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# EVALUATION OF NUTRITION EDUCATION MESSAGES FOR SUPPLEMENTARY FEEDING: The Bangladesh Experience

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COVER PHOTO: Volunteer Mother with healthy sample child on follow-up visit, June 1989, 1 1/2 years after project ended. The mother still recalled all the nutrition messages and had gone on to teach new mothers in the community. She wanted the project to return to her village so she could learn more ways to help keep her child healthy.

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# EXECUTIVE SUMMARY

## EVALUATION OF NUTRITION EDUCATION MESSAGES FOR SUPPLEMENTARY FEEDING: THE BANGLADESH EXPERIENCE

### DESCRIPTION OF PROJECT

This report evaluates the impact of nutrition messages on changes in the infant feeding practices of rural Bangladeshi mothers, and growth of their weaning age infants. The project, a collaborative effort between Bangladesh Rural Advancement Committee (BRAC) and Tufts University, implemented behavioral trial methods, in village homes, to design and modify the messages.

Traditionally, all infants in Bangladesh are breastfed from birth until well into the second or third year (Huffman 1980). When the mother feels her milk is "not enough", she introduces other foods, such as diluted cereal gruels or animal milk (if she can afford it), mashed banana, or softened biscuits (Brown 1982, Rizvi 1979, Brown 1988). However, quantities consumed remain insufficient to sustain normal growth, and child malnutrition rates are extremely high (Brown 1982, West 1986, BBS 1987).

This project attempted to design nutrition and feeding messages that had the potential for behavioral change which would result in positive outcomes on child growth, despite extreme economic, environmental, and social constraints. The messages, which included teaching analogies and demonstrations encouraging supplementary feeding after age 5 months, were designed and tested at the village level in three stages. Messages included in-home demonstrations of recipes (for example, an energy-enriched cereal food "Chop Chop"), and techniques to "doctor up" foods from the family pot with energy (for example adding oil and molasses), protein (adding milk, fish, or legume flour), along with addition of vegetables or fruits in season. Hygienic preparation of foods was stressed, and mothers were encouraged to continue breastfeeding, in addition to frequently and persistently feeding new foods; an analogy was made between human babies and baby chicks who need to peck all day.

In the first stage of the trials, hired village workers tried the messages in their own homes; next, they trained volunteer mothers with weaning age infants who disseminated the messages to other village mothers. All children were breastfeeding throughout the trials. Teaching was by modelling, demonstration and practice. A total of 117 children between the ages of 4-14 months--62 treatment and 55 age and season matched controls (from a distant site)--were followed from May through November 1987. Monthly dietary, anthropometric and morbidity data were collected on all sample children.

According to the mother's reports and informal field observations, food refusal by the infants was a major limiting factor to their consuming adequate quantities. A large part of this was, likely, due to anorexia resulting from frequent infectious illnesses. The study spanned the hot/dry and the rainy seasons, which are both characterized by high morbidity rates and a decline in nutritional status. Superimposed on these already difficult conditions was record flooding, which infiltrated all the homes, fields, and markets. In addition to morbidity, seasonal food shortages, inability to purchase foods due to poverty, and limited time of the mothers to prepare food and attentively feed their infants (especially during certain periods of heavy workloads), were barriers to achieving sustained compliance with nutrition messages.

## CONCLUSIONS

The findings from this analysis are very encouraging, given the fact that few education programs for impoverished populations have shown significant impacts on infant feeding practices or growth. A follow-up survey conducted March 1988 confirmed the persuasiveness of the campaign messages in changing the women's beliefs, and even at the 2 year field follow-up, the messages were still memorable.

- It is possible to alter the weaning food practices of rural village women in Bangladesh. The success in this project was due, in part, to the in-home "learning by demonstration" nature of the education, and the modelling of food preparation and feeding behaviors by local village mothers. Modelling of expected behaviors is more beneficial than a "beautifully worded" message.

- Increased intake of energy-enriched weaning foods (hygienically prepared) after age 5-6 months is likely to reduce the degree of growth faltering, however, will not sustain ideal growth rates, given other economic and environmental barriers, in rural Bangladesh.

- Poverty will limit the ability of many families to offer high quality protein food. However, due to frequent suckling, breastmilk still represents a large percentage of the Bangladesh child's diet, well into the second year, thus providing a good (though limited) source of protein. Since both the energy and protein deficits for normal growth are very large, the total "amount" of food is more important than the exact "composition" of the foods. If the families cannot easily afford protein-rich foods, lower cost energy-enriched foods should be encouraged. In the limited amounts the infants are willing to consume, a

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detrimental growth impact is not likely. Sustained breastfeeding is essential, since the energy foods would cause undernutrition if offered alone.

- Anorexia, resulting from frequent infectious illnesses in this age group, will limit the maximum potential of feeding messages to improve child nutritional status. Strategies to help mothers overcome feeding problems are desperately needed. In the long term, programs to prevent and treat infections, which cause much of the poor feeding, are essential.

RECOMMENDATIONS:

- Encourage supplementary feeding of simple, cheap, energy-enriched food after 5-6 months. In Bangladesh, the messages designed in village homes by this project have the demonstrated 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.

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

- Incorporate the teaching strategies and message content into programs that offer income generating activities and/or control infectious illness to help reduce barriers to compliance.

- Design strategies to deal with infant feeding problems. Of high priority should be programs to prevent and treat infectious illness. Combine handwashing and hygiene messages with feeding messages.

- Explore village based vs wide-scale production of time and fuel saving infant foods, for example, "quick cooking cereal bases" combining subsidized grains and legume 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.

- Design and implement "Safe Motherhood" programs to improve the health and nutritional status of women of childbearing age. This will, likely, reduce low birth weight, thus improving pre-weaning nutritional status of infants. Education programs will, then, be realistically challenged with "maintaining" normal growth, rather than promoting "catch-up" growth.

Village Workers exchanging ideas in an informal training session with staff from U.S. AID.

Village Worker interviewing Community Mother for what she has learned from the Volunteer Mother.

# I. INTRODUCTION

This report evaluates the impact of nutrition messages on changes in the infant feeding practices of rural Bangladeshi mothers, and growth of their weaning age infants. The project, a collaborative effort between Bangladesh Rural Advancement Committee (BRAC) and Tufts University, implemented behavioral trial methods, in village homes, to design and modify the messages.

Bangladesh is a country with numerous obstacles to achieving good child health--extreme poverty with seasonal food shortages, poor sanitation, a nearly non-existant health infrastructure, low status of women combined with extremely low levels of education, annual flooding and other catastrophic natural events, and a tropical climate with limited food preservation--to name a few. The widespread maternal undernutrition extends to the unborn children, and the viscious cycle of chronic nutritional deprivation is set in motion for, yet, the next generation. Nearly half the infants are born low birth weight (UNICEF 1988) to mothers who produce, on average, less breastmilk than well nourished women (Brown 1982, Brown 1986, Huffman 1980). Traditionally, these mothers have also provided extremely inadequate amounts of supplementary food to their infants. Childhood malnutrition and mortality rates are among the highest in the world (UNICEF 1988).

Nutrition messages, designed to improve child nutritional status during the weaning period, attempt to tackle one small aspect of the bigger problem. Some may argue that nutrition education has limited potential for significantly improving child health, given the major economic barriers. However, infant feeding practices are more ammenable to change, in the short term, than catastrophic weather events, seasonal food shortages or poverty. Exposure to education and information empowers a mother to maximize the few resources around her for the health of her child (Bariaigi 1980, Edirisinghe et al 1986). While other desperately needed development and health programs are gradually put into place, education can help make the best of the less than ideal situation.

What growth trends and infant feeding practices are characteristic of Bangladesh, and where does the potential for education to improve child nutrition fit in? As in other developing countries, children grow well in weight in the first few months. By 4-6 months weight gains falter from international standards (BBS 1987, Israel 1983). A study of semi-urban Bangladesh infants found about half were below weight standards at 3 months, and 92% at 5 months (Brown et al 1986). Another more representative study found 90% of rural girls and boys to weigh less than the NCHS 5th percentile by 8 and 15 months, respectively (Brown 1986). Whether this low weight is attributable to failure to catch up from low birth weights (LBW), or to unsatisfactory postnatal growth, is unclear, as birth weights were not reported. It may be assumed from data

from other studies--some in the same area--that birth weights were low on average, and thus may have accounted for a portion of the deficit (Brown 1986, UNICEF 1988). However, this does not fully explain the progressive decline in weights, relative to standards, after 3 months. A detailed discussion of the causes of this phenomenon of growth faltering--which is nearly universal to children raised in low income communities in Third World countries--is attatched in Appendix II.

Nearly 100% of newborn infants are breastfed in rural Bangladesh, and continue to be 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 (Huffman et al 1980). Small amounts of supplemental foods are offered in the first year of life, often when the mother feels her milk is not "enough". The first food offered is usually diluted cow's milk (powdered, condensed, or fresh); poorer families feed "milk look-alikes", often a diluted flour paste, sweetened with sugar. Introduction of foods is not based on age criteria (except religous "initiations" that involve introduction of foods at a certain age--Rizvi 1979), as few village women keep track of ages of their children. Sweetened cereal gruels are occasionally offered around 6 months, followed by finger foods, such as bananas, biscuits, and chapatis, as the child's oral-motor skills improve. 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.

Quantities of foods consumed are very small, and the infants are often not persistently encouraged to eat until about 18 months (Guldan and Zeitlin 1988). 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. Self-limitation by the infants is another important reason, likely a result of anorexia due to high infection rates (Molla et al 1983), and possibly a result of satiety from frequent suckling (Guldan and Zeitlin 1988). The degree of maternal restriction vs infant self restriction in limiting food intake is not clear. If maternal restriction is the major limitation, nutrition messages should focus on increased attentiveness to feeding of supplemental foods; however, if infant restriction is primary, these messages should have limited impact.

The project evaluated in this report designed nutrition messages to encourage supplemental feeding. While not negating the infant's contribution, we assumed maternal factors played a major role in limiting supplemental feeding. These finalized messages were designed for incorporation into the the Bangladesh Rural Advancement Committee's (BRAC) Child Survival Program, and dissemination on a wide-scale, throughout the country.

Field observations suggested encouraging results on modifying infant feeding practices of the rural mothers, at least in the short term of this project, through "modelling" methods of message dissemination. A follow-up survey in March 1988 confirmed these assumptions (Appendix III). However, we felt it was essential to evaluate the effects of the additional foods on the infants, and not to "assume" they were beneficial in promoting growth, as has been illustrated under better conditions. We conducted the project on the assumption that any additional food improve growth after age 5-6 months. However, given the poor sanitary conditions, the tropical climate, and the extreme poverty which limited the variety and quality of food affordable to our families, it is entirely possible that the traditional practice of limiting supplementary food intake in the first year, despite inadequate maternal supplies of breastmilk, is the lesser of two evils.

This analysis attempted to answer the following questions:

- o Does education, alone, have the potential for modifying infant feeding practices of rural Bangladesh mothers?
- o Which nutrition messages were women willing and able to practice, and which were they not? Why or why not?
- o If education resulted in behavior change, did this lead to an increased total nutrient intake (energy and protein) from the supplementary food?
- o If an increased intake of supplementary food was observed, was there a positive or a negative association with child nutritional status? Was there any relationship with calories, protein, or protein quality in the supplementary food, and growth?

Since the project was not designed as a "model" education program--rather as a forum for developing and testing nutrition messages for weaning, we will not be able to determine the maximum potential for change. The messages should be evaluated, again, after incorporation into an existing, organizational structure, or disseminated through a different medium.

## II. METHODS

### A. Field Methodology

The nutrition education intervention was conducted in 2 rural non BRAC sites in the Manikganj District of Bangladesh, between April 1987 through November 1987. The original sample consisted of 137 children--71 treatment and 67 controls--between the ages of 4-14 months at the time of recruitment. The intervention site, in the Gopinatpur Union, covered 3 villages. The control site, about one hour away (by foot in the dry season, and by boat in the rainy season) incorporated 5 villages

in the 2 unions of Ramkrishnapur and Boira. The 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 km northwest of the capital city, Dhaka, and on the banks of the great Padma river. Road transportation was poor, and the villages had no electricity.

The intervention, and the field methodology are described in detail elsewhere (Brown et al 1988). Briefly, field staff consisted of 8 paid village workers (VWs)--5 female and 3 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 and principal investigator from Tufts, Dr. Marian Zeitlin. Workers received training in anthropometric measurement using methods developed by Zerfas (1985), dietary, (dietary instrument developed by Zeitlin et al 1984), interviewing techniques, and child nutrition. Training was ongoing, and incorporated participatory techniques, using role modelling and small group discussion.

Preliminary behavior change messages were developed by the village and technical staff, in response to a community based nutritional needs assessment and problem diagnosis. Care was taken to select the most economically feasible messages. The messages were then tested and revised through modelling and practice on 3 levels: 1) in workers' homes; 2) in volunteer mothers' homes; and lastly 3) in community mothers' homes. In level 1, the feasibility of the behaviors demanded in the messages was tested, and impractical messages modified. Next, 15 volunteer mothers (VMs) were recruited, criteria being: they should have a child approximately 5-12 months old; they should have other mothers with young children living within close proximity; and they should be able to articulate the messages and be willing to teach other mothers on a volunteer basis. Each of the 5 female workers taught 3 VMs, visiting several times per week, for 1-2 months. The process of bargaining and persuasion was used to design messages that were motivating. Teaching was participatory, through active demonstration. Colorful flash cards aided in stimulating discussion with the VMs. When VMs had learned and practiced the messages, they would begin teaching other community mothers (CMs) with weaning age children living nearby. Each VM taught approximately 3-4 CMs. In reality, VMs often gossiped informally with the CMs--for example, while fetching water or during leisure time--thus, the third stage of the trial began almost simultaneously with the second. 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

Table 1

## SUPPLEMENTARY FOOD MESSAGES

PROBLEM: POOR NUTRITIONAL STATUS OF CHILDREN DURING WEANING AGE

REASON 1: LIMITED VARIETY OF SOLID FOODS, LOW ENERGY DENSITY OF DIET.

BEHAVIORAL CHANGE MESSAGES:
1) A baby should be breastfed until 2 years of age, and from 5 months should be given other food to keep him healthy.

2) 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;
- *1/2 poa (about 120 ml.) milk or tubewell water;
- *Cook until it becomes a soft, jelly consistency.

Special Chop Chop:
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 leafy greens and other vegetables
- *2 small spoons oil
- *4 chotak (about 240 ml.) water or milk, if available
- *Cook as above recipe until soft, jelly-like consistency.

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

A) 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 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) Mishawkaw can be made with 4 kinds of already cooked foods:

- *2 handfuls rice, potato, or sweet potato;
- *1 handful leafy greens and other vegetables;
- *If you have some, add small fish, lentils, or an egg;
- *Then, with a clean hand, mash, and add 2 small spoons oil

4) When fruits are in season, feed the mashed pulp to your baby.

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

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

REASON 2: INFREQUENCY OF SOLID FOOD FEEDING (INADEQUATE AMOUNTS).

BEHAVIORAL CHANGE MESSAGE:
1) Just as the baby chicken pecks all day on food, so should your baby be given food (small amounts and frequently).

REASON 3: LACK OF AWARENESS OF PROPER CHILD FEEDING TECHNIQUES.

BEHAVIORAL CHANGE MESSAGES:
1) If you want to habituate your baby to other foods give 2-3 small 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, softened biscuits, and bread. To make the food soft and keep germ free, use boiled water.

2) Let baby eat as much as he can. Be attentive to him but never force.

REASON 4: POOR SANITATION.

BEHAVIORAL CHANGE MESSAGE:
1) 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.

REASON 5: WITHHOLDING FOOD DURING ILLNESS.

BEHAVIORAL CHANGE MESSAGE:
1) When baby is sick, to help him to get better, feed him soft foods many times throughout the day (in addition to breastfeeding).

project, messages were synthesized and modified based on observations and outcomes during the trials (see Table 1).

All households were visited monthly by the village workers (VWs) for collection of infant anthropometric, dietary, and morbidity data, however, serious flooding interfered with data collection during August and September. Baselines of the above data were collected prior to the intervention, along with socioeconomic information on all sample households. Child weight was measured with a portable salter scale, which was regularly checked with a constant weight. The monthly 24 hour recall of the child's food intake was recorded on a recently developed instrument containing Bangladeshi foods (Zeitlin et al 1984, Rizvi et al 1984). 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.

B. Data Analysis Methodology

1. Anthropometry

The 6 infant weights, collected monthly, were transformed to weight-for-age z-scores (WAZ), using the Center for Disease Control's anthropometry program, since z-scores reduce age bias (WHO 1983). International standards, derived by the National Center for Health Statistics (NCHS) and presented in tables by the World Health Organization (1983), are used as the reference population in this program. Actual weights, and percent of median weight-for age (WAPM) were also analyzed for descriptive purposes. "Pre" and "post" intervention variables were created. This was the best technique for interpreting the longitudinal variables due to: missing data during certain months (due to flooding); a 3-4 month rolling recruitment (due to three phase intervention design); and the relatively short term nature of the study. The first available measurement during the 3-4 months recruitment (May-August) was computed as the "pre-intervention" WAZ. The "post intervention" WAZ was computed from the last measurement available for the final 2 months (October-November). These baseline and final variables, and the change in WAZ over the study period, were used in the multiple regressions and analysis of covariance procedures to determine the differences in growth rates between the treatment and control children.

2. Dietary Adequacy

Monthly energy, protein, fat, and carbohydrate intakes of the infants from supplementary foods were computed from the standardized field instrument (Zeitlin et al 1984) using recently released 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 best age-specific

country estimates were adapted and used as a standard (Brown et al 1982, Brown et al 1986) (see Appendix I, Table 1).

Energy and protein were expressed as absolute intakes, and as a percent of the recommendations of the World Health Organization (1985) (see Appendix I, Table 2 for description of standards used). Because of high infection rates, protein values for ages 6-24 months were multiplied by graduated increments up to 1.5 from 6 to 9 months and, thereafter, 1.5 (Scrimshaw and Zeitlin, personal communication 1989, Rand et al 1984). To prevent distorted changes in adequacy in the longitudinal analysis caused by children simply moving in and out of age categories, values were interpolated to the month, using the Minitab curve smoother. A modification was made for protein quality and digestibility of supplemental foods consumed with low protein quality (WHO 1985--see Appendix I, Table 2 for guidelines followed).

Next, the intakes of protein and energy were expressed as a percent of both "maintenance" and "ideal" requirements. Since most of the village children weighed considerably less than the international norm, a "maintenance" requirement was first computed, multiplying the above estimated requirement per kg of body weight by the child's actual weight. This estimate should provide sufficient energy and protein to maintain the child's present growth percentile (or WAZ), however would not be sufficient for catch-up growth, and would underestimate the real needs of undernourished children. Therefore, "ideal" requirements were also determined, using the child's ideal weight for chronological age and sex (NCHS 50th percentile values, WHO 1983) in place of actual weights.

All dietary values were determined both with, and without, breastmilk estimates. Percent of calories from carbohydrate, protein, and fat were computed for each observation, along with the energy contribution from each food group. The percents of poor and good protein quality were also computed to explore the protein adequacy of the diet.

In the final analysis, "pre" and "post" variables were created for all of the above adequacies. The baseline variable was taken, as with anthropometrics, from the first dietary intake available in the three months of recruitment. Since daily dietary intakes had high variability, the final variable was created by averaging the last 3 dietary intake measurements. Supporting this decision was the fact that the average food intakes of the treatment children appeared to already have increased in comparison to the controls by the third to last measurement and to remain stable at this higher level.

3. Morbidity

Reported monthly illness incidence and prevalence were computed. Since the purpose of morbidity variables was to control for the confounding effects on food intake and weight

gain in the children, the illnesses were grouped into 5 categories: 1) water loosing illness (diarrhea, dysentary, 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 illnesses). Since missing values were a problem some months (due to flooding or absence), the mean percent of days/month (combining all the observations) the child was sick with the illness category was computed. These variables were used in the regressions and ANOVAS to control for morbidity.

4. Socioeconomic Covariables

Categorical and ordinal variables were created, when needed for some of the socioeconomic (SES) factors. Scales for traditional wealth (household belongings and solvency), agricultural wealth (land and animals), and modernization/education (radios, watches, and education of household head and mother) were created for each household, using the factor analysis model pioneered by a similar project in Bangladesh (Guldan 1988) (see Appendix I, Table 3 for description of procedures). In the traditional wealth and agricultural wealth scales, items were assigned relative monetary values, according to their local Bangladesh market prices. Acceptable internal consistencies of the scales were confirmed using SPSSX's Reliability Program with Cronbach's Alpha. The agricultural wealth scale consisted of monetized possessions of cows, goats, chickens, cowsheds, poultry houses, other animal or grain sheds, land, income from rice paddy, corn, tree (e.g. date palm sugar), and vegetables. The traditional wealth scale consisted of monetized bedroom huts, kitchen huts, boats, bicycles, kitchenware (enamel, brass, or bronze), umbrellas, cots, pillows, blankets, lanterns, and a monetized value for claimed solvency status. The general wealth scale combined both of the above agricultural and traditional wealth scales into one. The modernization/education scale was not monetized, but consisted of the number of radios, watches, and years of education for the mother and the household head. Soap was also added to this scale in some of the analyses. These scales were used to control for socioeconomic factors in interpreting dietary intakes and growth of the infants.

5. Statistical Techniques and Final Sample

Analysis of covariance (ANCOVA) and multiple regression were used to determine the impact of the education intervention on infant dietary intakes and growth. The Multiple Classification Analysis procedure of SPSSX ANCOVA program was used to derive adjusted final mean values for anthropometrics, and dietary variables, while controlling for wealth, mother's education, morbidity, and baseline nutritional status or nutrient intake. T-tests 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 change in "pre" and "post"

categories 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 between the groups.

All 137 children (71 treatment and 66 control) were included in the preliminary analysis. In the final analysis, 20 children were excluded (9 treatment, 11 control) due to either missing baseline or final measurements. The cause of missing data was recorded at each observation; the primary reason was due to the child being absent on followup visits--in most cases, the child was visiting maternal relatives, or the family had outmigrated. Anthropometric, dietary, and SES analysis on the observations available, suggested no significant differences between those children included, and excluded, and did not alter the conclusions of the analysis. For the sake of consistency, the descriptive data presented below are based on the smaller sample of 117--62 treatment and 55 control--ranging from 4-14 months at baseline, to 9-18 months at the final measurement.

## III. DESCRIPTION OF THE SAMPLE

The sociodemographic characteristics of the treatment and control families are summarized in Tables 2 and 3. The mean number of household members was slightly higher for the treatment sample (7.4 vs 5.5). The number of Moslems and Hindus varied in the two sites; the control site had more Hindus (47%) than the treatment (6%). Fifty-three percent of the control and 92% of the treatment families were Moslem. The mean age of the sample mothers was 28 years, ranging from 18 to 45 years old, for both groups. The household head's mean age was slightly older in treatment (44 years) than controls (37 years). The mothers in both sites had, on average, 3 children, with a minimum of 1 (the sample child), and a maximum of 9 in treatments, and a range of 1 to 6 in the controls. Almost all of the mothers were married. The household head was, in all but 2 cases (treatment), a male. In controls, 93% of the sample mothers were the wives of the household head, compared to 69% of treatments, with the rest being daughters, wives of the household head's son, wives of the head's brother, or, in the case of 2 treatment families, head of the household.

Education levels were extremely low for mothers, though more of the control than treatment mothers had any schooling: 92% of treatment mothers, and 84% of controls had no formal education. Similarly, only 5% of treatment and 14% of control mothers had more than 5 years of schooling. The household heads, being predominantly male, had higher literacy and education rates than the mothers. Seventy-nine percent of treatment and 71% of control household heads had no education. The control group had more household heads with 6 or more years of education (20%) than treatments (3%).

Table 2

DEMOGRAPHIC INFORMATION FOR TREATMENT AND CONTROL HOUSEHOLDS:

| MATERNAL AND HOUSEHOLD HEAD CHARACTERISTICS | TREATMENT | CONTROL |
|---|---|---|
| | mean(min-max) | mean(min-max) |
| Mother's Age (yrs) | 28.0 (18-45) | 28.0 (18-45) |
| Household Head Age (yrs) | 44.0 (25-85) | 37.0 (25-65) |
| Household Members | 7.4 (3-15) | 5.5 (3-15) |
| Mother's Number of Children | 3.0 (1-9) | 3.0 (1-6) |
| Household Head Years in Village | 41.0 (3-85) | 15.0 (1-47) |
| Mother's Years in Village | 13.0 (2-45) | 9.0 (1-40) |
| | % (N) | % (N) |
| MOTHER'S EDUCATION | | |
| No Schooling | 92% (57) | 84% (46) |
| Some Primary (<5 yrs) | 3% (2) | 2% (1) |
| Completed Primary (5 yrs) | 3% (2) | 9% (5) |
| Some Secondary (6-11+ yrs) | 2% (1) | 5% (3) |
| HOUSEHOLD HEAD EDUCATION | | |
| No Schooling | 79% (49) | 71% (39) |
| Some Primary (<5 yrs) | 9% (6) | 4% (2) |
| Completed Primary (5 yrs) | 8% (5) | 5% (3) |
| Some Secondary (6-11+ yrs) | 3% (2) | 20% (11) |
| MOTHER'S LITERACY IN BENGALI | | |
| No | 92% (57) | 86% (47) |
| Yes | 8% (5) | 4% (8) |
| HOUSEHOLD HEADS LITERACY IN BENGALI | | |
| No | 79% (49) | 73% (40) |
| Yes | 21% (13) | 27% (15) |
| RELIGION | | |
| Moslem | 94% (58) | 53% (29) |
| Hindu | 6% (4) | 47% (26) |
| MOTHER'S MARITAL STATUS | | |
| Married | 96% (60) | 100% (55) |
| Unmarried | 2% (1) | -- |
| Lost Husband | 2% (1) | -- |
| MOTHER'S RELATION TO HOUSEHOLD HEAD | | |
| Wife | 69% (43) | 93% (51) |
| Son's Wife | 21% (13) | 7% (4) |
| Brother's Wife | 6% (4) | -- |
| Daughter | 2% (1) | -- |
| Household Head | 2% (1) | -- |

## Table 3 Household Wealth Indicators

| HOUSEHOLD CHARACTERISTICS | TREATMENT % (N) | CONTROL % (N) |
|---|---|---|
| **HOUSE OWNERSHIP** | | |
| OWNS HOUSE AND LOT | 98% (61) | 64% (35) |
| OWNS HOUSE, OTHER'S LOT | 2% (1) | 36% (20) |
| **HOUSING STRUCTURE** | | |
| ALL TIN | 5% (3) | 16% (9) |
| TIN ROOF ONLY | 82% (51) | 71% (39) |
| ALL THATCH OR STRAW | 13% (8) | 13% (7) |
| **LAND OWNERSHIP (PAKI)*** | | |
| LANDLESS | 47% (29) | 91% (50) |
| 1-3 PAKI | 13% (8) | 4% (2) |
| 4-6 PAKI | 14% (9) | -- |
| 7-12 PAKI | 18% (11) | 5% (3) |
| 12+ PAKI | 8% (5) | -- |
| **SOLVENCY** | | |
| DEFICIT | 5% (3) | 5% (3) |
| SOMEHOW MAINTAINS | 39% (24) | 58% (32) |
| SOLVENT THROUGH YEAR | 43% (27) | 33% (18) |
| SURPLUS | 13% (8) | 4% (2) |
| **DRINKING WATER SOURCE** | | |
| TUBEWELL | 100% (62) | 98% (58) |
| RINGWELL | -- | 2% (1) |
| **LATRINE** | | |
| CEMENT | 3% (2) | 2% (1) |
| BAMBO OR OTHER | 94% (58) | 93% (51) |
| NONE | 3% (2) | 5% (3) |
| **MAJOR SOURCE OF INCOME** | | |
| FARMER | 34% (21) | 7% (4) |
| AGRICULTURE/SKILLED DAY LABORER | 21% (13) | 20% (11) |
| FISHERMAN | 5% (3) | 11% (6) |
| SERVICE HOLDER | 12% (7) | 22% (12) |
| BUSINESS | 16% (10) | 20% (11) |
| BOATMAN | 7% (4) | 6% (3) |
| INCOME FROM OUTSIDE | -- | 2% (1) |
| OTHER | 5% (3) | 11% (6) |
| MISSING | (1) | (1) |

*1 PAKI=0.33 ACRE

| OWNERSHIP HOUSEHOLD BELONGINGS | TREATMENT % OWNING (N=62) | CONTROL % OWNING (N=55) |
|---|---|---|
| RADIOS | 11% | 15% |
| WATCHES | 21% | 16% |
| SOAP | 48% | 13% |
| UMBRELLAS | 63% | 20% |
| BICYCLES | 8% | 4% |
| BOATS | 29% | 7% |
| BEDROOMS | 100% | 100% |
| KITCHENS | 84% | 69% |
| BRASS DISHWARE | 95% | 73% |
| ENAMEL KITCHENWARE | 98% | 95% |
| COTS | 69% | 73% |
| BLANKETS | 92% | 98% |
| PILLOWS | 98% | 100% |
| LANTERNS | 74% | 44% |
| OUTSKIRT SHEDS | 19% | 0% |
| COWSHED | 50% | 13% |
| POULTRY SHED | 73% | 42% |
| COWS | 52% | 15% |
| POULTRY | 63% | 42% |
| GOATS | 45% | 18% |
| STORED PADDY (MAUNDS)* | 18% | 4% |

*1 MAUND=37.3 KG

A higher percent of control households were landless (91% vs 47%). This is due to the fact a number of families in the control area once owned land which is now 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.

The primary source of income in the treatment group was farming (34%), whereas, in the control area, government service jobs were the main source of income (22%). This, again, highlights the difference in landholdings between the two sites. The greater percent of service jobs in the control area were likely due to closer proximity to government health and administrative offices. Other sources of income were similar for both groups: agriculture or other skilled day labourer; small business; fishing; boatman; and other jobs such as traditional folk healing. Five percent of both treatment and control families reported to be operating at a deficit. A greater percent of treatment families (56%) reported to be solvent or in surplus, annually, than controls (37%).

The traditional homesteads consisted of one or more thatch, jute, bamboo, or tin one-room huts, surrounding an earthen courtyard. The huts generally functioned as bedrooms, but sometimes served as kitchens, animal sheds, or grain storage sheds. Tin houses were desireable because they more efficiently protected from rain leakage and other adverse weather conditions, however, they were considerably more expensive to build. A greater percent of control families (16% vs 5% treatment) had all tin structures. In both groups, 13% had only thatch, straw or bamboo huts.

Possession of various household belongings, or traditional wealth indicators, is listed in Table 3. As the average number of household members is higher in the treatment group, certain belongings would be expected to be greater, as is found for many of the items. Possession of "modern" items--such as watches and radios--was similar for treatment and controls, with 11% of treatments and 15% of controls having radios, and 21% of treatments and 16% of controls owning watches.

Almost all households claimed to use tubewell water for drinking, with the exception of one control family, whose water source was a ringwell. The majority of households had crude latrines made of wooden or bamboo platforms perched over either ground or water (Table 3). Forty-eight percent of treatment families claimed to have at least 1 bar of soap, compared to 13% of controls. This low figure for the controls, however, is inconsistent with reports from the same site the previous year, where 45% claimed to have soap (Guldan 1988).

## IV. RESULTS

### A. Summary of Major Findings

This section summarizes the major evaluation findings. The following sections present these results in detail. Statistical results of the major findings can be found in Appendix I, Tables 4-12.

In summary, the treatment children grew significantly better than the controls, even after adjusting for baseline nutritional status, age, morbidity, wealth, and mother's education. Adjusting for covariables, the treatment children had grown, on average, 0.58 standard deviations more in weight-for-age than the controls during the project. Over the five month period, the percentage of standard 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 (WAZ <-3 SD) during this time. 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 any of the analyses.

Treatment children consumed a significantly greater percent ($p<.05$) of their estimated ideal energy and protein requirement from supplementary foods, after adjusting for the effects of age, wealth, mother's education, morbidity, sex, and initial nutrient adequacy. For energy, beginning energy adequacy and mother's education were significant predictors of final energy adequacy. When women with any education were excluded from the analysis, wealth became significant. For protein, wealth and mother's education, in addition to initial protein adequacy, were significant factors in determining final protein adequacy of the supplementary food. Wealth remained a significant factor when the educated mothers were removed from the analysis.

As with protein adequacy, the percent of high quality protein (from animal sources) in the supplementary foods was significantly higher for treatment than control children. Mother's education and wealth also predicted protein quality.

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, after including estimates for breastmilk. In addition, in individual child-level analyses, the relationship between better growth, and additional supplementary food calories, protein, or protein quality did not achieve statistical significance, (with p-values not lower than 0.15). This may be due to the high variability in the dietary data, and possibly the individual (unknown) variation in breastmilk intake.

B. Growth Effects

1. Average Growth Rates

While the nutritional status of the treatment and control children were 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-for-age z-score (WAZ) was slightly, but not significantly better for controls than treatment (-1.94 vs -2.12). The mean age for both groups was 8 months with a range from 4-14 months and a standard deviation (SD) of 2.2. It is clear that by recruitment, the average weight of the 8 month Bangladeshi child was already 2 standard deviations less than the international reference (see Appendix I, Table 4).

Rates of growth, illustrated by changes in WAZ in Figure 1 and WAPM in Figure 2, were significantly different for treatment children than control children ($p<.05$). As expected, the control group worsened relative to the international reference over the 5 month critical weaning period studied. Adjusting for initial WAZ, age, morbidity, wealth, and maternal education, the weight of the controls dropped -.71 SD in WAZ, or six percentage points in WAPM, from 78% to 72%. By contrast, WAZ of the treatment children changed only by -.13 (Appendix I, Tables 4, 8 and 9) and WAPM held steady at 76% (Appendix I, Tables 4 and 11). Thus, this intervention prevented further severe flattening of the growth curve in the treatment children. The children in the treatment group grew over half a standard deviation unit (.58 SD) better than the controls. The adjusted final mean weight of the treatment group was 0.4 SD units in WAZ (Appendix I, Tables 8 and 9), or 4 percentage points in WAPM (Appendix I, Table 11), better than the controls. This difference was statistically significant ($p<.05$). The difference in time from the first to the last measurement was approximately 5 months for both groups, however, the exact time for individuals varied between 2.8 and 6.7 months (SD=0.9). This time difference was not found to be significantly associated with growth when the baseline age was entered into the regressions.

As shown in Figure 3, the mean weight at the initial observation was slightly less for the treatment (6.35 kg) than the controls (6.42 kg).

Final weight was 7.53 kg for treatment and 7.31 kg for control children. Thus, the average weight gain over the study period was 1.18 kg for treatment and 0.89 kg for controls. The difference is statistically significant ($p<.05$). Average gain

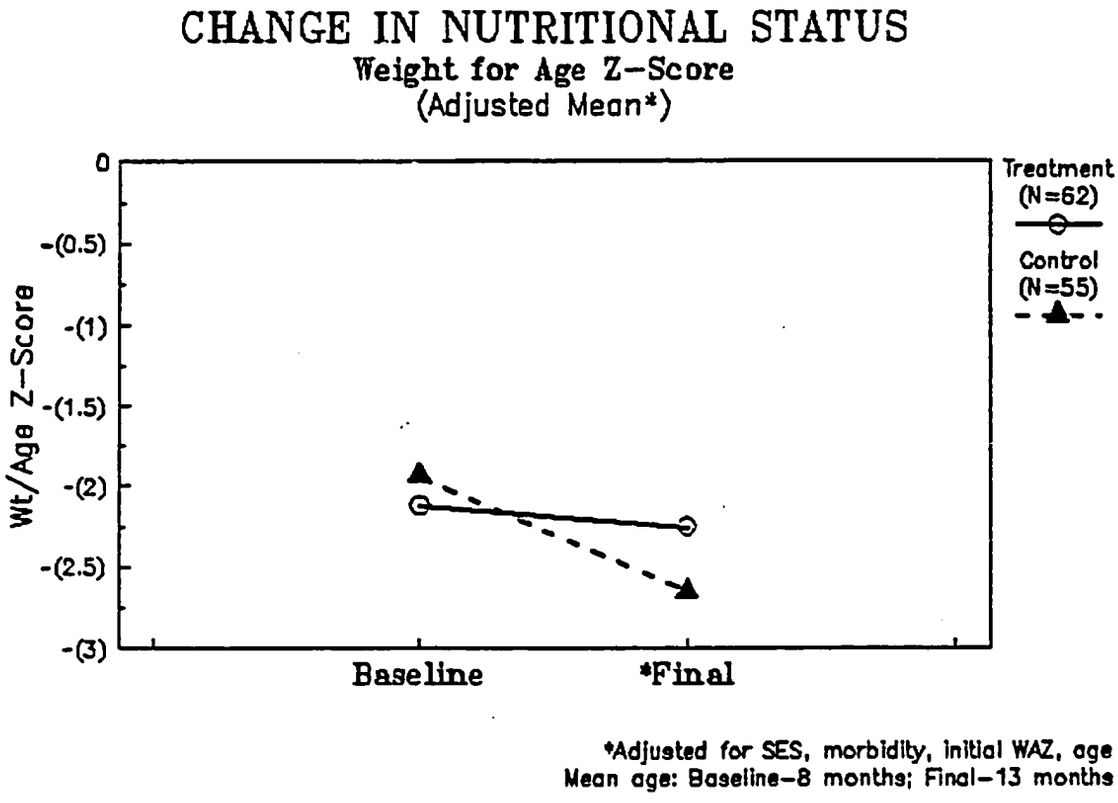

CHANGE IN NUTRITIONAL STATUS
Weight for Age Z-Score
(Adjusted Mean*)
Wt/Age Z-Score
0
-(0.5)
-(1)
-(1.5)
-(2)
-(2.5)
-(3)
Baseline
*Final
Treatment (N=62)
Control (N=55)
*Adjusted for SES, morbidity, initial WAZ, age
Mean age: Baseline-8 months; Final-13 months

Figure 2

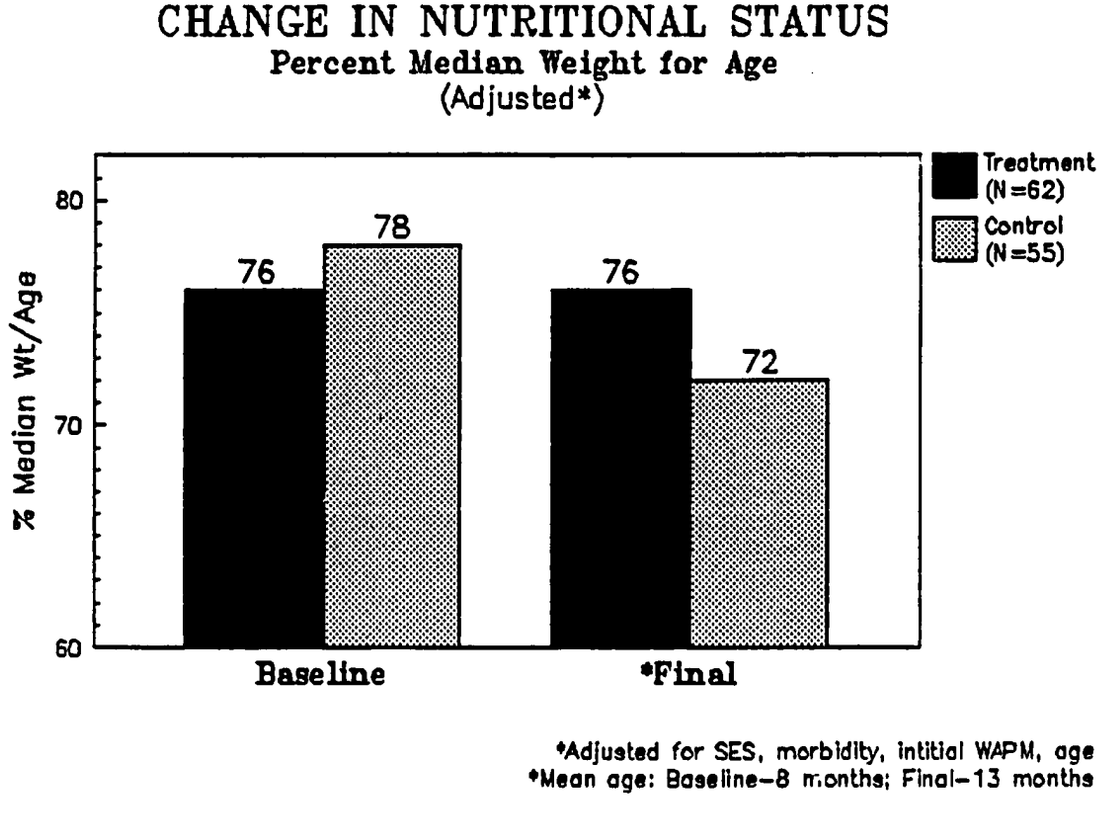
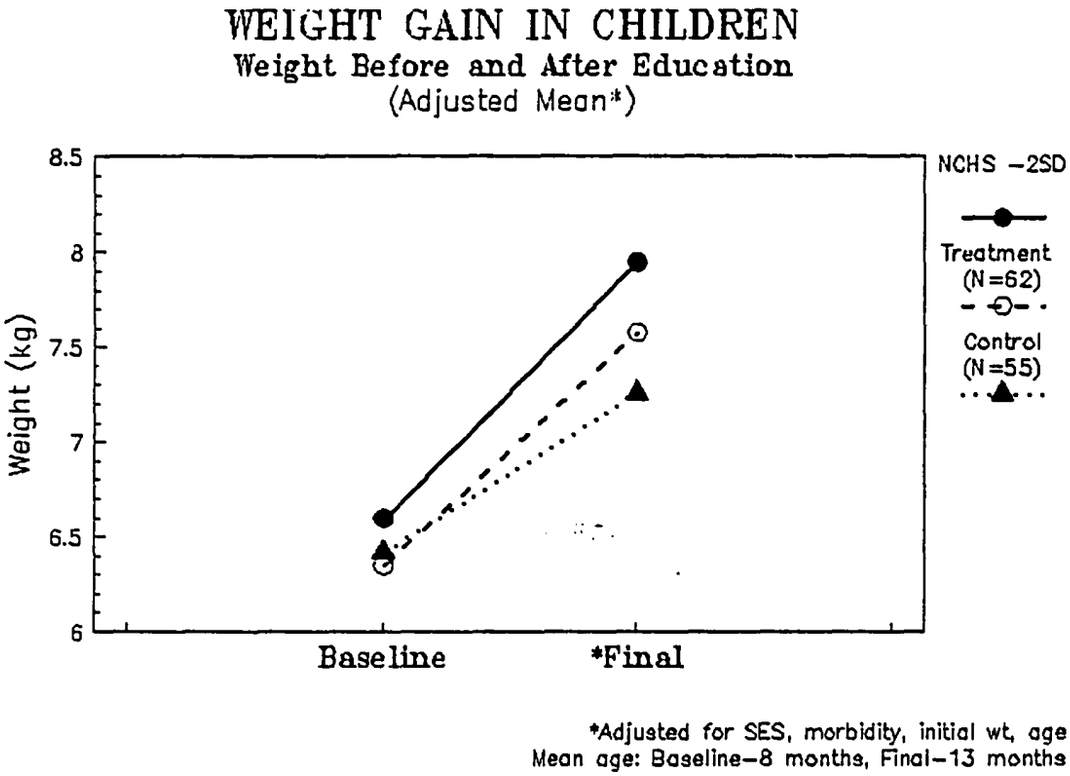

CHANGE IN NUTRITIONAL STATUS
Percent Median Weight for Age
(Adjusted*)
% Median Wt/Age
80
70
60
76
78
76
72
Baseline
*Final
Treatment (N=62)
Control (N=55)
*Adjusted for SES, morbidity, initial WAPM, age
*Mean age: Baseline-8 months; Final-13 months

Figure 3




Volunteer Mother with healthy 1 year old child. She prepares supplementary food regularly and feeds her child frequently despite a heavy domestic work load.

over the 5-6 months of observation was .24 kg/month or 8.0 grams/day for the treatment and only .17 kg/month or 5.7 grams/day for controls.

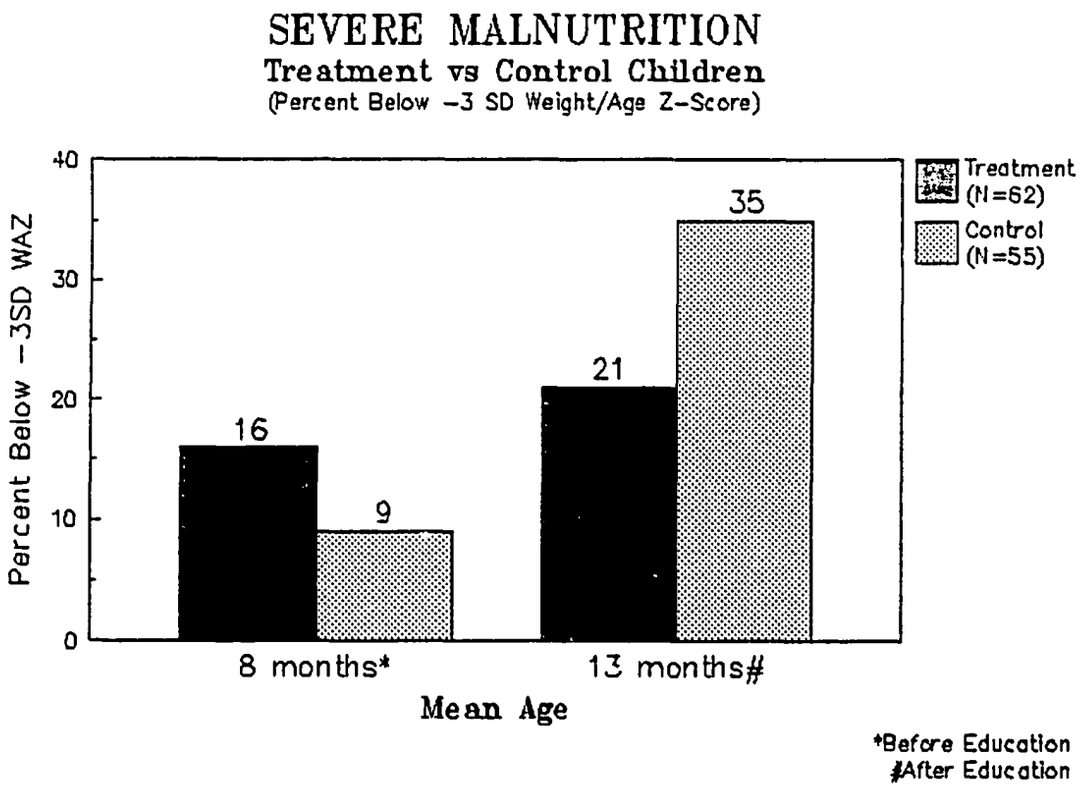
How does this compare with expected rates of growth at the ages studied--initial mean age 8 months, final age 13 months? A healthy 8 month child growing at the 50th percentile for weight-for-age, using international standards, would be expected to gain 1.6 kg in 5 months (averaging males and females), thus, 10.5 grams/day (WHO 1983). The treatment group was growing at 75% of this rate, while the controls, on average, were only growing at half (54%) the expected rate of gain. Using a more conservative estimate, a child growing at -2 standard deviations from the international reference median would gain approximately 1.35 kg in 5 months, which translates to .27 kg/month or 8.9 gms/day. The treatment children were growing at 91% of this reference rate, and the controls at only 64%.

2. Prevention of Severe Malnutrition

Since severely undernourished children (< -3 standard deviations from expected weight-for-age) are at highest risk of dying, it is important to look at the impact of the program, if any, on the nutritional status of this age group. While the messages 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. The control group had a significant increase ($p<.05$) in the number of children severely undernourished, while the treatment children did not (see Appendix I, Table 6 for statistical test result). Similarly the controls had a significantly greater number of children declining in standard deviation units of weight-for-age than the treatment children (Appendix I, Table 7). The increase in percentage points of severe malnutrition (WAZ<-3SD) was only 5% in the treatment group compared to 26% in the controls. Initially the treatment group had more severely undernourished children (16%, n=10) than controls (9%, n=5) though the difference is not statistically significant ($p>.05$). In the end, more control children were severely undernourished (35%, n=19) compared with treatments (21%, n=13) (see Figure 4). In the control group, 14 children changed from >-3 std dev to <-3 std dev; 5 children were <-3 std dev when recruited and did not improve. No children who were severely undernourished when recruited improved in nutritional category. However, in the treatment group, 3 children who were -3 std dev at recruitment improved; 7 children remained the same, and only 6 children changed from > -3 std dev to < -3 std dev from the mean over the 5-6 months (Appendix I, Table 6).

The third degree cutoff point in the Gomez (1956) classification of malnutrition, 60% of WAPM, was not as sensitive at identifying severely undernourished children in this sample age group as the -3 SD cutoff point in WAZ recently adopted by UNICEF (1989). No control group children, and only 4

Figure 4




Community Mother persistently trying to feed her severely malnourished child.

treatment children were < 60% WAPM at baseline. Two children (4%) in the control group dropped to < 60% WAPM during the 5 month study. No additional children in the treatment group dropped to < 60% WAPM; 2 of the initial 4 severely undernourished children improved in WAPM category, and the other 2 remained below 60% WAPM. The change in the number of severely undernourished cases from baseline to final measurement was not significant (p=>.05) for either group, using WAPM as a criteria; however, the number of children identified with this method are extremely small.

C. Dietary Adequacy

While average baseline energy and protein intakes showed no significant differences between treatment and controls (Figure 5, also Appendix I, Table 5), intakes following nutrition education were significantly higher (p<.05) for the treatment group (Appendix I, Tables 12-23).

1. Baseline

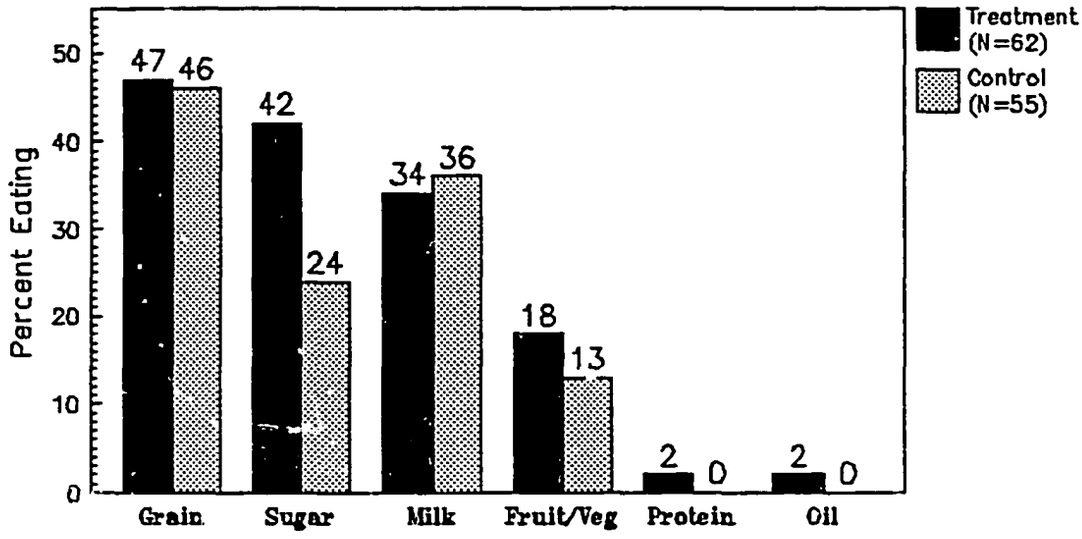
All (100%) of the sample were breastfeeding throughout the study. In addition, at baseline, almost three quarters (68% treatment, 73% control) were eating other foods on the day of recall. These foods consisted of diluted milk or cereal gruels sweetened with sugar, pieces of soft fruit, or bites of family foods (e.g. rice, flat bread); the mean age at that time was 8 months (range 4-14 months; SD=2.2). 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, with the exception of a higher percent of treatment children receiving added sugar on the day of recall (42% vs 24%). The energy and protein adequacy of the diets were 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 supplementary food and the remaining 80% were from breastmilk. The infants were consuming, from supplementary food, approximately 18% of the energy required to support maintenance growth, as defined earlier in the methodology. Including breastmilk in the computation brought this figure to 80% adequacy for treatments and 85% adequacy for controls. With these low intakes, the activity levels of the children would be minimized, and nutritional status would continue to decline.

Although the maintenance requirement, based on the child's actual weight, is a more realistic goal in practice, the ideal standard, which uses the child's ideal weight-for-age, was considered a better relative reference for comparing both groups, as the maintenance requirement underestimates the real needs of the acutely undernourished (thin) children. Ideal requirements may be considered to be estimates of the amount of energy (or protein) needed to promote "catch-up" growth to international reference standards. At baseline, treatments were

Figure 5

# BASELINE FOOD CONSUMPTION

## Percent Children Eating




Mean age 8 months; 100% children breastfeeding

receiving 16% of ideal energy requirements (64% including breastmilk), and controls 14% (61% including breastmilk) (Appendix I, Table 5).

As with energy, baseline protein intakes were insufficient to support normal growth (not to mention catch-up growth) and were similar for both groups. Supplementary food provided 23% (64% including breastmilk) of the treatment and 19% (61% including breastmilk) of the control group's maintenance protein requirement (adjustments were made for low protein quality, and for high infection rates--see Appendix I, Table 2). When ideal requirements were used, for comparison, adequacy was only 17% (48% including breastmilk) for the treatment group, and 15% (47% including breastmilk) for controls. Two thirds of the protein in the supplementary food was of low quality, and one third was from high quality sources (cow or goat milk) was still major source of protein in the diets of the sample, thus good quality protein constituted well over three quarters of the protein consumed (87% for treatment, 89% for controls).

The distribution of calories from supplementary food for treatment vs control children was 72% vs 69% carbohydrate, 11% protein for both, and 17% vs 20% fat. For supplementary food and breastmilk, combined, the distribution of calories was similar for both groups, with approximately 54% from carbohydrate, 7% from protein, and 39% from fat. Traditionally, fat consumption is very low in the Bangladeshi adult diet. The higher ratio of fat seen in the infants' diets was due, primarily, to the consumption of cow or goat milk, though the ratios were still low, compared to international diets. With estimates of breastmilk, the contribution of fat calories was, of course, higher, representing nearly 40% of the calories for both groups. The percent of calories from protein was in the low range of normal (7% of the calories), however the majority of this was highly digestible, high quality breastmilk protein. It is important to note that the precise ratio of protein in the diet is irrelevant if the total quantities of food consumed (i.e. energy and protein) are inadequate.

2. Final

a. Final Energy Adequacy

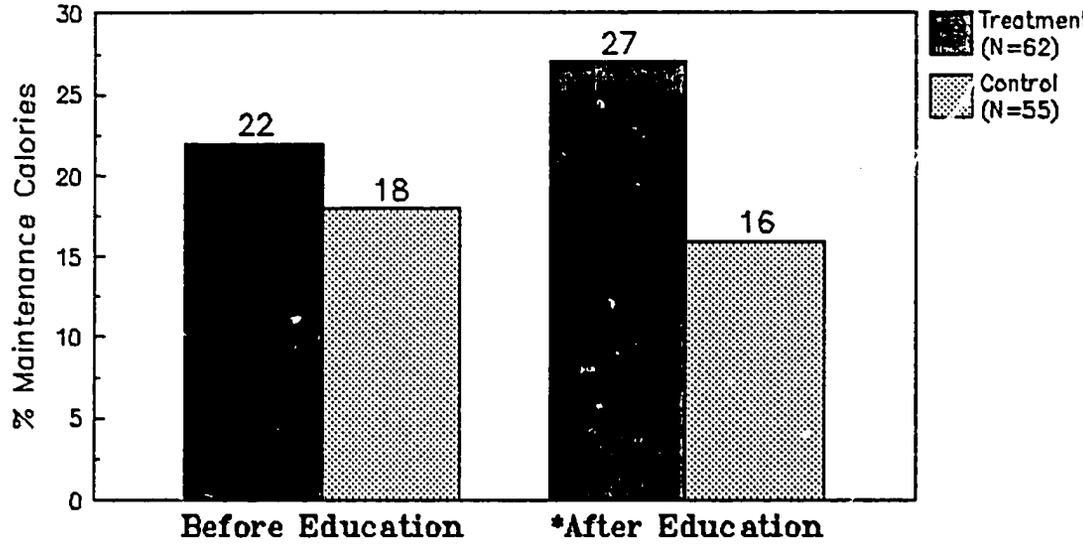
The energy adequacy of the supplementary food in the treatment group improved, as shown in Figure 6, from initial (18% of maintenance, 16% of ideal) to final measurement (27% of maintenance, 20% of ideal). In contrast, the energy adequacy of the control group actually decreased from initial (22% of maintenance, 14% of ideal) to final (17% of maintenance, 12% of ideal). Treatment children were consuming a significantly greater percent of their energy requirement from supplementary food, at final measurement, than the controls ($p=<.05$) (Appendix I, Tables 12 and 13).

Figure 6

## SUPPLEMENTARY FOOD CALORIES

**Percent Maintenance Requirement**

(Adjusted Mean*)




Breastmilk estimates not included

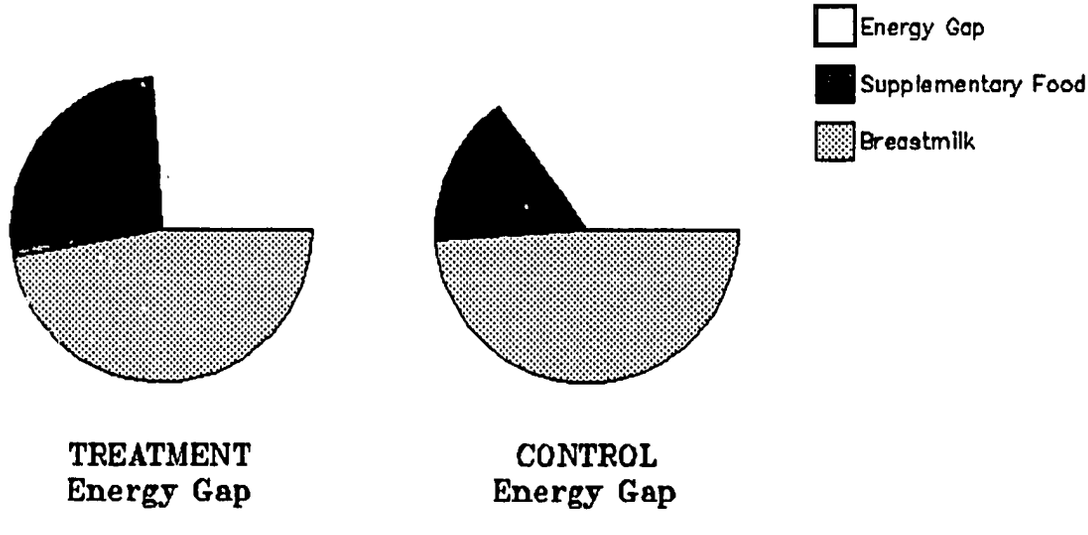
*Adjusted for SES, morbidity, initial Cals, age
Mean age: Before–8 months, After–13 months

Figure 7

## ENERGY GAP FOR NORMAL GROWTH

Percent Maintenance Calorie Requirement*

Treatment vs Control After Education




*Based on WHO/FAO standards & child's actual wt
Breastmilk amounts are age–specific estimates

The extra food consumed did not entirely compensate for the increased total requirement and the decrease in (estimated) breastmilk intake as the child grew older. Therefore the 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 energy adequacy of the diet (including breastmilk) was significantly greater ($p<.05$), after the intervention, for treatment compared with controls (74% vs 65% of maintenance; 55% vs 47% of ideal) (see Figure 7; also Appendix I, Tables 14 and 15).

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 more from supplementary 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 supplementary 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.

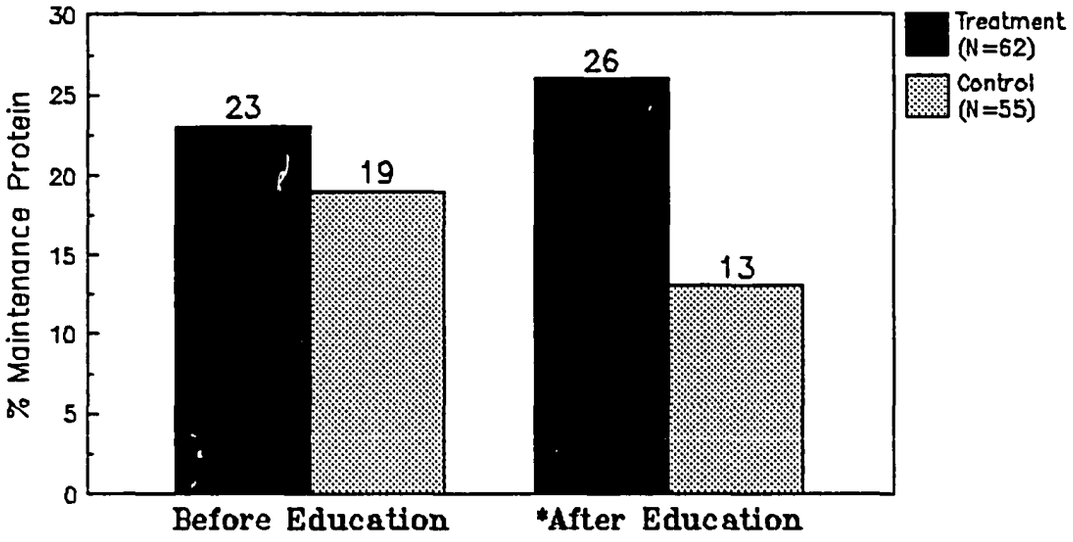
b. Final Protein Adequacy

Protein adequacy followed the same trend, for treatment and control, as that described for energy. While baseline intakes were similar, the final protein adequacy from supplementary food was significantly greater for the treatment group than controls ($p=<.05$) (Appendix I, Tables 16 and 17). The protein adequacy provided by supplementary food improved in the treatment group from initial (23% of maintenance, 17% of ideal) to final (27% of maintenance, 20% of ideal). For the control group, the supplementary food protein adequacy declined from initial (19% of maintenance, 14% of ideal) to final (15% of maintenance, 11% of ideal), as illustrated in Figure 8.

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). Less children in the control group were fed cows milk at final measurement than at baseline, though the same trend was not observed in the treatment group (see Figures 5 and 13B). This was compounded by an increased absolute 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.

Figure 8

## SUPPLEMENTARY FOOD PROTEIN
**Percent Maintenance Requirement**
(Adjusted Mean*)

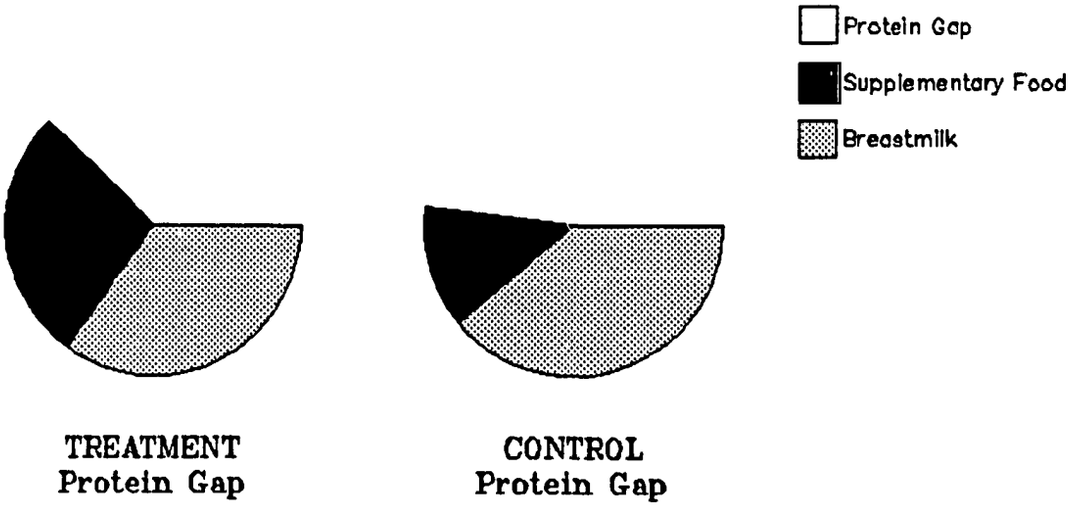



Breastmilk estimates not included

*Adjusted for SES, morbidity, initial pro, age
Mean age: Before–8 months, After–13 months

Figure 9

## PROTEIN GAP FOR NORMAL GROWTH
Treatment vs Control Children After Education
Percent of Maintenance Protein Requirement*




Breastmilk amounts are estimated

*Based on WHO/FAO standards & child's actual wt
*Adjusted for high infection rates (RQ x 1.5)

As with energy, the protein adequacy of the total diet (including breastmilk) 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 (see Figure 9). The protein adequacy of the diet, including food and breastmilk, was significantly greater after the intervention ($p<.05$), for treatment than controls (62% vs 53% maintenance; 46% vs 38% ideal) (Appendix I, Tables 18, 19).

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 grams of protein from supplementary foods at baseline, with a slight increase to 4.6 grams at final measure. Control children decreased their total consumption of protein, from 3.0 to 2.5 grams/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 gms to 10.4 gms), and control children actually decreasing their total consumption (from 9.2 gms to 8.2 gms).

### c. Final Protein Quality

The percent of good quality protein in the supplementary 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 higher for the treatments (29% of the protein) than controls (26%) (Appendix I, Tables 20 and 21). Since not all of the control children consumed supplementary foods, when breastmilk estimates were included, the ratio of good quality protein in the diet was higher for controls (85% of the protein) than for treatments (74% of the protein), although the total protein was lower for controls than treatment. 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 (see Figure 10).

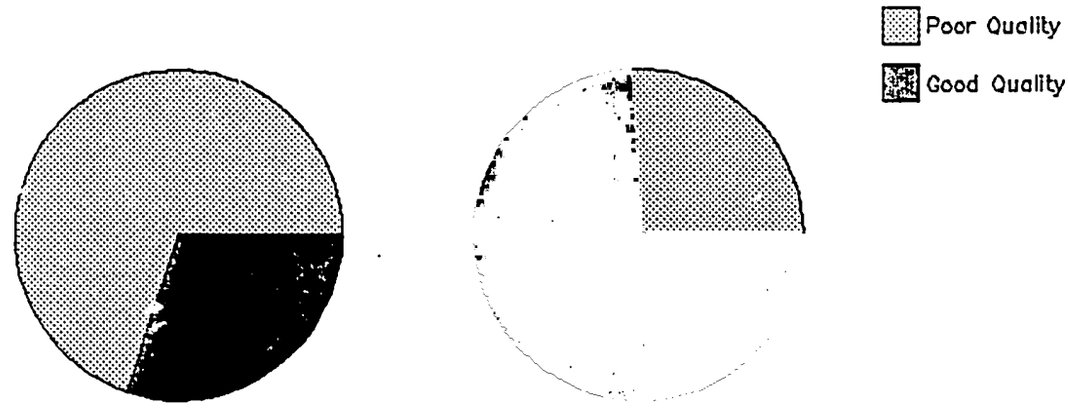
### d. Distribution of Final Calories

The percent of calories in the supplementary 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 (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. Carbohydrate makes up the difference in percent of calories.

# BREASTMILK AND FOOD PROTEIN QUALITY

## Percent Good vs Poor

Treatment Children After Education




SUPPLEMENTARY FOOD ONLY

BREASTMILK & FOOD

Mean age 13 months
Breastmilk amounts are estimates

Breastfeeding Mother; Sustained breastfeeding is essential for the weaning child, given the poor protein quality of the supplementary food affordable and offered.

With breastmilk estimates, the distributions of carbohydrate, protein, and fat change very little from pre to post measurements. At final measurement, they are 57% carbohydrate, 7-8% protein, and 35%-36% fat.

Approximately one third of the calories in treatment children compared to one fourth in the controls were provided by supplementary food, with the remaining two thirds in treatment children and three fourths in controls being from breastmilk (see Figure 11).

e. Percent Children Eating Supplementary Food

At final measurement, 100% of the treatment and 86% of the controls consumed supplementary food on recall (Figure 12). The average age was 13 months for both groups. The quality of the diet also varied, with treatment children consuming more varieties of food (Figures 13A, 13B). 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 protein (see Figure 13A). Sixty eight percent of treatment 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 chance of them causing 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, 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.

D. 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 supplementary foods. Incidence rates were similar for both groups (Figure 14), with 66% of treatment and 60% of controls reported to have at least one occurence of diarrheal illness over the 5-6 month study period. Respiratory and fever rates were highest in the last three months of the study (during and just after monsoons). Over the 5-6 months studied, nearly three quarters of the treatment children, and just over half of the controls, had at least one episode of respiratory illness. Sixty percent of both groups had a fever at least one time during the six months. Incidence of skin disease was highest in

Figure 11

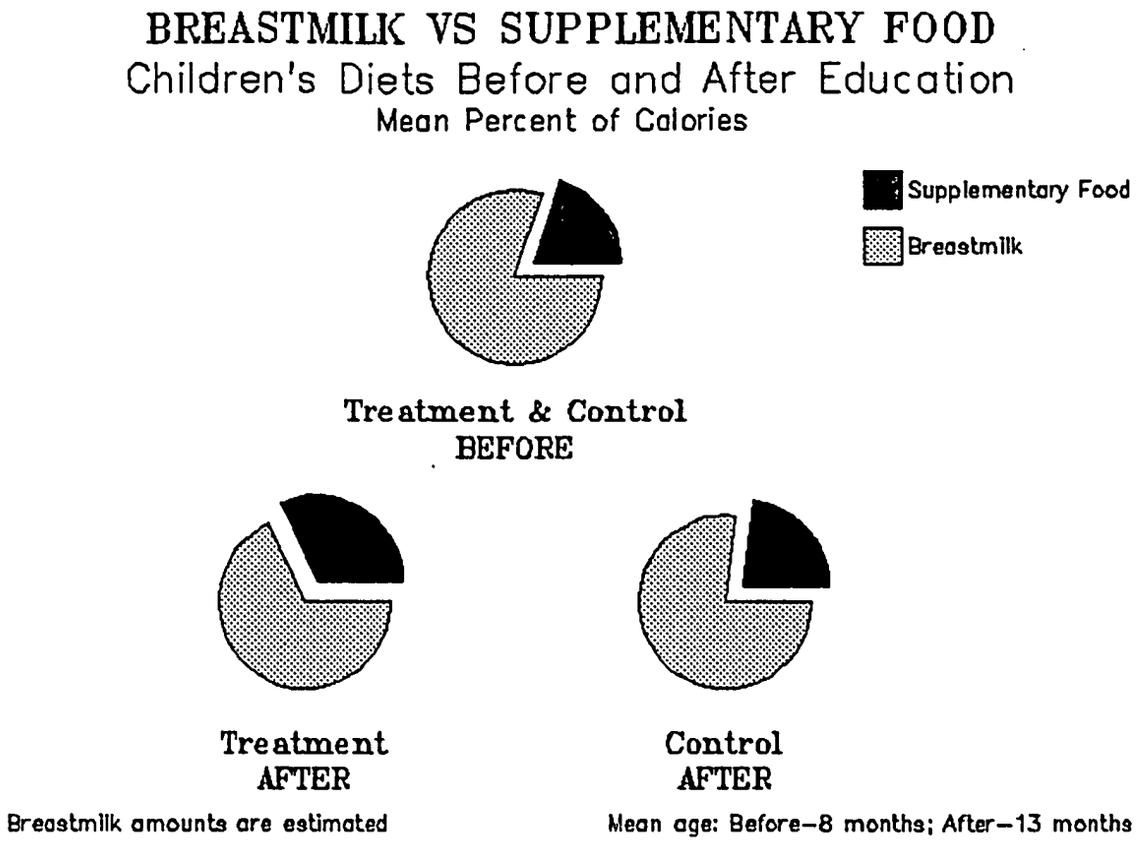



Figure 12

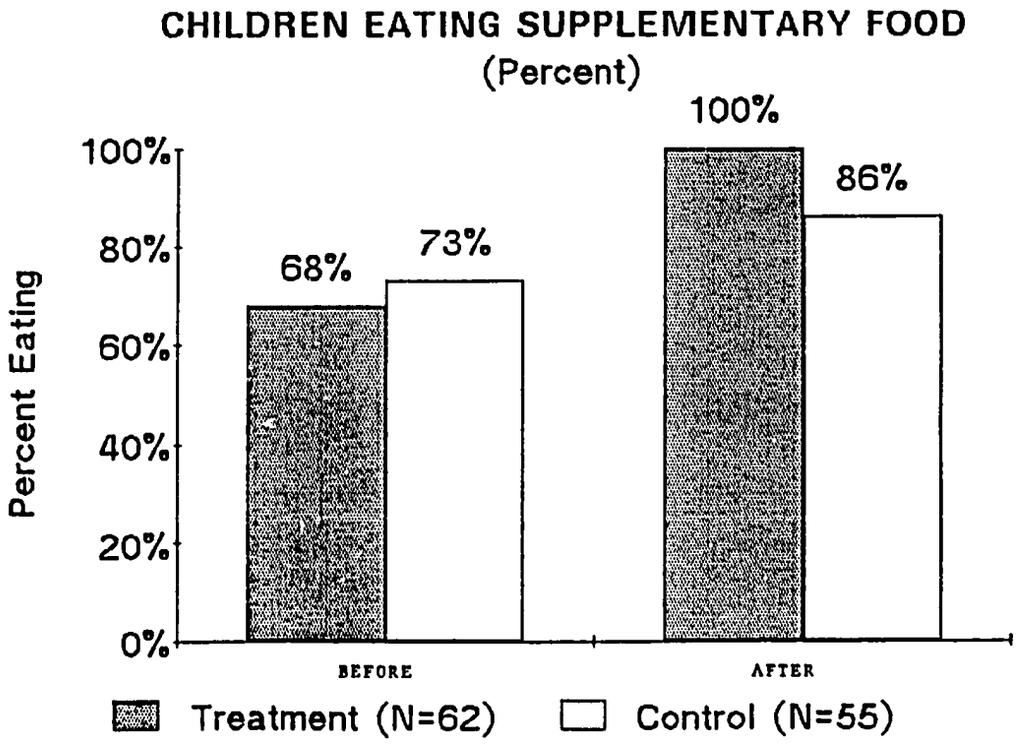
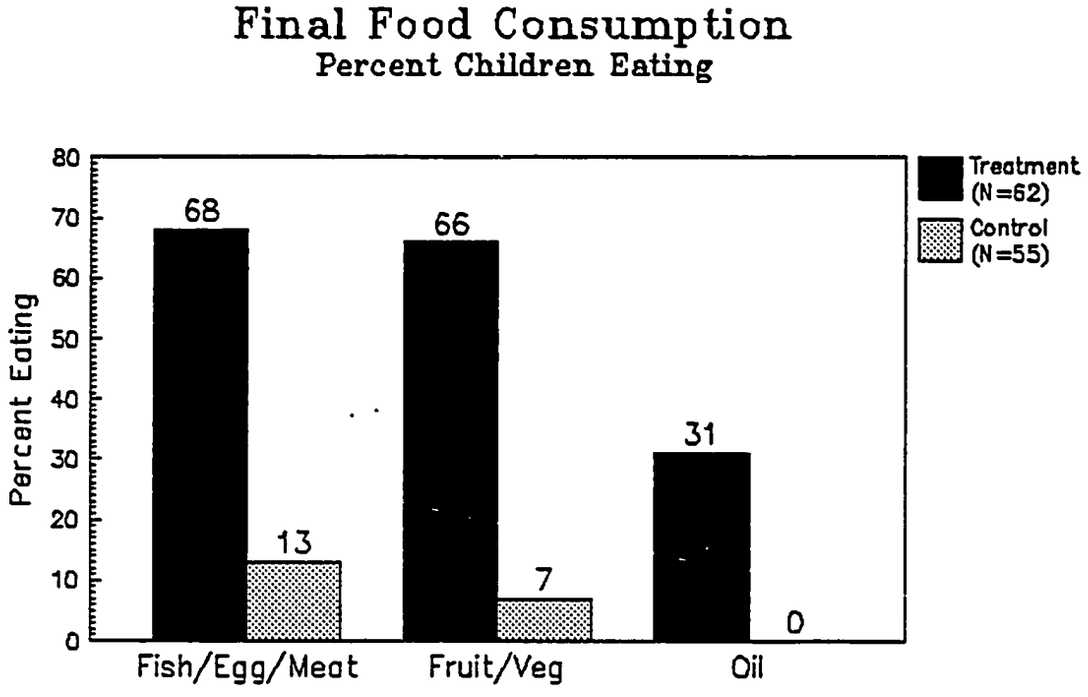


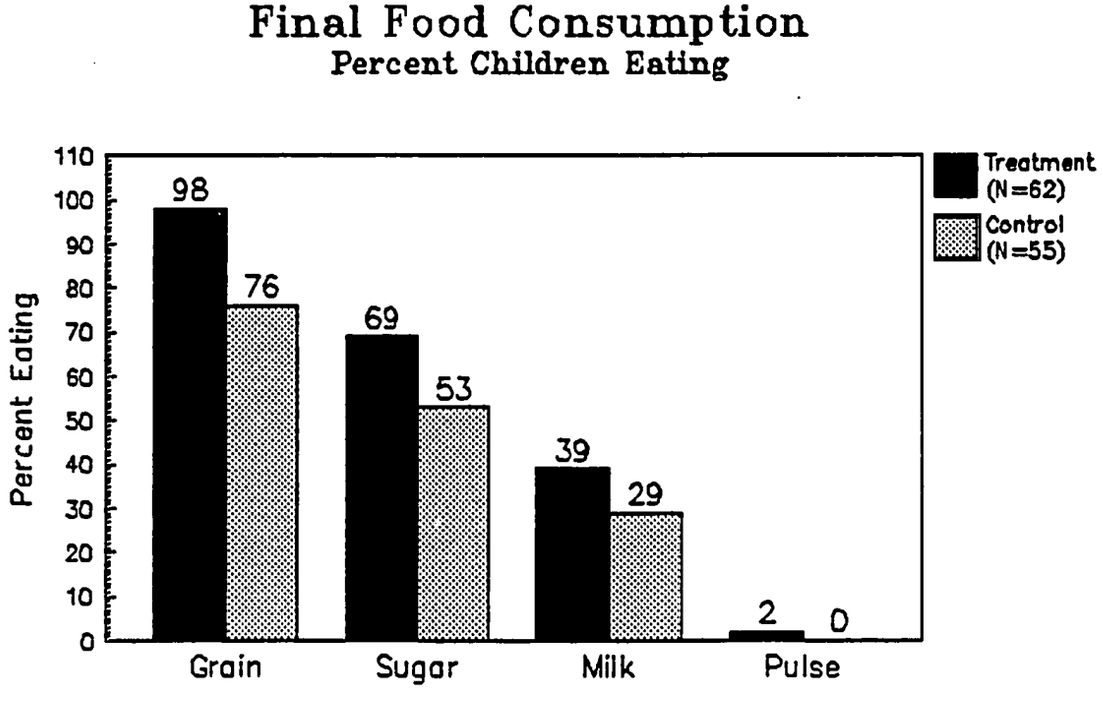
Figure 13A






Mean age 13 months; 100% children breastfeeding

Figure 13B




Mean age 13 months; 100% children breastfeeding

the hot, dry months for the treatment group, though was very low at this time for controls. More treatment children had skin and other minor infections than controls (37% vs 13%). The incidence of measles was very low, with only 5 (8%) treatment children and one (2%) control child reported to have the illness during the study.

Children in both groups were reported to be sick, on average, for a total of 7 days each month. Average monthly prevalence (% of days sick) of each of 3 major illness categories-- gastrointestinal (diarrhea, dysentary, or vomiting), respiratory, and fever-- was 5% to 7% (Figure 15). Treatment children were reported to have skin and other minor infections for 6% of the days each month, compared to only 2% for controls. Since so few children had measles, the prevalence was less than 1% for both groups.

## V. DISCUSSION

The findings from this analysis are very important, 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.

The intervention evaluated was not a "model education program", per se, but a forum for nutrition message development, however, the conclusions are applicable for future planning for nutrition education about supplementary feeding in Bangladesh and other developing countries. 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.

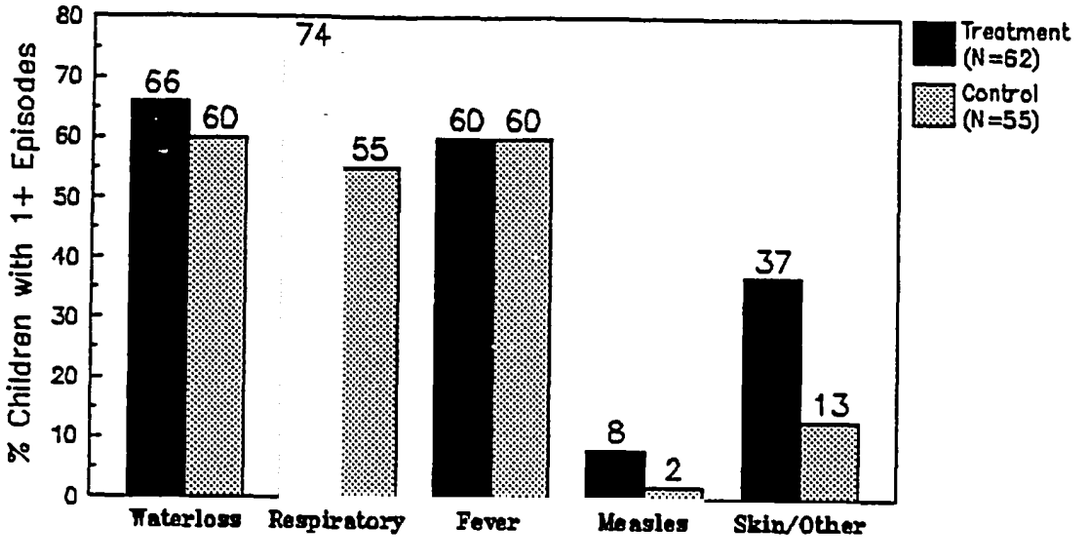
The other important finding is that increased consumption of hygienically prepared, energy-enriched weaning food, after age 5-6 months, did not result in a negative impact on infant growth, as would have been the case if the additional food were highly contaminated with diarrheal causing micro-organisms, 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.

### A. 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

Figure 14

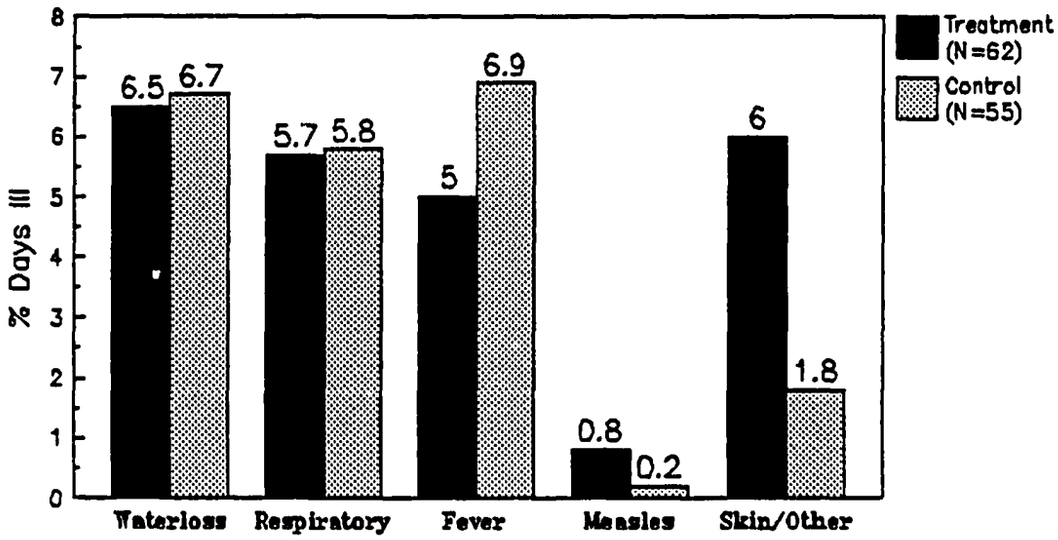
## INCIDENCE OF ILLNESS
(May–November)




% reporting at least 1 episode of illness
Age range 4–18 months

Figure 15

## PREVALENCE OF ILLNESS
(May–November)




Mean % days reported illness
Age range 4–18 months

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 was greater than half a standard deviation unit for weight-for-age. A z-score change of 0 illustrates maintenance growth (ie: maintaining the same distance in standard deviation units from the reference median). The treatment children nearly maintained a normal growth rate, with only a -.13 SD (adjusted for confounders) change over an average of 5 months. However, control children changed -.71 SD (adjusted) over the same time period, thus deviating to a much greater degree from international standards.

In more basic terms the treatment group was growing at a rate of .25 kg/month (8.1 gms/day) compared to only .18 kg/month (5.7 gms/day) for controls; thus the treatment group had a 25% better weight gain than the control group. These rates represent 91% and 77%, respectively, of expected growth for children with a starting age of 8 months and an ending age of 13 months growing -2 SD from the median of international (WHO 1985) standards (a more achievable standard than the median). Given that the intervention occured during the season of poorest growth in Bangladesh (Brown et al 1982, BBS 1987), with record floods infiltrating all the homes, freezing all normal activities (including cooking and daily wage earning), and eliminating clean water sources, the growth rates achieved for the treatment children are quite remarkable.

B. Energy and Protein Adequacy

While both groups showed similar baseline supplementary food intakes, at the final measurement children in the treatment group were eating significantly more supplementary food than the controls, and a greater variety, resulting in a greater intake of energy and protein. Treatment children were consuming 27% of their estimated energy requirement for maintenance growth, from supplementary foods, compared with only 16% for controls. Similarly, protein intake from supplementary food met 26% of the maintenance requirement for treatment children, but only 13% for controls. In addition to more total protein from supplementary 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 supplementary 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 occured 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 many of the mothers were practicing the messages--the frequency and extent varied from individual to individual and time to time.

Including breastmilk estimates with food intake, the treatment children were consuming, on average, 74% of their maintenance requirement compared with only 65% for controls. To compare with other similar studies, it is helpful to express the intake in kcalories/kg. A study of rural Bangladeshi children 5-30 months, which did test weighings of breastmilk, in addition to measuring supplementary food intakes, found the average total energy intakes to be 63-71 kcals/kg/day and protein intakes to be 1.2-1.5 gms/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 gms/kg/day for treatment and 1.12 gms/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 controls on the lower end of the range.

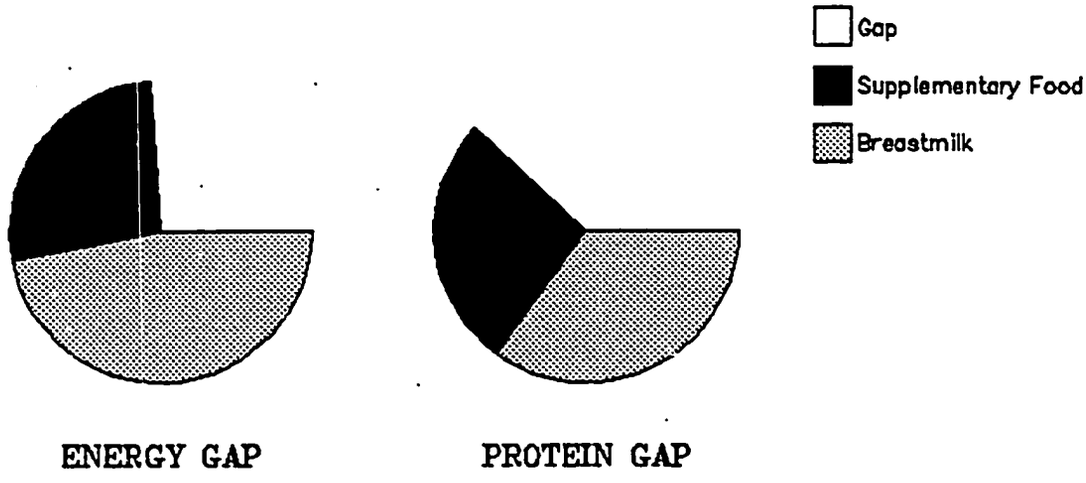
Another study in Bangladesh reported that intakes of 86.5 kcals/kg/day and 1.48 gms protein/kg/day in younger infants (under 9 months) were associated with maintaining weight gain comparable to the reference population, but didn't permit recovery from existing relative weight deficits (Brown et al 1986). 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 kilogram 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 gms protein/kg/day were not quite sufficient to maintain normal growth rates, resulting in a slight decline in weight-for-age z-score (-0.13 over 5 months). Figure 16 illustrates our estimates of the extent of maintenance energy and protein deficits remaining in the treatment children.

Figure 16

# ENERGY AND PROTEIN GAP FOR GROWTH

## Treatment Children After Education

Percent of Maintenance Requirement*




Breastmilk amounts are estimated

*Based on WHO/FAO standards & child's actual wt
*Protein adjusted for high infection rate (x1.5)

Comment: Despite at increase in supplementary food intake after education in treatment children, compared with controls, the energy and protein needs remain insufficient to promote maintenance growth. This remaining gap cannot be expected to be closed further by nutrition education alone.

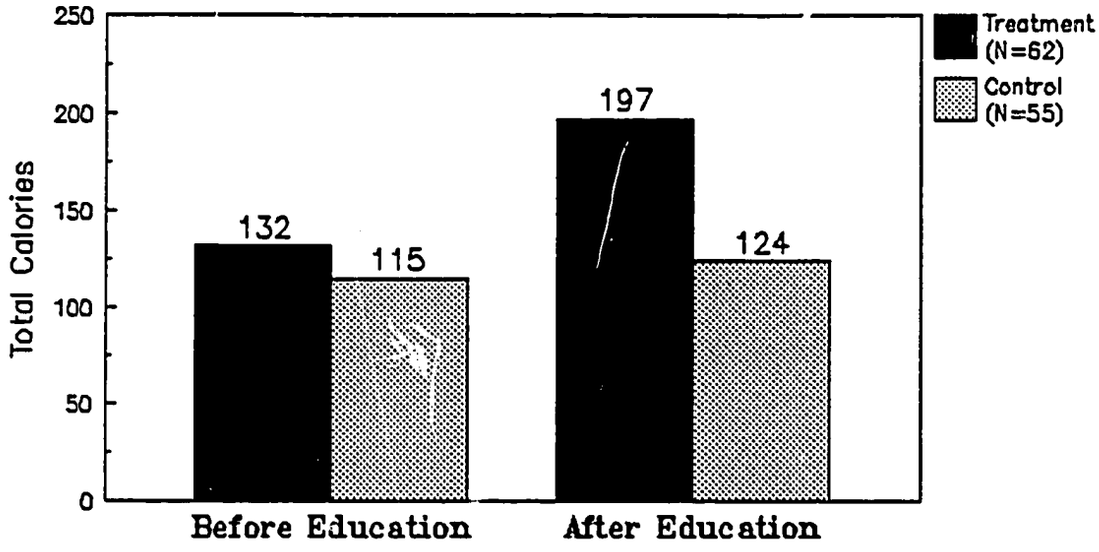
C. Breastmilk Repacement and Nutrient Needs

Did the increased consumption of supplementary 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 country estimates (see methods and Appendix I, Table 1). It is likely that the children who consumed the most supplementary food decreased their breastmilk intake some, 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 supplementary food substituted detrimentally for breastmilk. Studies of breastmilk outputs in developing countries where infants suckle frequently support this hypothesis (Pasricha 1973, Whitehead 1985, Khan 1984). 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 supplementary foods more than compensated for the decline (Pasricha 1973). Observational data in Bangladesh suggests that older infants and young children who consume more supplementary food, in addition to breastmilk, have better growth than those solely breastfed, despite an increase in diarrhea in those eating more supplementary 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 supplementary 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 supplementary food, suggest that the amounts declined from 632 grams/day in the first year to 563 grams/day in children 12-17 months (Brown et al 1982). This is a difference of approximately 40 kcals and 0.69 gms of protein. In our sample, the treatment children increased their intake of supplementary 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 (Figures 17 and 18). The daily protein intake increased in treatment children by 1 gram, which, adjusting for the poorer protein quality, still makes up for the (estimated) loss from breastmilk. The control group, however, consumed less protein from supplementary food at the final measure than at baseline (decrease of 0.55 grams). 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

Figure 17

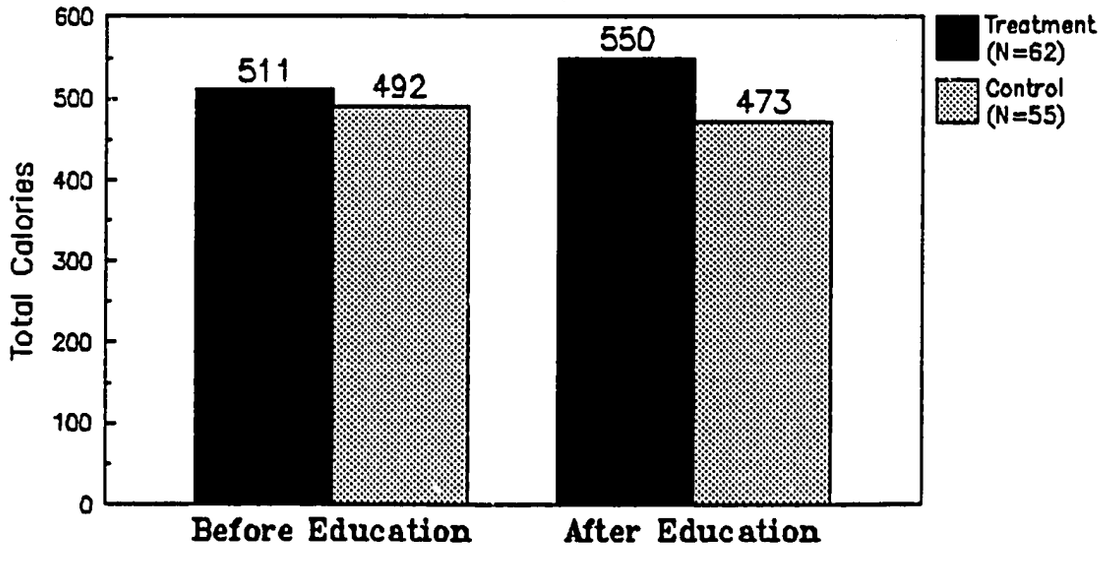
## SUPPLEMENTARY FOOD CALORIES
**Before and After Education**




Breastmilk estimates not included
Mean age: Before–8 months; After–13 months

Figure 18

## BREASTMILK AND FOOD CALORIES
**Before and After Education**




Breastmilk amounts are estimated
Mean age: Before–8 months, After–13 months

young children continuing to suckle frequently, the supplementary food likely provided "extra". 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 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.

D. Protein Quality

Is there need for concern about the amount of poor quality protein in the supplemental foods that were affordable to the families? Assuming breastmilk still constituted 75% of the diet, the ratio of good quality protein to poor quality was still very high (Figure 10). The total "amount" of all nutrients was inadequate, however, the "ratio" of nutrients was acceptable. Thus, we conclude that, while not ideal, it is more beneficial to encourage "energy rich, protein poor" supplemental 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 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.

E. 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 et al 1988), and could negate the benefits of the additional nutrients consumed from the food. We observed no differences in diarrheal rates in treatment and control children, however, due to the limitations in our monthly morbidity data, we cannot conclude whether the increase in supplementary food caused an increase in diarrhea. It is likely there was some increase in mild diarrhea in those consuming more supplementary 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 supplementary 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.

F. 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).

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, 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 (Appendix III).

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 a day, and 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.

G. Morbidity and Poor Feeding

One of the most common reasons reported for not giving more supplemental food was because "the child refused". While normal interactive feeding behaviors have been observed between Bangladesh infants and mothers (Zeitlin et al 1987), 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 illness probably accounted for a major part of the energy deficit. On sick days children in developing countries are reported to consume at least 30% less nutrients...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). This deficit is often not made up for when the child gets better. 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, 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 improving child health. 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.

## VI. INCORPORATION INTO BRAC'S PRIMARY HEALTH CARE PROGRAM

Findings from the analysis were reviewed with BRAC on a field visit to Bangladesh by nutritionist, Laurine Brown, June 13-27, 1989. The primary purpose of the visit was to solicit critique and input on the results from BRAC, and formulate policy decisions about incorporation of the concepts learned into BRAC's Child Survival Program.

The visit accomodated four specific agendas: 1) to revisit the study site and interview participants for acceptance/retention of messages; 2) to visit BRAC's Child Survival Program to evaluate the progress over the past 2 years and the potential incorporation of nutrition messages into the program; 3) to review findings from the analysis with BRAC staff and make policy decisions; and 4) to review findings with other organizations with an interest in child health in Bangladesh.

### A. Project Site Revisited

Ms. Brown revisited the study site and reunited with the village workers who had implemented the study in 1987. Most of the ex-workers were still living in the village and recalled their past nutrition work in great detail. Together, they revisited a sampling of volunteer mothers and community mothers for informal, impromptu interviews. As they walked through the village, some of the children spontaneously started chanting "Chop Chop, Chop Chop!", the name of the most popular and memorable weaning food in the campaign nearly 2 years before. All of the mothers recalled the campaign and some of them started singing some of the messages when the visitors entered their homes. Some of the mothers had continued to teach the messages. One volunteer mother, whose alert and healthy looking sample child was now about 2 1/2 years old, thanked us for teaching her ways to help keep her child healthy, and asked if we would come back and teach her some more. Believing in the usefulness of the messages for child health, she had passed them on to mothers who had given birth within the next 2 years.

The burdens of the mothers' daily lives had not lightened: poverty, past and pending flood damage, illness, and heavy domestic work remained constant concerns. But they felt the nutrition campaign and teachings were helpful to them in keeping their child healthy during a critical period. It gave them some power to do something about their situation.

Results of the follow-up survey conducted 8-10 months after the teaching to evaluate weaning-food beliefs and practices were being compiled by BRAC (Appendix III); the survey results, comparing treatment and controls, confirmed the analysis findings.

B. BRAC's Child Survival Program Revisited

Next, Ms. Brown visited BRAC's primary health care sites with the recently hired BRAC nutritionist, Nasreen Huq, and research staff physician, Nazrul Islam, to evaluate the operations and effectiveness of the programs, and to evaluate how the concepts learned in the present analysis have, and can be further incorporated. The major thrust of BRAC's child survival efforts has been on growth monitoring, in addition to continued ORT promotion, and collaboration with the government for immunization. Nutrition education, combined with practical cooking and feeding demonstrations, is conducted at each growth monitoring session with considerable input from volunteers. Volunteer mothers--a concept learned and transferred from this project-- have been organized into mother's clubs in many villages in Child Survival Program areas, with each mother responsible for teaching other community mothers about health and nutrition. The motivation and pride emanating from the volunteer mothers is difficult to convey in a written report. These rural women who, traditionally, are extremely isolated and repressed, are beginning to organize, speak their needs, and obtain knowledge and skills that enable them to better care for their children. While the community involvement and spirit have been very positive off-shoots of the growth monitoring sessions and mother's clubs, some technical concerns were raised during the site visits, compiled in a report, and reviewed with BRAC staff, including Mr. Abed, director.

Ms. Huq will follow-up on monitoring the incorporation of nutrition into BRAC's Child Survival Efforts, with the support of Dr. Nazrul.

C. Discussion of Findings with BRAC

A meeting then was held with all senior BRAC staff to review the analysis findings and formulate policy implications. Most of the staff had attended the field summary meeting in December 1987, and many had visited the study site during its implementation to learn about volunteer mothers and organizing village health committees. The findings were very positively received and the questions that arose were mainly about replicability on a large scale. The concepts of "volunteer mothers", demonstration of weaning food preparation, and several of the weaning food recipes, have already been implemented as a result of the field reports.

Dr. Salehuddin Ahmed, Program Coordinator for BRAC Training and Child Survivial Programs, summed up the meeting, stating--"this analysis comes at a very critical time for us, as we are in the process of evaluating our efforts and determining where we go from here. Your analysis of nutrition education confirms what we surmize from common sense: we assume if mothers give their weaning age infants any additional food, it will improve the growth of their child. Your analysis assures

us that even under extremely impoverished and unsanitary conditions, this relationship holds true. In addition, we have learned that women are more able and willing to implement a few simple messages that require little time and money. However, ideally what they need most are the more complex concepts--we need to find a way to bring about behavior change in these areas as well. Finally, you have shown us that while nutrition education can improve child growth, it cannot alone overcome the effects of frequent illness and extreme poverty. We need to continue to think of ways to address these problems."

Specific suggestions from BRAC have been incorporated into the conclusions and recommendations.

D. Discussion of Findings with Other Organizations

Finally, a meeting was organized by U.S. AID in Dhaka to review the study, convey recommendations, and discuss implications for other organizations throughout Bangladesh. Representatives were present from a number of international organizations including U.S. AID, CARE, UNICEF, International Center for Diarrheal Disease Research (ICDDRB), Save the Children USA, and the German Technical Cooperation. Many of the organizations had some nutrition education activities, ye were developing the programs on very little practical knowledge. They were hungry for the detailed practical knowledge gained through developing and testing the messages on the village level, and for conclusive guidance offered in this project.

## VII. CONCLUSIONS

### A. Findings from the Analysis

- Children whose mothers received education ate greater quantities of all foods, and a greater variety, particularly of fish, oil, vegetables and fruits.

- These treatment children grew significantly better than controls. After adjusting for SES, morbidity, age, and initial nutritional status, growth rates comparable to the international standard were not quite achieved, however, the severe growth faltering that characterizes the weaning age was prevented in the treatment group compared with the controls.

- Increased supplementary food consumption was associated with better, rather than poorer, growth rates in our sample (age ranges 4-18 months). Therefore, it is not likely that low protein supplementary foods displaced breastmilk to a large degree, or that greater losses occured from food related diarrhea.

## B. Interpretations of the Findings

- Well designed nutrition messages for weaning can play an important role in improving child health, by enabling the mother to best utilize her limited resources. Even conservative, impoverished mothers in rural Bangladesh are willing to modify their infant feeding practices if they are taught feasible new behaviors by their peers. Nutrition messages, however, cannot be expected to overcome the numerous consequences of poverty.

- Simple nutrition messages that demand little time and money, and that are modifications of existing practices, have the most potential for acceptance and practice. Complicated, time consuming, and expensive practices are not likely to achieve sustained compliance. The preparation of "special weaning dishes" is not essential. Mothers can "doctor up" existing foods to enrich the energy and protein amounts in each spoonful, for example with oil, sugar, or milk powder or legume flour (finances allowing).

- Finances will limit many poor families' abilities to provide high quality protein foods, such as milk and eggs, to their infants. If children continue to breastfeed, the "type" of food offered may be less important than the total amounts. Thus, any additional food is likely to help close the energy gap, and improve growth, although ideal growth rates are not likely to be achieved until improvements are made in sanitary and economic conditions. It is important to remember, however, such a protein-poor diet without breastmilk is likely to cause malnutrition.

- In many sick children, food intake will be self limiting. Nutrition education will not overcome this anorexia of illness, ever-present in village children; however it can alter detrimental cultural practices (such as withholding food), and modify the type of food offered. Mothers need as much support on infant "feeding" as on "foods". Strategies to help mothers deal with feeding problems are greatly needed, yet have been given very little attention in the field of nutrition.

- Whereas a verbal exchange of messages encourages "memorization of phrases", demonstration and "hands-on" practice teaches memorable skills. It is unknown if another style of dissemination (for example, radio spots) will have the same potential for behavioral change as modelling.

- Various vehicles for the dissemination of nutrition messages (for example: growth monitoring programs, radio spots, womens' groups) should be explored. Complementing nutrition messages with income generating programs, or with illness prevention and treatment, should help reduce some of the major barriers to effectiveness.

- Lastly, programs to improve maternal health and nutrition are likely to improve the child's growth, by preventing intrauterine malnutrition.

## VIII. RECOMMENDATIONS

- Encourage supplementary feeding of simple, cheap, energy-enriched food after 5-6 months. In Bangladesh, the messages designed in village homes by this project have the demonstrated 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.

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

- Incorporate the teaching strategies and message content into programs that offer income generating activities and/or control infectious illness to help reduce barriers to compliance.

- Design strategies to deal with infant feeding problems. Of high priority should be programs to prevent and treat infectious illness. Combine handwashing and hygiene messages with feeding messages.

- Explore village based vs wide-scale production of time and fuel saving infant foods, for example, "quick cooking cereal bases" combining subsidized grains and legume 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.

- Design and implement "Safe Motherhood" programs to improve the health and nutritional status of women of childbearing age. This will, likely, reduce low birth weight, thus improving pre-weaning nutritional status of infants. Education programs will, then, be realistically challenged with "maintaining" normal growth, rather than promoting "catch-up" growth.

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# APPENDICES

APPENDIX I: STATISTICAL PROGRAMS AND RESULTS
12 pages.

APPENDIX II: LITERATURE REVIEW: "SUPPLEMENTARY FOOD INTAKE AND GROWTH OF WEANING AGE INFANTS", by Laurine Brown, June 1989, 24 pages.

APPENDIX III: "CROSS-SECTIONAL SURVEY OF PUSTHI JIBON (NUTRITION FOR LIFE)", by Azmat Ahmad and Suaib Ahmed, BRAC, June 1989, 4 pages.

# APPENDIX I

## STATISTICAL PROGRAMS AND SELECTED MAJOR RESULTS

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ANALYSIS OF VARIANCE--MULTIPLE CLASSIFICATION ANALYSES BY TREATMENT GROUP:


8--Final Weight-for-age Z Score (WAZ) 5
Controlling for: initial WAZ, morbidity, wealth, mother's education, final kcals, initial age

9--Final Weight-for-age Z Score (WAZ) 5
Controlling for: initial WAZ, morbidity, wealth, mother's education, initial age 5

10--Final Weight (kg) 6
Controlling for: initial weight, morbidity, wealth, mother's education, initial age

11--Final Percent Median Weight-for-Age (WAPM) 6
Controlling for: initial WAPM, morbidity, wealth, mother's education, initial age

12--Final Percent Ideal Energy Requirement from Supplementary Food 7
Controlling for: initial energy intake, morbidity, wealth, mother's education, initial age

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13--Final Percent Maintenance Energy Requirement from Supplementary Food 7
Controlling for: initial energy intake, morbidity, wealth, mother's education, initial age

14--Final Percent Ideal Energy Requirement from Supplementary Food and Breastmilk 8
Controlling for: initial energy intake, morbidity, wealth, mother's education, initial age

15--Final Percent Maintenance Energy Requirement from Supplementary Food and Breastmilk 8
Controlling for: initial energy intake, morbidity, wealth, mother's education, initial age

16--Final Percent Ideal Protein Requirement from Supplementary Food 9
Controlling for: initial protein intake, morbidity, wealth, mother's education, initial age

17--Final Percent Maintenance Protein Requirement from Supplementary Food 9
Controlling for: initial protein intake, morbidity, wealth, mother's education, initial age

18--Final Percent Ideal Protein Requirement from Supplementary Food and Breastmilk 10
Controlling for: initial protein intake, morbidity, wealth, mother's education, initial age

19--Final Percent Maintenance Protein Requirement from Supplementary Food and Breastmilk 10
Controlling for: initial protein intake, morbidity, wealth, mother's education, initial age

20--Final Percent Good Quality Protein from Supplementary Food 11
Controlling for: initial intake of % good quality protein, morbidity, wealth, mother's education, initial age

21--Final Percent Poor Quality Protein from Supplementary Food 11
Controlling for: initial intake of % poor quality protein, morbidity, wealth, mother's education, initial age

TABLES, continued: PAGE

BY TREATMENT GROUP FOR MOTHERS WITH NO EDUCATION:

22--Final Percent Ideal Protein Requirement from Supplementary Food 12
Controlling for: initial protein intake, morbidity, wealth, initial age

23--Final Percent Ideal Energy Requirement from Supplementary Food 12
Controlling for: initial energy intake morbidity, wealth, initial age

# TABLE I

```
**********************************************************************
                          B A N G L A D E S H
                   ESTIMATION OF BREASTMILK INTAKE
**********************************************************************
BREASTMILK VOLUMES ADAPTED FROM:
1. BROWN,K., H. BLACK, S. BECKER, S. NAHAR, J. SAWYER: "CONSUMPTION
      OF FOODS AND NUTRIENTS BY WEANLINGS IN RURAL BANGLADESH",
   AM 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
   1980;78(5):909-919.

RATIONALE FOR "BEST GUESS" ADAPTED VALUES:
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 OURS.
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).
SUPPLEMENTARY FOODS WERE WITHHELD FROM THE INFANTS. THE MOTHERS
WERE FED A WELL BALANCED DIET DURING THEIR STAY IN THE
HOSPITAL. THUS DURING THE 24 HOUR BREASTMILK TEST WEIGHINGS.
BECAUSE THE WOMEN WERE WELL FED DURING THE STUDY, AND THE INFANTS
WERE SOLELY BREASTFED, THE BREASTMILK QUANTITIES WILL BE GREATER
THAN IN OUR STUDY OF RURAL WOMEN, WHERE SUPPLEMENTARY FOOD
WAS ENCOURAGED FROM 5-6 MONTHS. ALSO, THE VALUES  REPORTED
ARE ONLY FOR INFANTS < 10 KGS.

THE AVERAGE BREASTMILK IN REF 1, AGES 5-12 MONTHS, IS 632 GMS.
THE AVERAGE IN IN REF 2, AGES 5-9 MONTHS, IS 734 GMS. A CRUDE
ESTIMATE OF THE AVERAGE DIFFERENCE IN THE TWO SAMPLES IS:
632 GMS/734 GMS = 100-86%.  IE:THE VOLUMES PRODUCED BY THE
RURAL WOMEN, WHOSE DIETS ARE LIMITED, AND WHOSE CHILDREN 5-12 MOS
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 BELOW).
**********************************************************************

BREASTMILK VOLUMES:
```

| AGE MOS | VOLUME (REF#) | * | PERCENT OF REF #2 | * | ADAPTED VOLUME(G) | SMOOTHED VALUE(G) |
|---|---|---|---|---|---|---|
| 0 | 559(2) | | 100.0% | | 559 | 559 |
| 1 | 582(2) | | 97.2 | | 566 | 576 |
| 2 | 635(2) | | 94.4 | | 599 | 608 |
| 3 | 698(2) | | 91.6 | | 632 | 625 |
| 4 | 714(2) | | 88.8 | | 634 | 638 |
| 5 | 758(2) | | 86.0 | | 645 | 641 |
| 6 | 722(2) | | 86.0 | | 621 | 640 |
| 7 | 758(2) | | 86.0 | | 645 | 636 |
| 8 | 738(2) | | 86.0 | | 628 | 629 |
| 9 | 719(2) | | 86.0 | | 618 | 617 |
| 10 | 668 (INCREMENTAL INCREASE OF AVE OF REF #1 & MOS 6 #2 12 MOS) | | | | 605 | 601 |
| 11 | 582 (SAME AS 13 MOS) | | | | 582 | 583 |
| 12-17 | 563(1) | | | | 563 | 570 |
| 13 | | | | | | 564 |
| 14 | | | | | | 563 |
| 15 | | | | | | 564 |
| 16 | | | | | | 560 |
| 17 | | | | | | 544 |
| 18-23 | 501(1) | | | | 360 | 528 |
| 19 | | | | | | 504 |
| 20 | | | | | | 502 |
| 21 | | | | | | 502 |
| 22 | | | | | | 495 |
| 23 | | | | | | 462 |
| 24+ | 368(1) | | | | | 403 |

```
**********************************************************************
THE "ADAPTED VOLUMES" WERE THEN PUT INTO MINITAB CURVE SMOOTHER.
THESE SMOOTHED VALUES WERE ROUNDED, AND ARE USED TO ESTIMATE
BREASTMILK QUANTITIES AND NUTRIENTS BELOW.
**********************************************************************
BREASTMILK NUTRIENT COMPOSITION PER 100 GRAMS:
                                        51 KCALS
                                        1.3 GM PROTEIN
                                        3.8 GM FAT
                                        7.5 GM CHO
                                        1.0 MG IRON
                                        38 MCGM RETINOL EQ
                                          =(150 IU  VITA)
REFERENCE:BROWN ET AL, AM J CLIN NUTR 36:878-889, 1982
**********************************************************************
```

# TABLE 2

```
**********************************************************************
          COMPUTATION OF ENERGY AND PROTEIN REQUIREMENTS
**********************************************************************
                          C A L O R I E S
**********************************************************************
CALCULATION OF ENERGY REQUIREMENT/KG BODY WEIGHT/DAY
REFERENCE:WHO "ENERGY AND PROTEIN REQUIREMENTS",
          TECHNICAL REPORT SERIES 724, 1985.
REQUIREMENT FOR AGES 0-12 MONTHS FROM TABLE 21, PAGE 91,
CALCULATED AS "PREDICTED INTAKE" +5% (SEE TEXT):
**********************************************************************
EQUATION:KCAL/KG/DAY=(123 - 9.9(AGE) + 0.59(AGE SQUARED))*1.05
**********************************************************************
REQUIREMENT FOR AGE 1-2 YEARS FROM TABLE 49, PAGE 137:
105 KCALS/KG/DAY.
----------------------------------------------------------------------
              M A I N T E N A N C E   C A L O R I E S
                        R E Q U I R E M E N T
----------------------------------------------------------------------
CALRQMO TO CALRQM5=ESTIMATION OF TOTAL CALORIES REQUIRED
                   FOR MAINTAINING PRESENT GROWTH PERCENTILE
                   AT MONTHS 0 THROUGH 5.
COMPUTE "WHO'S" STANDARD CAL/KG/DAY REQUIREMENT, FROM
CALCULATION ABOVE (CALRQ@_K), MULTIPLIED BY
CHILD'S ACTUAL WEIGHT (KG).
----------------------------------------------------------------------
CALPMO-CALPM5=CHILD'S INTAKE OF FOOD, EXCLUDING BREASTMILK,
         AS A PERCENT OF CALORIE REQUIREMENT FOR MAINTAINING
         PRESENT GROWTH PERCENTILE (CALRQMO TO CALRQM5)
         FROM MONTH 0 TO 5.
----------------------------------------------------------------------
ALCALPMO-ALCALPM5=CHILD'S INTAKE OF FOOD, INCLUDING BREASTMILK,
    AS A PERCENT OF CALORIE REQUIREMENT FOR MAINTAINING
    PRESENT GROWTH PERCENTILE (CALRQMO TO CALRQM5).
----------------------------------------------------------------------
                   I D E A L   C A L O R I E
                     R E Q U I R E M E N T
----------------------------------------------------------------------
CALRQI0 TO CALRQI5=ESTIMATION OF TOTAL CALORIES REQUIRED
                   FOR CATCH-UP TO IDEAL WEIGHT FOR AGE
                   GROWTH PERCENTILE AT MONTHS 0 THROUGH 5.
COMPUTE "WHO'S" STANDARD CAL/KG/DAY REQUIREMENT, FROM
CALCULATION ABOVE (CALRQ@_K), MULTIPLIED BY IDEAL WEIGHT FOR AGE
(NCHS MEDIAN VALUES FOR MALES OR FEMALES--REFERENCE: WHO,
"MEASURING CHANGE IN NUTRITIONAL STATUS: GUIDELINES FOR ASSESSING
THE NUTRITIONAL IMPACT OF SUPPLEMENTARY FEEDING PROGRAMMES FOR
VULNERABLE GROUPS", GENEVA 1983).
----------------------------------------------------------------------
CALPI0 TO CALPCI5=CHILD'S INTAKE OF FOOD, EXCLUDING BREASTMILK,
         AS A PERCENT OF CALORIE REQUIREMENT FOR CATCH-UP GROWTH
         (CALRQI0 TO CALRQI5) FROM OBSERVATION MONTH 0 TO 5.
----------------------------------------------------------------------
ALCALPI0-ALCALPI5=CHILD'S INTAKE OF FOOD, INCLUDING BREASTMILK,
    AS A PERCENT OF CALORIE REQUIREMENT FOR CATCHUP GROWTH
    (CALRQMO TO CALRQM5).

**********************************************************************
                          P R O T E I N
**********************************************************************
CALCULATION OF PROTEIN REQUIREMENT/KG BODY WEIGHT/DAY.
REFERENCE:WHO "ENERGY AND PROTEING REQUIREMENTS",
          TECHNICAL REPORT SERIES 724, 1985.
BASELINE REQUIREMENT FOR AGES 3-24 MONTHS OBTAINED FROM
TABLE 33, PAGE 105. AGES 0-2 MONTHS ADAPTED FROM TABLE 32,
PAGE 104.
BECAUSE OF HIGH INFECTION RATES VALUES FOR AGES 6-24 MONTHS
WERE MULTIPLIED BY 1.: (SCREIMSHAW AND ZEITLIN, PERSONAL
COMMUNICATION, MARCH 1989).
ALL VALUES WERE INTERPOLATED TO THE MONTH USING MINITAB
CURVE SMOOTHER.
SINCE PROTEIN QUALITY OF THE SUPPLEMENTARY FOOD IS LOW,
A MODIFICATION IS MADE FOR PROTEIN QUALITY AND
DIGESTIBILITY (WHO 1985: TABLE 40 AND 41, PAGES 124-125).
ADJUSTP=ADJUSTMENT TO PROTEIN FOR DIGESTIBILITY AND AA SCORE.
         AVERAGE DIGESTIBILITY--ASSUME 85%
         AVERAGE AMINO ACID SCORE OF INDIAN DIET--75%
         ADJUSTP=(100/85)*(100/75)
         POOR PROTEIN FOODS: GRAINS, VEGETABLES, FRUITS,
                             LEGUMES, SUGARS, OILS
         GOOD PROTEIN FOODS: EGGS, FISH, MEAT, POULTRY,
                             MILK,
BREASTMILK DIGESTIBILITY AND AA-SCORE--100%
**********************************************************************
MAINTENANCE AND IDEAL REQUIREMENTS WERE COMPUTED FOR PROTEIN,
AS ABOVE FOR CALORIES, FOLLOWED BY DIETARY INTAKES AS A PERCENT
OF THESE REQUIREMENTS.
```

(PROGRAM EDITED FOR CLARITY)

```
*****************************************************************
COMPUTES THREE CATEGORIES OF SCALES FOR SES:
            - MODERNIZATION/EDUCATION
            - AGRICULTURAL WEALTH
            - TRADITIONAL WEALTH
THE MODERNIZATION/EDUCATION SCALES CONSISTS OF POSSESSION.
THE AGRICULTURAL AND TRADITIONAL WEALTH SCALES, AND THE COMBINED
WEALTH SCALE, ASSIGN MONETARY VALUES TO THE ITEMS BASED ON LOCAL
BANGLADESH MARKET COSTS, FOLLOWING GEORGIA GULDAN'S (1988) METHODOLOGY.
MONETARY VALUES OF ITEMS IN THIS SCALE ARE DIVIDED BY 10.
RELIABILITY CHECKS CONFIRM ACCEPTABLE INTERNAL CONSISTENCIES.
*****************************************************************
ASSIGNMENT OF COST OF ITEMS:
COMMANDS: ITEM MULTIPLIED BY COST IN
          TAKA (DIVIDED BY 10)          ITEM DESCRIPTION:
-----------------------------------------------------------------
  COMPUTE MBEDRM=BEDRM*40               BEDROOM
  COMPUTE MCOWSHED=COWSHED*30           COWSHED
  COMPUTE MKITCHEN=KITCHEN*200          KITCHEN
  COMPUTE MOUTSKRT=OUTSKRT*300          SHED IN OUTSKIRTS
  COMPUTE MCHICKHS=CHICKHS*10           POULTRY HOUSE
  COMPUTE MMETPOT=PITKAT*20             BRASS OR BRONZE DISHWARE
  COMPUTE MENDISH=ENDISH*5              ENAMEL DISHES
  COMPUTE MPADDY=PADDY*19               STORED PADDY
  COMPUTE MCORNIN=CORNIN*10             CORN INCOME
  COMPUTE MTREEIN=TREEIN/10             TREE INCOME
  COMPUTE MVEGIN=VEGIN/10               VEGETABLE INCOME
  COMPUTE MMATIN=MATIN/10               MAT (HANDICRAFT) INCOME
  COMPUTE MCHICKIN=CHICKIN/10           INCOME FROM POULTRY
  COMPUTE MCOT=COT*15                   COTS
  COMPUTE MBLANKET=BLANKET*7            BLANKETS
  COMPUTE MPILLOW=PILLOW*1.5            PILLOWS
  COMPUTE MLANTERN=LANTERN*8            LANTERNS
  COMPUTE MUMBRELA=UMBRELLA*10          UMBRELLAS
  COMPUTE MPOULTRY=DUKCHICK*5           DUCKS AND CHICKENS
  COMPUTE MSOAP=SOAP*1                  SOAP
  COMPUTE MWATCH=WATCH*20               WATCHES
  COMPUTE MBIKE=BIKE*130                BICYCLES
  COMPUTE MRADIO=RADIO*40               RADIOS
  COMPUTE MBOAT=BOAT*150                BOATS
  COMPUTE MCOW=COW*120                  COWS
  COMPUTE MGOAT=GOAT*10                 GOATS
  COMPUTE MLAND=(LAND*33)*35            PART OF LAND
  --LAND VARIABLE THEN LOGGED
  LATRINE TYPE:  RECODE LATRINE (3=1) (2=2) (1=3) INTO MLATRINE
  SOLVENCY:      RECODE SOLVENT (1=-10) (2=1) (3=100) (4=500)
                 INTO MSOLVENT
  COST OF HOUSE: RECODE HOUSE (1=500) (2=300) (3=240) (4=200)
                 (5=160) (6=80) (7=60) (8=40) (9=30) INTO MHUTCOST

*****************************************************************
                    -- S C A L E S --
*****************************************************************
"TRADRICH"=TRADITIONAL WEALTH (HOUSEHOLD BELONGINGS)

  COMPUTE  TRADRICH=MMETPOT+MENDISH+MCOT+MBEDRM+MKITCHEN+
                BOAT+MUMBRELA+MPILLOW+MBLANKET+MLANTERN+MBIKE+
                MSOLVENT+MHUTCOST

*****************************************************************
"AGRICH"=AGRICULTURAL WEALTH (LANDHOLDINGS AND ANIMALS)

  COMPUTE AGRICH=MCOW+MGOAT+MCOWSHED+MOUTSKRT+MCHICKHS+
               NLAND+MPOULTRY+MPADDY+MCORNIN+MTREEIN+MVEGIN

*****************************************************************
"WEALTH"=COMBINES TRADITIONAL AND AGRICULTURAL WEALTH, FOR A
         TOTAL MEASURE OF WEALTH.

  COMPUTE  WEALTH=MMETPOT+MENDISH+MCOT+MBEDRM+MKITCHEN+
                BOAT+MUMBRELA+MPILLOW+MBLANKET+MLANTERN+MBIKE+
                MSOLVENT+MHUTCOST+MCOW+MGOAT+MCOWSHED+
                MOUTSKRT+MCHICKHS+NLAND+MPOULTRY+MPADDY+
                MCORNIN+MTREEIN+MVEGIN
*****************************************************************
THESE 3 SCALES WERE THEN LOGGED DUE TO NON-NORMAL DISTRIBUTION.

*****************************************************************
COMPUTATION OF 4 VARIATIONS OF MODERNIZATION AND EDUCATIONAL
WEALTH SCALES:  (HEADED=HEAD OF HOUSEHOLD EDUCATION IN YEARS)
                (MOMED=MOTHERS EDUCATION IN YEARS)

  COMPUTE MODMYGED=HEADED+MOMED+WATCH+RADIO+SOAP
  COMPUTE MODERNED=HEADED+MOMED+WATCH+RADIO
  COMPUTE MODMYG=WATCH+RADIO+SOAP
  COMPUTE MODERN=WATCH+RADIO
*****************************************************************
```

# TABLE 4

AGE & ANTHROPOMETRICS: BASELINE, FINAL, & CHANGE

| TREATMENT GROUP | INITIAL AGE IN MONTHS | FINAL AGE IN MONTHS | INITIAL WEIGHT-FOR-AGE Z-SCORE | FINAL WEIGHT-FOR-AGE Z-SCORE | CHANGE IN WAZ | INITIAL PERCENT MEDIAN WEIGHT-FOR-AGE | FINAL PERCENT MEDIAN WEIGHT-FOR-AGE | CHANGE IN WAPM |
|---|---|---|---|---|---|---|---|---|
| CONTROL | | | | | | | | |
| Mean | 8.16 | 13.02 | -1.94 | -2.57 | -.63 | 78.14 | 72.94 | -5.20 |
| StdDev | 2.54 | 1.96 | .98 | .84 | .63 | 10.27 | 8.69 | 6.35 |
| N | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 |
| INTERVENTION | | | | | | | | |
| Mean | 8.13 | 12.90 | -2.12 | -2.34 | -.22 | 74.26 | 75.37 | -.89 |
| StdDev | 1.78 | 1.79 | .93 | .84 | .54 | 9.97 | 8.73 | 5.34 |
| N | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 |
| TOTAL | | | | | | | | |
| Mean | 8.15 | 12.96 | -2.03 | -2.44 | -.41 | 77.14 | 74.23 | -2.92 |
| StdDev | 2.16 | 1.86 | .95 | .84 | .62 | 10.11 | 8.77 | 6.20 |
| N | 117 | 117 | 117 | 117 | 117 | 117 | 117 | 117 |

# TABLE 5

% IDEAL CALORIES, PROTEIN, AND PROTEIN QUALITY: BASELINE AND FINAL

| TREATMENT GROUP | INITIAL FOOD %IDEAL CALORIES | FINAL FOOD %IDEAL CALORIES | INITIAL FOOD %IDEAL PROTEIN | FINAL FOOD %IDEAL PROTEIN | INITIAL FOOD %POOR QUALITY PROTEIN | FINAL FOOD %POOR QUALITY PROTEIN | INITIAL FOOD %GOOD QUALITY PROTEIN | FINAL FOOD %GOOD QUALITY PROTEIN |
|---|---|---|---|---|---|---|---|---|
| CONTROL | | | | | | | | |
| Mean | 13.77 | 12.09 | 14.80 | 11.15 | 37.76 | 74.31 | 42.24 | 25.69 |
| StdDev | 13.43 | 8.53 | 15.55 | 9.83 | 46.78 | 35.15 | 46.78 | 35.15 |
| N | 55 | 55 | 55 | 55 | 44 | 47 | 44 | 47 |
| % EATING | 72.7% | 85.5% | 72.7% | 85.5% | 72.7% | 89.4% | 47.7% | 48.9% |
| INTERVENTION | | | | | | | | |
| Mean | 16.34 | 19.83 | 17.42 | 20.13 | 63.90 | 69.57 | 36.10 | 29.09 |
| StdDev | 19.60 | 13.12 | 28.77 | 9.95 | 44.18 | 20.79 | 44.18 | 20.63 |
| N | 62 | 62 | 62 | 62 | 57 | 62 | 57 | 62 |
| % EATING | 67.7% | 100.0% | 67.7% | 100.0% | 80.7% | 100.0% | 42.1% | 85.5% |
| TOTAL | | | | | | | | |
| Mean | 15.13 | 16.19 | 16.19 | 15.91 | 61.23 | 71.61 | 38.77 | 27.62 |
| StdDev | 16.97 | 11.81 | 23.44 | 10.83 | 45.21 | 27.85 | 45.21 | 27.74 |
| N | 117 | 117 | 117 | 117 | 101 | 109 | 101 | 109 |
| % EATING | 70.1% | 93.2% | 70.1% | 93.2% | 77.2% | 95.4% | 44.6% | 69.7% |

# TABLE 6

CHANGE IN NUMBER OF SEVERELY MALNOURISHED
CHILDREN FROM BASELINE TO FINAL
(Weight for Age Z-Score)

TREATMENT:

McNemar Test

SEVCAT1 SEVERE INITIAL WAZ*
with SEVCAT5 SEVERE FINAL WAZ*

| | | SEVCAT5 2.00 | SEVCAT5 1.00 | TREATMENT | |
|---|---|---|---|---|---|
| SEVCAT1 | 1.00 | 6 | 46 | Cases | 62 |
| | 2.00 | 7 | 3 | (Binomial) 2-Tailed P | .5078 |

CONTROL

McNemar Test

SEVCAT1 SEVERE INITIAL WAZ
with SEVCAT5 SEVERE FINAL WAZ

| | | SEVCAT5 2.00 | SEVCAT5 1.00 | CONTROL | |
|---|---|---|---|---|---|
| SEVCAT1 | 1.00 | 14 | 36 | Cases | 55 |
| | 2.00 | 5 | 0 | (Binomial) 2-Tailed P | .0001 |

*SEVCAT1, SEVCAT5:

Category "1"= Greater or equal to -3 standard deviations (Weight for Age Z-Score)

Category "2"= Less than -3 standard deviations (Weight for Age Z-Score)

# TABLE 7

CHANGE IN WEIGHT FOR AGE Z-SCORE
FROM BASELINE TO FINAL
FOR TREATMENT VS CONTROL

ZDIFCAT WAZ CHANGE CATEGORY by GRPIC TREATMENT GROUP

| ZDIFCAT | Count / Row Pct / Col Pct | GRPIC .00 CONTROL | GRPIC 1.00 INTERVENTION | Row Total |
|---|---|---|---|---|
| 0 OR > | .00 | 7<br>24.1<br>12.7 | 22<br>75.9<br>35.5 | 29<br>24.8 |
| <0 TO-0.5 | 1.00 | 16<br>39.0<br>29.1 | 25<br>61.0<br>40.3 | 41<br>35.0 |
| <-0.5 TO-1 | 2.00 | 22<br>64.7<br>40.0 | 12<br>35.3<br>19.4 | 34<br>29.1 |
| <-1 | 3.00 | 10<br>76.9<br>18.2 | 3<br>23.1<br>4.8 | 13<br>11.1 |
| | Column Total | 55<br>47.0 | 62<br>53.0 | 117<br>100.0 |

| Chi-Square | Value | DF | Si |
|---|---|---|---|
| Pearson | 16.09340 | 3 | |
| Likelihood Ratio | 16.69236 | 3 | |
| Mantel-Haenszel | 15.55242 | 1 | |

Minimum Expected Frequency - 5.111

## TABLE 8

*** A N A L Y S I S  O F  V A R I A N C E ***

| | | |
|---|---|---|
| | WAZT5 | FINAL WEIGHT Z-SCORE |
| by | GRPIC | TREATMENT GROUP |
| with | AGEAT1 | AGE AT INTERV |
| | WAZT1 | INITIAL WEIGHT Z-SCORE |
| | MWATLOS | WATERLOSS ILLNESS |
| | MRESP | RESPIRATORY ILLNESS |
| | LWEALTH | LOG WEALTH SCALE |
| | MEDCATH | MOTHER'S EDUCATION CATEGORY |
| | ENDCALI | FINAL % TOTAL REQUIREMENT FOR CALORIES-SUPPLEMENTARY FOOD |

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 59.818 | 7 | 8.545 | 49.934 | .000 |
| AGEAT1 | 1.442 | 1 | 1.442 | 8.410 | .005 |
| WAZT1 | 39.007 | 1 | 39.007 | 227.477 | .000 |
| MWATLOS | 3.815 | 1 | 3.815 | 22.250 | .000 |
| MRESP | 1.305 | 1 | 1.305 | 7.610 | .007 |
| LWEALTH | .796 | 1 | .796 | 4.643 | .033 |
| MEDCATH | .435 | 1 | .435 | 2.537 | .114 |
| ENDCALI | .040 | 1 | .040 | .232 | .631 |
| Main Effects | 4.185 | 1 | 4.185 | 24.405 | .000 |
| GRPIC | 4.185 | 1 | 4.185 | 24.405 | .000 |
| Explained | 64.003 | 8 | 8.000 | 46.655 | .000 |
| Residual | 18.520 | 108 | .171 | | |
| Total | 82.523 | 116 | .711 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

*** M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S ***

Grand Mean = -2.44

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -.12 | | -.24 | |
| 1 INTERVENTION | 62 | .11 | | .21 | |
| | | | .14 | | .27 |
| Multiple R Squared | | | | .276 | |
| Multiple R | | | | .881 | |

## TABLE 9

*** A N A L Y S I S  O F  V A R I A N C E ***

| | | |
|---|---|---|
| | WAZT5 | FINAL WEIGHT-FOR-AGE Z-SCORE |
| by | GRPIC | TREATMENT GROUP |
| with | AGEAT1 | INITIAL AGE IN MONTHS |
| | WAZT1 | INITIAL WEIGHT-FOR-AGE Z-SCORE |
| | MWATLOS | WATERLOSS ILLNESS-MEAN # DAYS SICK |
| | MRESP | RESPIRATORY ILLNESS-MEAN # DAYS SICK |
| | LWEALTH | LOG OF WEALTH SCALE |
| | MEDCATH | MOTHER'S EDUCATION LEVEL |

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 59.779 | 6 | 9.963 | 57.402 | .000 |
| AGEAT1 | 1.425 | 1 | 1.425 | 8.211 | .005 |
| WAZT1 | 39.044 | 1 | 39.044 | 224.952 | .000 |
| MWATLOS | 3.804 | 1 | 3.804 | 21.918 | .000 |
| MRESP | 1.350 | 1 | 1.350 | 7.775 | .006 |
| LWEALTH | .883 | 1 | .883 | 5.087 | .026 |
| MEDCATH | .591 | 1 | .591 | 3.4 05 | .066 |
| Main Effects | 3.826 | 1 | 3.826 | 22.041 | .000 |
| GRPIC | 3.826 | 1 | 3.826 | 22.041 | .000 |
| Explained | 63.604 | 7 | 9.086 | 52.351 | .000 |
| Residual | 18.919 | 109 | .174 | | |
| Total | 82.523 | 116 | .711 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

*** M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S ***

Grand Mean = -2.44

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -.12 | | -.21 | |
| 1 INTERVENTION | 62 | .11 | | .19 | |
| | | | .14 | | .24 |
| Multiple R Squared | | | | .771 | |
| Multiple R | | | | .878 | |

## TABLE 10

* * * A N A L Y S I S  O F  V A R I A N C E * * *

| | | |
|---|---|---|
| | KIDWTTS | WEIGHT AT FINAL |
| by | GRPIC | TREATMENT GROUP |
| with | RNDAGETI | AGE AT ENTRIAL |
| | KIDWTTI | WEIGHT AT ENTRIAL |
| | MWATLOS | WATER LOSS |
| | MRESP | RESPIRATORY |
| | LWEALTH | LOG WEALTH SCALE |
| | MEDCATR | MOTHER'S EDUCATION CATEGORY |

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 65.055 | 6 | 10.841 | 53.369 | .000 |
| RNDAGETI | 3.918 | 1 | 3.918 | 19.282 | .000 |
| KIDWTTI | 49.647 | 1 | 49.647 | 244.303 | .000 |
| MWATLOS | 1.761 | 1 | 1.761 | 8.666 | .004 |
| MRESP | .321 | 1 | .321 | 1.580 | .211 |
| LWEALTH | .523 | 1 | .523 | 2.571 | .112 |
| MEDCATR | .878 | 1 | .878 | 4.318 | .040 |
| Main Effects | 2.417 | 1 | 2.417 | 11.892 | .001 |
| GRPIC | 2.417 | 1 | 2.417 | 11.892 | .001 |
| Explained | 67.482 | 7 | 9.640 | 47.438 | .000 |
| Residual | 22.151 | 109 | .203 | | |
| Total | 89.632 | 116 | .773 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 7.43

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -.12 | | -.17 | |
| 1 INTERVENTION | 62 | .10 | | .15 | |
| | | | .13 | | .18 |

Multiple R Squared .753
Multiple R .868

## TABLE 11

* * * A N A L Y S I S  O F  V A R I A N C E * * *

| | | |
|---|---|---|
| | WAPWTS | FINAL PERCENT MEDIAN WEIGHT-FOR-AGE |
| by | GRPIC | TREATMENT GROUP |
| with | RNDAGETI | INITIAL AGE IN MONTHS |
| | WAPWTI | INITIAL PERCENT MEDIAN WEIGHT-FOR-AGE |
| | MWATLOS | WATERLOSS ILLNESS-MEAN # DAYS SICK |
| | MRESP | RESPIRATORY ILLNESS-MEAN # DAYS SICK |
| | LWEALTH | LOG OF WEALTH SCALE |
| | MEDCATR | MOTHER'S EDUCATION LEVEL |

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 6510.263 | 6 | 1085.044 | 58.362 | .000 |
| RNDAGETI | 50.788 | 1 | 50.788 | 2.732 | .101 |
| WAPWTI | 4239.758 | 1 | 4239.758 | 228.045 | .000 |
| MWATLOS | 388.081 | 1 | 388.081 | 20.874 | .000 |
| MRESP | 98.991 | 1 | 98.991 | 5.324 | .023 |
| LWEALTH | 120.141 | 1 | 120.141 | 6.462 | .012 |
| MEDCATR | 58.224 | 1 | 58.224 | 3.132 | .080 |
| Main Effects | 380.890 | 1 | 380.890 | 20.487 | .000 |
| GRPIC | 380.890 | 1 | 380.890 | 20.487 | .000 |
| Explained | 6891.153 | 7 | 984.450 | 52.951 | .000 |
| Residual | 2026.499 | 109 | 18.592 | | |
| Total | 8917.652 | 116 | 76.876 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 74.23

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -1.29 | | -2.03 | |
| 1 INTERVENTION | 62 | 1.16 | | 1.86 | |
| | | | .14 | | .23 |

Multiple R Squared .773
Multiple R .879

## TABLE 12

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
          ENDCALI  FINAL FOOD %IDEAL CALORIES
     by   GRPIC    TREATMENT GROUP
with      RNDAGEYI INITIAL AGE IN MONTHS
          BEGCALI  INITIAL FOOD %IDEAL CALORIES
          MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
          MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
          LWEALTH  LOG OF WEALTH SCALE
          MEDCATR  MOTHER'S EDUCATION LEVEL
```

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 4358.218 | 6 | 726.368 | 7.924 | .000 |
| RNDAGEYI | 116.756 | 1 | 116.756 | 1.274 | .262 |
| BEGCALI | 1635.406 | 1 | 1635.406 | 17.840 | .000 |
| MWATLOS | 11.519 | 1 | 11.519 | .126 | .724 |
| MRESP | 59.815 | 1 | 59.815 | .653 | .421 |
| LWEALTH | 200.608 | 1 | 200.608 | 2.188 | .142 |
| MEDCATR | 1016.919 | 1 | 1016.919 | 11.093 | .001 |
| Main Effects | 1815.805 | 1 | 1815.805 | 19.808 | .000 |
| GRPIC | 1815.805 | 1 | 1815.805 | 19.808 | .000 |
| Explained | 6174.815 | 7 | 882.002 | 9.622 | .000 |
| Residual | 9991.553 | 109 | 91.669 | | |
| Total | 16165.969 | 116 | 139.362 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 16.19

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -4.18 | | -4.55 | |
| 1 INTERVENTION | 62 | 3.64 | | 4.05 | |
| | | | .33 | | .36 |

Multiple R Squared .382
Multiple R .618

## TABLE 13

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
          ENDCALM  FINAL FOOD %MAINTENENCE CALORIES
     by   GRPIC    TREATMENT GROUP
with      RNDAGEYI INITIAL AGE IN MONTHS
          BEGCALM  INITIAL FOOD %MAINTENENCE CALORIES
          MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
          MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
          LWEALTH  LOG OF WEALTH SCALE
          MEDCATR  MOTHER'S EDUCATION LEVEL
```

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 5382.159 | 6 | 897.026 | 5.233 | .000 |
| RNDAGEYI | 67.447 | 1 | 67.447 | .393 | .532 |
| BEGCALM | 2775.067 | 1 | 2775.067 | 16.189 | .000 |
| MWATLOS | 168.963 | 1 | 168.963 | .986 | .323 |
| MRESP | 53.136 | 1 | 53.136 | .310 | .579 |
| LWEALTH | 156.248 | 1 | 156.248 | .912 | .342 |
| MEDCATR | 1036.784 | 1 | 1036.784 | 6.048 | .015 |
| Main Effects | 2908.835 | 1 | 2908.835 | 16.970 | .000 |
| GRPIC | 2908.835 | 1 | 2908.835 | 16.970 | .000 |
| Explained | 8290.994 | 7 | 1184.428 | 6.910 | .000 |
| Residual | 18684.221 | 109 | 171.415 | | |
| Total | 26975.215 | 116 | 232.545 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 21.87

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -5.21 | | -5.76 | |
| 1 INTERVENTION | 62 | 4.62 | | 5.11 | |
| | | | .32 | | .36 |

Multiple R Squared .387
Multiple R .554

## TABLE 14

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
EMALCALE FINAL BMILKEFOOD %IDEAL CALORIES
by GRPIC   TREATMENT GROUP
with BMDAGETI INITIAL AGE IN MONTHS
     MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
     MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
     LWEALTH  LOG OF WEALTH SCALE
     MEDCATR  MOTHER'S EDUCATION LEVEL
     BALCALE  INITIAL BMILKEFOOD %IDEAL CALORIES
```

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 6568.124 | 6 | 1094.687 | 11.368 | .000 |
| BMDAGETI | 691.541 | 1 | 691.541 | 7.182 | .009 |
| MWATLOS | 5.844 | 1 | 5.844 | .061 | .806 |
| MRESP | 140.609 | 1 | 140.609 | 1.460 | .230 |
| LWEALTH | 260.917 | 1 | 260.917 | 2.710 | .103 |
| MEDCATR | 795.138 | 1 | 795.138 | 8.260 | .005 |
| BALCALE | 1725.696 | 1 | 1725.696 | 17.921 | .000 |
| Main Effects | 2124.277 | 1 | 2124.277 | 22.061 | .000 |
| GRPIC | 2124.277 | 1 | 2124.277 | 22.061 | .000 |
| Explained | 8692.401 | 7 | 1241.772 | 12.896 | .000 |
| Residual | 10495.891 | 109 | 96.293 | | |
| Total | 19188.292 | 116 | 165.416 | | |

```
117 cases were processed.
0 cases (.0 pct) were missing.
```

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 51.34

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -4.58 | | -4.92 | |
| 1 INTERVENTION | 62 | 4.06 | | 4.36 | |
| | | | .34 | | .36 |
| Multiple R Squared | | | | | .453 |
| Multiple R | | | | | .673 |

## TABLE 15

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
EMALCALM FINAL BMILKEFOOD %MAINTENENCE CALORIES
by GRPIC   TREATMENT GROUP
with BMDAGETI INITIAL AGE IN MONTHS
     MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
     MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
     LWEALTH  LOG OF WEALTH SCALE
     MEDCATR  MOTHER'S EDUCATION LEVEL
     BALCALM  INITIAL BMILKEFOOD %MAINTENENCE CALORIES
```

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 9433.109 | 6 | 1572.185 | 7.460 | .000 |
| BMDAGETI | 375.081 | 1 | 375.081 | 1.780 | .185 |
| MWATLOS | 681.236 | 1 | 681.236 | 3.233 | .075 |
| MRESP | 62.612 | 1 | 62.612 | .297 | .587 |
| LWEALTH | 10.175 | 1 | 10.175 | .048 | .826 |
| MEDCATR | 286.937 | 1 | 286.937 | 1.362 | .246 |
| BALCALM | 6225.355 | 1 | 6225.355 | 29.541 | .000 |
| Main Effects | 2248.915 | 1 | 2248.915 | 10.672 | .001 |
| GRPIC | 2248.915 | 1 | 2248.915 | 10.672 | .001 |
| Explained | 11682.024 | 7 | 1668.861 | 7.919 | .000 |
| Residual | 22970.484 | 109 | 210.738 | | |
| Total | 34652.508 | 116 | 298.729 | | |

```
117 cases were processed.
0 cases (.0 pct) were missing.
```

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 69.81

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -5.02 | | -5.08 | |
| 1 INTERVENTION | 62 | 4.45 | | 4.50 | |
| | | | .27 | | .28 |
| Multiple R Squared | | | | | .337 |
| Multiple R | | | | | .581 |

## TABLE 16

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
          ENDPROI  FINAL FOOD %IDEAL PROTEIN
     by   GRPIC    TREATMENT GROUP
     with RNDAGETI INITIAL AGE IN MONTHS
          BEGPROI  INITIAL FOOD %IDEAL PROTEIN
          RWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
          RRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
          LWEALTH  LOG OF WEALTH SCALE
          MEDCATR  MOTHER'S EDUCATION LEVEL
```

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 2778.992 | 6 | 463.165 | 5.934 | .000 |
| RNDAGETI | 396.188 | 1 | 396.188 | 5.076 | .026 |
| BEGPROI | 585.937 | 1 | 585.937 | 7.507 | .007 |
| RWATLOS | 167.381 | 1 | 167.381 | 2.145 | .146 |
| RRESP | .891 | 1 | .891 | .011 | .915 |
| LWEALTH | 421.318 | 1 | 421.318 | 5.398 | .022 |
| MEDCATR | 464.805 | 1 | 464.805 | 5.945 | .016 |
| Main Effects | 2321.384 | 1 | 2321.384 | 29.742 | .000 |
| GRPIC | 2321.384 | 1 | 2321.384 | 29.742 | .000 |
| Explained | 5100.296 | 7 | 728.614 | 9.335 | .000 |
| Residual | 8507.286 | 109 | 78.048 | | |
| Total | 13607.582 | 116 | 117.307 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 15.91

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -4.76 | | -5.14 | |
| 1 INTERVENTION | 62 | 4.22 | | 4.56 | |
| | | | .42 | | .45 |

Multiple R Squared .375
Multiple R .612

## TABLE 17

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
          ENDPROM  FINAL FOOD %MAINTENENCE PROTEIN
     by   GRPIC    TREATMENT GROUP
     with RNDAGETI INITIAL AGE IN MONTHS
          BEGPROM  INITIAL FOOD %MAINTENENCE PROTEIN
          RWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
          RRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
          LWEALTH  LOG OF WEALTH SCALE
          MEDCATR  MOTHER'S EDUCATION LEVEL
```

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 4261.715 | 6 | 710.286 | 4.853 | .000 |
| RNDAGETI | 1074.291 | 1 | 1074.291 | 7.340 | .008 |
| BEGPROM | 1131.200 | 1 | 1131.200 | 7.729 | .006 |
| RWATLOS | 561.225 | 1 | 561.225 | 3.835 | .053 |
| RRESP | 27.931 | 1 | 27.931 | .191 | .663 |
| LWEALTH | 416.527 | 1 | 416.527 | 2.846 | .094 |
| MEDCATR | 448.176 | 1 | 448.176 | 3.062 | .083 |
| Main Effects | 4176.904 | 1 | 4176.904 | 28.540 | .000 |
| GRPIC | 4176.904 | 1 | 4176.904 | 28.540 | .000 |
| Explained | 8438.618 | 7 | 1205.517 | 8.237 | .000 |
| Residual | 15952.478 | 109 | 146.353 | | |
| Total | 24391.096 | 116 | 210.268 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 21.53

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | [illegible] | -6.33 | | -6.89 | |
| 1 INTERVENTION | 62 | 5.61 | | 6.11 | |
| | | | .41 | | .45 |

Multiple R Squared .346
Multiple R .588

## TABLE 18

* * * A N A L Y S I S  O F  V A R I A N C E * * *

ENALPROI FINAL SMILKEFOOD %IDEAL PROTEIN
by GRPIC TREATMENT GROUP
with RNDAGETI INITIAL AGE IN MONTHS
RWATLOS WATERLOSS ILLNESS-MEAN % DAYS SICK
RRESP RESPIRATORY ILLNESS-MEAN % DAYS SICK
LWEALTH LOG OF WEALTH SCALE
MEDCATR MOTHER'S EDUCATION LEVEL
BALPROI INITIAL SMILKEFOOD %IDEAL PROTEIN

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 2398.527 | 6 | 399.754 | 5.631 | .000 |
| RNDAGETI | 289.829 | 1 | 289.829 | 2.956 | .088 |
| RWATLOS | 98.444 | 1 | 98.444 | 1.274 | .252 |
| RRESP | 1.057 | 1 | 1.057 | .015 | .903 |
| LWEALTH | 329.330 | 1 | 329.330 | 4.639 | .033 |
| MEDCATR | 632.839 | 1 | 632.839 | 8.913 | .004 |
| BALPROI | 484.998 | 1 | 484.998 | 5.785 | .019 |
| Main Effects | 1790.233 | 1 | 1790.233 | 25.217 | .000 |
| GRPIC | 1790.233 | 1 | 1790.233 | 25.217 | .000 |
| Explained | 4188.760 | 7 | 598.394 | 8.429 | .000 |
| Residual | 7738.298 | 109 | 70.994 | | |
| Total | 11927.058 | 116 | 102.819 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 42.21

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -4.68 | | -4.55 | |
| 1 INTERVENTION | 62 | 3.55 | | 3.99 | |
| | | | .37 | | .42 |
| Multiple R Squared | | | | | .35 |
| Multiple R | | | | | .593 |

## TABLE 19

* * * A N A L Y S I S  O F  V A R I A N C E * * *

ENALPROM FINAL SMILKEFOOD %MAINTENENCE PROTEIN
by GRPIC TREATMENT GROUP
with RNDAGETI INITIAL AGE IN MONTHS
RWATLOS WATERLOSS ILLNESS-MEAN % DAYS SICK
RRESP RESPIRATORY ILLNESS-MEAN % DAYS SICK
LWEALTH LOG OF WEALTH SCALE
MEDCATR MOTHER'S EDUCATION LEVEL
BALPROM INITIAL SMILKEFOOD %MAINTENENCE PROTEIN

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| Covariates | 3915.336 | 6 | 652.556 | 4.304 | .001 |
| RNDAGETI | 1478.775 | 1 | 1478.775 | 9.754 | .002 |
| RWATLOS | 875.670 | 1 | 875.670 | 5.776 | .018 |
| RRESP | 40.679 | 1 | 40.679 | .268 | .606 |
| LWEALTH | 51.044 | 1 | 51.044 | .337 | .563 |
| MEDCATR | 230.670 | 1 | 230.670 | 1.522 | .220 |
| BALPROM | 1534.484 | 1 | 1534.484 | 10.122 | .002 |
| Main Effects | 2573.070 | 1 | 2573.070 | 16.972 | .000 |
| GRPIC | 2573.070 | 1 | 2573.070 | 16.972 | .000 |
| Explained | 6488.405 | 7 | 926.915 | 6.114 | .000 |
| Residual | 16524.972 | 109 | 151.605 | | |
| Total | 23013.377 | 116 | 198.391 | | |

117 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 57.48

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| GRPIC | | | | | |
| 0 CONTROL | 55 | -4.70 | | -5.40 | |
| 1 INTERVENTION | 62 | 4.17 | | 4.79 | |
| | | | .32 | | .36 |
| Multiple R Squared | | | | | .282 |
| Multiple R | | | | | .531 |

6

## TABLE 20

```
O          * * * A N A L Y S I S   O F   V A R I A N C E * * *

                ENDTOGOD FINAL FOOD %GOOD QUALITY PROTEIN
          by    GRPIC    TREATMENT GROUP
        with    RNDAGET1 INITIAL AGE IN MONTHS
                BETOGOD  INITIAL FOOD %GOOD QUALITY PROTEIN
                MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
                MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
                LWEALTH  LOG OF WEALTH SCALE
                MEDCATR  MOTHER'S EDUCATION LEVEL
O
                                  Sum of                    Mean              Sig
 Source of Variation            Squares   DF              Square     F       of F
OCovariates                    19139.030    6            3189.838  6.431    .000
    RNDAGET1                     941.269    1             941.269  1.898    .172
    BETOGOD                      232.490    1             232.490   .469    .495
    MWATLOS                       56.067    1              56.067   .113    .737
    MRESP                        244.551    1             244.551   .493    .484
    LWEALTH                     1570.209    1            1570.209  3.182    .078
    MEDCATR                    13278.076    1           13278.076 26.772    .000
OMain Effects                   3957.821    1            3957.821  7.979    .006
    GRPIC                       3957.821    1            3957.821  7.979    .006
OExplained                     23096.851    7            3299.550  6.652    .000
OResidual                      45136.419   91             496.009
OTotal                         68233.270   98             696.258
O
 117 cases were processed.
 18 cases (15.4 pct) were missing.

  * * * M U L T I P L E   C L A S S I F I C A T I O N   A N A L Y S I S * * *

                ENDTOGOD FINAL FOOD %GOOD QUALITY PROTEIN
          by    GRPIC    TREATMENT GROUP
        with    RNDAGET1 INITIAL AGE IN MONTHS
                BETOGOD  INITIAL FOOD %GOOD QUALITY PROTEIN
                MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
                MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
                LWEALTH  LOG OF WEALTH SCALE
                MEDCATR  MOTHER'S EDUCATION LEVEL
O
 Grand Mean =    26.60                                  Adjusted for
                                                        Independents
                                      Unadjusted        + Covariates
 Variable + Category            N     Dev'n  Eta       Dev'n   Beta
OGRPIC
     0 CONTROL                 42     -4.45            -8.33
     1 INTERVENTION            57      3.28             6.14
                                                 .19              .27
OMultiple R Squared                                              .338
 Multiple R                                                      .582
```

## TABLE 21

```
O          * * * A N A L Y S I S   O F   V A R I A N C E * * *

                ENDTOPOR FINAL FOOD %POOR QUALITY PROTEIN
          by    GRPIC    TREATMENT GROUP
        with    RNDAGET1 INITIAL AGE IN MONTHS
                BETOGOD  INITIAL FOOD %GOOD QUALITY PROTEIN
                MWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
                MRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
                LWEALTH  LOG OF WEALTH SCALE
                MEDCATR  MOTHER'S EDUCATION LEVEL
O
                                  Sum of                    Mean              Sig
 Source of Variation            Squares   DF              Square     F       of F
OCovariates                    19184.235    6            3197.372  6.374    .00
    RNDAGET1                     419.848    1             419.848   .837    .36
    BETOGOD                      256.283    1             256.283   .511    .477
    MWATLOS                      236.271    1             236.271   .471    .494
    MRESP                        191.551    1             191.551   .382    .538
    LWEALTH                     2379.011    1            2379.011  4.742    .032
    MEDCATR                    11767.076    1           11767.076 23.457    .000
OMain Effects                   4250.907    1            4250.907  8.474    .005
    GRPIC                       4250.907    1            4250.907  8.474    .005
OExplained                     23435.142    7            3347.877  6.674    .000
OResidual                      45650.132   91             501.650
OTotal                         69085.274   98             704.952
O
 117 cases were processed.
 18 cases (15.4 pct) were missing.

  * * * M U L T I P L E   C L A S S I F I C A T I O N   A N A L Y S I S * * *

O
 Grand Mean =    72.96                                  Adjusted for
                                                        Independents
                                      Unadjusted        + Covariates
 Variable + Category            N     Dev'n  Eta       Dev'n   Beta
OGRPIC
     0 CONTROL                 42      5.29             8.63
     1 INTERVENTION            57     -3.90            -6.36
                                                 .17              .28
OMultiple R Squared                                              .339
 Multiple R                                                      .582
```

## TABLE 22

```
TEMPORARY
SELECT IF (HOMEDCAT EQ 0)
```

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
          ENDPROI  FINAL FOOD %IDEAL PROTEIN
     by   GRPIC    TREATMENT GROUP
     with RNDAGETI INITIAL AGE IN MONTHS
          BEGPROI  INITIAL FOOD %IDEAL PROTEIN
          RWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
          RRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
          LWEALTH  LOG OF WEALTH SCALE
```

0

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| OCovariates | 1347.465 | 5 | 269.493 | 4.489 | .001 |
| RNDAGETI | 223.839 | 1 | 223.839 | 3.247 | .075 |
| BEGPROI | 337.516 | 1 | 337.516 | 4.896 | .029 |
| RWATLOS | 192.867 | 1 | 192.867 | 2.798 | .098 |
| RRESP | 116.959 | 1 | 116.959 | 1.697 | .196 |
| LWEALTH | 524.442 | 1 | 524.442 | 7.607 | .007 |
| OMain Effects | 1879.141 | 1 | 1879.141 | 27.258 | .000 |
| GRPIC | 1879.141 | 1 | 1879.141 | 27.258 | .000 |
| OExplained | 3426.606 | 6 | 571.101 | 8.284 | .000 |
| OResidual | 6618.179 | 96 | 68.939 | | |
| OTotal | 10044.785 | 102 | 98.478 | | |

0

103 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 14.93

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| OGRPIC | | | | | |
| 0 CONTROL | 46 | -5.28 | | -5.23 | |
| 1 INTERVENTION | 57 | 4.24 | | 4.22 | |
| | | | .48 | | .48 |
| OMultiple R Squared | | | | | .341 |
| Multiple R | | | | | .584 |

## TABLE 23

```
TEMPORARY
SELECT IF (HOMEDCAT EQ 0)
```

* * * A N A L Y S I S  O F  V A R I A N C E * * *

```
          ENDCALI  FINAL FOOD %IDEAL CALORIES
     by   GRPIC    TREATMENT GROUP
     with RNDAGETI INITIAL AGE IN MONTHS
          BEGCALI  INITIAL FOOD %IDEAL CALORIES
          RWATLOS  WATERLOSS ILLNESS-MEAN % DAYS SICK
          RRESP    RESPIRATORY ILLNESS-MEAN % DAYS SICK
          LWEALTH  LOG OF WEALTH SCALE
```

0

| Source of Variation | Sum of Squares | DF | Mean Square | F | Sig of F |
|---|---|---|---|---|---|
| OCovariates | 1182.213 | 5 | 236.443 | 3.363 | .008 |
| RNDAGETI | 50.901 | 1 | 50.901 | .724 | .397 |
| BEGCALI | 753.421 | 1 | 753.421 | 10.715 | .001 |
| RWATLOS | 47.924 | 1 | 47.924 | .682 | .411 |
| RRESP | 4.547 | 1 | 4.547 | .065 | .800 |
| LWEALTH | 315.427 | 1 | 315.427 | 4.486 | .037 |
| OMain Effects | 1207.077 | 1 | 1207.077 | 17.167 | .000 |
| GRPIC | 1207.077 | 1 | 1207.077 | 17.167 | .000 |
| OExplained | 2389.290 | 6 | 398.215 | 5.663 | .000 |
| OResidual | 6750.027 | 96 | 70.313 | | |
| OTotal | 9139.317 | 102 | 89.601 | | |

0

103 cases were processed.
0 cases (.0 pct) were missing.

* * * M U L T I P L E  C L A S S I F I C A T I O N  A N A L Y S I S * * *

Grand Mean = 14.86

| Variable + Category | N | Unadjusted Dev'n | Unadjusted Eta | Adjusted for Independents + Covariates Dev'n | Adjusted for Independents + Covariates Beta |
|---|---|---|---|---|---|
| OGRPIC | | | | | |
| 0 CONTROL | 46 | -4.30 | | -4.18 | |
| 1 INTERVENTION | 57 | 3.47 | | 3.37 | |
| | | | .41 | | .40 |
| OMultiple R Squared | | | | | .261 |
| Multiple R | | | | | .511 |

# APPENDIX II

## SUPPLEMENTARY FOOD INTAKE

## AND

## GROWTH OF WEANING AGE INFANTS

Prepared by Laurine Brown, MPH, RD
June 1989

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# RELATIONSHIP OF SUPPLEMENTARY FOOD INTAKE TO GROWTH OF WEANING AGE INFANTS

## I. THE WEANING DILEMMA

In developing countries, the practice of predominant breastfeeding provides a partial buffer for the newborn to environmental threats to health, allowing the infant's defense mechanisms to mature while providing a top nutritional quality diet. However, most outgrow their undernourished mother's capacity to produce adequate quantities of milk after 3-4 months (Waterlow, 1979), and breastmilk substitutes are usually offered. This, transitional period brings a package of risks, including: potential substitution of breastmilk with a poor nutrient quality food; bacterial contamination of the food, resulting in diarrhea; and a requirement for more complex feeding behaviors and skills, for both the caretaker (usually mother) and the child. Some have labeled this the period of the "weanling dilemma" (Rowland 1978) --choice of being undernourished at the breast or infected from external sources of food. At the same time, the mobile child begins to actively explore his, often, highly contaminated environment, further increasing his risks for infection. The challenge remains, under the adverse environmental conditions in each culture, of finding the balance between beneficial and hazardous feeding practices.

To prevent the growth faltering characteristic in this age group, the theoretic solutions appear to be to: 1) introduce supplementary foods to the infant's diet; 2) increase production of mother's milk; or 3) provide better protection from infections (Brown 1986).

Underwood (1982) provides an excellent review of the weaning issues for breastfed infants in developing countries; The reader is referred to this for a more thorough discussion about the causes of the weaning child's growth failure, the advantages and disadvantages of early vs late introduction of supplementary foods, and examples of studies from a variety of developing countries. This report complements the Underwood review, summarising additional research on weaning food supplementation to the breastfeeding child's diet after 4-6 months.

## II. GROWTH FALTERING AND BREASTMILK ADEQUACY

The growth faltering trends of infants are similar in most developing countries, despite very different cultural practices regarding the duration of breastfeeding, timing of introduction of supplemental food, the quality and quantity of food given, and the method of feeding. Most infants, if breastfed, grow well up until the third or fourth month, when growth begins to

falter from international norms (Waterlow 1979 and 1980, Underwood 1982 and 1985). The poor growth continues through the first year, and on into the second year (see Figures 1 and 2). Waterlow and Rutishauser (1974) compared the growth of weight and height in three longitudinal studies in very different environments--The Gambia, Jamaica, and Uganda. The rate of growth of all three groups had begun to decline sharply by 3 months. Mata (1978, 1975) reports a similar trend in Guatemalan children, with growth in the first 3-4 months approximating the reference standard, and growth faltering beginning at 4-5 months. Brown (1986) found growth faltering in 29%, 48%, 79%, and 92% of children in semi-urban Bangladesh by 2, 3, 4, and 5 months of age, respectively. A rural study found 90% of girls and boys to weigh less than the NCHS 5th percentile by 8 and 15 months, respectively (Brown 1982).

Table 1 (from Waterlow 1980) compares observed intakes of breastmilk, with the volumes needed, on average, to fulfill theoretical requirements for energy and protein from the 2nd month of life onwards (assuming growth at the 25th percentile of international standards, [WHO 1983]). Energy becomes limiting first; the protein requirement will just be met even in the 6th month. The estimates suggest that, although on average, the intake is adequate in the 3rd month, breastmilk will often be inadequate by the 4th month. Under more favorable circumstances, exclusive breastfeeding can meet the infant's needs for 4 to 6 months (Wallgren 1944-45, Evans 1978, Ahn 1980, Whitehead 1980), thus this is recommended as an achievable target. Whether it is possible for a well nourished woman, under favorable conditions, to produce enough breastmilk to support normal infant growth past the 6th month is not clear, as few women in affluent countries do so in practice (many reporting they stopped breastfeeding because of inadequate milk). Nearly all children, even in affluent societies, will falter in growth after 6 months unless additional food is given (Waterlow 1980). Thus, the "grey area" of justifying the need for complementary foods to breastmilk, is in infants between 3-6 months.

Some may argue that many of children in developing countries are born low birth weight, due to intrauterine deprivation, so should not be expected to grow at the same rate as a well nourished normal birth weight infant (Waterlow 1980). Table 2 illustrates estimates of the prevalence of low birth weight in several Asian countries, along with breastfeeding and undernutrition prevalence (from UNICEF in Baumslag 1988). Others suggest that after the first month, birth weight has very little effect on the increment in weight (Mata 1978). Another common argument is that the international standards may not be appropriate for breastfed infants, having been developed from a sample of primarily formula fed infants (Wallgren 1944-45). However, many studies have disputed this claim, showing healthy breastfed infants grow similar to formula fed infants (Evans 1978, Whitehead 1985). While a debate continues around the exact requirement for energy and protein, and the perfect

FIGURE I

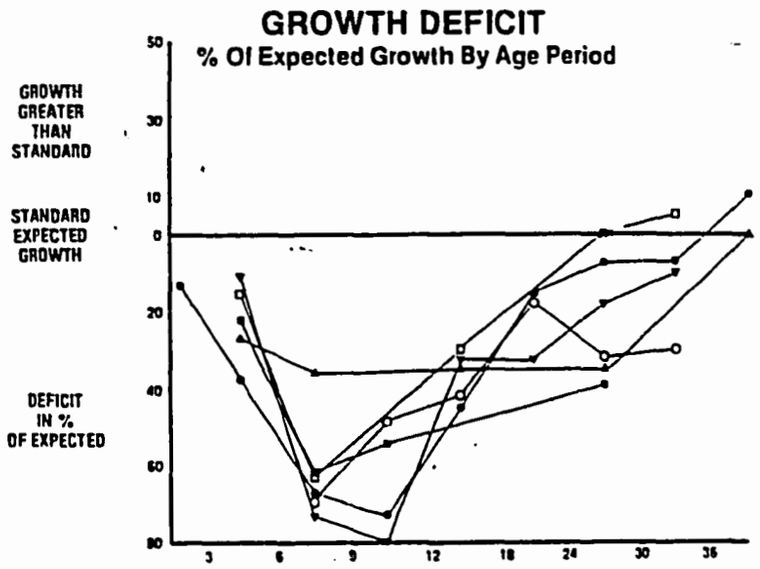



Fig. 2. Maximum growth faltering occurs in the age group 4 to 12 months. Data drawn from the same sample.

FIGURE 2

PREVALENCE OF MALNUTRITION

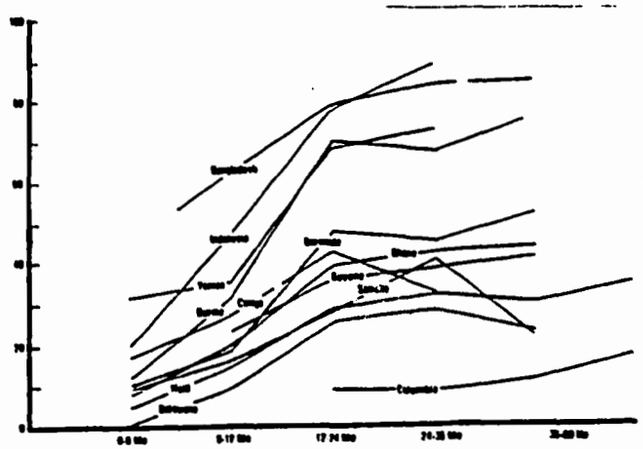


Fig. 1. Prevalence (%) of malnutrition (less than 80% weight/age) at different ages in various countries. It is maximum in the age-group 2-4 years.

In Rhohde et al, Indian Jour Ped 55(Suppl):S110-S123, 1988.

TABLE I —AVERAGE OUTPUT OF BREAST MILK COMPARED WITH CALCULATED VOLUMES NEEDED TO MEET PROTEIN AND ENERGY REQUIREMENTS

| Age interval (months) | Mean interval body-weight (kg)* | Milk output (ml/day)† | Volume (ml)/day needed to meet requirement: | |
|---|---|---|---|---|
| | | | For protein‡ | For energy§ |
| 1–2 | 4·2 | 685 | 628 | 684 |
| 2–3 | 4·95 | 774 | 674 | 744 |
| 3–4 | 5·65 | 810 | 735 | 826 |
| 4–5 | 6·3 | 820 | 777 | 897 |
| 5–6 | 6·9 | 820 | 798 | 940 |

*NAS standard,[5] 25th centile weight, boys; †from Wallgren;[19] ‡from table I, "protein" of breast-milk taken as 1·2 g/dl; §from table II, "energy" of breast-milk taken as 70 kcal/dl.

In Waterlow et al, Lancet 1980.

TABLE 2: ASIA/NEAR EAST SELECTED STATISTICS, 1980-86

| | PERCENT BREASTFEEDING, 1980-86 | | | INFANT MORTALITY | PERCENT LOW BIRTH RATE 1982-85 | PERCENT CHILDREN UNDER 5 SUFFERING FROM MALNUTRITION | | TOTAL FERTILITY |
|---|---|---|---|---|---|---|---|---|
| | 3 Months | 6 Months | 12 Months | | | Moderate | Severe | |
| **ASIA** | | | | | | | | |
| Bangladesh | 98 | 97 | 89 | 123 | 50 | 63 | 21 | 5.8 |
| Burma | 90 | 90 | 90 | 66 | 20 | 50 | ... | 3.9 |
| Fiji | ... | ... | ... | 28 | ... | ... | ... | 3.3 |
| India | ... | ... | ... | 103 | 30 | 33 | 5 | 3.9 |
| Indonesia | 98 | 97 | 83 | 78 | 14 | 27 | 3 | 3.7 |
| Nepal | 99 | 99 | 97 | 132 | ... | 30 | 5 | 5.6 |
| Pakistan | 78 | 73 | 67 | 113 | 27 | 60 | 10 | 3.5 |
| Papua | ... | ... | 67 | 25 | 38 | ... | 5.4 | ... |
| Philippines | 66 | 58 | 28 | 47 | 18 | 18 | 4 | 4.1 |
| Thailand | 48 | 47 | 20 | 43 | 12 | 27 | ... | 3 |
| Sri Lanka | 83 | 74 | 48 | 35 | 25 | ... | ... | 3.1 |
| **NEAR EAST** | | | | | | | | |
| Egypt | ... | 91 | 84 | 91 | 9 | 40 | 5 | 4.6 |
| Jordan | 70 | 52 | 25 | 48 | 7 | ... | ... | 7.3 |
| Morocco | 95 | 61 | ... | 88 | 9 | 40 | 5 | 4.6 |
| Tunisia | 95 | 92 | 71 | 77 | 7 | 60 | 4 | 4.4 |
| Yemen | 80 | 76 | 55 | 126 | 9 | 54 | 4 | 6.8 |

1986 data in: UNICEF, State of the World's Children, 1987. In Baumslaug, 1988.

standard for growth (Scrimshaw 1976, WHO 1985, Rand 1984), it is clear that many children living in developing countries fall well below even minimal standards for adequacy. The high mortality and morbidity statistics confirm this (UNICEF 1988).

## III. EXTENDED DURATION OF BREASTFEEDING AND INFANT GROWTH

How long should women continue to breastfeed for the nutritional benefits to their child? Despite the high nutritional quality of breastmilk, are there disadvantages to continuing breastfeeding, say, beyond the first year, even when supplementary foods are given?

The relationship of extended breastfeeding duration and malnutrition has been explored in some studies. Underwood (1982) presents more discussion of this. Researchers in Ghana found that breasfeeding for more than a year was associated with malnutrition and that complete weaning, within weeks, resulted in almost a two fold increase in energy intake. They recommended that breastfed infants who are resistant to eating supplemental food be weaned at 12 months (Michaelsen 1988). However, Briend (1988) studied severely undernourished children in Bangladesh, and found lower mortality up to age 3 years in those children who were breastfed, although among better nourished children, there was a slightly higher risk of death. In Mali, mothers reported children ate much more when weaned completely, and many showed improved growth after complete weaning (Dettwyler 1987).

Data from Botswana found malnutrition was more prevalent among children 12-17 months who had been on breastmilk only--probably due to insufficient energy intake. Above 18 months, more malnutrition was found among those still being partially breastfed. Poverty, however, was not controlled for. In Brazil, the prevalence of malnutrition was smallest for those breastfed for 3-6 months, but after this age, nutritional status appeared to be worse in those breastfed longer (Victora 1983).

Some of these studies elude to the 'breast addiction' syndrome, which theorizes that the breast acts as a pacifier for the child (Guldan and Zeitlin 1988). The child, kept close to his mother around the clock, suckles often, possibly receiving just enough milk to satiate him, but not to sustain normal growth. He prefers the suckling, with the closeness it offers to his mother, over the more foreign eating skills and independence required for other foods. What these studies don't sort out is why the child is "addicted". Indeed, when a child is sickly, he often regresses in feeding skills, reverting back to his mother's familiar and comfortable breast. For example, observational data from Bangladesh illustrated undernourished children suckled more frequently (Guldan 1988). The causal relationship could also be the inverse of what Briend (1988)

suggests in his research--that undernutrition and illness leads to exclusive breastfeeding, simply because of the child's preference, and lack of energy to explore other foods.

Certainly in situations of exteme poverty, where the traditional adult diet is nutritionally inadequate to support child growth, complete weaning after one year could prove disastrous to the health of the weaning age child, whose only good quality protein source (among other essential nutrients) is from breastmilk.

## IV. MATERNAL FACTORS AND BREASTMILK QUANTITY

In general, breastmilk outputs of women in developing countries are lower than in industrialized countries (most of the latter studies are from European women). The poor nutritional status of the mother limits her breastmilk quality and quantity (Underwood 1982, Waterlow 1980, Jelliffe 1978, Jelliffe 1979, Rao 1959, Gopalan 1961, Bailey 1965, Bassir 1959, Brown 1986). The fat and energy concentrations of the breastmilk have been shown to be significantly less for mothers with smaller tricep skin folds or arm circumference measurements. Also, changes within individual women in nutritional status are related to changes in the amount of milk produced, and all major nutrients.

The low dietary intakes of lactating women in many countries, contribute to their poor nutritional status and low milk production. Lactating women in urban slums of India (Manjrekar 1985) were reported to consume only 1109 to 1540 kcals/day. This intake was not associated with adequate growth in all infants. Hira (1988) found Indian women consuming 60.5-74.8% of their requirement for energy and 72-90% of their protein requirement. Other countries have found similarly low intakes.

What is an adequate dietary intake for a lactating mother; that is, what intake will assure adequate growth of her infant, while maintaining her own health? Deriving this answer is not easy--even if we just consider energy--and complicating attempts to determine maternal dietary requirements are a number of individual maternal variations (size, activity, adaptability) and infant factors (size, sucking ability, illness). However, putting all these aside for simplicity sake, the estimated energy need for a moderately active, small-in-stature, non-pregnant, non-lactating woman is approximately 1800 kcals/day. Lactation adds an additional 500 kcals to the daily requirement in the first 6-12 months, or up to 700 additional kcals/day if energy needs during pregnancy were not met, for a total of approximately 2300-2500 kcals/day (WHO 1985). Dietary intakes of many women in developing countries do not even approach these intakes. To complicate the situation more, in the second year, a new pregnancy is often superimposed on the already nutritionally taxed lactating mother, adding additional

nutrient needs. In Bangladesh, 50% of pregnant women continued to breastfeed through the sixth month of pregnancy (Huffman 1980). All three--the lactating, pregnant mother with a short intraconceptual period, the unborn child, and the one year old--are at nutritional risk.

In tropical and subtropical countries, seasonal differences in food availability and the incidence of certain infections affect maternal nutritional status with the leanest periods resulting in decreased milk production (Brown 1986, Huffman 1980, Chowdhury 1987, Hassan 1985). In agricultural societies, this is often just before the harvest. The worsening of the mother's nutritional status, complemented with decreased infant suckling time during harvest (in countries where the women are involved in the harvest), results in decreased breastmilk consumption by the infants, and slower growth rates (Huffman 1980). Seasonal fluctuations in child nutritional status have also been documented from various countries in Asia (Brown 1982, Chen 1979, Bairagi 1980, Taylor 1978, Bangladesh Burea of Statistics 1987), Africa (Rowland 1977, Tomkins 1986) and Latin America (Trowbridge 1979).

Often women know they will produce more milk if they eat a "good" diet, however, economic factors may limit their access to adequate quantity and quality of food (Brown 1988). Can supplementation (in the form of food handouts) of mothers' diets help increase breastmilk outputs? Results have been mixed. In many cases it was not clear whether the mother actually consumed the food. Studies in the Gambia have shown that supplementation of mothers' diets resulted in increased dietary intake, weight, and fat, but did not result in increased milk production (Endozian 1976, Prentice 1980). In a metabolic unit, protein supplementation (from 25-50 to 100 grams/day) of Nigerian mothers with energy adequate diets lead to increased milk production and increased infant growth, suggesting, under controlled conditions it is possible to increase breastmilk supplies (Endozian 1976). Gopalan (1958) found a 20% increase in milk yield when protein intake was increased from 61 grams/day to 100 grams/day, but daily output was still only 500 milliliters/day. Thus, the potential for improved breastmilk outputs is real, but the conditions in deprived environments continue to dictate insufficient quantities of breastmilk to support normal growth in the older infant.

## V. INTRODUCTION OF COMPLEMENTARY FOODS AND GROWTH

Infant feeding practices "within" a country, among different cultural or socioeconomic groups, can vary as much as "between" country differences (Haaga 1987). In addition, infant feeding practices, within a given culture are not static, being constantly subjected to the dynamics of change in "styles" (Van Esterik 1986, Conton 1985), even in the most remote villages in the world.

Baumslag (1988) summarized some feeding characteristics in several Asian countries. Many offer milk (condensed, powder, or fresh) as a first food. In addition, non-milk supplements are given in Thailand to 58% of infants by two to three months. In Pakistan, in one study, 18% of infants under one month were given buffalo or goat milk, weak tea, chapati soaked in ghee, seminola, pulse soups, wheat porridge, or khir. In Nepal a pablum-like rice water paste of ghee and sugar is given. In Bangladesh diluted rice or wheat paste, biscuits, and bananas are offered at six months. In Indonesia, mashed banana and rice are given in the first month. One third of Filipino infants receive supplements by two to three months. On other continents: in rural Peru, soups, puddings, and cereal gruels are given from 4-6 months (Marquis 1986). In St Kitts-Nevis, nearly all children have received a bottle, with evaporated milk or infant formula, by 6 months; cereal and porridge are added next. Sixty percent of children 4-6 months in Zaire are receiving solid corn gruels with powdered milk being offered in the earlier months (Gussler 1983).

After an exhaustive review of differences in weaning practices and infant growth outcomes, Underwood (1982) concluded there is no specific time for which complementary feeding is universally shown to have positive short- or long-term effects, but most evidence suggests that complementing before 2-3 months, or later than 6 months has more costs than benefits for the underprivileged infant. The ambiguity of the findings between 3 and 6 months is attributed to the lack of rigorous accounting for variable degrees of morbidity, nutritional contribution of unknown amounts of the food complement to total infant needs, influence of seasonal variables on lactational performance, and other independent contributing factors. Underwood (1982) presents examples from Pakistan, India, New Guinea, Guatemala, Nigeria, and Mexico where supplements were provided to children, from an external source, before 6 months. Only the Indian, and Mexican study showed significant differences (positive) in growth of the children; however, in the Indian study, when the complement was withdrawn at 6 months, the growth rate dropped.

While the question remains of whether to introduce supplemental foods between 3-6 months, it is clear in most cases that additional foods are necessary at least by 6 months. However, the question arises: given the poor, unsanitary conditions in many countries, will the supplementation, in reality, be more beneficial, or more harmful, than breastfeeding alone? Will the supplement (often of poor nutrient quality) displace breastmilk, thus, actually reducing the child's nutritient intake and nutritional status further? Is the potential for contamination of the complementary food with harmful micro-organisms so great, especially in the tropical moist environments, that the morbidity from increased diarrhea will negate any positive effects from the additional energy, protein, and other nutrients. Some feel these risks out-weigh the risks of introducing complementary foods later, but the argument is still hotly debated (Anonymous, Swedish Code of

Ethics 1977). Certainly, all these issues are a major consideration before widescale promotion of weaning foods is undertaken.

Whitehead (1985) suggests that the concern of a reduction in breastmilk quantity with the introduction of supplementary food is greatly over-rated. The concern stems from observations of mothers from Western countries who breastfeed only 5-6 times daily (not the 12-20 times encountered among babies fed on demand in developing countries) and "substitute" other foods for a breastfeeding; thus, their milk output immediately drops by about 150 ml/day, the average size of a single feeding. In the Gambia, breastmilk intakes were reported not to decrease with the addition of supplementary food intake; the researchers hypothesize the reason is because they were still breastfeeding 12-20 times daily (Rowland 1980). Khan (1984) studied rural Bangladesh children, who were either breastfeeding or breastfeeding with additional homemade supplements. The average weights of the children who were breastfed only were not significantly different from those who were breastfed and were receiving supplements. Thus the supplementation did not appear to be harmful, nor helpful. What is not answered is what the growth of the supplemented infants would have been had they not been given additional foods, as often the reason for supplementing is because the mother feels her milk is not enough (Brown 1988, Waterlow 1980). Possibly the supplements helped the infants maintain the same growth rates as those infants whose mothers had more adequate supplies of milk.

In a study in a metabolic unit in India (Pasricha 1973), where breastfeeding infants between 6 months to 2 years were fed a "bulky, home-type" (sanitary) diet, the mean intakes of breastmilk declined after supplementary food was given, particularly in children over 12 months. It is not known whether these children consumed the supplementary food before, or after consuming breastmilk. However, the increased intake of supplementary food far exceeded the reduction in energy and protein resulting from lowered breastmilk intake, and the children grew at ideal rates. Two other very important findings can be derived from this study: first, in this ideal setting, the young children were able to consume enough "bulky" foods, along with breastmilk, to promote ideal weight gain (17 grams/day, or 0.4 kg in 23 days); the second important finding, highlights the limitations of the realities of the home...the mothers in the study remarked that their children ate considerably larger amounts of food than at home, primarily because of their having more time to look after and feed the child, without the demands of other domestic duties. While they realized dividing the food up into several meals was beneficial to the child, many could not cook 4 times a day (fuel and time limitations); if the food were prepared only once and stored, the bacterial contamination would be a concern. Thus the extent to which these practices are feasible in the home setting is not known, but the mothers' response points to a yet, undiscussed, but very critical issue in child undernutrition--the

mother/child interaction, and the dynamics of the domestic setting. Feeding issues are discussed in brief in a following section.

The composition of the supplementary food may affect the growth response. A study in Brazil (Victora 1984) found breastfeeding children who were given dry skim milk supplements gained more weight than breastfed children who were given beans. However, if not breastfed, the reverse was true. They suggested it may be beneficial to bottle-feed children beyond 6 months. Given the poor sanitation in many countries, this recommendation would have to be rigorously tested before implemented. In addition, financial barriers often limit the infant feeding choices. In many cultures, milk (in various forms--condensed, powdered, fresh) is a desirable first food (Baumslaug 1988), but often not affordable; if given, it is often diluted. Infant formula, in some cultures, is considered a "super food" (Van Esterik 1986), but the cost is prohibitive to many poor families. In addition, cultural principles and taboos around infant feeding are common (Millard 1985, Israel 1983, Rizvi 1979), but the extent to which they are followed varies considerably.

Most studies do show an increase in diarrheal rates with the introduction of supplementary foods (Manjrekar 1985, Chen 1983), but there is no clear answer on whether the additional food helped to "close the nutrient gap", despite the risks of diarrhea. K. Brown (personal communication, 1989), in some unpublished data from Bangladesh, found that, while "non-breastmilk" calories in infants were associated with increased diarrhea, growth was still better than for those children only receiving breastmilk. A temporary change in the frequency and consistency of bowel movements is expected with the introduction of a more complex diet to the infant who has only received breastmilk. However, a common, and more detrimental cause of a change in bowel movements in many developing countries results from environmental contaminants. This issue is discussed in more detail in the following section.

## VI. INFECTIOUS ILLNESS AS A CAUSE OF GROWTH FAILURE

What role does infectious illness play in the poor growth of infants? Some hypothesize it is a critical determinant (Walsh 1979, Scrimshaw 1, Martorell 1975, Rowland 1977, Black 1984, Matta 1977). Diarrheal disease is a major cause of death in poor societies, but the effects on morbidity are even greater (Chen 1983). Investigators world-wide have found diarrheal incidence peaking between 6 months and 3 years with annual rates between 2 to 12 episodes/year, averaging 4/year (Chen 1983, Mata 1967, Mata 1979, Rohde 1978, Rohde 1976). In the Gambia, diarrheal disease was estimated to cause half the observed growth deficit (1.2 kg) by 1 year of age, and lower respiratory tract infection (LRTI) one fourth (Rowland 1988). LRTI decreased weight gain by 14.7 gms/day of illness and diarrhea

decreased weight gain by 14.4 gms/day. LRTI had a greater negative impact on growth per day of illness, decreasing weight gain by 14.7 gms/sick day compared with 14.4 gms/sick day with diarrhea. However, because diarrhea was present for so many days (15.8% of the time) the overall impact of diarrhea on growth was greater.

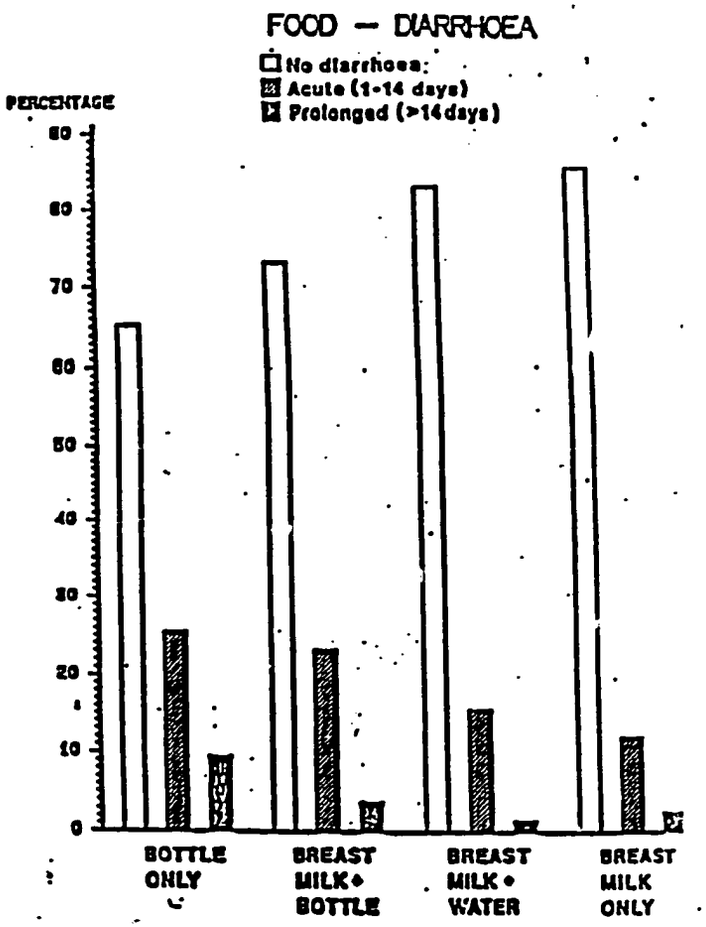
Interestingly, the researchers found the diarrhea in exclusively breastfed children had almost no impact on growth, while that in weaned children was four times greater (3.6 gms/day vs 14.4 gms/day). The difference was not due to less diarrhea--possibly the causes were different, or as Northrup (1988) suggests, the breastfed children suckled frequently and actually consumed more nutrients. Growth velocity was normal, despite continued infection in the second year. Other research describes a protective effect of breastmilk, even when breastmilk substitutes are given. Figure 3 illustrates such a trend using data from Lahore, Pakistan (Hanson 1986). However, the protective effect of breastmilk suggested here does not appear to hold after 6 months, in many settings (Thoren 1988, Michaelsen 1988) (see Figure 4).

Black (1984) found that diarrhea in Bangladesh children had a significant inverse relationship with short term (2 months) increments of weight, and, over the long term (one year), length. Children with no diarrhea grew .42 cm more each year than children with 12.8% prevalence of diarrhea. The impact of different kinds of diarrhea varied--E.coli had a significant negative effect on bimonthly weight gain and annual linear growth, and shigellosis had the strongest negative effect.

While frequent diarrheal episodes can cause undernutrition, (Black 1984, Cherian 1985) undernutrition is thought to predispose the child to the risk of more frequent illness, including diarrhea, due to lowered resistance. Anorexia resulting in reduced food intake often complements the frequent illness and undernutrition (Kielmann 1978, Chen 1980). Thus a viscious cycle of infection/malnutrition is established. A recent study in Mexico (Sepulveda 1988) of children under age 2, suggests that malnourished children had 60% greater risk of diarrhea than normally nourished children, even after adjusting for SES, sanitation, and demographic variables. Others have found only an increase in duration of diarrhea, not incidence (Black, 1984).

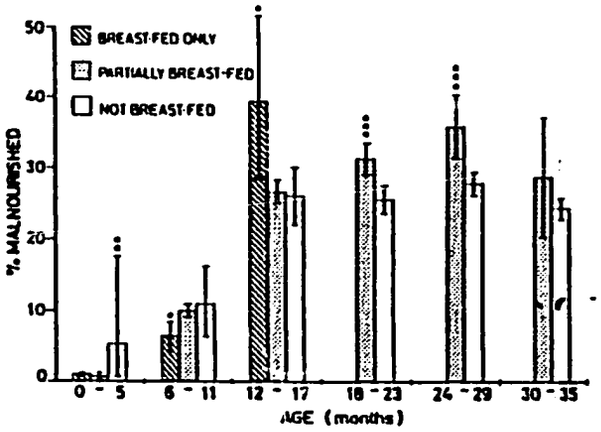
In any case, diarrheal disease, and possibly some other illnesses, appear to play a major role in the extent of growth failure observed in young children in developing countries.

Figure 3




In Hanson et al, 1986.

Figure 4




—Percentage of malnourished children according to breastfeeding status and age.

32 children above age 18 months being breast-fed only are excluded. Adjacent columns are compared by chi-squared test (95% confidence intervals shown by bars); $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Hatched columns = breast-fed only; stippled columns = partly breast-fed; open columns = not breast-fed.

In Michaelsen, Lancet 1988.

## VII. CONTAMINATION OF WEANING FOODS AS A CAUSE OF DIARRHEA

Some researchers believe it is better to undergo the risk of moderate marasmus from underfeeding than to be introduced too early to supplementary foods (Anonymous, Swedish Code of Ethics 1977). Are weaning foods really the potential culprits of the weanling diarrhea, or is the increased diarrhea noted simply due to an inevitable process of bowel adaptation?

Studies of the contamination of weaning foods have been done in the Gambia (Rowland 1978), and in Bangladesh (Black 1982). In a longitudinal study in Bangladesh, researchers found that 41% of food samples fed to weaning age children contained E.coli (indicator of fecal contamination). Foods and milk prepared specially for infants were more frequently heavily contaminated than the family rice (Black 1982). The concentration of E.coli was related to the storage of cooked food at high environmental temperatures, and the E.coli concentration was significantly related to the child's annual incidence of diarrhea associated with enterotoxigenic E.coli, but not from other pathogens, such as rotavirus or shigella.

Rowland (1978), in the Gambia, also found supplemental gruels, from start to finish, were frequently contaminated with potential pathogenic micro-organisms. They found both the raw dry ingredients and the water (especially in the rainy season) were contaminated. With minimal cooking, many of the organisms survived; the empty serving bowl was also contaminated. With increasing storage time, the counts of the organisms grew rapidly. Even hygienically prepared milk mixtures, after 8 hours, had very high levels of micro-organisms.

A study in Bangladesh revealed some potential dangers in food sanitation practices (Guldan and Zeiltin 1988). Infant foods had been prepared just before the feeding in only 29% of the in-home observations, within several hours in 58% of the observations, and more than 8 hours before (the previous night) in 14% of the cases. Observations of other sanitary practices revealed that the infants' hands were cleaned before only 18% of he feedings--only 6% at 7-9 months to 41% at 25-27 months. Certainly the potential for contamination resulting in infection is a daily hazard in many countries.

## VIII. FEEDING, FOOD INTAKE, AND ILLNESS

Common illness is reported to account for much of the energy deficits in young children. The mechanisms for growth failure resulting from illness are tied to appetite and food intake, in addition to metabolic alterations. Research in Bangladesh found, regardless of the etiology of diarrhea, a 30% decrease in food intake occurred. The researchers concluded common illness decreased intakes by 40 kcals/day (18% of the

energy deficit). When healthy children became sick, intakes decreased by 131 kcals/day. When sick children became healthy, intakes increased by 139 kcals/day, thus, the deficit was often not made up after illness. No deleterious effect of food intake on the volume or duration of diarrhea was found, though the trends varied (Molla 1983).

Hoyle (1980) found that the anorexia of illness was not overcome by intensive educational efforts--young children with acute diarrhea consumed 75 kcals/kg and .96 gms protein/kg, and those with diarrhea who received education consumed only 60.9 kcals/kg and .7 gms protein/kg. These intakes were significantly lower than those of healthy controls (129.9 kcals/kg and 1.89 gms/kg). This should come as no surprize to those who have cared for sickly children. Strategies to overcome feeding resistance or apathy in children with chronic and underlying, or frequent and acute infections are less than ideal, if non-existant. When a child is sick and growing poorly, a health professional often recommends a change in the "composition" of the food (often refused by the child), or simply blames the uneducated mother for her ignorance on how to feed her child. Little has been done to help the mother of a sick child overcome the real feeding resistance that frequently occurs, probably because it is so difficult. Interdisciplinary health teams treating undernourished children in the U.S. (using the affluent societies' terminology "failure to thrive") have begun to realize the number of feeding problems associated with undernutrition, be they causal or a result of the sickness (Pollit 1975, Pollit 1976, MDPH 1989). Feeding evaluation tools, such as the Nursing Child Assessment Tool (Barnard 1978) have enabled health professionals to begin to sort out the etiology of infant and child feeding problems in the child/mother dyad. Some observational data is available from developing countries, looking at maternal/child interactions around feeding. For example, in Bangladesh, Guldan and Zeitlin (1988) found termination of the feeding by the mother (vs by the infant) was associated with more severe malnutrition. It is clear, the dynamics of the feeding are as crucial as the composition of the feeding, and both the infant, and the caretaker play a major role, yet the problem is rarely dealt with.

In the area of feeding problems, but aside from illness, are issues of developmental delays and the effects on the feeding environment. It has been observed that if additional foods are not given at certain critical ages of development in the first year of life, feeding problems can develop. Research in affluent countries on children with "failure-to-thrive" or other feeding problems, suggests that, even in the healthy child, if the introduction of solids is delayed beyond approximately 8 months, he is often resistant, remaining addicted to liquids, and immature in oral and hand-motor feeding skills (Cronk 1982). This can be an important issue from the

issue from the second year, and on into the preschool years when the child's ability to secure food for himself may determine his share of the family pot.

Caloric deficits can also lead to decreased activity of the child, as he conserves energy for maintenance. This can hamper his mental development in addition to causing feeding indifference. Decreased activity is the first adaptation that occurs with an inadequate caloric intake, yet this compromise is rarely quantified due to extreme technical difficulties.

## IX. MATERNAL EDUCATION AND CHILD HEALTH

In recent years, much has been written about the differences in child care practices and health outcomes observed in mothers of varying education levels. Maternal education has been shown to be related to gestational month at term (Choudhury 1984), hygiene practices (Guldan 1988) and illness rates (Becker 1986), mortality (Hobcroft 1984), and feeding practices (Guldan 1988), especially the intake of animal protein (Becker 1986). The education of other household members has also been correlated to child health. For example, in Bangladesh, Becker (1986) found that children of richer or better educated parents were more likely to consume an greater variety and quantity of food (especially animal products), were less likely to be ill, and had better growth.

There is often a strong association with education and wealth, and the contributions of each to the child's health are not always teased out, with some claiming wealth is the pimary determintant. But education appears to act independently of wealth. Behrman (1984) feels the strong emphasis the World Bank places on income and health may be over-rated, suggesting more emphasis should be given to education. Research in Sri Lanka also supports this finding; Edirisingh (1986) found, whereas even in the highest expenditure class, all adult members consumed over 100% of their energy requirement, preschoolers took only 80% of their recommended intake. He suggests child malnutrition may not be solved by income alone, but by a combined effort involving non-income related factors. Bairagi (1980) found that a higher income was a relatively greater benefit to children of literate mothers than illiterate mothers in improving the child's nutritional status.

In some cases formal education actually may lead to practices detrimental to child health, such as the mother working outside the home, or adapting modern feeding behaviors, such as bottle feeding (of diluted, unsanitary milk mixtures). Edirisingh (1986) concluded that nutrition specific information was missing with the more educated mothers--these women did not possess different or better knowledge of foods for the child. Others reinforce that primarily women's access to material

resources--and to some extent their lack of knowledge about feeding of children during weaning--restrict their opportunities to ensure their children are getting adequate nutrition (Wandel 1988).

Can education programs alter nutrition practices? The results are mixed, however, often the intervention itself is poorly or inappropriately conducted (Henry 1986). Some claim income limits the ability of many poor families to put nutrition education into practice. For example, Hira (1988) found no effect of a nutrition education program on changes in food practices in India, except in the higher income classes, due to income constraints. Pinto (1985) found no significant differences in nutritional practices with pregnant Indian women, and during weaning, except for the use of green vegetables, though the women had an increased knowledge. The researchers concluded that poverty was the main reason families couldn't put the education into practice. Indeed, especially with adult diets, the cost of the additional food can be considerable to the low income family. However, income should be less of a barrier to implementation of carefully designed nutrition messages for young children, than for adults, as the quantities of food needed are much less. Other factors, such as feeding problems, time required to prepare food for and to feed an unskilled toddler, and morbidity with resulting anorexia--in addition to limited maternal knowledge--are probably much greater barriers in this age. Pregnancy, although out of the focus of this discussion, is a special case for nutrition education, surrounded often by numerous food taboos.

Unfortunately nutrition education has gotten a bad rap, some deserved, and some not (Henry 1986, Gibson 1986). Unrealistic, unachievable goals are often set, and the education programs frequently leave much to be desired, in terms of cultural awareness, sensitivity to the financial and time costs of each message. As Rohde (1988) states, "Nutrition is, frankly, a bore", requiring continuous action on a daily basis, but producing little visible "proof" of success. The education is often delivered in a non-motivating lecture format, and demands additional daily costs of both time and money of the recipient. Often the messages are not compatible with food taboos, especially with pregnancy, and to a lesser extent with lactation and infant feeding (Rizvi 1979, Rao 1985). No wonder so many programs are doomed to fail.

More creative programs, using social marketing techniques, offer encouraging findings about the potential for nutrition education to change infant/child feeding practices, and ultimately result in improved growth of the children (Griffiths 1986, Gwatkin 1980). Findings from the Indonesia nutrition education progam suggest that children whose mothers received only nutrition education grew better than those who did not receive education (Griffiths 1984). In Bangladesh, Stanton (1987) and Clemens (1987) suggest diarrhea can effectively be decreased if educational efforts focus only on a few empirically

observed behaviors, avoiding generic communication based on general principals (Northrup 1989). The same applies for nutrition education programs.

## X. SUMMARY AND CONCLUSIONS

The weanling dilemma described a decade ago (Rowland 1978) remains a dilemma, despite a larger repertoire of studies and interventions. If the dilemma were straightforward, it might be solved by a single magic bullet, as other potential child survival efforts directed at problems less interwoven into the complex social, economic and environmental web of society. The long term solution, no doubt, lies in gradual improvements in economic and social equalities, but some important conclusions for the short term can be drawn to guide future planning efforts in reducing the weaning dilemma:

- Growth faltering trends are similiar in most developing countries, despite very different feeding practices, with growth deviating from international standards by age 3-4 months.

- Introduction of weaning foods before 3 months or after 6 months is likely to be more harmful than beneficial. Between 3-6 months, the benefits are uncertain.

- The ideal duration of breastfeeding for child health is not clear, and cannot be considered out of the cultural context.

- The type of complementary food offered may affect growth rates, with high quality protein supplements being more beneficial, however, the affordability and the sanitation are major concerns. This has yet to be shown outside the clinical setting.

- Morbidity accounts for a large degree of the energy deficits of young children in developing countries.

- Innovative social marketing methods hold promising for nutrition education.

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# APPENDIX III

## "Cross-Sectional Survey of Pusthi Jibon (Nutrition for Life)"

By Azmat Ahmad and Suaib Ahmed
BRAC
June 1989

Cross - Sectional Survey of Pusthi Jibon (Nutrition life)

**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 behavioural 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 above objectives were fulfilled. The following is a short summary of the survey.

Method used for the survey:

A detailed questionaire seeking to evaluate the KAB (knowledge, attitude and behaviour) changes was constructed. Two female research workers working in 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 behavioural change.

Knowledge, Attitude and Behaviour on supplementary feeding:

Before the intervention, our data, suggested that mothers in general were willing to and often did feed their children foods other then the breast milk 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 food 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 emphasised 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 infants food. Energy enriched cereal food such as "chop chop" and more complete food like "Mishaw Khaw" 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 (VM) and community mothers (CM)) 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 emphasised that oil and fruits should be given to babies (Table: 2, Table: 4). In the intervention site more than 90% of the mothers (including VMs and CMs) claimed that they fed their babies more than 3 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. 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.

As regarding the preparation of special weaning foods, one-third of the women in the intervention site could remember the correct ingredients of "chop chop" receipe, while about 23% of the mothers could recall correctly the items in "mishaw khaw" receipe.

There were very little difference between the intervention and the 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 hands and utensils with water before cooking and feeding the baby. Almost all of the women in the trail and control site stated that they used tubewell water for cooking and washing.

Conclusion:

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 2/3) couldn't correctly recollect the receipe of the two weaning foods which we introduced to them as nutritious and cheap. This means, the majority of the mothers who were giving weaning foods were failing to give adequate nutrition to their babies. This fact doesn't suggest the failure of our intervention. The positive thing is that, roughly one-third of the women did know the correct receipes, - a situation much better than in control areas where hardly anyone knew how to make cheap and nutritions weaning food. We can hope that the situation would be made better by the "spill over' effect - if one women has the correct knowledge for preparing the weaning food and practise 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 interwined.

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%) |