weanlings in Rural Bangladesh'. An J Clin Nutr 1982;36:878-889.
2. Brown, K., N. Akhtar, A. Robertson, M.G. Ahmed. 'Lactational Capacity of Marginally nourished Mothers: Relationships Between Maternal Nutritional Status and Quantity and Proximate Composition of Milk', Pediatrics 1986;78(5):909-919.

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PROTEIN REQUIREMENT

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1. PROTEIN REQUIREMENT FOR NON-LACTATING WOMAN

WHO (1985) recommendation for adult protein requirement (lower end of safe range of protein intake of high quality):

Adult Protein RQ = .6 gm/kg/day + 25% (2SD)
= .75 gm/kg/day

Assuming the average Bangladeshi woman weighs 40.4 kg, the requirement would be:

Protein RQ for Non-lactating Bangladesh Woman: = .75gm/kg/day x 40.4kg
= 30.3 gm protein/day

2. ADDITIONAL PROTEIN NEEDS FOR LACTATION

The additional protein needed for lactation was derived from WHO 1985 (pg 89 - as described in text includes RQ +2 SD). This is the amount of protein needed to produce the assumed breastmilk volumes (see also Table B2 above). As with energy, this suggested amount may be more than what malnourished Bangladeshi women are *actually* producing.

Breastfed Child Age	Lactation Factor	Non-lactating pro RQ	**Total pro RQ**
0-6 mos =	16 gm	+ 30.3 gm	**=> 46.3 gm protein**
6-12 mos =	12	+ 30.3	**=> 42.3**
12+ mos =	11	+ 30.3	**=> 41.3**

3. ADJUSTMENT FOR LOW PROTEIN QUALITY

Since protein quality of the complementary food was low, a modification was made for dietary protein quality and digestibility according to WHO guidelines (WHO 1985: Tables 40 and 41, pg 124-125). The protein requirement of the woman was adjusted upward based on the *intake* of low quality protein foods. The requirement RQ was adjusted using the following equation:

ADJUSTED PROTEIN RQ = (((PRO RQ) * (gms POOR)/(gms TOTAL PRO)) * (ADJUST)) + ((PRO RQ) * (gms GOOD)/(gms TOTAL PRO))

POOR QUALITY PROTEIN: *(POOR)*	Grains, vegetables, fruits, legumes, sugars, oils
Assumptions: *(ADJUST)*	85% Digestibility 75% Amino Acid Score (Indian Diet) *Adjustment of RQ: (100/85)*(100/75)*
GOOD QUALITY PROTEIN: *(GOOD)*	Eggs, fish, meat, poultry, milk,
Assumptions:	100% Digestibility 100% Amino Acid Score *No adjustment to requirement*

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IRON REQUIREMENT

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The iron requirement for non-lactating and lactating women was derived from (NRC 1989).

TOTAL IRON REQUIREMENT FOR LACTATING WOMAN = **15 mg/day**

RATIONALE: Iron loss is not normally distributed in women. Losses amount to 1 mg/day for males, with an additional .5 mg/day for women. In menstruating women, intakes of 10 mg/day are associated with adequate iron status in 86% of the population. Distribution analysis suggests 14 mg/day is sufficient to meet the needs of all but 5% of menstruating healthy women. Therefore, 15 mg is the recommendation. During lactation, losses are about .15 to .3 mg/day. However, women are not menstruating, so the requirement is the same as a non-lactating woman for the first and second 6 months of lactation.

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VITAMIN A REQUIREMENT

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The vitamin A requirement for the non-lactating and lactating women was derived from NRC (1989). A normal, health non-lactating woman requires 800 ug retinol equivalents (RE) daily. Lactating women require an additional 500 ug RE the first 6 months (assuming 750 ml breastmilk produced) and 400 ug RE the second 6 months (assuming 600 ml breastmilk).

TOTAL VITAMIN A REQUIREMENT FOR LACTATING WOMAN:

CHILD AGE < 6 Mos = 1300 ug RE or 3900 IU Vitamin A*
CHILD AGE > 6 Mos = 1200 ug RE or 3600 IU Vitamin A*

* micrograms (ug) of retinol equivalents (RE) x 3 = International Units (IU) (WHO 1974)

The vitamin A content of breastmilk from well-nourished women in the U.S.A. and Europe is .4 to .7 ug RE/ ml milk. 750 ml of breastmilk has 300-525 ug. Over 6 months, this amounts to total 54-95 mg RE. Indian women of low socioeconomic status put out 420 IU of vitamin A in milk. The FAO/WHO/UNU expert groups recommend intakes of 450 ug RE or 1350 IU for lactation. In this study, the more optimum levels of breastmilk were selected as the basis for determining the additional vitamin A requirement for lactation.

APPENDIX C
ESTIMATION OF BREASTMILK INTAKE AND COMPUTATION OF NUTRIENT REQUIREMENTS FOR INFANTS IN BANGLADESH

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APPENDIX C.

ESTIMATION OF BREASTMILK INTAKE AND NUTRIENT REQUIREMENTS FOR INFANTS IN BANGLADESH

Guidelines used in computing breastmilk intakes, and nutrient requirements (calories, protein, vitamin A, and iron) for infants in Weaning Intervention. (by Laurine Brown, 1989, 1990)

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*** BREASTMILK ***

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BREASTMILK VOLUMES ADAPTED FROM TWO BANGLADESH REFERENCES:

1. *Brown, K, R Black, S Becker, S Nahar and J Sawyer. 'Consumption of Foods & Nutrients By Weanlings in Rural Bangladesh', Am J Clin Nutr 1982;36:878-889.*

2. *Brown, K, N Akhtar, A Robertson and MG Ahmed. 'Lactational Capacity of Marginally Nourished Mothers: Relationships Between Maternal Nutritional Status & Quantity & Proximate Composition of Milk', Pediatrics 1986;78(5):909-19.*

RATIONALE FOR "BEST GUESS" ADAPTED VALUES FOR BREASTMILK

Ref #1 studied rural Bangladesh women and their infants, ages 5-30 months, incorporating test weighing of breastmilk in homes. Other foods eaten were also measured and computed. The rural study setting is similar to that of the Weaning and Lactation Intervention. Unfortunately, the values for breastmilk volumes under age 12 months are averaged to only one value. Breastmilk volumes are known to change with age in the first year. Therefore, another reference was needed.

Ref #2 studied urban Bangladesh women and their infants, aging from 0-9 months, in a clinical setting (ICDDRB). Complementary foods were withheld from the infants. The mothers were fed a well balanced diet during their stay in the hospital, thus during the 24 hous breastmilk test weighings. Because the women were well fed during the study, and their infants were solely breastfed, the breastmilk quantities will be greater than in our study of rural women, where complementary food was encouraged from 5-6 months. Also, the values reported are only for infants < 10 months.

The average breastmilk in Ref #1, for ages 5-12 months, is 632 gms. The average in Ref #2, for ages 5-9 months, is 734 gms. A crude estimate of the average difference in the two samples is: 632 gms/734 gms x 100 = 86%. I.e. the volumes produced by the rural women, whose diets are limited, and whose children 5-12 months are eating other foods, are 86% of the volumes produced by well- nourished women whose children are solely breastfeeding.

Since the difference would not be as marked in children younger than 5 months (who traditionally only breastfeed), an incremental percentage from 100% to 86% was interpolated from 0 to 5 months (see Table C1 below).

TABLE C1. ESTIMATED BREASTMILK VOLUMES FOR BANGLADESH INFANTS

CHILD AGE (mos)	VOLUME (REF#)	xPERCENT OF REF #2	=	ADAPTED VOLUME (ml)	SMOOTHED* VALUE (ml)
0 mos	559(2) ml	100 %		559 ml	559 ml
1	582(2)	97.2		566	576
2	635(2)	94.4		599	600
3	690(2)	91.6		632	625
4	714(2)	88.8		634	638
5	750(2)	86.0		645	641
6	722(2)	86.0		621	640
7	750(2)	86.0		645	636
8	730(2)	86.0		628	628
9	719(2)	86.0		618	617
10	600	(Incremental increase of average of Ref #1 for 9 mos & Ref #2 for 12 mos)		600	601
11	582	(Same as 10 mos)		582	583
12-17	563(1)			563	570
13					564
14					563
15					564
16					560
17					544
18-23	501(1)			501	520
19					504
20					502
21					502
22					495
23					462
24+	368(1)			368	403

*The "adapted volumes" were put into the Minitab Curve Smoother. These smoothed values were rounded and were used to estimate breastmilk quantities and total nutrients consumed by breastfed infants.

BREASTMILK NUTRIENT COMPOSITION/100 GMS: 61 KCALS
1.0 GM PROTEIN
3.0 GM FAT
7.5 GM CHO
1.0 MG IRON
30 MCGM RETINOL EQ
=(100 IU VITA)

Reference: Brown et al, Am Jour Clin Nutr 36:878-889, 1982.

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COMPUTATION OF ENERGY AND PROTEIN REQUIREMENTS FOR INFANTS IN BANGLADESH

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CALORIES

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REFERENCES:

World Health Organization (WHO) 'Energy and Protein Requirements', Technical Report Series 724, 1985.

World Health Organization (WHO). 'Measuring Change in Nutritional Status', WHO, Geneva, 1983.

1. CALCULATION OF ENERGY REQUIREMENT/KG/DAY

The requirement for ages *0-12 months* was derived from Table 21, pg 91 in WHO (1985), and calculated as "predicted intake" +5% using the following equation:

KCAL/KG/DAY = (123 - 8.9(AGE) + 0.59(AGE SQUARED))*1.05

The requirement for children ages *1-2 years* was obtained from Table 49, pg 137 of WHO (1985): **105 KCALS/KG/DAY.**

2. CALCULATION OF DAILY ENERGY REQUIREMENT FOR "MAINTENANCE" AND "IDEAL" GROWTH NEEDS

MAINTENANCE - A "maintenance" energy requirement was computed for each child by multiplying the child's actual weight by the requirement/kg determined above. This requirement would supply adequate energy for the child to maintain their present growth curve (percentile), however, would not be sufficient to promote catch-up growth to ideal standards.

The child's energy intake (*food only, and food+breastmilk*) was illustrated as a percent of this maintenance requirement.

IDEAL - An "ideal" energy requirement was also computed for each child by multiplying the child's energy requirement/kg (above) by a child's ideal weight for his or her age and sex. National Center for Health Statistics (WHO 1983) median weights for males or females were used as the ideal reference. This requirement may be more than what the child needs to maintain their present growth rate, however, may not be sufficient to support catch-up growth for the underweight child to international standards.

The child's calorie intake (*food only, and food+breastmilk*) was illustrated as a percent of this ideal requirement.

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PROTEIN

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1. CALCULATION OF PROTEIN REQUIREMENT/KG/DAY

The protein requirement for children ages 3-24 months was obtained from WHO (1985) Table 33, pg 105. The requirement for children ages 0-2 months was adapted from Table 29, pg 104 in WHO. See Table C2 below for values.

Because of high infection rates, values for ages 6-24 months were multiplied by 1.5 - (Scrimshaw and Zeitlin, personal communication, March 1989). Since sudden increases in requirements month by month would artificially inflate the requirement month to month, and since it would be expected the increased infection rates would be gradual, the requirements for children over 5 months were multiplied by graduated increments up to 1.5 from age 5 to 9 months, and thereafter 1.5. All values were interpolated to the month using the Minitab Curve Smoother (Table C2).

2. ADJUSTMENT FOR LOW PROTEIN QUALITY

Since protein quality of the complementary food was low, a modification was made for dietary protein quality and digestibility according to WHO guidelines (WHO 1985: Table 40 and 41, pg 124-125). The protein requirement of the child was adjusted upward based on the *intake* of low quality protein foods. The requirement RQ was adjusted using the following equation:

ADJUSTED PRO RQ = (((RQ-for-age) * (gms POOR)/(gms TOTAL PRO)) * (ADJUST)) + ((RQ-for-age) * (gms GOOD)/(gms TOTAL PRO))

POOR QUALITY PROTEIN: *(POOR)*	Grains, vegetables, fruits, legumes, sugars, oils
Assumptions: *(ADJUST)*	85% Digestibility 75% Amino Acid Score (Indian Diet) *Adjustment of RQ: (100/85)*(100/75)*
GOOD QUALITY PROTEIN: *(GOOD)*	Eggs, fish, meat, poultry, milk, breastmilk
Assumptions:	100% Digestibility 100% Amino Acid Score *No adjustment to requirement*

3. CALCULATION OF DAILY PROTEIN REQUIREMENT FOR "MAINTENANCE" AND "IDEAL" GROWTH NEEDS

Daily maintenance and ideal requirements were computed for protein, as above for calories, and dietary intakes (*food only, food+breastmilk*) were illustrated as a percent of these requirements.

TABLE C2.
ESTIMATION OF PROTEIN REQUIREMENT FOR BREASTFEEDING INFANTS (0-24MOS) IN BANGLADESH

CHILD AGE (months)	PROTEIN RQ (gms)	SOURCE (WHO 1985)	FACTOR FOR INFECTION	ADJUSTED RQ VALUE (gms)	SMOOTHED RQ* (gms)
0	2.43}	Tab 29	x 1	2.43	2.30
1	1.93}	(Ave male	x 1	1.93	2.02
2	1.76}	& female)	x 1	1.76	1.86
3	1.86	Tab 33	x 1	1.86	1.83
4	1.86	(includes	x 1	1.86	1.86
5	1.86	+ 2SD)	x 1.083	2.014	1.92
6	1.65		x 1.167	1.926	2.01
7	1.65	T	x 1.250	2.063	2.08
8	1.65		x 1.333	2.199	2.13
9	1.48	a	x 1.417	2.097	2.15
10	1.48		x 1.5	2.22	2.16
11	1.48	b	x 1.5	2.22	2.11
12	1.26	l	x 1.5	1.89	2.01
13	1.26		x 1.5	1.89	1.92
14	1.26	e	x 1.5	1.89	1.89
15	1.26		x 1.5	1.89	1.89
16	1.26		x 1.5	1.89	1.88
17	1.26		x 1.5	1.89	1.85
18	1.17	3	x 1.5	1.755	1.80
19	1.17	3	x 1.5	1.755	1.76
20	1.17		x 1.5	1.755	1.75
21	1.17		x 1.5	1.755	1.75
22	1.17		x 1.5	1.755	1.75
23	1.17		x 1.5	1.755	1.74
24	1.17		x 1.5	1.755	1.71

* Values smoothed using Minitab Curve Smoother, Minitab Version 7.2, VAX/VMS Version, Minitab Inc, 3081 Enterprise Dr., State College, PA 16801.

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IRON REQUIREMENT

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The child's iron requirement was derived from: FAO, "Handbook on Human Nutritional Requirements", 1974. Requirements based on the child's age:

Child Age	Iron RQ (mg)
0-4 mos	5 mg
6	6
7	7
8	8
9+	9

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VITAMIN A REQUIREMENT

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The child's vitamin A requirement was derived from: FAO, "Handbook on Human Nutritional Requirements", 1974. Requirements based on the child's age:

Child Age	Vitamin A RQ (IU)*
0-12 mos	1000 IU
12+ mos	833 IU

* IU = International Units. 3 IU = 1 ug retinol equivalents (WHO 1974).

APPENDIX D
COMPUTATION OF BANGLADESH WEALTH SCALES

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APPENDIX D

COMPUTATION OF BANGLADESH WEALTH SCALES

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Computes three categories of scales for socioeconomic status and wealth. These scales were used to control for socioeconomic status and wealth in the analysis of the Weaning and Lactation Intervention.

- MODERNIZATION/HYGIENE/EDUCATION
- AGRICULTURAL WEALTH
- TRADITIONAL WEALTH

Items were grouped into scales based on results of factor analysis. The modernization/education scales consist of possessions and years of education. The agricultural and traditional wealth scales, and the combined wealth scale assigns monetary values to the items based on local Bangladesh market costs, using a similar methodology as Georgia Guldan (doctoral thesis, April 1988).

Reliabilities of the scales were confirmed (using both the Weaning and Lactation Intervention samples) with Cronbach's Alpha on SPSSX's Reliability Program:

MODERN-HYGIENE-EDUCATION:	.6242	
MODERN-HYGIENE:	.5788	} alpha, non logged scale
MODERN:	.7206	
TRADITIONAL WEALTH	.7983	
COMBINED WEALTH:	.8683	} alpha for per capita, logged scale
AGRICULTURAL WEALTH:	.7817	

ASSIGNMENT OF COST OF ITEMS

ITEM DESCRIPTION	MARKET VALUE *(taka)*	ITEM DESCRIPTION	MARKET VALUE *(taka)*
BEDROOM	= 400 *taka*	COWSHED	= 300 *taka*
KITCHEN	= 2000	OUTSKIRT HOUSE	= 3000
POULTRY HOUSE	= 100	BRASSWARE	= 200
ENAMEL DISHES	= 50	PADDY (mounds*)	= 190
CORN INCOME	= Actual	TREE INCOME	= Actual
VEGETABLE INCOME	= Actual	MAT INCOME	= Actual
POULTRY INCOME	= Actual	BEDDING COTS	= 150
BLANKETS	= 70	PILLOWS	= 15
LANTERNS	= 80	UMBRELLA	= 100
POULTRY	= 50	SOAP	= 10
WATCH	= 200	BIKE	= 1300
RADIO	= 400	BOAT	= 1500
COW	= 1200	GOAT	= 100
LAND	= (paki^ x 33) x 350		

SOLVENCY: Deficit = -100; Maintains = 10; Solvent 1000; Surplus = 5000

COST OF HOUSE: All tin = 5000
Tin roof & earthen wall = 3000
4-side tin, bamboo wall = 2400
2-side slant tin roof, bamboo wall = 2000
flat tin roof, bamboo side = 1600
thatch roof, bamboo side = 800
4-side thatch roof, straw side (jute) = 600
Grass roof, straw side (jute-like) = 400
All thatch or grass = 300

(missing values coded as 210.73)

NOTE: All monetized values were divided by a factor of 10 before putting into the scales.
* 1 mound = 37.3 kg
^ 1 paki = 0.33 acre

-- MODERNIZATION SCALES--

Computation of 3 variations of modernization, education, and hygiene scales. The unit used was the *number* of each of the items owned by the household (or with education, the number of years of schooling). Modern-Hygiene-Education Scale was selected for most analyses.

Note: Headed = Head of Household years of education
Momed = Mother's years of education

MODERN-HYGIENE-EDUCATION = Headed + Momed + Watch + Radio + Soap
MODERN-HYGIENE = Watch + Radio + Soap
MODERN = Watch + Radio

-- MONETIZED WEALTH SCALES--

All monetized variables used in the wealth scales were logged (using natural log) before creating scales. Logging was necessary to reduce poor *reliability* due to extremely high values for the land variable, Before logging, a constant of .5 was added to the variable since all items have some zero values. For *solvency*, some households have a value -10, so 10.5 was added to this variable before logging.

TRADITIONAL WEALTH =
Brassware + Enamelware + Cots + Bedrooms + Kitchens + Boats + Umbrellas + Pillows + Blankets + Lanterns + Bikes + Solvency + HutCost

AGRICULTURAL WEALTH =
Cows + Goats + Cowsheds + OutskirtHuts + PoultryHouse + Land + Poultry + Paddy + PoultryIncome + TreeIncome + VegetableIncome

COMBINED TRADITIONAL AND AGRICULTURAL WEALTH =
Brassware + Enamelware + Cots + Bedrooms + Kitchens + Boats + Umbrellas + Pillows + Blankets + Lanterns + Bikes + Solvency + HutCost + Cows + Goats + Cowsheds + OutskirtHuts + PoultryHouse + Land + Poultry + Paddy + PoultryIncome + TreeIncome + VegetableIncome

The TRADITIONAL, AGRICULTURAL and COMBINED WEALTH scales were divided by the number of household members to create "per capita" scales. See Table D1 for group differences with scales, and Table D2 for possession of items.

(1990 Laurine Brown)

TABLE D1. WEALTH SCALES
LACTATING MOTHERS AND WEANING FOOD INTERVENTIONS

WEALTH SCALES§ (LOG)	LACTATING MOTHERS SAMPLE			WEANING FOOD SAMPLE		
	TREATMENT n=48	CONTROL n=30		TREATMENT n=62	CONTROL n=55	
	log	log	signif#	log	log	signif#
AGRICULTURAL WEALTH (Per Capita)	1.57	-0.61	***	1.46	-1.40	***
TRADITIONAL WEALTH (Per Capita)	6.09	5.20	NS	5.33	5.69	NS
COMBINED WEALTH (Per Capita)	7.66	4.59	***	6.79	5.29	**
MODERNIZATION	6.10	5.10	NS	2.34	3.65	NS

p-values were calculated from t-tests with continuous variables and x^2 tests with catagorical variables.
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, NS (not significant) $p>0.05$

§ Agricultural Wealth Scale = monetized (taka) possession of cows, goats, chickens, cowsheds, poultry houses, other animal and grain sheds, land, income from rice paddy, corn, trees (e.g date palm sugar), and vegetables.

Traditional Wealth Scale = monetized (taka) possession of bedroom huts, kitchen huts, boats, bicycles, kitchenware (enamel, brass, or bronze), umbrellas, cots, pillows, blankets, lanterns, and a monetized value for claimed solvency status.

Modernization Scale = possession of radios, watches, soap, years of education for mother and household head.

TABLE D2. HOUSEHOLD BELONGINGS
TREATMENT AND CONTROL DIFFERENCES FOR LACTATION AND WEANING INTERVENTIONS

OWNERSHIP HOUSEHOLD BELONGINGS	LACTATING MOTHERS SAMPLE		WEANING FOOD SAMPLE	
	TREATMENT n=48	CONTROL n=30	TREATMENT n=62	CONTROL n=55
	% Owning	*% Owning*	*% Owning*	*% Owning*
RADIOS	38%	20%	11%	15%
WATCHES	46%	23%	21%	16%
SOAP	63%	17%	48%	13%
UMBRELLAS	75%	20%	63%	20%
BICYCLES	19%	7%	8%	4%
BOATS	44%	7%	29%	7%
BEDROOMS	100%	100%	100%	100%
KITCHENS	79%	77%	84%	69%
BRASS DISHWARE	94%	67%	95%	73%
ENAMEL KITCHENWARE	96%	93%	98%	95%
COTS	73%	73%	69%	73%
BLANKETS	96%	100%	92%	98%
PILLOWS	100%	100%	98%	100%
LANTERNS	85%	50%	74%	44%
OUTSKIRT SHEDS	21%	0%	19%	0%
COWSHED	42%	13%	50%	13%
POULTRY SHED	67%	43%	73%	42%
COWS	46%	10%	52%	15%
POULTRY	73%	30%	63%	42%
GOATS	27%	10%	45%	18%
STORED PADDY (Maunds)*	21%	3%	18%	4%

*1 Maund=37.3 kg

APPENDIX E
STATISTICAL RESULTS AND TABLES

TABLE E1. SAMPLE SIZES FOR WEANING AND LACTATION INTERVENTIONS

WEANING INTERVENTION: Number of Children Having All Measurements:

INDICATOR	ALL	TREATMENT	CONTROL
TOTAL SAMPLE	138	71	67
Number having any followup data:	132	71	61
Child Dietary & Weight - baseline-final	117	62	55
Child Arm Circumference - baseline-final	101	62	39

LACTATION INTERVENTION: Number Having All Measurements for the Following Indicators:

INDICATOR	ALL	TREATMENT	CONTROL
TOTAL SAMPLE	78	48	30
Mother Dietary - baseline-midpoint-final	67	39	28
Mother Dietary - baseline-midpoint	74	45	29
Infant Weight (< 6mo @baseline) - baseline-midpoint-final	49	21	28
Infant Weight (< 6mo @baseline) - baseline-midpoint	52	24	28
Mother Arm Circumference - baseline-final	64	39	25
Infant Arm Circumference - baseline-final	63	38	25

TABLE E2. LACTATION INTERVENTION:
ENERGY ADEQUACY OF LACTATING MOTHERS' (LM) DIETS
BEFORE AND AFTER NUTRITION EDUCATION
MEAN VALUES FOR PERCENT OF ENERGY REQUIREMENT (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	% ENERGY REQUIREMENT TREATMENT (n=39) %	±SD	% ENERGY REQUIREMENT CONTROL (n=28) %	±SD	Treatment Group Signif p-value	Model R^2 and Covariates for Adjusted Means§
MOTHERS' DIETARY ENERGY ADEQUACY						
BASELINE (Feb-Mar)						
Unadjusted	61.7	±14.7	68.4	±11.2	p =.001	R^2=.380
Adjusted§	60.1		70.6			LM education***
						Child age*
MIDPOINT (May-July)						
Unadjusted	55.4	±6.7	54.0	±7.4	p =.806	R^2=.219
Adjusted§	54.6		55.1			LM education***
						Child age*
						Baseline energy(NS)
FINAL (Oct-Nov)						
Unadjusted	54.8	±5.3	48.4	±5.4	p =.000	R^2=.403
Adjusted§	55.5		47.3			Child age**,Mom age*
						Baseline energy(NS),
						Agricultural wealth(NS)
AVERAGE (Feb-Nov)						
Unadjusted	56.3	±4.6	55.5	±6.7	p =.722	R^2=.359
Adjusted§	55.8		56.2			LM education***
						Child age**
CHANGE IN MOTHERS' DIETARY ENERGY ADEQUACY						
Baseline to Midpoint						
Unadjusted	-6.3	±16.6	-14.4	±10.4	p =.806	R^2=.826
Adjusted§	-9.9		-9.5			LM education***
						Child age*
						Baseline energy***
Baseline to Final						
Unadjusted	-6.9	±15.4	-20.0	±12.5	p =.001	R^2=.887
Adjusted§	-10.1		-15.5			Child age**
						Baseline energy***

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p>0.05$

TABLE E3. LACTATION INTERVENTION:
ARM CIRCUMFERENCE OF LACTATING MOTHERS (LM)
BEFORE AND AFTER NUTRITION EDUCATION
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	ARM CIRCUMFERENCE (cm) TREATMENT (n=39) cm ±SD	ARM CIRCUMFERENCE (cm) CONTROL (n=25) cm ±SD	Treatment Group Signif p-value	Model R^2 and Covariates for Adjusted Means§
MOTHERS' MID UPPER ARM CIRUCUMFERENCE (AC)				
BASELINE (Feb-Mar)				
Unadjusted	23.1 ±1.6	22.1 ±1.7	p =.420	R^2=.273
Adjusted§	22.8	22.4		LM education*
				Child age**,LM age**
				Baseline diet energy**
FINAL (Oct-Nov)				
Unadjusted	23.0 ±1.2	22.7 ±2.3	p =.026	R^2=.670
Adjusted§	22.6	23.3		LM aver diet energy***
				Baseline AC***
				Agricultural wealth(NS)
AVERAGE (Feb-Nov)				
Unadjusted	23.0 ±1.2	22.5 ±1.9	p =.470	R^2=.070
Adjusted§	23.0	22.6		LM education(NS)
				Child age(NS)
CHANGE IN MOTHERS' ARM CIRCUMFERENCE				
BASELINE TO FINAL				
Unadjusted	0.0 ±1.2	0.6 ±1.3	p =.026	R^2=.372
Adjusted§	0.1	0.6		LM aver diet energy***
				Baseline AC**
				Agricultural wealth(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E4. LACTATION INTERVENTION:
WEIGHT-FOR-AGE Z-SCORES (WAZ) FOR CHILDREN OF LACTATING MOTHERS (LM)
BEFORE AND AFTER MATERNAL NUTRITION EDUCATION
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=21)		CONTROL (n=28)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE mo	WAZ ±SD	AGE mo	WAZ ±SD	p-value	
CHILDREN'S WEIGHT-FOR-AGE Z-SCORE						
BASELINE (Feb-Mar) *Unadjusted* *Adjusted§*	*3.4mo*	-0.97 ±1.01 -0.69	*3.0mo*	-0.92 ±0.72 -1.12	p =.154	R^2=.255 Child age(NS) Sex* Agricultural wealth*
MIDPOINT (May-July) Unadjusted Adjusted§	*7.4mo*	-1.92 ±0.78 -1.96	*7.3mo*	-1.73 ±0.94 -1.70	p =.082	R^2=.728 Child age**,Sex(NS) Baseline WAZ*** # days base->mid*** LM cals @mid(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*11.5mo*	-2.35 ±0.55 -2.33	*12.1mo*	-2.37 ±0.82 -2.38	p =.716	R^2=.592 LM aver cals*** Child final food cal* Baseline WAZ*** Diarrhea**,Sex(NS)
CHANGE IN CHILDREN'S WEIGHT-FOR-AGE Z-SCORE						
BASELINE TO MIDPOINT *Unadjusted* *Adjusted§*		-0.94 ±0.73 -0.75		-0.80 ±0.83 -1.01	p =.082	R^2=.668 Child age**,Sex(NS) Baseline WAZ*** # days base->mid*** LM cals @mid(NS)
BASELINE TO FINAL *Unadjusted* *Adjusted§*		-1.38 ±0.75 -1.39		-1.45 ±0.71 -1.44	p =.716	R^2=.603 LM aver cals*** Child final food cal* Baseline WAZ*** Diarrhea**,Sex(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E5. LACTATION INTERVENTION:
WEIGHT-FOR-AGE PERCENT MEDIAN (WAPM) FOR CHILDREN OF LACTATING MOTHERS (LM)
BEFORE AND AFTER MATERNAL NUTRITION EDUCATION
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=21)		CONTROL (n=28)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE mo	WAPM ±SD	AGE mo	WAPM ±SD	p-value	
CHILDREN'S WEIGHT-FOR-AGE % MEDIAN						
BASELINE (Feb-Mar)	*3.4mo*		*3.0mo*			R^2=.165
Unadjusted		86.[illegible] ±15.0		86.9 ±9.8	p =.828	Child age(NS)
Adjusted§		86.9		86.0		Sex*
						Agricultural wealth*
MIDPOINT (May-July)	*7.4mo*		*7.3mo*			R^2=.663
Unadjusted		78.0 ±8.4		80.2 ±10.2	p =.044	Child age*,Sex(NS)
Adjusted§		77.0		80.7		Baseline WAPM***
						# days base->mid**
						LM cals @mid*
FINAL (Oct-Nov)	*11.5mo*		*12.1mo*			R^2=.590
Unadjusted		75.2 ±6.2		75.0 ±8.6	p =.977	LM aver cals***
Adjusted§		75.1		75.1		Child final food cal*
						Baseline WAPM***
						Diarrhea*,Sex(NS)
CHANGE IN CHILDREN'S WEIGHT-FOR-AGE % MEDIAN						
BASELINE TO MIDPOINT						R^2=.682
Unadjusted		-8.4 ±10.8		-6.7 ±10.0	p =.091	Child age(ns),Sex(NS)
Adjusted§		-9.4		-6.3		Baseline WAPM***
						# days base->mid**
						LM cals @mid**
BASELINE TO FINAL						R^2=.756
Unadjusted		-11.2 ±11.9		-11.9 ±8.1	p =.977	LM aver cals***
Adjusted§		-11.6		-11.6		Child final food cal*
						Baseline WAPM***
						Diarrhea*,Sex(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E6. LACTATION INTERVENTION:
ARM CIRCUMFERENCE (AC) FOR CHILDREN OF LACTATING MOTHERS (LM)
BEFORE AND AFTER MATERNAL NUTRITION EDUCATION
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=38)			CONTROL (n=25)			Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE	AC		AGE	AC			
	mo	cm	±SD	mo	cm	±SD	p-value	
CHILDREN'S MID UPPER ARM CIRUCUMFERENCE								
BASELINE (Feb-Mar)	*5.2mo*			*2.9mo*				R^2=.243
Unadjusted		12.6	±1.4		12.2	±1.4	p =.720	Child age***
Adjusted§		12.5			12.3			Sex(NS)
								Agricultural wealth(NS)
FINAL (Oct-Nov)	*13.1mo*			*12.2mo*				R^2=.414
Unadjusted		13.9	±1.1		13.6	±1.1	p =.142	LM aver diet energy***
Adjusted§		14.0			13.4			Sex**,Child age(NS)
								Baseline AC(NS)
								# days base-final(NS)
CHANGE IN CHILDREN'S ARM CIRCUMFERENCE								
BASELINE TO FINAL								R^2=.673
Unadjusted		1.3	±1.4		1.5	±1.6	p =.142	LM aver diet energy***
Adjusted§		1.6			1.0			Sex**,Child age(NS)
								Baseline AC***
								# days base-final(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E7. LACTATION INTERVENTION: CHANGE IN WEIGHT-FOR-AGE Z-SCORE CATEGORIES IN CHILDREN FROM BASELINE TO FINAL by TREATMENT GROUP

Count
Row Pct
Column

WAZ CHANGE*	CONTROL	TREATMENT	Row Total
0 or >			
<0 to-0.5	2 100.0 *7.1*		2 4.1
<-0.5 to -1	5 45.5 *17.9*	6 54.5 *28.6*	11 22.4
<-1	21 58.3 *75.0*	15 41.7 *71.4*	36 73.5
Column Total	28 *57.1*	21 *42.9*	49 100.0

Chi-Square	Value	DF	Significance
Pearson	2.13447	2	.34396
Likelihood Ratio	2.86488	2	.23873
Mantel-Haenszel test for linear association	.05099	1	.82135

Minimum Expected Frequency - .857
Cells with Expected Frequency < 5 - 3 of 6 (50.0%)
Number of Missing Observations: 29

*WAZ CHANGE: Change in weight-for-age z-score categories.

TABLE E8. CHANGE NUMBER OF SEVERELY MALNOURISHED CHILDREN (WAZ < -3SD)* FROM BASELINE TO MIDOPOINT AND BASELINE TO FINAL - Treatment Children in Lactation Intervention.

LACTATION INTERVENTION: TREATMENT CHILDREN

----- McNemar Test CHANGE IN WAZ FROM BASELINE TO MIDPOINT

SEVCAT1 Number Severely Malnourished at Baseline (WAZ)*
with SEVCAT2 Number Severely Malnourished at Midpoint (WAZ)*

	SEVCAT2 #2	SEVCAT2 #1		
SEVCAT1 #1	1	23	Cases	24
SEVCAT1 #2	0	0	(Binomial) 2-Tailed P	1.0000

----- McNemar Test CHANGE IN WAZ FROM BASELINE-FINAL

SEVCAT1 Number Severely Malnourished at Baseline (WAZ)*
with SEVCAT7 Number Severely Malnourished at Final (WAZ)*

	SEVCAT7 #2	SEVCAT7 #1		
SEVCAT1 #1	2	19	Cases	21
SEVCAT1 #2	0	0	(Binomial) 2-Tailed P	.5000

WAZ = Weight-for age z-score (SD units)

SEVERE MALNUTRITION CATEGORIES (Sevcat1, Sevcat2, Sevcat7):
1 = "Not Severely Malnourished" - Equal to or above -3 WAZ
2 = "Severely Malnourished" - Below -3 WAZ

TABLE E9. CHANGE NUMBER OF SEVERELY MALNOURISHED CHILDREN (WAZ < -3SD)* FROM BASELINE TO MIDOPOINT AND BASELINE TO FINAL - Control Children in Lactation Intervention.

LACTATION INTERVENTION : CONTROL CHILDREN

- - - - - McNemar Test CHANGE IN WAZ FROM BASELINE TO MIDPOINT

SEVCAT1 Number Severely Malnourished at Baseline (WAZ)*
with SEVCAT2 Number Severely Malnourished at Midpoint (WAZ)*

	SEVCAT2 #2	SEVCAT2 #1		
SEVCAT1 #1	2	26	Cases	28
SEVCAT1 #2	0	0	(Binomial) 2-Tailed P	.5000

- - - - - McNemar Test CHANGE IN WAZ FROM BASELINE-FINAL

SEVCAT1 Number Severely Malnourished at Baseline (WAZ)*
with SEVCAT7 Number Severely Malnourished at Final (WAZ)*

	SEVCAT7 #2	SEVCAT7 #1		
SEVCAT1 #1	7	21	Cases	28
SEVCAT1 #2	0	0	(Binomial) 2-Tailed P	.01056

WAZ = Weight-for age z-score (SD units)

SEVERE MALNUTRITION CATEGORIES (Sevcat1, Sevcat2, Sevcat7):
1 = "Not Severely Malnourished" - Equal to or above -3 WAZ
2 = "Severely Malnourished" - Below -3 WAZ

TABLE E10. WEANING INTERVENTION:
WEIGHT-FOR-AGE Z-SCORES (WAZ) FOR WEANING AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)		CONTROL (n=55)		Treatment Group Signif	Model R^2 and Covariates
	AGE mo	WAZ ±SD	AGE mo	WAZ ±SD	p-value	Adjusted Means§
CHILDREN'S WEIGHT-FOR-AGE Z-SCORE						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo*	-2.12 ±0.93 -2.11	*8.2mo*	-1.94 ±0.98 -1.94	p =.327	R^2=.391 Child age*** Sex(NS) Modern/Education** Agricultural wealth*
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo*	-2.34 ±0.84 -2.22	*12.0mo*	-2.57 ±0.84 -2.68	p =.000	R^2=.771 Baseline WAZ*** Child age** Diarrhea*** Respiratory ill** Agricultural wealth* Mother's education(NS) Child final food cals(NS)
CHANGE IN CHILDREN'S WEIGHT-FOR-AGE Z-SCORE						
BASELINE TO FINAL *Unadjusted* *Adjusted§*		-0.22 ±0.54 -0.22		-0.63 ±0.63 -0.63	p =.000	R^2=.563 Baseline WAZ*** Child age** Diarrhea*** Respiratory ill** Agricultural wealth* Mother's education(NS) Child final food cals(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E11. WEANING INTERVENTION:
WEIGHT-FOR-AGE PERCENT MEDIAN (WAPM) FOR WEANING AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)		CONTROL (n=55)		Treatment Group Signif	Model R^2 and Covariates Adjusted Means§
	AGE mo	WAPM ±SD	AGE mo	WAPM ±SD	p-value	
CHILDREN'S WEIGHT-FOR-AGE % MEDIAN						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo*	76.3 ±10.0 76.4	*8.2mo*	78.1 ±10.3 78.0	p =.392	R^2=.312 Child age*** Modern/Education** Agricultural wealth(NS) Sex(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo*	75.4 ±8.8 76.4	*12.0mo*	72.9 ±8.7 71.8	p =.000	R^2=.773 Baseline WAPM*** Child age(NS) Diarrhea*** Respiratory ill* Mother's education* Agricultural wealth* Child final food cals(NS)
CHANGE IN CHILDREN'S WEIGHT-FOR-AGE % MEDIAN						
BASELINE TO FINAL *Unadjusted* *Adjusted§*		-0.89 ±5.34 -0.75		-5.2 ±6.35 -5.37	p =.000	R^2=.547 Baseline WAPM*** Child age(NS) Diarrhea*** Respiratory ill* Mother's education* Agricultural wealth* Child final food cals(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E12. WEANING INTERVENTION:
ARM CIRCUMFERENCE (AC) FOR WEANING-AGE CHILDREN
BEFORE AND AFTER EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)			CONTROL (n=39)			Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE	AC		AGE	AC			
	mo	cm	±SD	mo	cm	±SD	p-value	
CHILDREN'S MID UPPER ARM CIRUCUMFERENCE								
BASELINE (May-July)	*8.1mo*			*9.9mo*				R^2=.048
Unadjusted		13.1	±1.1		12.9	±0.8	p =.685	Child age(NS)
Adjusted§		13.0			13.0			Sex(NS)
								Agricultural wealth(NS)
								Traditional wealth(NS)
								Mother's education(NS)
FINAL (Oct-Nov)	*12.9mo*			*13.6mo*				R^2=.482
Unadjusted		13.8	±1.0		13.3	±0.9	p =.014	Child final food cals(NS)
Adjusted§		13.8			13.3			Sex(NS),Child age(NS)
								Baseline AC***
								Diarrhea(NS)
								Respiratory ill(NS)
								Agricultural wealth(NS)
								Traditional wealth(NS)
								Mother's education(NS)
CHANGE IN CHILDREN'S ARM CIRCUMFERENCE								
BASELINE TO FINAL								R^2=.241
Unadjusted		0.7	±0.9		0.4	±0.8	p =.014	Child final food cals(NS)
Adjusted§		0.8			0.3			Sex(NS),Child age(NS)
								Baseline AC***
								Diarrhea(NS)
								Respiratory ill(NS)
								Agricultural wealth(NS)
								Traditional wealth(NS)
								Mother's education(NS)

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E13. CHANGE NUMBER OF SEVERELY MALNOURISHED CHILDREN (WAZ < -3SD)* FROM BASELINE TO FINAL - Treatment and Control Children in Weaning Intervention.

WEANING INTERVENTION: TREATMENT CHILDREN

- - - - - McNemar Test CHANGE IN WAZ FROM BASELINE TO FINAL

SEVCAT1 Number Severely Malnourished at Baseline (WAZ)*
with SEVCAT5 Number Severely Malnourished at Final (WAZ)*

	SEVCAT5 #2	SEVCAT5 #1		
#1 SEVCAT1 #2	6	46	Cases	62
	7	3	(Binomial) 2-Tailed P	.5078

WEANING INTERVENTION: CONTROL CHILDREN

- - - - - McNemar Test CHANGE IN WAZ FROM BASELINE-FINAL

SEVCAT1 Number Severely Malnourished at Baseline (WAZ)*
with SEVCAT5 Number Severely Malnourished at Final (WAZ)*

	SEVCAT5 #2	SEVCAT5 #1		
#1 SEVCAT1 #2	14	36	Cases	55
	5	0	(Binomial) 2-Tailed P	.0001

WAZ = Weight-for age z-score (SD units)

SEVERE MALNUTRITION CATEGORIES (Sevcat1, Sevcat5):
1 = "Not Severely Malnourished" - Equal to or above -3 WAZ
2 = "Severely Malnourished" - Below -3 WAZ

TABLE E14. WEANING INTERVENTION: CHANGE IN WEIGHT-FOR-AGE Z-SCORE CATEGORIES IN CHILDREN FROM BASELINE TO FINAL by TREATMENT GROUP

Count
Row Pct
Column

WAZ CHANGE*	CONTROL	TREATMENT	Row Total
0 or >	7 24.1 *12.7*	22 75.9 *35.5*	29 24.8
<0 to-0.5	16 39.0 *29.1*	25 61.0 *40.3*	41 35.0
<-0.5 to -1	22 64.7 *40.0*	12 35.3 *19.4*	34 29.1
<-1	10 76.9 *18.2*	3 23.1 *4.8*	13 11.1
Column Total	55 *47.0*	62 *53.0*	117 100.0

Chi-Square	Value	DF	Significance
Pearson	16.08340	3	.00109
Likelihood Ratio	16.68236	3	.00082
Mantel-Haenszel test for linear association	15.55242	1	.00008

Minimum Expected Frequency - 6.111
Number of Missing Observations: 0

*WAZ CHANGE: Change in weight-for-age z-score categories.

TABLE E15. WEANING INTERVENTION:
ENERGY ADEQUACY (MAINTENANCE#) OF DIETS FOR WEANING AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)			CONTROL (n=55)			Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE	%ENERGY RQ		AGE	%ENERGY RQ			
	mo	%	±SD	mo	%	±SD	p-value	
ENERGY ADEQUACY OF CHILDREN'S DIETS (FOOD ONLY)								
BASELINE (May-July)	*8.1mo*			*8.2mo*				R^2=.090
Unadjusted		21.9	±25.3		18.1	±17.8	p =.442	Child age(NS)
Adjusted§		21.8			18.2			Mother's education*
								Agricultural wealth(NS)
								Traditional wealth(NS)
FINAL (Oct-Nov)	*12.9mo*			*12.0mo*				R^2=.304
Unadjusted		26.5	±16.5		16.8	±11.7	p =.000	Child age(NS)
Adjusted§		27.1			16.1			Mother's education**
								Child base food cals***
								Diarrhea(NS)
								Respiratory ill(NS)
								Agricultural wealth(NS)
								Traditional wealth(NS)
CHANGE IN CHILDREN'S DIETARY ENERGY ADEQUACY (FOOD ONLY)								
BASELINE TO FINAL								R^2=.662
Unadjusted		4.6	±24.7		-1.2	±17.7	p =.000	Child age(NS)
Adjusted§		7.0			-4.1			Mother's education**
								Child base food cals***
								Diarrhea(NS)
								Respiratory ill(NS)
								Agricultural wealth(NS)
								Traditional wealth(NS)

Maintenance energy requirement based on child's actual weight. This requirement will support growth at the child's present percentile, but will not support normal growth for the international reference child. Values reported do not include breastmilk estimates - 100% children were breastfeeding throughout the study.

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E16. WEANING INTERVENTION
ENERGY ADEQUACY (IDEAL#) OF DIETS FOR WEANING AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)		CONTROL (n=55)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE mo	%ENERGY RQ % ±SD	AGE mo	%ENERGY RQ % ±SD	p-value	
ENERGY ADEQUACY OF CHILDREN'S DIETS (FOOD ONLY)						
BASELINE (May-July) Unadjusted Adjusted§	*8.1mo*	16.3 ±19.6 16.3	*8.2mo*	13.8 ±13.5 13.8	p =.469	R^2=.111 Child age(NS) Mother's education** Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) Unadjusted Adjusted§	*12.9mo*	19.8 ±13.1 20.2	*12.0mo*	12.1 ±8.5 11.6	p =.000	R^2=.378 Child age(NS) Mother's education*** Child base food cals*** Diarrhea(NS) Respiratory ill(NS) Agricultural wealth(NS) Traditional wealth(NS)
CHANGE IN CHILDREN'S DIETARY ENERGY ADEQUACY (FOOD ONLY)						
BASELINE TO FINAL Unadjusted Adjusted§		3.5 ±18.6 5.1		-1.7 ±13.2 -3.5	p =.000	R^2=.675 Child age(NS) Mother's education*** Child base food cals*** Diarrhea(NS) Respiratory ill(NS) Agricultural wealth(NS) Traditional wealth(NS)

Ideal energy requirement based on international reference median weight for child's age and sex. This requirement may be more than what the child needs to maintain present growth rate, however, may not be sufficient to support catch-up growth for the underweight child to international standards. Values do not included breastmilk estimates - 100% children were breastfeeding throughout the study.

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

(NS) = not significant, $p > 0.05$

TABLE E17. WEANING INTERVENTION:
ENERGY ADEQUACY OF DIETS INCLUDING BREASTMILK FOR WEANING AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)		CONTROL (n=55)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE mo	%ENERGY RQ % ±SD	AGE mo	%ENERGY RQ % ±SD	p-value	
ENERGY ADEQUACY (MAINTENANCE#) OF CHILDREN'S DIETS (BREASTMILK & FOOD)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo*	85.2 ±28.3 84.9	*8.2mo*	79.5 ±18.9 79.8	p =.362	R^2=.062 Child age(NS) Mother's education(NS) Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo*	74.2 ±18.8 74.2	*12.0mo*	64.8 ±13.9 64.8	p =.004	R^2=.334 Child age(NS) Mother's education(NS) Child base cals*** Diarrhea(NS) Respiratory ill(NS) Agricultural wealth(NS) Traditional wealth(NS)
ENERGY ADEQUACY (IDEAL¤) OF CHILDREN'S DIETS (BREASTMILK & FOOD)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo*	64.0 ±20.7 63.9	*8.2mo*	61.3 ±14.2 61.4	p =.485	R^2=.195 Child age** Mother's education** Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo*	55.4 ±14.3 55.5	*12.0mo*	46.8 ±9.2 46.6	p =.000	R^2=.449 Child age** Mother's education** Child base cals*** Diarrhea(NS) Respiratory ill(NS) Agricultural wealth* Traditional wealth(NS)

Note: Breastmilk intakes estimated from country data - 100% children breastfeeding throughout study.
§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.
# Maintenance energy requirement based on child's actual weight. This requirement will support growth at the child's present percentile, but will not support normal growth for the international reference child.
¤ Ideal energy requirement based international reference median for child's age and sex. This requirement may be more than what the child needs to maintain present growth rate, however, may not be sufficient to support catch-up growth for the underweight child to international standards.
*** $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$, (NS) = not significant: $p > 0.05$.

TABLE E18. WEANING INTERVENTION:
PROTEIN ADEQUACY OF DIETS FOR WEANING AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)		CONTROL (n=55)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE mo	% PRO RQ % ±SD	AGE mo	% PRO RQ % ±SD	p-value	
PROTEIN ADEQUACY (MAINTENANCE#) OF CHILDREN'S DIETS (FOOD ONLY)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo* 25.1 ±37.6 25.8		*8.2mo* 20.7 ±21.3 20.0		p =.358	R^2=.171 Child age(NS),Sex(NS) Mother's education*** Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo* 27.3 ±13.3 27.5		*12.0mo* 15.4 ±13.3 15.2		p =.000	R^2=.366 Child age**,Sex(NS) Mother's education* Child base pro** Diarrhea* Respiratory ill(NS) Agricultural wealth** Traditional wealth(NS)
PROTEIN ADEQUACY (IDEAL¤) OF CHILDREN'S DIETS (FOOD ONLY)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo* 19.1 ±32.5 19.8		*8.2mo* 16.1 ±17.1 15.4		p =.400	R^2=.205 Child age(NS),Sex(NS) Mother's education*** Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo* 20.3 ±10.1 20.2		*12.0mo* 11.1 ±9.8 11.2		p =.000	R^2=.397 Child age*,Sex* Mother's education** Child base pro** Diarrhea(NS) Respiratory ill(NS) Agricultural wealth*** Traditional wealth(NS)

Note: Values reported do not include breastmilk estimates - 100% children breastfeeding throughout study.

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.

Maintenance protein requirement based on child's actual weight. This requirement will support growth at the child's present percentile, but will not support normal growth for the international reference child.

¤ Ideal protein requirement based on international reference median for child's age and sex. This requirement may be more than what the child needs to maintain present growth rate, however, may not be sufficient to support catch-up growth for the underweight child to international standards.

*** $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$, (NS) = not significant: $p > 0.05$.

TABLE E19. WEANING INTERVENTION:
PROTEIN ADEQUACY OF DIETS INCLUDING BREASTMILK FOR WEANING-AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=62)		CONTROL (n=55)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE	% PRO RQ	AGE	% PRO RQ		
	mo	% ±SD	mo	% ±SD	p-value	
PROTEIN ADEQUACY (MAINTENANCE#) OF CHILDREN'S DIETS (BREASTMILK & FOOD)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo* 69.8 ±38.3 70.4		*8.2mo* 66.0 ±21.0 65.3		p =.424	R^2=.169 Child age(NS),Sex(NS) Mother's education*** Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo* 61.7 ±13.7 62.3		*12.0mo* 52.9 ±12.9 52.7		p =.000	R^2=.317 Child age**,Sex* Mother's education(NS) Child base pro** Diarrhea** Respiratory ill(NS) Agricultural wealth* Traditional wealth(NS)
PROTEIN ADEQUACY (IDEAL¤) OF CHILDREN'S DIETS (BREASTMILK & FOOD)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.1mo* 52.9 ±33.3 53.5		*8.2mo* 51.3 ±18.0 50.6		p =.577	R^2=.269 Child age**,Sex(NS) Mother's education** Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*12.9mo* 46.2 ±9.6 46.2		*12.0mo* 38.3 ±9.4 38.2		p =.000	R^2=.402 Child age(NS),Sex** Mother's education** Child base pro* Diarrhea(NS) Respiratory ill(NS) Agricultural wealth*** Traditional wealth(NS)

Note: Breastmilk intakes estimated from country data - 100% children breastfeeding throughout study.

§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability of the model, or variables felt to confound the outcome.

Maintenance protein requirement based on child's actual weight. This requirement will support growth at the child's present percentile, but will not support normal growth for the international reference child.

¤ Ideal protein requirement based on international reference median for child's age and sex. This requirement may be more than what the child needs to maintain present growth rate, however, may not be sufficient to support catch-up growth for the underweight child to international standards.

*** $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$, (NS) = not significant: $p > 0.05$.

TABLE E20. WEANING INTERVENTION:
PERCENT HIGH QUALITY PROTEIN IN DIETS OF WEANING-AGE CHILDREN
BEFORE AND AFTER NUTRITION EDUCATION FOR COMPLEMENTARY FEEDING
MEAN VALUES (UNADJUSTED AND ADJUSTED§)

DEPENDENT VARIABLE	TREATMENT (n=57)		CONTROL (n=42)		Treatment Group Signif	Model R^2 and Covariates for Adjusted Means§
	AGE	GOOD PRO	AGE	GOOD PRO		
	mo	% ±SD	mo	% ±SD	p-value	
PERCENT HIGH QUALITY PROTEIN IN CHILDREN'S DIETS (FOOD ONLY)						
BASELINE (May-July) *Unadjusted* *Adjusted§*	*8.2mo* 36.1 ±44.2 36.0		*8.7mo* 42.3 ±46.8 44.4		p =.429	R^2=.097 Child age(NS),Sex(NS) Mother's education* Agricultural wealth(NS) Traditional wealth(NS)
FINAL (Oct-Nov) *Unadjusted* *Adjusted§*	*13.0mo* 29.9 ±19.7 33.1		*13.4mo* 22.2 ±33.2 17.9		p =.008	R^2=.284 Child age(NS),Sex(NS) Mother's education*** Child base pro quality(NS) Diarrhea(NS) Respiratory ill(NS) Agricultural wealth(NS) Traditional wealth(NS)

Note: Values reported do not include breastmilk estimates - 100% children breastfeeding throughout study. Only those children consuming complementary food with any protein on the day of recall are included in this analysis. High quality protein ("good protein") foods include milk, fish, and some meats or egg.
§ Means adjusted by analysis of covariance for significant covariates, variables that improved predictability
*** $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$, (NS) = not significant: $p > 0.05$.

APPENDIX F
RECIPES AND MARKET SURVEYS

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TABLE F1. CHOP CHOP INFANT FOOD - RECIPES AND NUTRIENTS

CHOP CHOP - BASIC	Weight (gms)	Vol (ml)	KCAL	PRO (gms)	ADJ* PRO	FAT (gms)	IRON (mg)	VITA (IU)	Cost in Taka# Ave	Cost in Taka# Low
2 handfuls flour	40	73	138	4.6	3.0	0.5	2.8	6	0.35	0.27
1 handful molasses/sugar	20	20	78	0.0	0.0	0.0	0.4	0	0.46	0.38
2 small spoons oil	8	8	72	0.0	0.0	8.0	0.0	0	0.25	0.25
water (1/2 poa)	117	117								
Total before cooking:	185	218	288	4.7	3.0	8.5	3.2	6	1.07	0.90
--1/2 recipe	93	109	144	2.3	1.5	4.3	1.6	3	0.53	0.45
Retention (wt 84%, vol 64%)	155	139								
Nutrients/100gms (cooked wt)	100	90	185	3.0	1.9	5.5	2.1	4	0.69	0.58
Cost (taka) per 100 kcals									0.37	0.31

CHOP CHOP w/MILK	Weight (gms)	Vol (ml)	KCAL	PRO (gms)	ADJ* PRO	FAT (gms)	IRON (mg)	VITA (IU)	Cost in Taka# Ave	Cost in Taka# Low
2 handfuls flour	40	73	138	4.6	3.0	0.5	2.8	6	0.35	0.27
1 handful molasses/sugar	20	20	78	0.0	0.0	0.0	0.4	0	0.46	0.38
2 small spoons oil	8	8	72	0.0	0.0	8.0	0.0	0	0.25	0.25
milk (1/2 poa: 75%milk 25%water)	117	117	59	2.8	2.8	3.6	0.2	112	0.90	0.90
Total before cooking:	185	218	347	7.5	5.8	12.1	3.4	118	1.97	1.81
--1/2 recipe	93	109	173	3.7	2.9	6.1	1.7	59	0.98	0.90
Retention (wt 84%, vol 64%)	155	139								
Nutrients/100gms (cooked wt)	100	90	223	4.8	3.7	7.8	2.2	76	1.26	1.16
Cost (taka) per 100 kcals									0.57	0.52

CHOP CHOP w/LENTILS	Weight (gms)	Vol (ml)	KCAL	PRO (gms)	ADJ* PRO	FAT (gms)	IRON (mg)	VITA (IU)	Cost in Taka# Ave	Cost in Taka# Low
2 handfuls flour	40	73	138	4.6	3.0	0.5	2.8	6	0.35	0.27
1 handful molasses/sugar	20	20	78	0.0	0.0	0.0	0.4	0	0.46	0.38
2 small spoons oil	8	8	72	0.0	0.0	8.0	0.0	0	0.25	0.25
1 handful lentil flour	20	24	69	4.7	3.0	0.4	1.4	12	0.37	0.37
water (1 poa)	234	234								
Total before cooking:	322	358	357	9.4	6.0	8.9	4.6	18	1.44	1.28
--1/2 recipe	161	179	178	4.7	3.0	4.4	2.3	9	0.72	0.64
Retention (wt 84%, vol 64%)	270	229								
Nutrients/100gms (cooked wt)	100	85	132	3.5	2.2	3.3	1.7	7	0.53	0.47
Cost (taka) per 100 kcals									0.40	0.39

#Note: Food costs (in taka) based on average market prices in Zhitka, Manikganj District, Bangladesh during the study. 30.5 Bangladesh taka = 1 US$. 'Low' cost estimates are figured using the lowest price foods available on the market (e.g., coarse flour); 'Average' costs use an average of all kinds available (e.g., average of refined and coarse flour).

*Low quality protein adjusted assuming 85% digestibility, 75% amino acid score.

TABLE F2. MISHOWKOW WEANING FOOD - RECIPES AND NUTRIENTS

MISHOWKOW-from raw ingredients	Weight (gms)	Vol (ml)	KCAL	PRO (gms)	ADJ* PRO	FAT (gms)	IRON (mg)	VITA (IU)	Cost# Ave
Rice, 2 small handfuls	20	20	70	1.7	1.1	0.1	0.6	1	0.21
Lentils, 1 handful	10	10	34	2.3	1.5	0.2	0.7	6	0.19
or Egg (1/2)	20	20	35	2.7	2.7	2.7	0.4	307	1.06
Green Leaves, I handful	20	50	9	0.7	0.5	0.1	3.0	680	0.12
Oil, 2 small spoons	8	8	72	0.0	0.0	8.0	0.0	0	0.25
Water	287	287							
Total before cooking (w/lentils):	345	375	185	4.8	3.0	8.4	4.3	687	0.78
--1/2 recipe	173	188	93	2.4	1.5	4.2	2.2	343	0.39
Retention (wt 64%, vol 56%)	221	210							
Nutrients/100gms (cooked wt)	100	95	84	2.2	1.4	3.8	1.9	311	0.35
Cost (taka) per 100 kcals									0.42
Total before cooking (w/egg):	355	385	185	5.1	4.2	10.9	4.0	987	1.65
--1/2 recipe	178	193	93	2.5	2.1	5.5	2.0	494	0.83
Retention (wt 64%, vol 56%)	227	216							
Nutrients/100gms (cooked wt)	100	95	84	2.3	1.9	4.9	1.8	447	0.73
Cost (taka) per 100 kcals									0.89

MISHOWKOW, pre-cooked	Weight (gms)	Vol (ml)	KCAL	PRO (gms)	ADJ* PRO	FAT (gms)	IRON (mg)	VITA (IU)	Cost# Ave
Rice, 2 small handfuls	40	40	47	1.2	0.7	0.1	0.4	1	0.15
Lentils, 1 spoon	40	40	21	1.4	0.9	0.1	0.4	4	0.11
or Egg (1/2)	20	20	35	2.7	2.7	2.7	0.4	307	1.06
or Fish, small handful	15	15	16	2.6	2.6	0.4	0.3	0	0.57
Green Leaves, I handful	20	50	15	1.3	0.8	0.2	5.3	1189	0.21
Oil, 2 small spoons	8	8	72	0.0	0.0	8.0	0.0	0	0.25
TOTALS:									
Rice,lentils,greens,oil:	108	138	155	3.8	2.4	8.4	6.1	1194	0.72
-1/2 recipe	54	69	78	1.9	1.2	4.2	3.1	597	0.36
-Nutrients/100gms (cooked wt)	100	128	144	3.5	2.3	7.8	5.7	1105	0.67
-Cost (taka) per 100 kcals									0.47
Rice,egg,greens,oil:	88	118	169	5.1	4.2	11.0	6.1	1497	1.67
-1/2 recipe	44	59	85	2.5	2.1	5.5	3.1	748	0.84
-Nutrients/100gms (cooked wt)	100	134	192	5.8	4.8	12.5	7.0	1701	1.90
-Cost (taka) per 100 kcals									0.99
Rice,fish,greens,oil:	83	113	151	5.0	4.1	8.7	6.0	1190	1.18
-1/2 recipe	42	57	76	2.5	2.1	4.4	3.0	595	0.59
-Nutrients/100gms (cooked wt)	100	136	182	6.0	5.0	10.5	7.2	1434	1.42
-Cost (taka) per 100 kcals									0.78

#Note: Food costs (in taka) based on average market prices in Zhitka, Manikganj District, Bangladesh during the study. 30.5 Bangladesh taka = 1 US$. Average costs are figured using the average price of foods available on the market (e.g., average cost of molasses and refined sugar).

*Low quality protein adjusted assuming 85% digestibility, 75% amino acid score.

TABLE F3. BANGLADESH MARKET SURVEY (1987) - MONTHLY FOOD PRICES PER KILOGRAM OF EDIBLE PORTION*

FOOD	F/Mar	April	May	June	July	August	Sept	Oct	Nov	AVER Tk/Kg	Std Dev
	---------- taka per kg edible portion ----------										
MILK											
Barley Water	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	0.0
Condensed Milk (Full)	32.7	32.7	35.3	35.3	35.3	37.8	37.8	37.8	37.8	35.8	2.0
Condensed Milk (Skim)	32.7	32.7	35.3	35.3	35.3	37.8	37.8	37.8	37.8	35.8	2.0
Powder Milk (Full)	92.5	92.5	92.5	92.5	95.0	95.0	95.0	95.0	100.0	94.4	2.3
Powder Milk (Skim)	92.5	92.5	92.5	92.5	95.0	95.0	95.0	95.0	100.0	94.4	2.3
Fresh Milk	8.6	8.6	9.6	8.6	10.7	8.6	10.7	15.0	12.0	10.3	2.0
STAPLES											
Rice	11.8	11.8	9.6	9.1	10.2	12.8	11.8	9.6	10.0	10.7	1.2
Jai (Rice)	5.9	5.9	4.8	4.6	5.1	6.4	5.9	4.8	5.0	5.4	0.6
Atar Jai	2.9	2.9	2.8	2.8	3.2	2.9	3.0	2.9	2.9	2.9	0.1
Ruti/Chapati (Refined Flour)	7.5	7.5	7.1	7.5	8.2	7.5	7.5	7.5	7.5	7.5	0.3
Ruti/Chapati (Brown Flour)	4.6	4.6	4.6	4.2	5.4	5.0	5.4	4.6	4.6	4.8	0.4
Ruti/Chapati (Average)	6.1	6.1	5.9	5.9	6.8	6.2	6.4	6.1	6.1	6.2	0.3
Sapri	6.1	6.1	5.9	5.9	6.8	6.2	6.4	6.1	6.1	6.2	0.3
Pitha	8.3	8.3	6.8	6.4	7.2	9.1	8.3	6.8	7.0	7.6	0.9
Potato (Alo)	5.0	5.0	5.0	5.7	7.6	7.6	10.1	10.1	10.1	7.3	2.1
Sweet Potato (Misti Alo)	3.3	3.3	2.2	2.2	3.3	4.4				6.0	0.8
Chirra (Flattened Rice)	16.1	16.1	17.1	12.8	12.8	15.0	15.0	15.0	15.0	15.0	1.3
Muri (Puffed Rice)	21.4	21.4	21.4	21.4	21.4	25.7	21.4	21.4	21.4	21.9	1.3
Kichuri w/Veg	11.9	11.9	10.3	9.9	11.2	13.2	12.8	11.1	11.5	11.5	1.0
Kichuri w/o Veg	14.4	14.4	13.0	12.3	13.7	15.9	15.1	13.5	14.0	14.0	1.0
Biscuit (average sweet & salt)	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	0.0
VEGETABLES											
Potato (Alo)	5.0	5.0	5.0	5.7	7.6	7.6	10.1	10.1	10.1	7.3	2.1
Arum (Kachu)		13.5			13.4	13.7		13.4	13.4	13.5	0.1
String Beans (Sim/Barbati)	9.1	4.3						13.4	17.0	10.9	4.8
Cabbage/Radish (PKapi/Mula)	3.5	5.8						11.5	12.0	8.2	3.7
Leafy Greens (Sak)	4.0	4.0	2.7	2.3	5.4	5.4	6.7	11.6	12.8	6.1	3.5
Snake Gourd (Chichinga)		7.1	7.5	6.6	4.4		11.1	10.2		7.8	2.3
Eggplant (Begun)	3.5	3.5	5.9	4.7	4.7	5.9	17.6	18.8	10.9	8.4	5.7
Okra (Dherosh)			10.2	10.2	10.2	10.2				10.2	0.0
Ridge Gourd (Jhinga)		3.9	3.9	6.5	5.2	6.5	15.7	15.7	12.1	8.7	4.7
Bitter Gourd (Korolla)		5.5	3.3	4.4		8.8				5.5	2.1
Caulif/Radish/SGourd/Cuke	2.1	3.6	8.0	4.9		5.5		12.3	12.6	7.0	3.8
Pumpkin/Ridge Gourd/Okra		3.3	6.9	8.1	7.8	8.2	14.4	14.4	14.0	9.6	3.9
Eggplant (Begun)	3.5	3.5	5.9	4.7	4.7	5.9	17.6	18.8	10.9	8.4	5.7
Ash Gourd/Amaranth/Beans	6.6	6.6	5.4	1.3	5.7	5.7	13.2	11.0	19.4	8.3	5.1
Arum Tuber (Kachu Muki)		18.6	16.3	11.6	9.3	5.8	5.8	7.0	5.8	10.0	4.7
Bottle Gourd (Lao)	1.9	1.9	2.9					6.0	6.0	3.7	1.9
Tomato	3.7	3.7	5.4							4.3	0.8
Chili (Kacha Marich)	38.9	38.9	35.6	35.6	31.1	44.4	50.0	50.0	38.9	40.4	6.2
PROTEIN											
Fish (average of 28 kinds)	52.1	52.1	63.8	46.1	52.7	47.2	49.7	41.4	43.9	49.9	6.1
Fish (weighted by consumpt)	39.3	39.3	42.7	24.7	43.9	41.7	47.6	27.9	34.1	37.9	7.1
Chicken Egg	42.1	42.1	56.2	56.2	56.2	42.1	70.2	56.2	56.2	53.1	8.8
Duck Egg	24.3	24.3	24.3	37.5	37.5	28.1	46.8	37.5	28.1	32.0	7.6
Beef/Mutton	49.4	49.4	49.4	49.4	43.2	43.2	74.1	80.2	74.1	56.9	13.9
Chicken/Pigeon	51.9	51.9	45.5	39.0	39.0	51.9	90.9	90.9	77.9	59.9	19.8
Pulse (Dal; average of 5 kinds	17.6	17.6	16.7	16.9	18.8	18.4	20.1	19.7	21.0	18.5	1.4
Oil (average of 3 kinds)	29.2	29.2	32.1	29.2	32.1	33.4	32.1	33.5	34.3	31.7	1.9

(continued)

(Table F3, continued)

FOOD	PRICE (taka) PER KILOGRAM OF EDIBLE PORTION										
	F/Mar	April	May	June	July	August	Sept	Oct	Nov	AVER Taka/Kg	Std Dev
	---------- taka per kg edible portion ----------										
FRUIT											
Banana (Kola)	46.0	46.0	46.0	26.0	30.0	30.0	30.0	40.0	40.0	37.1	7.7
Mango (Am)			31.7	23.1	17.4	17.4				22.4	5.9
Jackfruit (Katal)			20.8	16.7	25.0	33.3				24.0	6.2
Borai	5.5	5.5								5.5	0.0
Guava (Peara)	11.2	11.2	12.9		17.2	8.6	12.9	10.8	8.6	11.7	2.6
Pineapple (Anarosh)			6.7	6.7	3.3	4.4		4.4		5.1	1.3
Papaya (Pepe)		10.7	26.7	26.7	21.3	10.7	32.0	40.0	21.3	23.7	9.4
Starfruit (Kamranga)			6.0		100.0	60.0	20.0			46.5	36.7
Orange (Komola)		99.5	74.6						49.8	74.6	20.3
ADDITIONAL FOODS											
Sugar	21.4	21.4	19.3	20.3	25.7	27.8	25.7	25.7	25.7	23.7	2.9
Molasses	16.1	16.1	12.8	12.8	21.4	21.4	19.3	19.3	25.7	18.3	4.0
Liquid Molasses	8.0	8.0	6.4	6.4	10.7	10.7	9.6	9.6	12.8	9.2	2.0
Date or Cane Juice	9.6				10.7				10.7	10.3	0.5
Jilapi (Sweet)	28.0	25.0	30.0	27.0	35.0	35.0	40.0	40.0	45.0	33.9	6.5
Shazna (Horseradish)	12.9	7.7	5.2	5.2						7.7	3.2
Satu	7.0	7.0	7.0	7.0	6.5	6.0	6.0			6.6	0.4
Melon (Bangee)		17.0	2.4	2.4						7.3	6.9
Sagu	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	0.0
Suji (Seminola)	12.8	12.8	12.8	12.8	15.0	15.0	15.0	13.9	15.0	13.9	1.0
Barley	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	0.0
Wheat Flour (Refined)	10.7	10.7	10.2	10.7	11.8	10.7	10.7	10.7	10.7	10.8	0.4
Wheat Flour (Brown)	6.4	6.4	6.4	5.9	7.5	7.0	7.5	6.4	6.4	6.7	0.5
Wheat Flour (average)	8.6	8.6	8.3	8.3	9.6	8.8	9.1	8.6	8.6	8.7	0.4
Rice Flour	11.8	11.8	9.6	9.1	10.2	12.8	11.8	9.6	10.7	10.8	1.2
Naru (Coconut Sweet)	21.4	21.4	25.7	25.7	24.6	25.7	32.1	32.1	37.5	27.4	5.1
Candy	48.2	48.2	48.2	48.2	42.8	58.9	58.9	58.9	48.2	51.2	5.7
Chanachur (Trail Mix)	18.0	15.0	15.0	16.0	17.0	17.0	20.0	20.0	20.0	17.6	1.9
Banana Flower (Vadail)	11.6	14.0							14.0	13.2	1.1
Mishty (Sweet)	48.2	53.5	53.5	53.5	48.2	48.2	64.2	64.2	64.2	55.3	6.7
Lactogen (Infant Formula)	155.6	155.6	155.6	155.6	155.6	155.6	155.6	155.6	155.6	155.6	***
Wood Apple (Bel)		19.9	15.9							17.9	2.0
Jackfruit Seed (Katal Bichi)			6.6	5.3	8.0	10.6				7.6	2.0
Chop Chop (Refined Flour)	7.0	7.0	6.8	6.9	8.0	8.1	7.7	7.8	7.8	7.5	0.5
Chop Chop (Brown Flour)	5.9	5.9	5.8	5.6	6.9	7.1	6.9	6.7	6.7	6.4	0.5
Chop Chop (Average)	6.5	6.5	6.3	3.3	7.5	7.6	7.3	7.2	7.3	6.9	0.5
Sugar Water (Shorbot)	1.9	1.9	1.7	1.8	2.3	2.5	2.3	2.3	2.3	2.1	0.3
Onions	8.0	8.0	8.0	10.7	17.1	12.8	30.0	21.4		14.5	7.4
Onion Fry (Piaz Torkari)	9.0	9.0	9.1	11.8	18.5	14.1	31.9	23.0	0.7	14.1	8.7
Green Coconut (Gab)	7.1	8.6			7.9					7.9	0.6
Green Banana (Kacha Kola)	15.5	17.2	13.8	13.8						15.1	1.4

Note: Food costs based on 1987 monthly market prices in Zhitka & Bhadurpur, Manikganj District, Bangladesh.
* 30.5 Bangladesh taka = 1 US$

TABLE F4. BANGLADESH MARKET SURVEY (1987) -- MONTHLY FOOD PRICES* IN COMMON MARKET UNITS

FOOD	F/Mar	April	May	June	July	Aug	Sept	Oct	Nov	MARKET UNITS§	% WASTE
	---------- taka per unit ----------										
MILK											
Barley Water	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	kg	0%
Condensed Milk (Full)	13.0	13.0	14.0	14.0	14.0	15.0	15.0	15.0	15.0	397 gm	0%
Condensed Milk (Skim)	13.0	13.0	14.0	14.0	14.0	15.0	15.0	15.0	15.0	397 gm	0%
Powder Milk (Full)	37.0	37.0	37.0	37.0	38.0	38.0	38.0	38.0	40.0	400 gm	0%
Powder Milk (Skim)	37.0	37.0	37.0	37.0	38.0	38.0	38.0	38.0	40.0	400 gm	0%
Fresh Milk	8.0	8.0	9.0	8.0	10.0	8.0	10.0	14.0	11.2	seer	0%
STAPLES											
Rice	11.0	11.0	9.0	8.5	9.5	12.0	11.0	9.0	9.3	seer	0%
Jai (Rice)	5.5	5.5	4.5	4.3	4.8	6.0	5.5	4.5	4.7	seer	0%
Atar Jai	2.7	2.7	2.6	2.6	3.0	2.8	2.8	2.7	2.7	seer	0%
Ruti/Chapati (Refined Flour)	7.0	7.0	6.7	7.0	7.7	7.0	7.0	7.0	7.0	seer	0%
Ruti/Chapati (Brown Flour)	4.3	4.3	4.3	3.9	5.0	4.6	5.0	4.3	4.3	seer	0%
Ruti/Chapati (Average)	5.7	5.7	5.5	5.5	6.4	5.8	6.0	5.7	5.7	seer	0%
Sapri	5.7	5.7	5.5	5.5	6.4	5.8	6.0	5.7	5.7	seer	0%
Pitha	7.8	7.8	6.3	6.0	6.7	8.5	7.8	6.3	6.6	seer	0%
Potato (Alo)	4.0	4.0	4.0	4.5	6.0	6.0	8.0	8.0	8.0	seer	15%
Sweet Potato (Misti Alo)	3.0	3.0	2.0	2.0	3.0	4.0				seer	3%
Chirra (Flattened Rice)	15.0	15.0	16.0	12.0	12.0	14.0	14.0	14.0	14.0	seer	0%
Muri (Puffed Rice)	20.0	20.0	20.0	20.0	20.0	24.0	20.0	20.0	20.0	seer	0%
Kichuri w/Veg	11.1	11.1	9.6	9.2	10.4	12.3	11.9	10.4	10.8	seer	0%
Kichuri w/o Veg	13.5	13.5	12.2	11.5	12.8	14.8	14.1	12.6	13.1	seer	0%
Biscuit (average sweet & salt)	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	kg	0%
VEGETABLES											
Potato (Alo)	4.0	4.0	4.0	4.5	6.0	6.0	8.0	8.0	8.0	seer	15%
Arum (Kachu)		10.1			10.0	10.2		10.0	10.0	seer	20%
String Beans (Sim/Barbati)	7.5	3.5						11.0	14.0	seer	12%
Cabbage/Radish (PKapi/Mula)	3.0	5.0						10.0	10.4	seer	7%
Leafy Greens (Sak)	3.0	3.0	2.0	1.7	4.0	4.0	5.0	8.7	9.6	seer	20%
Snake Gourd (Chichinga)			6.5	6.9	6.0	4.0		10.2	9.3	seer	2%
Eggplant (Begun)	3.0	3.0	5.0	4.0	4.0	5.0	15.0	16.0	9.3	seer	9%
Okra (Dherosh)			8.0	8.0	8.0	8.0				seer	16%
Ridge Gourd (Jhinga)		3.0	3.0	5.0	4.0	5.0	12.0	12.0	9.3	seer	18%
Bitter Gourd (Korolla)		5.0	3.0	4.0		8.0				seer	3%
Caulif/Radish/SGourd/Cuke	1.7	2.9	6.5	4.0		4.5		10.0	10.2	seer	13%
Pumpkin/Ridge Gourd/Okra		2.5	5.3	6.2	6.0	6.3	11.0	11.0	10.7	seer	18%
Eggplant (Begun)	3.0	3.0	5.0	4.0	4.0	5.0	15.0	16.0	9.3	seer	9%
Ash Gourd/Amaranth/Beans	5.0	5.0	4.1	1.0	4.3	4.3	10.0	8.3	14.7	seer	19%
Arum Tuber (Kachu Muki)		16.0	14.0	10.0	8.0	5.0	5.0	6.0	5.0	kg	14%
Bottle Gourd (Lao)	1.5	1.5	2.3					4.8	4.8	seer	14%
Tomato	3.5	3.5	5.0							seer	0%
Chill (Kacha Marich)	35.0	35.0	32.0	32.0	28.0	40.0	45.0	45.0	35.0	kg	10%
PROTEIN											
Fish (average of 26 kinds)	46.9	46.9	57.4	41.5	47.4	42.5	44.7	37.3	39.5	kg	10%
Fish (weighted by consumpt)	35.4	35.4	38.4	22.2	39.5	37.5	42.8	25.1	30.7	kg	10%
Chicken Egg	1.5	1.5	2.0	2.0	2.0	1.5	2.5	2.0	2.0	40 gm	11%
Duck Egg	1.3	1.3	1.3	2.0	2.0	1.5	2.5	2.0	1.5	60 gm	11%
Beef/Mutton	40.0	40.0	40.0	40.0	35.0	35.0	60.0	65.0	60.0	kg	19%
Chicken/Pigeon	40.0	40.0	35.0	30.0	30.0	40.0	70.0	70.0	60.0	1 kg	23%
Pulse (Dal; average of 5 kinds)	16.4	16.4	15.6	15.8	17.6	17.2	18.8	18.4	19.6	seer	0%
Oil (average of 3 kinds)	27.3	27.3	30.0	27.3	30.0	31.2	30.0	31.3	32.0	seer	0%

(continued)

(Table F4, continued)

FOOD PRICES IN COMMON MARKET UNITS

FOOD	F/Mar	April	May	June	July	Aug	Sept	Oct	Nov	MARKET UNITS§	% WASTE
	---------- taka per unit ----------										
FRUIT											
Banana (Kola)	2.3	2.3	2.3	1.3	1.5	1.5	1.5	2.0	2.0	50 gm	0%
Mango (Am)			21.9	16.0	12.0	12.0				seer	26%
Jackfruit (Katal)			25.0	20.0	30.0	40.0				3-5 kg	70%
Borai	1.8	1.8								80 pc	30%
Guava (Peara)	1.3	1.3	1.5		2.0	1.0	1.5	1.3	1.0	116 gm	0%
Pineapple (Anarosh)			6.0	6.0	3.0	4.0		4.0		1.5 kg	40%
Papaya (Pepe)		4.0	10.0	10.0	8.0	4.0	12.0	15.0	8.0	0.5 kg	25%
Starfruit (Kamranga)			0.3		5.0	3.0	1.0			50 gm	0%
Orange (Komola)		8.0	6.0						4.0	120 gm	33%
ADDITIONAL FOODS											
Sugar	20.0	20.0	18.0	19.0	24.0	26.0	24.0	24.0	24.0	seer	0%
Molasses	15.0	15.0	12.0	12.0	20.0	20.0	18.0	18.0	24.0	seer	0%
Liquid Molasses	7.5	7.5	6.0	6.0	10.0	10.0	9.0	9.0	12.0	seer	0%
Date or Cane Juice	9.0				10.0				10.0	seer	0%
Jilapi (Sweet)	28.0	25.0	30.0	27.0	35.0	35.0	40.0	40.0	45.0	kg	0%
Shazna (Horseradish)	10.0	6.0	4.0	4.0						seer	17%
Satu	7.0	7.0	7.0	7.0	6.5	6.0	6.0			kg	0%
Melon (Bangee)		14.3	2.0	2.0						seer	10%
Sagu	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	kg	0%
Suji (Seminola)	12.0	12.0	12.0	12.0	14.0	14.0	14.0	13.0	14.0	seer	0%
Barley	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	kg	0%
Wheat Flour (Refined)	10.0	10.0	9.5	10.0	11.0	10.0	10.0	10.0	10.0	seer	0%
Wheat Flour (Brown)	6.0	6.0	6.0	5.5	7.0	6.5	7.0	6.0	6.0	seer	0%
Wheat Flour (average)	8.0	8.0	7.8	7.8	9.0	8.3	8.5	8.0	8.0	seer	0%
Rice Flour	11.0	11.0	9.0	8.5	9.5	12.0	11.0	9.0	10.0	seer	0%
Naru (Coconut Sweet)	20.0	20.0	24.0	24.0	23.0	24.0	30.0	30.0	35.0	seer	0%
Candy	45.0	45.0	45.0	45.0	40.0	55.0	55.0	55.0	45.0	seer	0%
Chanachur (Trail Mix)	18.0	15.0	15.0	16.0	17.0	17.0	20.0	20.0	20.0	kg	0%
Banana Flower (Vadail)	5.0	6.0							6.0	kg	57%
Mishty (Sweet)	45.0	50.0	50.0	50.0	45.0	45.0	60.0	60.0	60.0	seer	0%
Lactogen (Infant Formula)	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	450 gm	0%
Wood Apple (Bel)		7.5	6.0							375-800g	36%
Jackfruit Seed (Katal Bichi)			25.0	20.0	30.0	40.0				4 kg	6%
Chop Chop (Refined Flour)	6.6	6.6	6.3	6.4	7.5	7.5	7.2	7.3	7.3	seer	0%
Chop Chop (Brown Flour)	5.5	5.5	5.4	5.3	6.4	6.6	6.4	6.2	6.3	seer	0%
Chop Chop (Average)	6.0	6.0	5.9	5.9	7.0	7.1	6.8	6.8	6.8	seer	0%
Sugar Water (Shorbot)	1.9	1.9	1.7	1.8	2.3	2.5	2.3	2.3	2.3	kg	0%
Onions	7.5	7.5	7.5	10.0	16.0	12.0	28.0	20.0		seer	
Onion Fry (Piaz Torkari)	8.5	8.5	8.5	11.1	17.4	13.3	30.0	21.7	0.7	kg	6%
Green Coconut (Gab)	5.0	6.0			5.5					kg	30%
Green Banana (Kacha Kola)	9.0	10.0	8.0	8.0						kg	42%
COUNT	70	77	78	73	72	72	63	67	68		

Note: Food costs based on 1987 monthly market prices in Zhitka & Bhadurpur, Manikganj District, Bangladesh.

* 30.5 Bangladesh taka = 1 US$

§ 1 seer = .934 kg

APPENDIX G
BRAC'S CROSS-SECTIONAL SURVEY

CROSS-SECTIONAL SURVEY OF PUSTHI JIBON (NUTRITION FOR LIFE): MAJOR FINDINGS FROM THE WEANING INTERVENTION

By Dr. Azmat Ahmad and Mr. Suaib Ahmed, BRAC, June 1989.

INTRODUCTION

During the period from September 1986 to December 1987 we undertook a project in Zhitka to provide nutrition messages to the people. The objectives of the project were to increase the knowledge on nutrition and to cause a positive attitudinal and behavioral change of the people.

During a two week period in March 1988, we conducted a cross-sectional survey at Zhitka to ascertain how far the objectives were fulfilled. The following is a short summary of the survey.

METHOD USED FOR THE SURVEY

A detailed questionnaire seeking to evaluate the KAB (knowledge, attitude and behavior) change was constructed. Two female research workers from another BRAC field research site were hired for two weeks to conduct the study. They interviewed women both in intervention and in control sites. As a word of caution, we should note that interviewing is not a sure way to determine the behavioral change.

KNOWLEDGE, ATTITUDE AND BEHAVIOR ON SUPPLEMENTARY FEEDING

Before the intervention, or data suggested that mothers in general were willing to, and often did, feed their children foods other than the breastmilk as early as 6-7 months of age. However, the nutritional contents were poor and the quantity of food was insufficient to support the growth of the infants. There were some inhibiting factors preventing the early introduction of weaning food. These factors were the fear that food can make the child sick, poor knowledge about correct nutritional content of supplementary food, belief that adult foods are inappropriate for the children, and poverty resulting in insufficient quantity and quality of food available for the child.

In developing the nutrition messages on supplementary feeding these were taken into consideration. The messages emphasized increasing the frequency of feeding as well as the amount of food (or nutrients) given in each feed. Mothers were encouraged to add energy supplements such as oil and molasses to the infant's food. Energy enriched cereal food, such as *Chop Chop*, and more complete foods, like *Mishowkow*, were introduced. Mothers were also asked to feed their infants seasonal fruits and vegetables.

In the cross-sectional survey, it was found that more than 90% of the mothers in the intervention site (including volunteer mothers [VMs] and community mothers [CMs]) thought that the children under 13 months of age should be given weaning food as opposed to 62% of the mothers in the control site (Table 1). They also emphasized that oil and fruits should be given to babies (Tables 2, 3 and 4). In the intervention site, more than 90% of the mothers (including VMs and CMs) claimed that they fed their babies more than three times a day, as opposed to 67% of the mothers in the control site (Table 5). In the intervention site mothers stressed the similarity of feeding their child to feeding chicks (Table 6). This is probably due to the message "just as the baby chicken pecks all day on food, so should your baby be given food - small amounts and frequently". Chickens, we should note, are a valued possession for women in the Bangladesh rural households.

Regarding the preparation of special weaning foods, one-third of the women in the intervention site could remember the correct ingredients of *Chop Chop*, while about 23% of the mothers could recall correctly the items in *Mishowkow*.

There were very little differences between the intervention and control site on the question whether any food should be given to a sick child. Most of the mothers (97% in both sites) claimed that they washed their hands and utensils with water before cooking and feeding the baby. Almost all of the women in the trial and control site stated that they used tubewell water for cooking and washing.

CONCLUSIONS

The results of the survey show that the mothers in the intervention area had an increased awareness about the necessity of early introduction of weaning foods. Also most mothers in the intervention area (more than in the control area) claimed giving their babies frequent feeds.

Another point to emphasize is that the majority of the mothers in the intervention site (roughly two-thirds) couldn't correctly recollect the recipe of the two weaning foods which we introduced to them as nutritious and cheap foods. This finding doesn't suggest the failure of our intervention. The positive thing is that roughly one-third of the women did know the correct recipes, a situation much better than in the control area where hardly any mothers could recall how to make cheap, nutritious weaning foods. We can hope that the situation would be made better by the "spill over" effect: if one woman has the correct knowledge for preparing the weaning food and practices it in reality, other women can learn through observation. The preparation of the food and the proper feeding method should be demonstrated adequately. In this context the role of the volunteer mothers need to be stressed.

Another fact needs mentioning. No matter how nutritious, tasty and appropriate a weaning food is, in reality the child may refuse to eat it. Therefore, mere preparation of special food is not sufficient unless the technique of feeding the child is also taught. Weaning food preparation and the method of feeding are intertwined.

Table - 1

Group	AT WHAT AGE OTHER FOOD SHOULD BE GIVEN	
	Less than 13 months	More than 13 months
Intervention Vm	15 (100%)	0 (0.0%)
Intervention Cm	46 (93.88%)	3 (6.12%)
Control	26 (61.90%)	16 (38.09%)

Table - 2

Group	SHOULD FRUIT BE GIVEN UNDER ONE YEAR		
	Yes	No.	N.S.
Intervention Vm	15 (100%)	0 (0.0%)	0 (0.0%)
Intervention Cm	47 (95.92%)	2 (4.08%)	0.(0.0%)
Control	22 (52.38%)	14 (33.33%)	6 (14.29%)

Table - 3

Group	WHETHER FRUIT OR FRUIT JUICE GIVEN TO THE BABY		
	Yes	No.	N.S.
Intervention Vm	15 (100%)	0 (0.0%)	0 (0.0%)
Intervention Cm	40 (81.63%)	9 (18.37%)	0.(0.0%)
Control	22 (52.38%)	14 (33.33%)	6 (14.29%)

Table - 4

Group	WHETHER OIL IS GOOD OR BAD FOR THE BABY		
	Good	Bad	N.S.
Intervention Vm	15 (100%)	0 (0.0%)	0 (0.0%)
Intervention Cm	48 (97.96%)	1 (2.04%)	0 (0.0%)
Control	9 (21.43%)	23 (54.76%)	10 (23.81%)

Table - 5

Group	HOW MANY TIMES A BABY FED	
	Less than 3 times	More than 3 times
Intervention Vm	2 (6.67%)	28 (93.33%)
Intervention Cm	4 (4.08%)	94 (95.92%)
Control	28 (33.33%)	56 (66.66%)

Table - 6

Group	HOW OFTEN A BABY SHOULD BE FED		
	LIKE A CHIKEN	4/MORE TIMES	N.S.
Intervention Vm	13 (43.33%)	8 (26.67%)	9 (30%)
Intervention Cm	24 (24.49%)	42 (42.86%)	32 (32.65%)
Control	0 (0.0%)	23 (27.38%)	61 (72.62%)

APPENDIX H
FLASH CARD VISUAL AIDS FOR LACTATION INTERVENTION

MESSAGES FOR DISCUSSION:

Mother's milk is the best milk for baby. Baby should not be bottle-fed because it may cause illness.

If mother has much milk, baby will be very happy.

When baby is offered 2 breasts he gets more milk; let the baby, himself, stop the feeding when his stomach is full.

প্রসূতি/স্তন্যদাত্রী মাকে নিজের ও সন্তানের, দুজনের জন্য খেতে হয়।

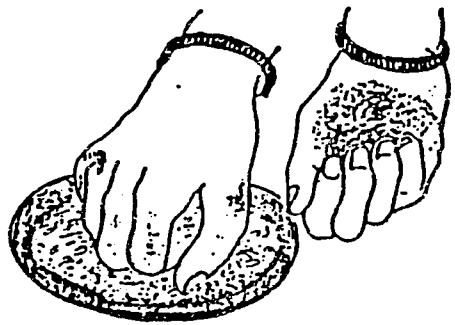
MESSAGES FOR DISCUSSION:

If you eat large amounts of all kinds of foods, you will produce much milk, and your baby will receive much milk.

Eat 3 plates of rice with 5 handfuls of rice per plate (OR 2-3 flat breads 3 times a day) WITH 2 handfuls of leafy greens and other vegetables, small fish or lentils at each serving, and you will have much breast milk.

গর্ভবতী মা কে যা খেতে হয়।

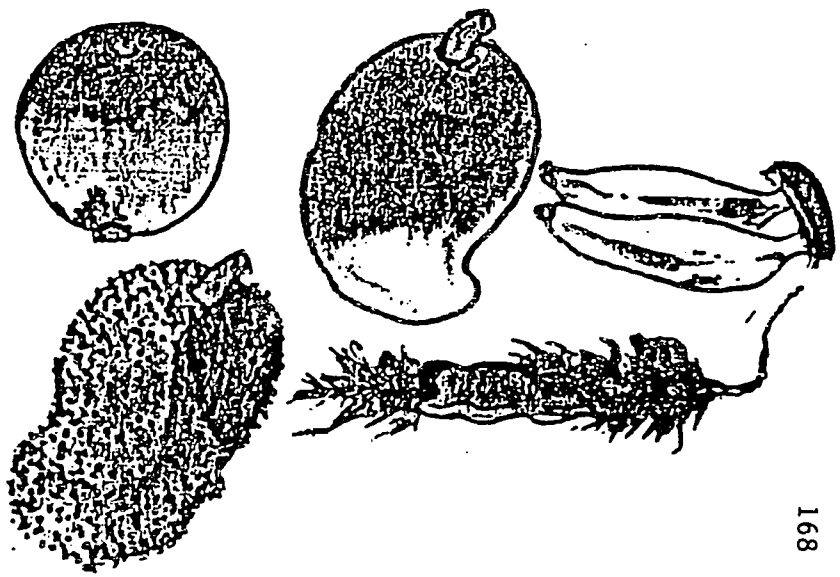
(Same message as previous card)



বাড়তি দুধ ভাত।

বাড়তি এক চামচ তেল।

বাড়তি কিছু শুকনো।



আর কিছু ফল খেতে হবে।

MESSAGES FOR DISCUSSION:

Daily drink 8 or more glasses of water and you (mother) will produce much milk.

APPENDIX I
FLASH CARD VISUAL AIDS FOR WEANING INTERVENTION

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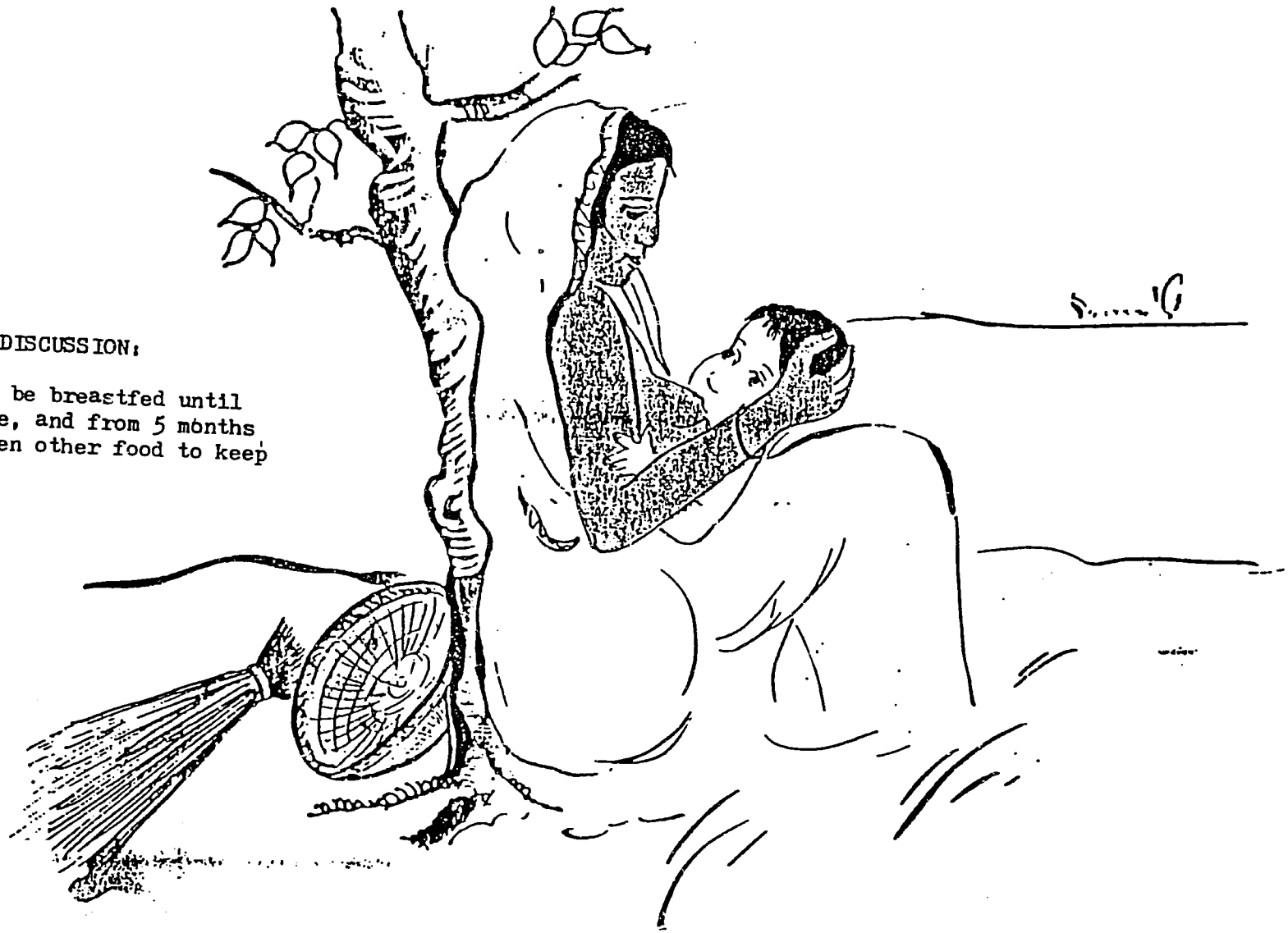
MESSAGES FOR DISCUSSION:

A baby should be breastfed until 2 years of age, and from 5 months should be given other food to keep him healthy.



এক বছর বয়সের শিশু আনুমানিক ৯০০ ক্যালোরী দরকার মায়ের দুধ থেকে শিশু ২০০ ক্যালোরী পায়।

MESSAGES FOR DISCUSSION:

What are the differences between these two children?
One child received supplementary food from 5 months,,
and the other was solely breastfed.

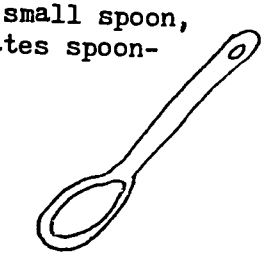
MESSAGES FOR DISCUSSION:

If you want to habituate your baby to other foods give 2-3 spoons, 2-3 times (small amounts) daily of soft food. Slowly and gradually increase the amount as the baby adjusts. Soft foods include wheat flour, rice flour, banana, potato, sweet potato, potato, softened biscuits, and bread. To make the food soft, and keep germ free, use boiled water.

Let the baby eat as much as he wishes. Be attentive to him and never force.

DEMONSTRATION:

Worker takes small spoon, and demonstrates spoon-feeding.



Worker demonstrates facial expressions of a child being force-fed, and a child who will willingly accept more food, if offered.

MESSAGE FOR DISCUSSION:

Just as the baby chicken pecks all day on food, so should your baby be given food (small amounts and frequently).

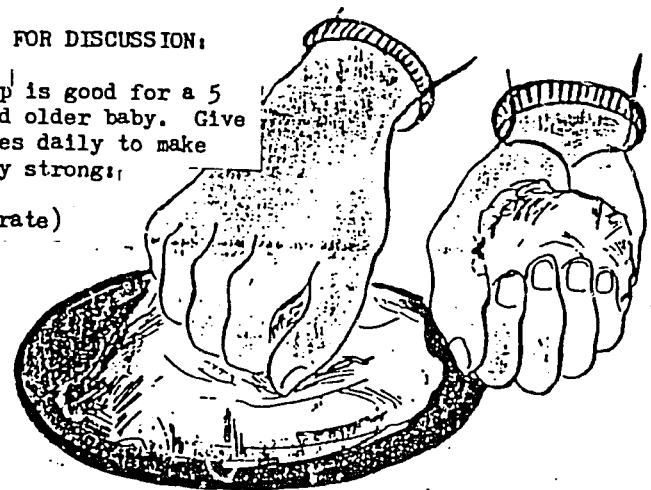
DEMONSTRATION:

Worker points out chickens in the yard and asks mother how baby chickens eat, and how rapidly they grow.

MESSAGES FOR DISCUSSION:

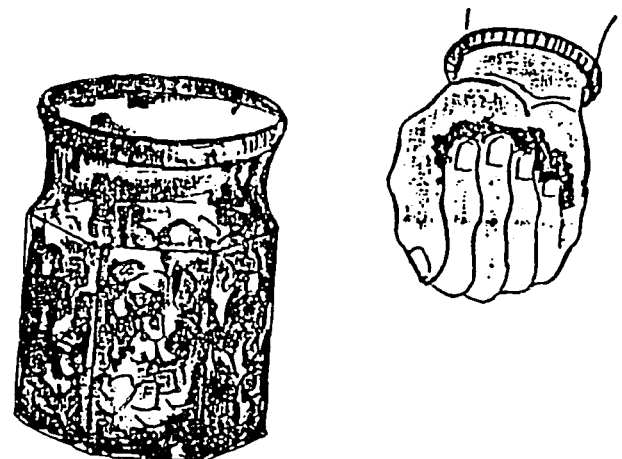
Chop Chop is good for a 5 month and older baby. Give it 4 times daily to make your baby strong.

(demonstrate)



2 handful (closed fist) wheat or rice flour

চালের গুড়োর ক্ষীর ছ'মাস বয়সের শিশু খাবে।

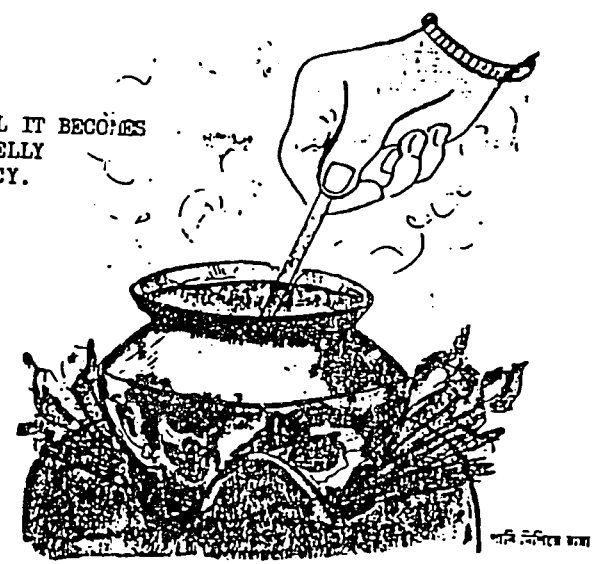


1 handful molasses (or sugar)

(Later, demonstrate preparation of Special Chop Chop)

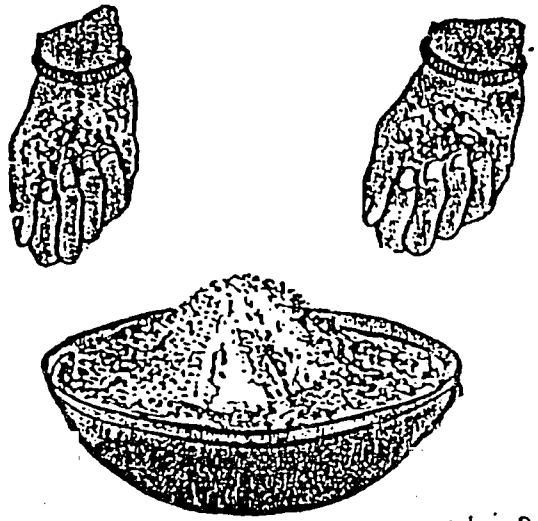
2 small spoons oil

COOK UNTIL IT BECOMES A SOFT, JELLY CONSISTENCY.

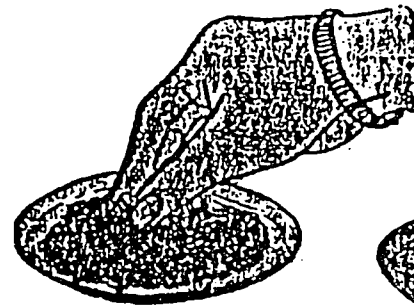


½ poa (about 120 ml.) milk or tubewell water

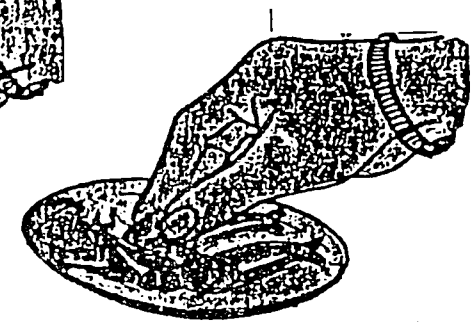
ছ'মাস বয়সের শিশুর বাড়তি খাবারের একটি নমুনা।



দু'মুঠো ভাত নিন



কিছু শাক, নিন।



মাছ দু'একটি মাছ নিন

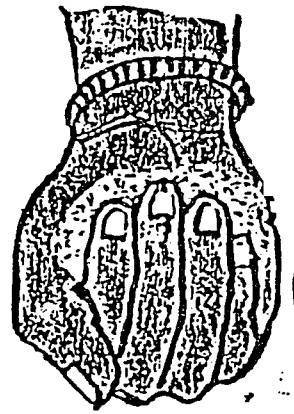
২ চামচ তেল মেশান

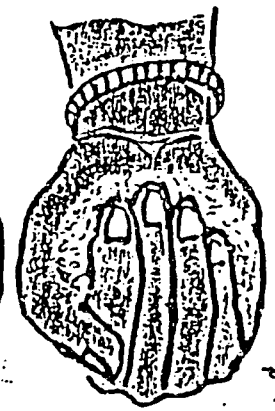
MESSAGES FOR DISCUSSION:

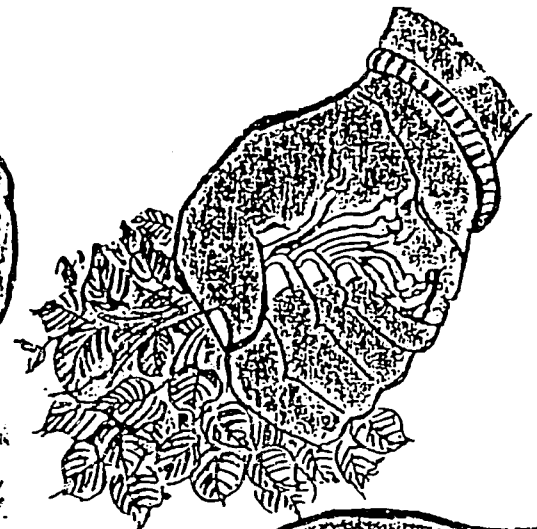
In a 7 month baby, if you want to protect from disease, give Mishawkaw (mixed food) 4 times daily.

Mishawkaw can be make with 4 kinds of already cooked foods:

*2 handfuls rice, potato, or sweet potato;
*1 handful leafy greens and other vegs;
*If you have some, add small fish, lentils or an egg;
*Then, with a clean hand, mash, and add 2 small spoons oil.







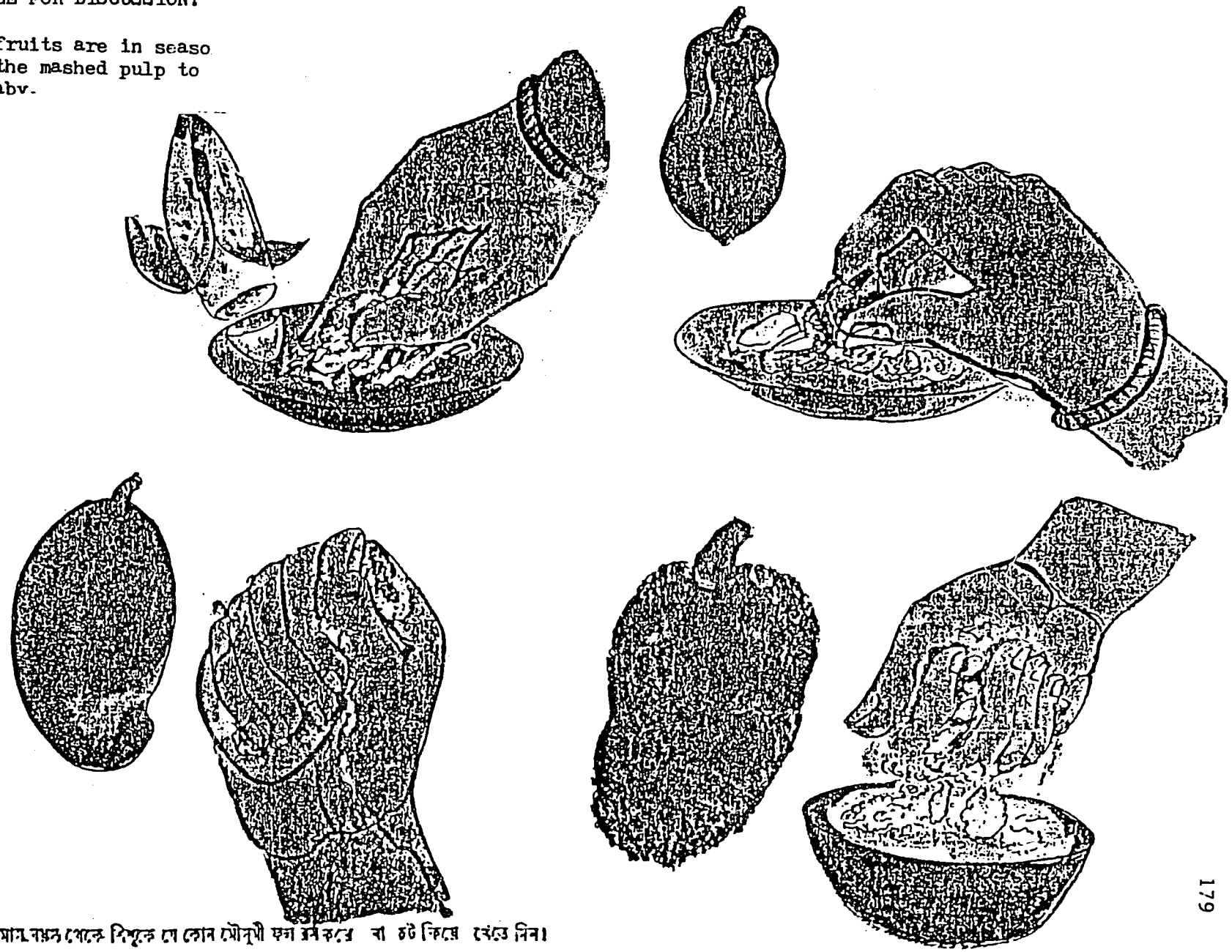
MESSAGE FOR DISCUSSION:

If possible, cook Mishawkaw seperately for the baby in the morning and afternoon:

*2 clean handfuls rice, wheat or rice flour, potato, or sweet potato;
*If you have, add 1 handful lentils or egg;
*Some leafy greens and other vegetables cut very fine;
*2 small spoons oil;
*Add $\frac{1}{2}$ seer ($\frac{1}{2}$ liter) water and cook until soft;
*Them, with a clean hand, mash, and add 2 small spoons oil.

MESSAGE FOR DISCUSSION:

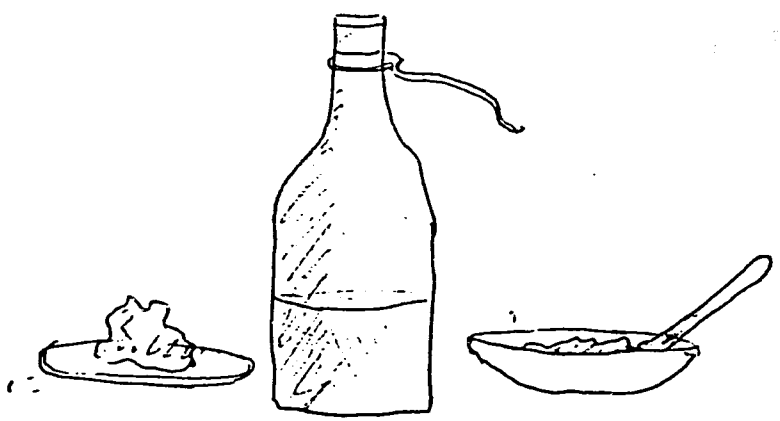
When fruits are in seaso
feed the mashed pulp to
your baby.



ছয় মাস বয়স থেকে শিশুকে যে কোন মৌসুমী ফল ভর্তা করে বা চট্টকিয়ে খেতে দিন।

MESSAGE FOR DISCUSSION:

If you want your baby to be strong, add 1 small spoon of oil or molasses to his food.



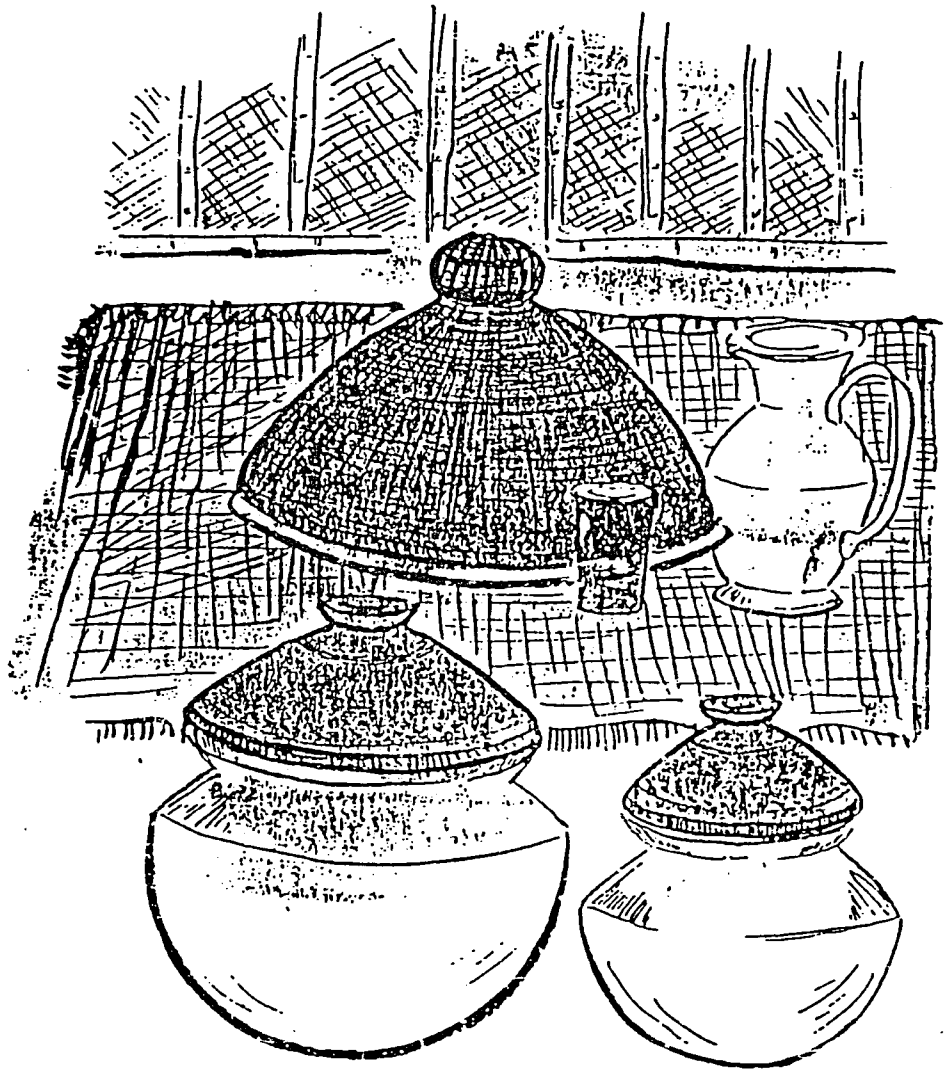
DEMONSTRATION:

Worker asks mother to bring a bottle of cooking oil or molasses and, using a spoon, demonstrates how she should mix the oil or molasses into the food.

MESSAGES FOR DISCUSSION:

Whatever you cook for your family, give some to your baby (without hot spices).

দু'বছর বয়সের একটি শিশু পরিবারের সবাই যা খায় তাই খাবে।



খাবার ঢেকে রাখুন।

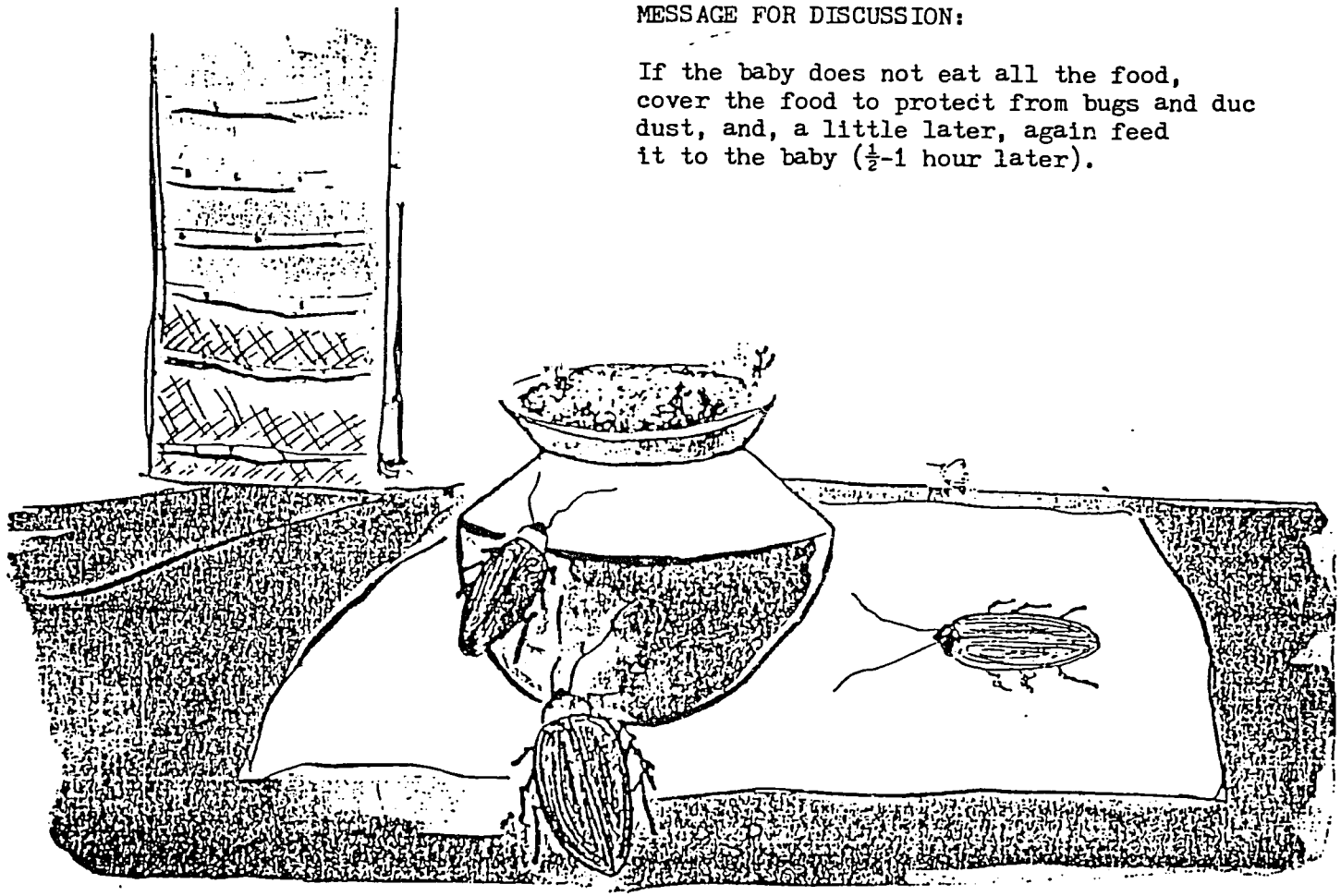
খাবার আগে ভালো করে হাত ধুয়ে নিন

MESSAGE FOR DISCUSSION:

Before cooking and eating, wash your hands, utensils, and spoons very well with tubewell water and soap or ash, so they will be free of dirt and germs.

MESSAGE FOR DISCUSSION:

If the baby does not eat all the food, cover the food to protect from bugs and duc dust, and, a little later, again feed it to the baby ($\frac{1}{2}$-1 hour later).



খাবার ঢেকে রাখুন এবং মাছি, তেলাপোকার হাত থেকে রক্ষা করুন।

MESSAGE FOR DISCUSSION:

When baby is sick, to help him get better, feed him soft foods many times throughout the day (in addition to continuing breastfeeding).

(Worker discusses the last time her child was sick and her feeding practice; she discusses the strength-giving benefits of the food and the need of the child for food, despite his poor appetite.)