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The impact of food supplementation on infant weight gain in rural Bangladesh; an assessment of the Bangladesh Integrated Nutritional Program (BINP)

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Abstract

Objectives: To examine the efficiency of the Bangladesh Integrated Nutritional Program (BINP) in identifying which infants should be supplemented, whether full supplementation was given for the stipulated period of time, and whether the correct exit criteria from the supplementation programme were used. To test whether targeted food supplementation of infants between 6–12 months of age resulted in enhanced weight gain.
Setting: Mallickbari Union, Bhaluka, a rural area located about 100 km north of Dhaka, Bangladesh.
Participants: Five hundred and twenty-six infants followed for 6 to 12 months.
Results: Of the 526 infants studied, 368 should have received supplementation based on BINP criteria but only 111 infants (30%) did so, while a further 13% were incorrectly given supplementation. So in total over half (52.8%) of the sample was incorrectly identified for supplementation. In addition, less than a quarter of the infants received the full 90 days of supplementation and close to half of the infants exited the programme without the requisite weight gain. Infants were assigned to one of four groups: correctly supplemented, correctly non-supplemented, incorrectly supplemented or incorrectly non-supplemented. This classification provided natural controls; the correctly supplemented infants versus the incorrectly non-supplemented infants, and the correctly non-supplemented infants versus the incorrectly supplemented infants. There were no significant differences in weight gain between the correctly supplemented group and the incorrectly non-supplemented group or between the correctly non-supplemented and the incorrectly supplemented groups, nor was there any evidence of growth faltering in the incorrectly non-supplemented group.
Conclusions: This study found serious programmatic deficiencies – inability to identify growth faltering in infants, failure to supplement for the full time period and incorrect exit procedures. There was no evidence that food supplementation had any impact on improving infant weight gain.

Keywords
Food supplementation
Weight gain
Nutrition

Childhood undernutrition remains a major health problem in many developing countries[1,2] and food supplementation programmes have been used to alleviate the problem. However, these programmes have been quite heterogeneous, with target groups ranging from all children in the community[3–5] to high-risk infants and children only[6–10].

There are also conflicting views on the impact of supplementary feeding trials. In a meta-analysis of supplementary feeding programmes, Beaton and Ghassemi[11] concluded that the effect of supplementation on anthropometric improvement was surprisingly small while Habicht and Butz[12] suggested that such feeding, when given in adequate amounts to malnourished children, had a positive effect on growth. Field trials in Colombia, India and Guatemala carried out on supplemented and non-supplemented children showed that an annual weight gain of 0.50–1.00 kg can be achieved among young children through supplementary feeding programmes[13,14].

In Bangladesh, the percentage of <5-year-old children suffering from moderate and severe underweight is estimated to be 48% and 13%, respectively; 10% suffer from severe wasting; and 19% of all children are severely stunted and 30% are moderately stunted[15]. In order to reduce the extent of malnutrition, in 1995 the Government of the People's Republic of Bangladesh started a food supplementation programme, called the Bangladesh Integrated Nutrition Program (BINP), which was based

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on the Tamil Nadu Integrated Nutrition Programme[16]. The aims of the project were reduce severe protein–energy malnutrition by 40% and moderate protein–energy malnutrition by 25% among children < 2 years old.

The present paper examines the impact of the food supplementation programme on the weight gain of 6–12-month-old infants in a rural area of Bangladesh. It also focuses on whether the correct infants were identified to receive supplementation based on the BINP criteria, whether full supplementation was given for the stipulated period of time, and whether the correct exit criteria from the supplementation programme were used.

Participants and methods

This longitudinal study was conducted from January to December 2002 in Mallickbari Union, Bhaluka, which is located about 100 km north of Dhaka, the capital of Bangladesh. In the BINP infants received a food supplement (consisting of a cereal–pulse mixture with raw sugar (*jaggery*) of which approximately 12% was protein, 8% fat and the remainder carbohydrate) if their weight gain over the previous three consecutive months was less than 600 g for 0–11-month-old children or less than 300 g for 12–24-month-old children; if there was a loss of weight or no weight gain over the last two months; or if children were suffering from third-degree malnutrition defined by the Gomez classification.

Guardians of infants meeting any of these criteria were asked to asked to take their child to a local community nutrition centre for 6 days each week in order to receive an average ration of 300 kcal day^{-1} (for severely malnourished) or 150 kcal day^{-1} (for growth faltering) for 3 months. Children exited the supplementary feeding programme if their weight gain over the 3-month feeding period was at least 500 g.

Every attempt was made to measure the baby as close to the birth as possible and thereafter at 30-day intervals. However, the days on which measurements were taken were not consistent, so a 'month' could be as short as 20 days or as long as 45 days. In order to standardise the interval between measurements so that growth changes could be monitored, the predicted weight and length at 30-day intervals were computed for all 526 children individually using a third-order polynomial regression equation (linear, quadratic and cubic terms of the number of days since birth). These equations provided very good fits and explained between 96.7 and 99.9% of the variance in weight and length. Subsequently the predicted (corrected) weights and lengths of each child at 30-day intervals were computed and these corrected values have been used in all subsequent analyses[17]. In addition, the number of days of supplementary feeding (if any) during the previous month was recorded.

The UNICEF Electronic Scale (UNI-Scale), an automatic solar-powered digital machine, was used to measure the weight of the children. The weight of the child was obtained by first weighing the mother/helper and then the mother/helper holding the child. The machine subtracted the combined mother/helper plus child weight from the mother/helper weight only, so as to give the child weight only to the nearest 0.1 kg[18]. Inter-observer errors were determined and the technical error of measurement and reliability were calculated. Reliability was 0.99[19].

Statistical analyses were performed using SPSS software, version 11.5 (SPSS Inc., Chicago, IL, USA).

Results

Identification of children to be supplemented

A total of 526 children were studied (53.6% male), of whom 25.1% received supplementation. As shown in Table 1, 368 infants should have received supplementation based on the BINP criteria but only 111 were supplemented. These relative frequencies come from ratios of INS (incorrectly non-supplemented) and CS (correctly supplemented) groups presented in Table 2. Infants correctly supplemented fell from 78% (11/14) at month 6 to 52% (13/25), 36% (26/72), 23% (22/95) and 20% (31/154) at months 7 to 10 (Table 2), respectively. In addition, 21 infants were incorrectly given supplementation and so over half (52.8%) of the sample was either not receiving supplementation or being given it incorrectly (Table 1). The infants should have received supplementation 6 days a week for 3 months (i.e. 90 days) but as can be seen from Table 3 only slightly more than a quarter (27.3%) received the daily supplementation for all 90 days. The exit criteria were also not adhered to and over 40% of infants left the feeding programme without the requisite weight gain.

Commencement of supplementation

The month of registration for supplementation varied from child to child. Thus, in order to determine the impact of supplementation, the whole study period was divided into a maximum of four periods: i.e. the 3-month period before supplementation commenced, the 3-month supplementation period, the 3-month post-supplementation period and the whole period from 6 to 12 months. So, for example, a child who received supplementation starting in month 6 would have a pre-supplementation period from month 3 to the end of month 5, supplementation from month 6 to the

Table 1 Overall supplementation status of the children

Should receive supplementation	Actually supplemented: Yes		Actually supplemented: No		Total	
	n	%	*n*	%	*n*	%
Yes	111	21.1	257	48.9	368	70.0
No	21	4.0	137	26.0	158	30.0
Total	132	25.1	394	74.9	526	100.0

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Table 2 Distribution of children in different supplementation groups

Month of commencement of supplementation	*n*	Infant group			
		CNS	INS	CS	IS
6	526	512	3	11	–
7	526	494	12	13	7
8	526	451	46	26	3
9	526	425	73	22	6
10	526	367	123	31	5

CNS – correctly non-supplemented; INS – incorrectly non-supplemented; CS – correctly supplemented; IS – incorrectly supplemented.

end of month 8, and a post-supplementation period from month 9 to the end of month 11. For a child receiving supplementation from month 7, the pre-supplementation period would have been from month 4 to the end of month 6, supplementation from month 7 to the end of month 9, and a post-supplementation period from month 10 to the end of month 12.

Weight gain in supplemented and non-supplemented infant groups

Figures 1 and 2 show the monthly mean weights of supplemented (who commenced at any time between months 6 and 9) and non-supplemented females and males, respectively. Boys had higher mean weights than girls independent of supplementation status. Repeated-measures analyses of variance provided no evidence in either sex that supplemented children showed any catch-up. Over the whole period supplemented boys were on average 0.49 kg heavier than supplemented girls ($P = 0.003$) whereas non-supplemented boys were 0.38 kg heavier than the non-supplemented girls ($P < 0.001$). Analyses also failed to show any significant relationship between the number of days of supplementation and weight gain. Analyses were conducted to determine if there was any association between the number of days a child received supplementation and weight gain in the 90-day period. Regression analyses of weight gain against days of supplementation were undertaken for each supplementation period separately and combined, and no significant linear or curvilinear associations were found.

The analyses were repeated after dividing the children into four groups of < 30 days, 31–60 days, 61–89 days and 90 days. No significant differences were apparent for any

Table 3 Number of children fulfilling the BINP 90-day supplementation period

Days	*n*	%
< 30	24	18.2
31–60	34	25.8
61–89	38	28.9
90	36	27.3
Total	132	100.0

BINP – Bangladesh Integrated Nutritional Program.

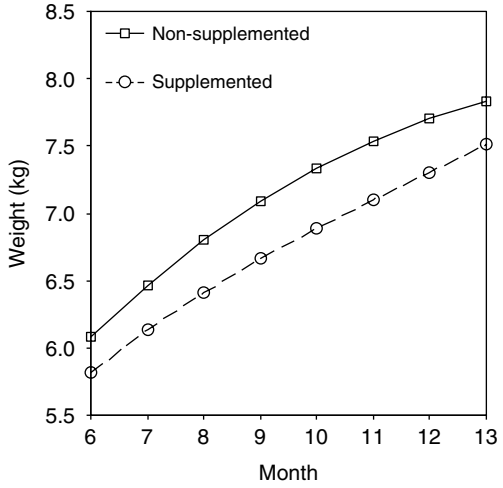

Fig. 1 Monthly mean weight of females by supplementation status

of the supplementation periods, nor were there any obvious trends of increasing weight with more days of supplementation. The overall weight gain independent of the month at which supplementation commenced was determined and no significant association was found with days of supplementation. Analyses which took into account the days of supplementation also failed to show significant differences.

Weight gain in the four infant groups

In order to test whether the supplementation programme was effective, the infants were divided into the four groups shown in Table 1; i.e. those correctly supplemented (CS), those correctly not receiving supplementation (CNS), those who should have received supplementation (INS) and those incorrectly receiving supplementation (IS). These four groups provide two sets of natural controls: correctly supplemented versus those who should have received supplementation, and those correctly not

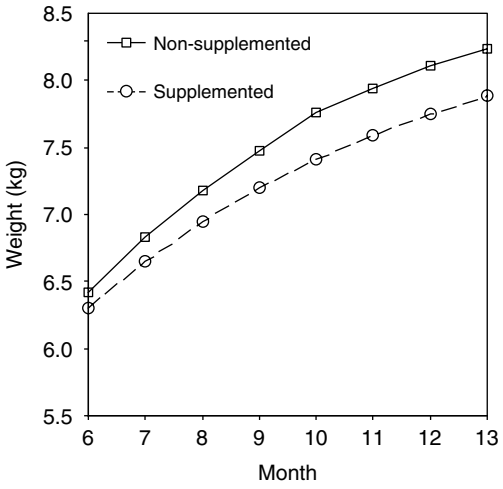

Fig. 2 Monthly mean weight of males by supplementation status

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receiving supplementation versus those incorrectly receiving supplementation. Repeated-measures analyses of variance were conducted separately for commencement of supplementation at months 6 to 9. All analyses indicated that there was some heterogeneity in means between the four groups, but as Fig. 3 illustrates for month 8, the main difference in all months was between the incorrectly supplemented and correctly non-supplemented versus the correctly supplemented and incorrectly non-supplemented. If the programme was having a significant impact there should have been either catch-up of the correctly supplemented group or catch-down in the incorrectly non-supplemented group.

Analyses using incremental weights (monthly changes in weight) revealed significant within-subject variation. There was a tendency in each month and overall for incremental weight to be higher in the correctly non-supplemented and incorrectly supplemented groups than in the other two groups.

Discussion

This study indicates serious shortcomings in the implementation of the BINP in this rural area with nearly 70% of those infants who should have received supplementation not doing so, while 13% were incorrectly supplemented. Nearly three-quarters of infants failed to receive the full 90 days of supplementation and the exit criterion was not adhered to in 40% of cases. In June 2000, the total number of children aged <2 years in BINP areas was 437 041[20]. Extrapolating from the present study would indicate that of the 305 929 infants who should receive supplementation, there would be a shortfall of over 200 000 infants.

Supplementation commenced when the infant was 6 months of age, in keeping with a number of other studies such as the Integrated Nutrition Project in Tamil Nadu, India[16] and a recent programme in Guatemala[21]. In the present study 124 children received supplementation but comparisons of supplemented and non-supplemented children revealed that the latter group were heavier each month. In addition, weight gain in the 3 months prior to commencement of supplementation and during the supplementation period was significantly lower in the supplemented than the non-supplemented infant groups.

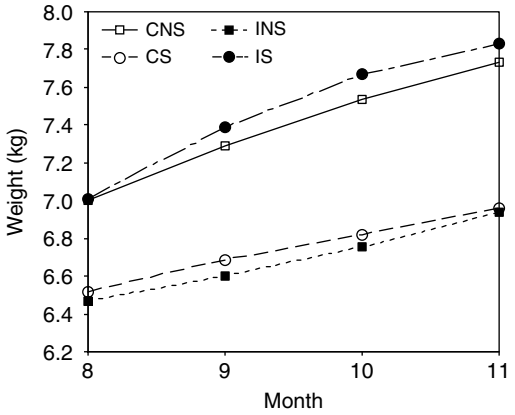

Fig. 3 Monthly mean weight for supplementation starting at month 8 (CNS – correctly non-supplemented; INS – incorrectly non-supplemented; CS – correctly supplemented; IS – incorrectly supplemented)

There was no significant difference in weight gain between the correctly supplemented group and the non-supplemented groups, or between the correctly non-supplemented and the incorrectly supplemented groups. If supplementation had some impact then one would expect to see (1) significantly greater catch-up of the correctly supplemented group than of the non-supplemented group or (2) significant growth faltering in the incorrectly non-supplemented group or (3) significantly greater weight gain in the incorrectly supplemented group than in the correctly non-supplemented group.

None of these occurred and the failure to show a significant improvement could be due to a number of factors. First are those involving programme errors, e.g. incomplete days of supplementation, which was also found by Hossain *et al.* [22]. Second, the food supplied in the BINP may have been used as a replacement not a supplement. This is supported by findings of BINP operational research[23], which found that 28% of the children substituted at least part of their domestic food intake by BINP food supplements. Finally, the lack of significant improvement could be attributed to differences in morbidity, which may occur by chance alone or because of the supplement itself. For example, Bhandari *et al.*[24] found that the food supplementation group had significantly higher prevalences of fever and dysentery compared with the control group because of the high risk of contamination during supplementation, but the incidence and prevalence of diarrhoea and acute lower respiratory tract infection were not significantly affected by either intervention. However, many studies have not reported increased morbidity in food supplementation trials or programmes[25–34].

The results of the present study are in keeping with a recent evaluation of the BINP by Save the Children UK[35], which showed that the project had no impact on nutritional status and that rates of malnutrition were the same in project and control areas after 6 years of project implementation. There was some indication that caring practices as reported by mothers were better in project areas, but these had no impact on nutritional status. Save the Children UK also found low levels of effectiveness in supplementary feeding of the project.

The failure to correctly identify children to be supplemented can be improved by training and supervision of field staff. However, motivating mothers to attend feeding centres and ensuring that the food is used as supplement not replacement requires motivation and

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counselling of mothers as to the longer-term benefits that food supplementation will bring their children. If supplementation is to have the desired effect of reducing growth faltering, then further research is needed to determine the appropriate quantity and quality of supplementation for children between 6 months and 2 years of age. Knowledge of the morbidity status and breast-feeding status of the child is essential in the assessment of growth throughout the vulnerable childhood period.

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