J HEALTH POPUL NUTR 2005 Dec;23(4):320-330
ISSN 1606-0997 $ 5.00+0.20

Intensive Nutrition Education with or without Supplementary Feeding Improves the Nutritional Status of Moderately-malnourished Children in Bangladesh

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ABSTRACT

This prospective randomized trial was carried out to test the efficacy of a specific intervention for reducing the extent of their malnutrition and to change behaviour of mothers relating to child-feeding practices, care-giving, and health-seeking practices under the Bangladesh Integrated Nutrition Project (BINP). The study was conducted in rural Bangladesh among 282 moderately-malnourished (weight-for-age between 61% and 75% of median of the National Center for Health Statistics standard) children aged 6-24 months. Mothers of the first intervention group received intensive nutrition education (INE group) twice a week for three months. The second intervention group received the same nutrition education, and their children received additional supplementary feeding (INE+SF group). The comparison group received nutrition education from the community nutrition promoters twice a month according to the standard routine service of BINP. The children were observed for a further six months. After three months of interventions, a significantly higher proportion of children in the INE and INE+SF groups improved (37% and 47% respectively) from moderate to mild or normal nutrition compared to the comparison group (18%) ($p<0.001$). At the end of six months of observation, the nutritional status of children in the intervention groups improved further from moderate to mild or normal nutrition compared to the comparison group (59% and 86% vs 30%, $p<0.0001$). As the intensive nutrition education and supplementation given were highly effective, more children improved from moderate malnutrition to mild or normal nutritional status despite a higher incidence of morbidity. The frequency of child feeding and home-based complementary feeding improved significantly ($p<0.001$) in both the intervention groups after three months of interventions and six months of observation. Body-weight gain was positively associated with age, length-for-age, weight-for-length, frequency of feeding of *khichuri*, egg, and potato ($p<0.05$). Ability of mothers to identify malnutrition improved from 15% to 99% in the INE group and from 15% to 100% in the INE+SF group, but reduced from 24% to 21% in the comparison group. Use of separate feed pots, frequency of feeding, and cooking of additional complementary feeds improved significantly in the INE and INE+SF groups compared to the comparison group after three months of interventions and six months of observation. It can be concluded from the findings of the study that intensive nutrition education significantly improves the status of moderately-malnourished children with or without supplementary feeding.

***Key words*:** Food supplementation; Nutrition education; Interventions; Infant growth; Child growth; Infant nutrition disorders; Child nutrition disorders; Anthropometry; Prospective studies; Intervention studies; Bangladesh

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INTRODUCTION

Despite taking great strides in the past few decades, child malnutrition is still a challenging health problem in Bangladesh. The global database of the World Health Organization on child growth reveals that Bangladesh has a very high prevalence of protein-energy malnutrition (1). The Child Nutrition Survey of Bangladesh 2000 showed that about 2.4% of children were severely malnourished (weight-for-age <60% of median of the National Center for Health Statistics [NCHS] standard), while about 34.7% were moderately malnourished (weight-for-age 61-75%) (2). A report of a mid-term evaluation of the Bangladesh Integrated Nutrition Project (BINP), an initiative of the Government of Bangladesh, showed that about 5% of Bangladeshi children aged less than two years were severely malnourished, 48% were moderately malnourished, 41.6% were mildly malnourished, and 4.9% were normally nourished according to Gomez classification (3).

The BINP aims at reducing malnutrition in children aged less than two years and in pregnant and lactating women (4). It runs a specific programme to provide food supplements to severely-malnourished children at the community level, which has already shown a significant reduction in severe malnutrition among children aged less than two years. Moderate-degree malnutrition in children has less-striking features and often goes unnoticed compared to severe malnutrition. In absence of interventions for moderately-malnourished children, we undertook a study to test the hypothesis that moderately-malnourished children, whose mothers receive intensive nutrition education with or without supplementary feeding for their children, would improve in nutritional status within three months compared to those of the comparison group.

MATERIALS AND METHODS

Subjects

The study included 282 moderate-degree malnourished (weight-for-age between 61% and 75% of median of the NCHS standard) children aged 6-24 months and their mothers/caregivers from 15 community nutrition centre areas in three unions of Shahrasti, a sub-district in Chandpur district in Bangladesh. The subjects were identified from the register books of the community nutrition promoters, which were provided by the BINP to keep records of body-weights from monthly growth-monitoring and promotion sessions. Most study population came from families of low socioeconomic status.

Calculation of sample size

In each community nutrition centre, about 18-20 children aged less than two years were expected to have moderate-degree malnutrition. It was assumed that there would be a 30% difference in proportion improving from moderate malnutrition in the intervention group receiving nutrition education. Using the formula $n=\{(z_\alpha+z_\beta)^2.2.pq\}/d^2$, n was 58. The sample size became 87 after adjusting for cluster effect (multiplied by a factor of 1.5). With a drop-out possibility of 10-15%, n was about 100 children in each group; so, the total sample size was 100x3=300. At the end of the study, the total sample size was 282.

Interventions

A prospective randomized trial was conducted with two intervention groups and one comparison group. The first intervention group—the intensive nutrition education (INE) group—received intensive nutrition education twice a week, and the second intervention group—the supplementary feeding (SF) group—received intensive nutrition education twice a week and supplementary feeding (8-9 g protein and 300 kcal per day from 40 g roasted and powdered rice, 20 g roasted and powdered pulse, 10 g molasses, and 6 g oil) for six days a week. The comparison group received nutrition education fortnightly from the community nutrition promoters of BINP under its usual programme activity. The intensive nutrition education was designed on the basis of food security, caring practices, and disease control. The nutrition education was also enriched by results of focus-group discussions of caregivers. All the groups received advice for referral to the local health facility for any illness. The interventions were continued for three months, and all the groups were observed for a further six months with the routine BINP activities in all three groups.

Randomization procedure

The study area covered a population of approximately 25,000. A stratified random-sampling technique was used for selecting subjects. Three of seven unions were randomly selected. Fifteen community nutrition centres were identified alternatively from the three unions to avoid contamination of the intervention methods. The comparison and intervention subjects were selected from each union. Ninety-four children in each group were selected from five community nutrition centres. Two hundred and eighty-two subjects were almost equally distributed among the three study groups. Individual child was not randomized but the children in each community nutrition centre as a group were allocated randomly to either of the three study groups according to a random number table.

Organization of field activities

The interventions were conducted during January-March 1999, and follow-up observations were made from April to September 1999. At the beginning of the study, a two-week training session was conducted for the project nutritionist, anthropologist, medical officer, and field supervisors. Locally-recruited graduate-level health assistants were also trained. A workplan was prepared for the health assistants for providing nutrition education to mothers twice weekly, collection of weekly morbidity data, weekly demonstration of preparation of complementary food, and fortnightly collection of anthropometry data. Baseline sociodemographic and anthropometric data were recorded. Data on two weekly anthropometric measurements, weekly recall for food frequency, and weekly morbidity were collected during the three months of intervention and were followed by three months of observation. Only anthropometric data were collected for a further three months beyond the first three months of the observation period.

Method of nutrition education

Groups of 10-12 mothers/caregivers of moderately-malnourished children were given training in their villages. Counselling subjects were demonstrated in posters and pictures, and leaflets were given to mothers or caregivers. Sessions were organized to increase the ability of mothers to identify moderately-malnourished children. A growth-monitoring and promotion (GMP) card was used for demonstrating the nutritional status and fortnightly weight gain or loss. The nutritionist gave training on the importance of breastfeeding, nutritional properties of food ingredients, e.g. egg, oil, vegetables, micronutrients, iodized salt, etc. Mothers were advised to allocate a separate feeding pot to quantify food for child. They discussed the importance of food security, caring practices, personal hygiene, and disease control for child nutrition.

Demonstration of diet

The procedures for preparing *khichuri*, a nutritionally-sound easy-to-prepare complementary food containing common, inexpensive, locally-available foods, were shown to mothers. Quantitative and qualitative specificities of food ingredients were emphasized to have better nutrient density. During education, mothers were requested to bring ingredients from their own sources. *Khichuri* was cooked in their presence and was fed to their children, and the benefits were explained to them.

Cooking procedure

Required amounts of rice, lentil, and oil were boiled in water in a cooking-pot. After about 10 minutes, potato, sweet pumpkin, and egg/fish/meat were also added. Green-leafy vegetables were added five minutes after boiling of rice, and the cooking-pot was then covered and cooked for about 25 minutes. After cooking, expected weight of *khichuri* was about 650 g (Table 1). Mothers were advised to cook in the morning and feed the whole amount in 5-6 servings within 12 hours. Table 1 presents the ingredients of *khichuri*.

Table 1. Ingredients of *khichuri*

Ingredient	Quantity	Cost (Tk*)
Rice	2 fistful (65 g)	0.90
Lentil	1 fistful (25 g)	1.00
Oil	5 teaspoonfuls (18.8 g)	1.00
Potato	1 medium size (50.0 g)	0.60
Egg/meat/fish	1 piece (55 g)	3.00
Onion	1 medium (17.6 g)	0.40
Pumpkin/vegetables	1 piece (26.0 g)	0.20
Garlic/ginger	½ teaspoonful (4 g)	0.10
Salt	¾ teaspoonful (3 g)	0.04
Water	4 glasses	
Total cooked volume	650 g	
Calorie	678 kcal	
Protein calorie (%)	10.6	
Total cost	7.24	

*US$ 1.00=66.00 taka

Preparation of other complementary foods at home

Usual household-cooked foods, such as boiled rice, lentil, potato, vegetables, fish, or egg as available, were thoroughly mixed with 5-6 teaspoonfuls of vegetable oil and then fed to the children 5-6 times a day. The 650 g *khichuri* provides 678 kcal of energy, which has 10.6% of protein and costs only Tk 7.24 (US$ 0.11). The mothers were shown how to prepare a supplementary food of BINP at home, which was essentially the same as given in the community nutrition centres. The ingredients included roasted rice-powder (40 g), roasted pulse-powder (20 g), molasses (10 g), and soybean oil (6 g). The ingredients were mixed with water to prepare pasty food ranging from thick to liquid according to the preference of the children.

The mothers were advised to allocate and use a separate feeding-pot for each child to ensure that a certain amount of food is given to the child everyday. Allocation of a separate feeding pot ensured the amount fed to a child. Moreover, children were seen to look for their own pots before eating. This indicates that children were also interested in eating from their own pots.

Quality-control measures

The recollected data of the project supervisor on 25% of randomly-selected cases matched those of the research assistants. Anthropometric measurement techniques were standardized every two weeks. During the interventions, an independent (external to the study) experienced nutritionist of ICDDR,B ran a quality-control programme on anthropometric measurements of all staff involved in data collection. This demonstrated as an acceptable quality. The supervisors re-checked the frequency of feeding after the day of interview in 25% of the subjects. The investigators checked the data-collection process in the field at two-weekly intervals and records of every 10th file within a week. Any discrepancy was communicated to the respective health assistant and was corrected immediately. A record of events for each subject was kept in the project office.

Focus-group discussions

At baseline, perceptions of mothers on child feeding, food taboos, caring practices, and health-seeking behaviour during illness were ascertained through focus-group discussions (5). The discussions were conducted, in two groups from each of six community nutrition centres, comprising 6-8 mothers in each group, for about two hours and were recorded using audio system. The anthropologist acted as a facilitator, while the field supervisor and health assistants helped record the discussions. Points of resistance were identified, and messages and explanations were built for necessary behaviour change communication. A nutrition-education package was developed based on the findings of focus-group discussions. Focus-group discussions were repeated after the intervention period to assess the impact of the educational intervention. Qualitative data from focus-group discussions and observations were transcribed, reduced, and coded manually.

Statistical analysis

The supervisors inspected data in the field and checked in the field office before entry into microcomputers. Consistency of data was checked using SPSS/PC+ (SPSS Inc., USA). Anthropometric data were analyzed using SPSS/PC+ and NCHS statistical packages. Data with normal distribution were compared for means using Student's *t*-test. Analysis of variance (ANOVA) was used for comparison of means among the three groups. Multiple analysis was done to compare the effects of confounding variables. In the case of non-normal distribution, non-parametric test was used. Statistical significance was accepted at a 5% probability level. The Kaplan-Meier survival analysis was done to compare the reduction of moderate malnutrition of children (weight-for-age median [WAM] <75% of median of the NCHS standard) at each time point (in each month) and after overall time period between the comparison and the intervention group.

For analysis of focus-group discussions, data were coded and analyzed manually according to Neogi (5).

RESULTS

The baseline characteristics of the study groups were comparable, except that the comparison group had a better socioeconomic status (Table 2). At the beginning of the study, all the subjects were moderately malnourished according to weight-for-age median (WAM between 61% and 75% of median of the NCHS standard). After three months of interventions, 37% of the children improved to mild malnutrition or normal nutrition with only nutrition education (INE group), and 47% improved with nutrition education and supplementary feeding (INE+SF group) compared to 18% in the comparison group ($p<0.001$, comparison vs INE, comparison vs INE +SF). After six months of observation, 59% of children in the INE group and 86% in the INE+SF group improved to have better nutritional status, whereas only 30% improved in the comparison group ($p<0.0001$, comparison vs INE, comparison vs INE+SF) (Fig. 1).

The three-month interventions were followed by three months of observation for morbidity and growth, and a further three months were observed for growth. The differences in the proportion of children remained under 75% of median of the NCHS standard over the nine-month period in different groups which was more perceivable in the Kaplan-Meier survival curve (Fig. 2). The Kaplan-Meier survival curve revealed that moderate malnutrition was reduced by 15%, 30%, and 55% in the INE group after the interval of 3, 6 and 9 months respectively. The percentages of reduction of moderate malnutrition were 30%, 42%, and 65% in the INE+SF group and 10%, 25%, and 45% in the comparison group after the same periods of interval. There were significant differences between the comparison vs education group and the comparison vs education + supplementation group.

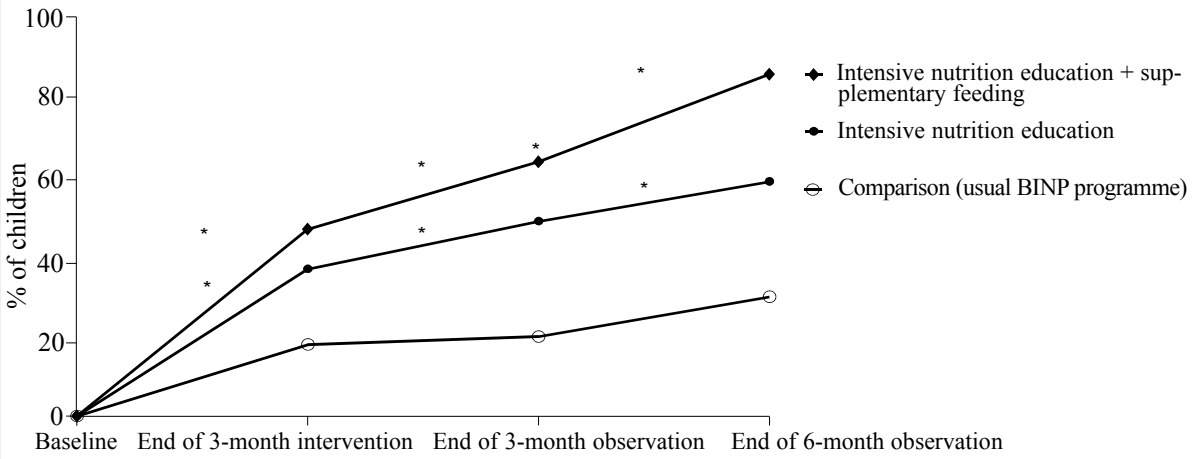
There was no statistically significant difference in the improvement of nutritional status between the INE group and the INE+SF group at any of these time points (Fig. 3). After three months of interventions, the mean weight-for-age z-score significantly improved in the intervention groups (-2.51 in INE, -2.36 in INE+SF) and in the comparison group (-2.79) ($p<0.001$, comparison vs INE, comparison vs INE+SF) compared to baseline.

Table 2. Comparison of baseline characteristics of three different study groups

Factor	INE group (n=93)	INE+SF group (n=99)	Comparison group (n=90)
Nutritional status (mean±SD)†			
Age (months) of children	14±4	14±5	15±5
Weight (kg) of subjects	7.0±.76	7.0±.81	7.0±.84
Weight-for-age median (% of NCHS median)	69±4	69±4	69±4
Weight-for-length median (% of NCHS median)	81.9±7.0	83.0±7.7	80.4±6.6
Weight-for-length z-score	-2.0±0.8	-1.9±0.9	-2.2±0.8
Length-for-age z-score	-2.2±1.1	-2.3±1.2	-2.1±1.2
Sex, no. (%)‡			
Male	35 (38)	48 (49)	41 (46)
Female	58 (62)	51 (51)	59 (54)
Occupation, no. (%)‡			
Daily labourer	23 (25)	30 (30)	26 (29)
Service-holder	27 (29)	20 (20)	24 (27)
Farmer	14 (15)	16 (16)	15 (17)
Petty trader	13 (14)	16 (16)	14 (16)
Living condition, no. (%)‡			
Kancha house	95 (96)	83 (89)	82 (91)
Semi-*pucca* house	1 (1)	4 (4)	3 (3)
Pucca house	3 (3)	6 (6)	5 (6)
Income (taka/month) of family§			
Mean income ±SD	1,748±908	1,616±1007	1,907±1,159*
Land ownership (decimal)§			
Median	30	12	18**
Range	2.0-360.0	1.0-420.0	0.0-616.0

†Compared between and within groups (one way ANOVA); ‡Chi-square test was done to compare proportion between three groups; §*t*-test, comparison vs education, comparison vs supplementation (*p<0.01, **p<0.005)
INE=Intensive nutrition education; NCHS=National Center for Health Statistics; SD=Standard deviation; SF=Supplementary feeding

Fig. 1. Proportion of study children improved by WAM above 75% of median of the NCHS standard from baseline up to end of 6-month observation



*p<0.001 (intervention vs comparison group); p=NS (education vs supplementation)
BINP=Bangladesh Integrated Nutrition Project; NCHS=National Center for Health Statistics; NS=Not significant; WAM=Weight-for-age median

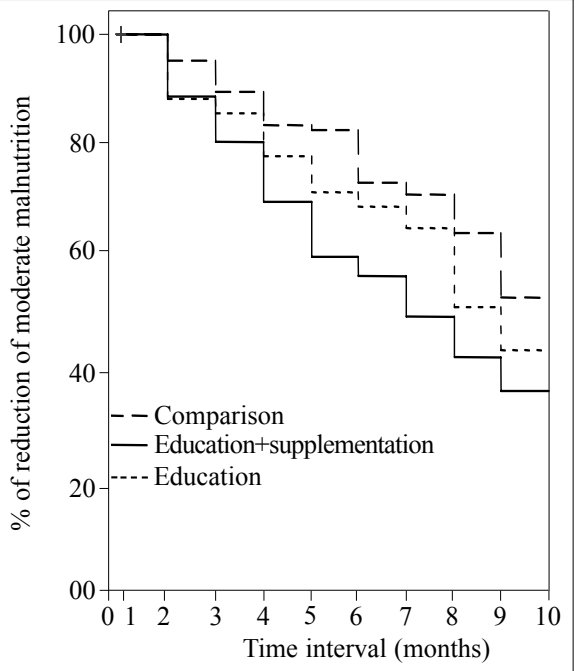
After three months of observation, the mean weight-for-age z-scores were -2.84, -2.41, and -2.15 in the comparison, INE and INE+SF groups respectively ($p<0.001$) (Fig. 3).

Table 3 shows the change in feeding behaviour of mothers over time. The mothers of the intervention groups were advised to allocate and use a separate feeding-pot for each child. This message was included in the design of counselling to ensure that a certain amount of food is given to the child everyday. It was also considered a visual reminder for the mother.

In the intervention groups, mothers used separate feeding-pots for their children more frequently compared to mothers in the comparison group. After three months of interventions, 99%, 100%, and 47% of mothers of the INE, INE+SF and comparison groups used feeding-pots respectively. After six months of observation, 100%, 100%, and 48% of mothers continued using feeding-pots in the INE, INE+SF and comparison groups respectively.

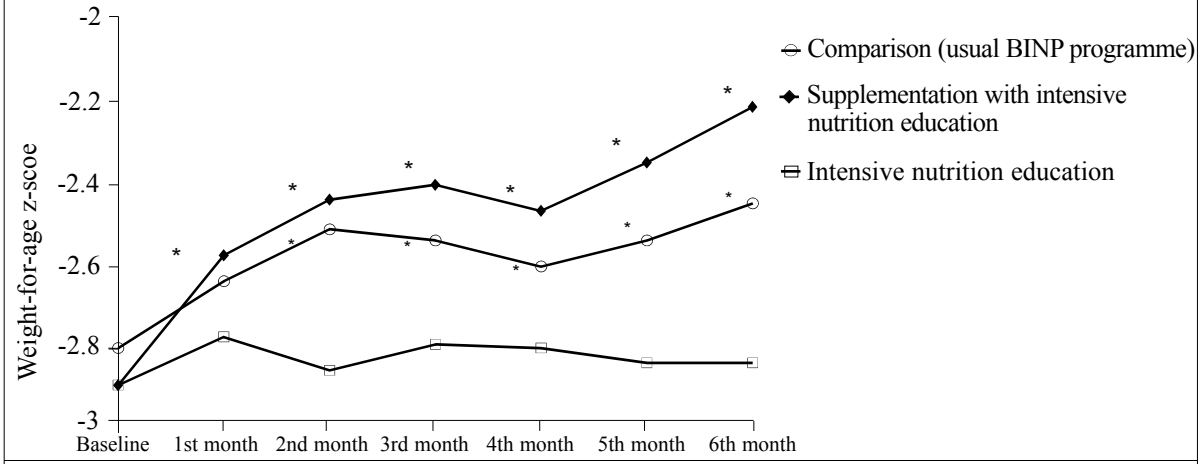
The mothers of the comparison group did not increase extra cooking of complementary food intake from baseline to the end of three months of interventions and six months of observation (6% vs 6%), but the INE and INE+SF groups improved significantly (from 1% to 76% in the INE group, and from 9% to 92% in the INE+SF group at the end of six months of observation respectively). Feeding children more than three times per day was observed in 54% of mothers in the comparison, 98% in the INE, and 99% in the INE+SF group at the end of the three months of the intervention period. Improved practice of complementary feeding continued during the six-month observation period, i.e. 58%, 97%, and 100% in the comparison, INE and INE+SF groups respectively.

Fig. 2. Kaplan-Meier survival analysis of reduction of moderately-malnourished children (WAM <75% of median of the NCHS standard)



*p<0.001, chi-square test (comparison vs education, comparison vs education + supplementation)
p=NS (education vs education + supplementation)
NCHS=National Center for Health Statistics;
WAM=Weight-for-age median

Fig. 3. Growth (weight-for-age z-score) of study children during three-month interventions and three-month observation



*p<0.001 (intervention vs control group); p=NS (education vs supplementation)
BINP=Bangladesh Integrated Nutrition Project; NS=Not significant

At the beginning, *khichuri* was given to children almost equally in the three groups (Fig. 4). Compared to the comparison group, there was an impressive rise in feeding *khichuri* to children as the main complementary food in the three-month intervention period. At the 4th, 8th and 12th weeks, 86%, 91%, and 99% of children in the INE+SF group and 66%, 74%, and 89% in the INE group respectively were fed *khichuri*. In the comparison group, the range was only 4% to 13% at the same points of time.

Table 3. Change in child-feeding behaviour of mothers after three months of interventions, followed by six months of observation

Factor	INE group		INE+SF group		Comparison group	
	No.	%	No.	%	No.	%
Use of feeding-pots by mothers						
At baseline	42	43	59	66	40	43
After 3-month interventions	92	99	99	100	42	47*
After 6-month observation	93	100	99	100	44	48*
Extra cooking of complementary food for children						
At baseline	1	1	8	9	5	6
After 3-month interventions	84	90	96	97	5	6*
After 6-month observation	71	76	91	92	5	6†
Feeding frequency of children >3 times/day						
At baseline	3	3	13	13	14	15
After 3-month interventions	97	98	89	99	50	54
After 6-month observation	90	97	99	100	52	58

*Chi-square test, $p<0.0001$ (comparison vs education, comparison vs education + supplementation); †Chi-square test, $p<0.001$ (comparison vs education, comparison vs education + supplementation)
INE=Intensive nutrition education; SF=Supplementary feeding

After controlling for the confounding variables, weight gain was positively associated with age, length-for-age, weight-for-length, frequency of feeding *khichuri*, egg, and potato. There was a negative association of weight gain with initial body-weight, weight-for-age, and diarrhoeal episodes. Education of mothers and family income were not associated with weight change (Table 4).

Table 5 shows that the incidence of diarrhoea was higher in the intervention groups than in the comparison group ($p<0.002$) during the 1st and 2nd months of interventions. More febrile episodes were seen in the supplementary feeding group than in the comparison group ($p<0.002$) in the 2nd and 3rd months of interventions, but there was significantly higher respiratory tract infection in the comparison group compared to the education ($p<0.03$) and supplementary feeding groups ($p<0.0001$) during the first two months of interventions.

Findings from focus-group discussions

Before the intervention, the mothers neither had much knowledge on complementary feeding nor recognized the need for giving more food during rapid growth of children. Significant changes in feeding practices, e.g. addition of oil and eggs in home-made complementary food were observed, and the importance of frequent feeding was recognized after the intervention. Before the intervention, some mothers firmly believed that only expensive fruits, such as grapes, apples, etc. produce blood in children. Oil and eggs were considered too strong, gas-producing, and indigestible for young children. After the intervention, their beliefs changed, and they re-directed their resources to provide low-cost nutritious foods for their children. The frequency of child feeding increased from three times per day before the intervention to 5-6 times per day after the intervention. The mothers changed their ideas and used oil, egg, and pulse as they realized that these are essential for the growth of their children. Before the intervention, some mothers thought that diseases occur by God's will, and they visited local *hekim* or traditional healers for treatment. After the intervention, they realized that diseases can be treated, and they changed their health-seeking behaviour by visiting the local health service providers.

DISCUSSION

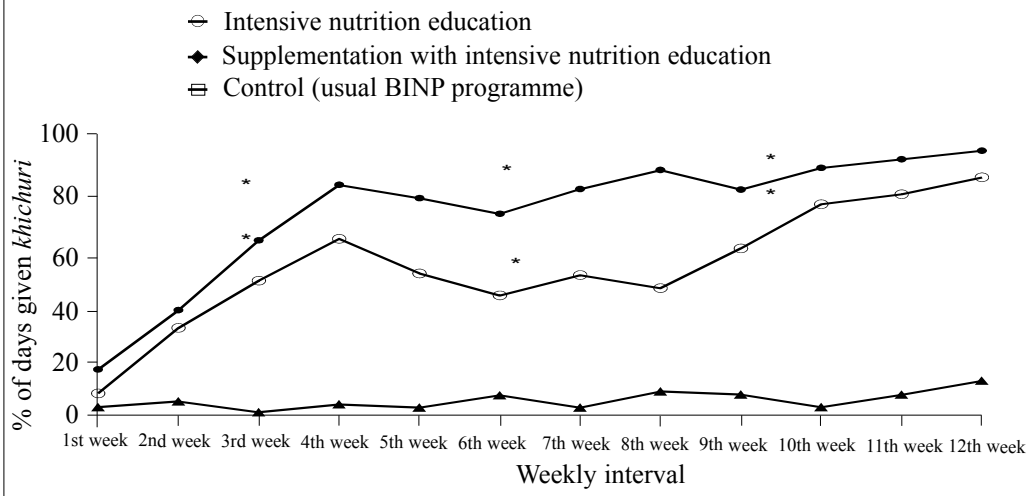
The purpose of the study was to find effective means of reducing moderate malnutrition in children through specific nutrition education at the household level. The subjects of the study were of low socioeconomic status, were at the most vulnerable age for growth faltering and

morbidity, and were at risk of malnutrition. They represent the major proportion of children in South Asia.

The results of our study showed that the nutritional status of children significantly improved in their home environment in a relatively short period, which has not been reported earlier. The group receiving both intensive nutrition education and food supplementation had better weight gain or improvement in nutritional status compared to the comparison group and the group which received only intensive nutrition education. Although the difference between INE+SF and INE was not statistically significant, the difference between the intervention groups and the comparison group was large and significant.

Food insecurity is a problem, especially among ultra-poor families (20-30% in Bangladesh). Some families of this study were very poor and could not afford adequate food. The mothers had to work and lacked the time

Fig. 4. Proportion of subjects taking *khichuri* during the intervention period by week (during 3 months of interventions)



*p<0.001 (intervention vs control group); p=NS (education vs supplementation)
BINP=Bangladesh Integrated Nutrition Project; NS=Not significant

Table 4. Determinants of cumulative weight gain (g/kg of body-weight) after observation (all children) (multiple r 0.58, r square 0.34)

Factor	Slope	SE B	p value*
Age (months)	6.72	4.81	0.16
Body-weight (kg)	-46.73	28.52	0.10
Length-for-age z-score	55.53	36.25	0.13
Weight-for-age median (% NCHS median)	-6.48	7.39	0.38
Weight-for-length median (% of NCHS median)	2.60	4.88	0.59
Intake of egg (frequency/week)	1.12	0.57	0.05
Intake of *khichuri* (frequency/week)	0.73	0.19	0.000
Intake of potato (frequency/week)	0.98	0.42	0.02
Duration (days) of fever	-0.72	0.68	0.29
Episodes (no.) of diarrhoea	-16.41	7.26	0.02
Duration (days) of diarrhoea	0.45	0.79	0.56
Episodes (no.) of respiratory distress	-11.41	10.39	0.27
Duration (days) of respiratory distress	-0.25	1.03	0.80
Education (years) of mothers	3.19	1.97	0.10
Income (taka/month) of family	-0.01	0.01	0.36

*Multivariate analysis employing multiple regression analysis
NCHS=National Center for Health Statistics; SE=Standard error

to prepare food for their children. Despite these difficulties, they continued to provide the required food to their children as they were highly motivated by the nutrition education. Food insecurity should not be an obstacle for those families which can allocate the necessary amount of food for their babies despite poverty. Effect of nutrition education has a direct implication for the programme as the cost of supplementary food takes about 70% of the total budget of BINP.

We made special efforts to understand the perceptions of caretakers on child-feeding practices. At the beginning of the study, perceptions of mothers were studied through focus-group discussions, which provided important components for developing the nutrition-education intervention for moderately-malnourished children. It is considered that intervention strategies in health-promotion programmes should attempt to increase people's awareness and personal concerns about nutrition and health before introducing any action strategies (6). We developed our curriculum of nutrition education using the perceptions of mothers at the beginning of the study. The intervention led to the better catch-up growth of moderately-malnourished children, which was an effect of the strategies undertaken based on the United Nations Children's Fund's concept of food security, disease control, and caring practices as determinants of malnutrition (7).

Table 5. Proportion of illness among study children during three months of interventions (rate per 100-child months)

Factor	INE group	INE+SF group	Comparison group
Incidence of diarrhoea			
1st month	23*	24*	17
2nd month	23*	16	14
3rd month	11	11	10
Incidence of fever			
1st month	40	33	35
2nd month	30*	25*	17
3rd month	26	31*	19
Incidence of ARI			
1st month	7*	3*	12
2nd month	2*	2*	5
3rd month	2	2	3

*p<0.001 (comparison vs education, comparison vs supplementation), chi-square test; p=NS (education vs supplementation); ARI=Acute respiratory infection; INE=Intensive nutrition education; NS=Not significant; SF=Supplementary feeding

The changes in feeding behaviour after nutrition education in the study have shown a significant shift from the traditional concepts and practices of child feeding in this region. After six months of observation, the results proved that behavioural changes were sustainable. Sustainability in behavioural changes is a crucial factor for continued outcome. Follow-up showed the sustainability of behavioural changes in mothers with corresponding improvement in the growth of children. The follow-up was done according to the routine programme of BINP, which included growth-monitoring sessions, nutrition and health education, home gardening, etc.

The patterns of child feeding have not changed much since 1937 (8). Earlier, rice provided 80% of the daily requirement for energy in village areas. Children were not given green-leafy vegetables, and expensive food items, such as meat, fish, and eggs, were far less available. They were given rice-gruel as a complementary feed, whereas egg, meat, or fish were never given. A review of 50 years of data on health and nutrition in Bangladesh showed a gradual deterioration in child health and food intake, warranting an effective and urgent intervention (9). There is no intervention programme to reduce moderate malnutrition in children in Bangladesh. The interventions of the present study were based on several considerations. The procedures for preparing *khichuri* from home-based food were shown to the mothers. It was energy- and protein-dense, cost-effective, contained limiting amino acids for growth, and easy to prepare from household ingredients. It was adopted and properly practised by mothers of the intervention groups, which resulted in a reduction in moderate malnutrition by a large proportion. We are not aware of any study that was done in this way.

It is generally perceived that nutrition education alone is not very effective but a community-based intervention study in Thailand showed improved nutritional status and overall use of healthcare resources and parental attitude (10). Results of studies in South Africa and Michigan showed that education programmes succeeded in improving the weight of children after intervention (11,12). In our study, demonstration of the preparation of complementary food from household ingredients was emphasized. The mothers of both the intervention groups exhibited greater changes in behaviour relating to child-feeding practices compared to the comparison group. After the intervention, most mothers recognized the need for improved child-feeding practices, including frequency of feeding, choice of nutrient-dense food items, and preparation of complementary feeds at home. There were significant changes in feeding behaviour, including increased frequency of feeding, improving energy-dense ingredients, and use of a separate feeding-pot for the child, which enhanced growth compared to the compar-

ison group where no such behavioural changes were observed. A separate feeding-pot for the child was useful in developing a visual impact on mothers for the requirement of a certain quantity of separate food for their children. Repeated explanation for the role of specific food on physical growth of children was effective in bringing about desired changes in feeding behaviour.

In a study in the Netherlands, a substantial change in nutritional behaviour was achieved by interactive group education in a socioeconomically-deprived population (13). The study population was people with three risk factors for the development of cardiovascular diseases; all of them were from a socioeconomically-deprived area in the Netherlands. The study did not mention any specific ethnicity. In our study, the mothers were initially resistant to the idea of giving eggs, oil, and *khichuri* to their children but they readily accepted these when nutrition education was given with their agreement after explaining its benefit to the child. The growth of Chinese infants improved because of improved feeding practices (14). The intervention included training and mobilization of village nutrition educators who conducted monthly growth-monitoring sessions and complementary feeding counselling to all pregnant women and families with infants born during intervention in study villages. Results of a rural community-based nutritional intervention study in Iran showed that nutritional awareness of mothers successfully reduced the incidence of malnutrition in children aged less than five years (15).

Improvement in the nutritional status of our study subjects was positively associated with frequency of feeding. Weight gain was also positively associated with age, length-for-age z-score, frequency of feeding of *khichuri*, egg, and potato. Better weight gain was dependent on more food and required nutrients from the ingredients of *khichuri*. Similarly, a Latin American study has shown increased height after a nutrition intervention leading to change in feeding behaviour (16).

Although more frequent illness was observed in the intervention groups in our study, it did not affect weight gain, which indicates the strength of our study on the prevention of growth faltering despite increased morbidity. If the burden of morbidity had been equal, the intervention groups could have benefited more from the intensive nutrition education and food supplementation. It is known that morbidity has a strong negative role on child growth (17). No other illnesses but diarrhoea showed a negative effect on weight gain in our study children. The incidence of illness is a natural occurrence with multiple factors of hygiene, sanitation, bacterial and viral doses, etc. The incidence of diarrhoea and fever may be due to viral infection. Healthy babies are more likely to be attacked by viral infection. The comparison group was economically better-off than the intervention groups. A better-socioeconomic group is more likely to practise better hygiene. This may be one of the factors for the lower incidence of diarrhoea in the comparison groups. The higher incidence of acute respiratory infection in the comparison group may be due to lack of knowledge. It may happen that the mothers in the intervention groups became more aware of how to protect their children from cold. Comparing the results of our study with other nutrition-intervention programmes, we found that 'oversimplified health-education' messages were less effective to mothers, whereas our strength was to deliver specific knowledge on the function of dietary ingredients and explain their roles in child growth. Our counselling was based on explaining the risks of malnutrition compared to the benefits of good nutrition and then giving the necessary information to achieve good nutrition. Regarding the scaling up of this effective method through a large programme, it needs to be considered that the success was achieved through intensive work by qualified nutritionists and well-trained health assistants. It, therefore, remains a challenge to reduce major health problems with minor efforts.

Based on the findings of the study, it is concluded that intensive nutrition education significantly improves the nutritional status of moderately-malnourished children through improving the behaviour of mothers relating to child-feeding and caring practices, which was sustained during the subsequent period of observation. This effective means of reducing moderate malnutrition in children should be scaled up in communities as preventive and management strategies and should involve the community to build culturally-based skills for long-term nutrition goals.

ACKNOWLEDGEMENTS

This study was conducted at ICDDR,B: Centre for Health and Population Research with the support of a grant from the Bangladesh Integrated Nutrition Project (BINP) and World Bank (WB). ICDDR,B acknowledges with gratitude the commitment of BINP-WB to the Centre's research efforts.

REFERENCES

1. de Onis M, Monteiro C, Akré J, Clugston G. The worldwide magnitude of protein-energy malnutri-

tion: an overview from the WHO Global Database on Child Growth. *Bull World Health Organ* 1993; 71:703-12.

2. Bangladesh Bureau of Statistics. Survey results. *In*: Child nutrition survey of Bangladesh 2000. Dhaka: Bangladesh Bureau of Statistics, 2002:21-46.
3. Institute of Nutrition and Food Science. Midterm evaluation: final report. Dhaka: Bangladesh Integrated Nutrition Project, Ministry of Health and Family Welfare, Government of Bangladesh, 1999:65.
4. Bangladesh Integrated Nutrition Project. Project implementation plan (PIP). Dhaka: Bangladesh Integrated Nutrition Project, 1995:8.
5. Neogi MH. Focus group discussion in training needs assessment and evaluation: theory and practice. Dhaka: A H Development Publishing House, 2001: 19-22.
6. López-Azpiazu I, Martinez-González MA, León-Mateos A, Kearney J, Gibney M, Martinez JA. Stages of dietary change and nutrition attitudes in the Spanish population. *Public Health* 2000;114:183-9.
7. Johnsson U. Malnutrition in South Asia. *In*: Nutrition and poverty; ACC/SCN symposium report. Geneva: World Health Organization, 1997:53-68. (Nutrition policy paper no. 16).
8. Wilson HEC, Mitra D. A diet and physique survey in Asian rural Bengal and Calcutta. Indian *J Med Res* 1938;2:131-45.
9. Roy SK, Haider R. Is nutritional status deteriorating in Bangladesh? *Health Policy Plan* 1988;3:325-8.
10. Saowakontha S, Pongpaew P, Vudhivai N, Tungtrongchitr R, Sanchaisuriya P, Mahaweerawat U *et al*. Promotion of the health of rural women towards safe motherhood—an intervention project in Northeast Thailand. *Southeast Asian J Trop Med Public Health* 2000;31(Suppl 2):5-21.
11. Walsh CM, Dannhauser A, Joubert G. The impact of a nutrition education programme on the anthropometric nutritional status of low-income children in South Africa. *Public Health Nutr* 2002;5:3-9.
12. Omar MA, Coleman G, Hoerr S. Healthy eating for rural low-income toddlers: caregivers' perceptions. *J Community Health Nurs* 2001;18:93-106.
13. Siero FW, Broer J, Bemelmans WJ, Meyboom-de Jong BM. Impact of group nutrition education and surplus value of Prochaska-based stage-matched information on health-related cognitions and on Mediterranean nutrition behaviour. *Health Educ Res* 2000;15:635-47.
14. Guldan GS, Fan H-C, Ma X, Ni ZZ, Xiang X, Tang M-Z. Culturally appropriate nutrition education improves infant feeding and growth in rural Sichuan, China. *J Nutr* 2000;130:1204-11.
15. Malekafzali H, Abdollahi Z, Mafi A, Naghavi M. Community-based nutritional intervention for reducing malnutrition among children under 5 years of age in the Islamic Republic of Iran. *East Mediterr Health J* 2000;6:238-45.
16. Ruel MT, Menon P. Child feeding practices are associated with child nutritional status in Latin America: innovative uses of the demographic and health surveys. *J Nutr* 2002;132:1180-7.
17. Becker S, Black RE, Brown KH. Relative effects of diarrhea, fever, and dietary energy intake on weight gain in rural Bangladeshi children. *Am J Clin Nutr* 1991;53:1499-503.