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THE EFFECT OF BIRTH INTERVAL ON MALNUTRITION IN BANGLADESHI INFANTS AND YOUNG CHILDREN

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Summary. This study was undertaken to investigate the independent effect of the length of birth interval on malnutrition in infants, and children aged 6–39 months. Data for this study were drawn from a post-flood survey conducted during October–December 1988 at Sirajganj of the Sirajgani district and at Gopalpur of the Tangail district in Bangladesh. The survey recorded the individual weights of 1887 children. Cross-tabulations and logistic regression procedures were applied to analyse the data. The proportion of children whose weight-for-age was below 70% (moderate-to-severely malnourished) and 60% (severely malnourished) of the NCHS median was tabulated against various durations of previous and subsequent birth intervals. The odds of being moderately or severely malnourished were computed for various birth intervals, controlling for: the number of older surviving siblings; maternal education and age; housing area (a proxy for wealth); age and sex of the index child; and the prevalence of diarrhoea in the previous 2 weeks for the index child.

About one-third of infants and young children were moderately malnourished and 15% were severely malnourished. The proportion of children who were under 60% weight-for-age decreased with the increase in the length of the subsequent birth interval, maternal education and housing area. The proportion of malnourished children increased with the number of older surviving children. Children were at higher risk of malnutrition if they were female, their mothers were less educated, they had several siblings, and either previous or subsequent siblings were born within 24 months. This study indicates the potential importance of longer birth intervals in reducing malnutrition in children.

Introduction

Malnutrition is a major public health concern in Bangladesh. It increases the risk of mortality in children by weakening the child's defence mechanism, resulting in disease.

The primary victims of malnutrition are infants and young children. In 1993, it was estimated that 67% of children aged 6–59 months were moderately-to-severely malnourished in Bangladesh (Helen Keller International, 1994).

Investigators have identified several variables related to infant and child malnutrition including low dietary intake, low birth weight, family size, lack of parental education, faulty infant feeding practices, incidence of diarrhoea and delayed weaning (Bhuiya, Zimicki & D'Souza, 1986; Chowdhury & Bhuiya, 1993; Islam *et al.*, 1994; Victora *et al.*, 1984). Inadequate nutrition of the mother may also be responsible for malnutrition in breast-fed infants and young children (Rahman *et al.*, 1993). It has been estimated that the prevalence of low body mass index in Bangladeshi adults ranges from 18·3 to 18·9% among poor women and from 1·8 to 2·1% among better-off women (Ahmed *et al.*, 1998; Baqui *et al.*, 1994). Another important factor is birth interval: the length of time between a child's birth and a previous and/or subsequent sibling's birth. Birth intervals can be lengthened through various approaches, but are principally increased through the use of family planning methods, extended exclusive breast-feeding, and/or spontaneous or induced abortions. Longer spacing between two births allows for the optimum use of the parent time inputs and resources for each child, which, in turn, improves child health. Analysing the data of nineteen national demographic and health surveys from around the world, Sommerfelt (1991) found that children born less than 24 months compared with those born more than 24 months after a previous sibling were physically shorter. There is disagreement, however, about the effects of birth interval on malnutrition in children. Using data from Kenya, Boerma & van Vianen (1984) found that children with short previous or short subsequent birth intervals were not at higher risk either for mortality or growth retardation during the perinatal period or first 2 years of life compared with children with longer birth intervals.

The negative effects of short birth interval are most clearly demonstrated in areas where infant mortality is high. Information on the effects of birth spacing on malnutrition in Bangladesh, however, is inadequate. Swenson (1984) reported that the proportion of Bangladeshi children in the severely malnourished category is almost twice as high among children born within 12 months of a younger sibling than those children born more than 12 months. Roy (1996) found that, among other factors, subsequent birth interval in Matlab has a significant effect on child nutritional status. However, since a unique primary health infrastructure is in existence there, generalization from research, including nutritional indicators, should be met with caution (Bairagi, Koenig & Mozumder, 1993).

The present study uses data from the Mother and Child Health and Family Planning (MCH–FP) Extension Project sites. The MCH–FP Extension Project (Rural) was originally launched in 1982 to transfer successful elements of the Matlab pilot MCH–FP programme to the Government of Bangladesh's national programme, where it could make use of existing bureaucratic and administrative government organizations and financing. Thus, in these sites, unlike Matlab, MCH–FP services are provided by the government fieldworkers.

The objective of this study was to investigate the independent effect of the length of birth intervals on the nutritional status of infants and young children aged 6–39 months.

Setting and data

The study sample came from Sirajganj and Gopalpur, the two field sites of the MCH–FP Extension Project (Rural) of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). These sites are respectively located about 100 and 120 km north-west of Dhaka, the capital city of Bangladesh. Agriculture dominates the economy, though most households own no arable land. The female literacy rate is lower than that of males, and both are below the national average. Flooding is common at these project sites. The contraceptive prevalence rate (CPR) among the currently married women of reproductive age (MWRA) at the project sites was, on average, 31% during the time of the study. This CPR closely corresponds to the national level for the same time period. The infant mortality rate recorded in 1984 was as high as 173 per 1000 live births – one of the highest in the country (Mozumder *et al.*, 1990).

The data for this study were drawn from a post-flood survey conducted during October–December 1988. The survey collected data on the weight of 1887 children aged 6–39 months, along with other necessary information. The weights of these children were measured by a team of two well-trained fieldworkers – one female and one male – and a supervisor. The weight was measured to the nearest 100 g on a bar scale developed by the Bangladesh National Nutrition Council (BNNC). The BNNC scales have been used in several studies carried out by government and non-government organizations in Bangladesh (Jahan & Hassan, 1994). On each day when measurements of weight were taken, the BNNC scales were checked for accuracy against a standard weight. The supervisor spot-checked the measurements of a 5% sample. On the day when the weight measurement was taken, information on the prevalence of diarrhoea during the previous 2 weeks was also collected. Diarrhoea was defined as three or more abnormal bowel movements with or without the presence of blood or mucus in the stool, within a 24-hour period. The supervisor re-interviewed 5% of mothers about accuracy on the prevalence of diarrhoea among their children in the 2 weeks prior to the date of weight measurement taken by interviewers.

The Sample Registration System (SRS) of the MCH–FP Extension Project (Rural), a longitudinal survey which conducts repeated interviews at every fifth household at 3-month intervals, had recorded the birth dates of these children just prior to the post-flood survey (Mozumder *et al.*, 1990). All age-appropriate children were selected from these households. Other covariates of interest were sex of index child, number of surviving children at weight date, previous birth interval, subsequent birth interval, maternal age and education. All these covariates came from the SRS as well.

Method

Weight-for-age was used as a measure of nutritional status in this study. This was calculated as a ratio of the child's weight to an age–sex-adjusted standard set by the National Centre for Health Statistics (NCHS, 1977). The weight-for-age index was chosen because the exact birth dates of children were available, and age-dependent measures have been used for effectively measuring chronically malnourished populations. Furthermore, this measure has been found to be one of the two strongest existing indicators of mortality risk among children aged 13–23 months (Chen, Hoque

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& D'Souza, 1980). Two nutritional classifications (under 60% weight-for-age and under 70% weight-for-age) were used. The under 60% measure serves as an indicator of severe malnutrition, while the under 70% cut-off includes both moderate and severely malnourished children.

Cross-tabulations and multivariate logistic regression procedures were applied to analyse the data. The proportion of children whose weight-for-age was below 70 and 60 was tabulated against various lengths of previous and subsequent birth intervals. The odds of being moderate-to-severely, or severely malnourished were computed for various lengths of birth intervals, controlling for: sex and age of the index child; number of older surviving siblings; maternal age and education; housing unit area (used as a measure of wealth); and the prevalence of diarrhoea for the index child during the previous 2 weeks. Breast-feeding data were not available in this survey. This is unfortunate, because breast-feeding is expected to be highly and positively correlated with the length of birth interval and the level of malnutrition among the infants and young children. In fact, contraception and breast-feeding contribute almost equally to the lengthening of birth intervals (Xenos, 1984).

Although some studies have found a reciprocal causal relationship between diarrhoea and malnutrition (Chen, Choudhury & Huffman, 1981; Bairagi *et al.*, 1987; Briend *et al.*, 1989), other studies have found an association between diarrhoea and severe malnutrition in children (Roy, 1996). Diarrhoea episodes may inflict temporary depression on the nutritional status of children (Briend *et al.*, 1989). Briend, however, suggested that the effect of diarrhoea was transient and that the control of diarrhoea was not expected to reduce the prevalence of malnutrition in children in poor communities in the long run. The possible effects of diarrhoea on the nutritional status of children were therefore controlled for by including this variable in the multivariate model. Information on housing area was available from the 1982 baseline survey and was assumed to have remained relatively unchanged during the 1982–1988 period. However, information on housing area was not available for 231 children, and these were therefore excluded from the logistic regression analysis.

Results

Table 1 shows the characteristics of the respondents in the post-flood survey. The distribution and reference categories of variables included in the model are also shown in the table. The flood that preceded this survey may have increased the prevalence of diarrhoea among the children through the contamination of water and food supplies, since one out of every two index children had suffered from diarrhoea during the 2 weeks prior to the weight date. Four-fifths of the women were completely uneducated.

Table 2 shows that the proportion of children who were under 60% weight-for-age decreased as the length of the subsequent birth interval, maternal education and housing area increased. Severely (under 60% weight-for-age) and moderate-to-severely (under 70% weight-for-age) malnourished cases were highly and significantly associated with the shortest subsequent birth interval group. The proportion of malnourished children born to mothers with no education was significantly higher than the proportion of malnourished children born to mothers with 6 or more years of schooling. This finding endured, whether the cut-off point of malnutrition was under

Table 1. Background characteristics of the sample ($n = 1887$)

Characteristics	% in category
Previous birth interval (months)	
≤18	8·7
19–24	12·8
25+(RC)[a]	61·3
No previous birth	17·2
Subsequent birth interval (months)	
≤24	12·2
25+(RC)	30·6
No subsequent birth	57·2
Sex	
Female	48·1
Male (RC)	51·9
Number of surviving siblings at weight date	
None (RC)	22·5
1–2	39·7
3–4	24·1
5+	13·7
Maternal age (years)	
≤19	18·7
20–34 (RC)	67·7
35+	13·6
Maternal education	
None	79·1
Some (RC)	20·9
Housing unit area (sq. ft)[b]	
≤150	52·8
151–300	39·1
301+ (RC)	8·1
Age of index child (months)	
≤11 (RC)	13·1
12–23	41·1
24+	45·8
Diarrhoea in the last 2 weeks (index child)	
Yes	51·1
No (RC)	48·9
Total %	100
Total cases	1887

[a]RC means reference category.
[b]Total number of children is 1656 for housing unit area. This is due to missing data.

60% or under 70% weight-for-age. The proportion of malnourished children also clearly increased with the number of older surviving siblings in the family. Prevalence of malnutrition during the second year of life was significantly higher than it was

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Table 2. Proportion of children aged 6–39 months under 70% and 60% of weight-for-age at Sirajganj project site

Characteristics	No. of children	Weight-for-age	
		Under 70%	Under 60%
Previous birth interval (months)			
≤18	164	48·78	15·85
19–24	241	53·53	17·84
25–36	679	51·10	13·11
37–48	276	49·64	15·22
49+	202	41·58	12·38
No previous birth	325	44·62	14·15
Subsequent birth interval (months)			
≤18	52	69·23**	28·85*
19–24	178	56·18	16·29
25–36	438	47·95	13·47
37+	139	43·88	10·07
No subsequent birth	1080	47·69	14·26
Sex			
Female	908	50·11	16·41**
Male	979	47·70	12·46
Number of surviving siblings at weight date			
0	424	43·63	13·21
1–2	750	48·60	13·30
3–4	455	50·33	13·63
5+	258	55·43**	20·54**
Maternal age (years)			
≤19	352	51·14	15·34
20–34	1278	47·26	13·07
Maternal education			
None	1493	52·58*	15·74**
1–5	317	39·12	10·41
6+	77	16·88	3·90
Housing unit area (sq. ft)			
≤150	874	54·58*	16·13
151–300	648	44·14	11·73
301+	134	39·55	13·43
N	1656[a]		
Age of index child (months)			
≤11	247	40·08	12·15
12–23	775	52·13*	16·00
24+	865	48·44	13·53
Diarrhoea in the last two weeks			
Yes	965	53·26*	17·41*
No	922	44·25	11·17
N	1887	48·90	14·40

[a]Information on housing unit area is missing for 231 cases.
*Significantly different ($p<0·001$) from the category of interest.
**Significantly different ($p<0·01$) from the category of interest.

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during the second half of the first year of life. Also, the proportion of female children who fell into the severely malnourished category was larger than that of male children.

Another factor that was found to increase the likelihood of malnutrition was having had diarrhoea during the previous 2 weeks. Children who had experienced diarrhoea in the previous 2 weeks were more likely to suffer from moderate-to-severe malnutrition compared with children who had not had diarrhoea. These findings support those of an earlier Bangladesh study (Roy, 1996; Baqui *et al.*, 1993). Among the children who had experienced diarrhoea in the past 2 weeks, more than 17% were severely malnourished, compared with 11% of the children who had not had diarrhoea. This difference was statistically significant. In the bivariate analysis, with regard to the length of previous birth interval and maternal age, no clear trend was evident in either the under 70% or under 60% weight-for-age groupings.

Logistic coefficients and odds ratios were estimated in the multivariate analysis to assess the effect of the length of birth interval – the principal explanatory variable of interest in this study – on the nutritional status of children. Control variables included in the analysis were: the number of older surviving siblings; age and sex of the index child; maternal age and education; and the prevalence of diarrhoea in the index child during the previous 2 weeks. Household living area has been found to be a very good proxy measure for wealth (Bhuiya *et al.*, 1986; Islam & Becker, 1979). For this reason, it has also been included in the logistic regression model. In the case of severe malnourishment, the dichotomous dependent variable assumes the value of one (1) if weight-for-age of the index child is less than 60%; and zero (0) if weight-for-age is 60% or more of the NCHS standard child. In the case of moderate-to-severe malnourishment, the dichotomous dependent variable assumes the value of one (1) if weight-for-age is less than 70%; and zero (0) if weight-for-age is 70% of an NCHS standard child, or more. The estimated logistic regression coefficients have been exponentiated to show the odds ratios in comparison with the reference categories for each independent variable in the model.

The results of the logistic analysis are shown in Table 3. Short subsequent birth interval emerges as a significant predictor of malnutrition in children. Index children having siblings born within 24 months of their birth had a 56% higher risk of moderate-to-severe malnourishment than children who had a sibling born more than 24 months after their (index child's) birth. The risk of severe malnourishment was 66% higher for children having siblings born within 24 months of their birth. However, the length of the previous birth interval did not affect the risk of moderate-to-severe, or severe malnourishment among the children. This is probably due to the fact that the new infant holds an advantageous position with the mother, compared with any older siblings, because of breast-feeding.

Table 3 shows that children were at higher risk of moderate-to-severe malnourishment if they had several surviving siblings. It is common for children to compete for parental resources, which include nurturing and food, among other more durable family resources. This competition results in a negative effect on the health of a child, who is neither old enough to compete with his older siblings, nor breast-fed, due to the presence of younger, breast-fed siblings.

Among the other covariates of interest, maternal age and education, age of the index child, prevalence of diarrhoea during the previous 2 weeks, and the family's

Table 3. Odds ratios of logistic regression coefficients of nutritional status of children ($n = 1656$) aged 6–39 months at the Sirajganj site of MCH–FP Extension Project: October–December, 1988

Variables	Under 70%	95% CI	Under 60%	95% CI
Previous birth interval (months)				
≤18	1·06	0·72–1·57	1·38	0·82–2·31
19–24	1·17	0·86–1·61	1·36	0·89–2·08
25+(RC)[a]	1·00	—	1·00	—
No previous birth	1·22	0·68–2·19	1·23	0·50–3·00
Subsequent birth interval (months)				
≤24	1·56**	1·09–2·23	1·66*	1·03–2·67
25+(RC)	1·00	—	1·00	—
No subsequent birth	0·98	0·77–1·25	1·23	0·85–1.76
Sex				
Female	1·14	0·93–1·39	1·38*	1·04–1·85
Male (RC)	1·00	—	1·00	—
Number of surviving siblings at weight date				
None (RC)	1·00	—	1·00	—
1–2	2·03**	1·19–3·46	1·65	0·73–3·73
3–4	2·18**	1·25–3·80	1·64	0·69–3·85
5+	2·66***	1·44–4·94	2·49*	1·00–6·18
Maternal age (years)				
≤19	1·90***	1·28–2·82	1·58	0·91–2·73
20–34 (RC)	1·00	—	1·00	—
35+	1·07	0·75–1·53	1·28	0·80–2·04
Maternal education				
None	1·90***	1·45–2·50	1·83**	1·17–2·84
Some (RC)	1·00	—	1·00	—
Housing unit area (sq. ft)				
≤150	1·47*	0·99–2·21	1·03	0·59–1·82
151–300	1·05	0·70–1·57	0·72	0·40–1·28
301+ (RC)	1·00	—	1·00	—
Age of index child (months)				
≤11 (RC)	1·00	—	1·00	—
12–23	1·69***	1·22–2·35	1·32	0·83–2·11
24+	1·38*	0·99–1·92	1·11	0·69–1·80
Diarrhoea in the last two weeks				
Yes	1·42***	1·16–1·74	1·59***	1·19–2·14
No (RC)	1·00	—	1·00	—

*$p < 0·05$; **$p < 0·01$; ***$p < 0·001$.
[a]RC means reference category.

wealth status were significant. Children were at higher risk of moderate-to-severe malnourishment if their mothers were younger, compared with children who were born to mothers aged 20–34 years. This could be due to the fact that younger mothers are less experienced in rearing children, and are financially less well-off. Children were

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more likely to be malnourished if their mothers were uneducated than if their mothers had received some education. This suggests that educated mothers are more capable of caring for the health of their children and may be better off financially, and are, thus, more capable of providing better nutrition for their children.

Female children encountered a 38% higher risk of severe malnourishment (weight-for-age under 60%) than male children. Discrimination in the distribution of food between boys and girls within a family may be responsible for this phenomenon (Chen *et al.*, 1981). The proportional food intake of young girls has been found to be lower than young boys (Abdullah & Wheeler, 1985). Diarrhoea was an important factor in determining the severe as well as moderate-to-severe malnourishment in children, and increased the risk by 59 and 42% respectively.

The age of the index child was a significant factor in determining moderate-to-severe child malnourishment, but not in the case of severe child malnourishment. Index children aged 12–23 months were much more likely to be malnourished than children aged less than 1 year. Children in the second year of life may be more vulnerable to malnutrition, because of a sharp reduction in exclusive breast-feeding in the second year, along with increase in food supplementation. Children aged 1–2 years are often unable to get adequate food for themselves, and may suffer nutritionally if their mothers are busy breast-feeding their newly born infants and do not have the time to feed them. Older siblings can also compete successfully for some of the younger child's food.

Discussion

The study results clearly indicate that the index children in families with short subsequent birth intervals are significantly more likely to be moderate-to-severely or severely malnourished than those children in families having longer intervals before the birth of another child in the family. This finding has important policy and programme implications. Nutritional, health and family planning programmes should encourage longer intervals between births (i.e. spacing births more than 2 years apart) to reduce the prevalence of malnutrition among young children, and to enhance the health of both children and their mothers. Longer birth intervals may be achieved through prolonged breast-feeding on demand (with supplemental feedings when necessary as the infant gets older) and/or through the effective use of modern contraceptive methods. Longer birth intervals allow more time for the allocation of sufficient family resources for the provision of food for additional children, and help ensure more time and attention are given to the nutritional needs of young children (especially those between 12 and 23 months old). Index children who were aged 12–23 months were found in the multivariate analysis to be particularly vulnerable to malnutrition. This may be due to the fact that many 12–23 month old children are being weaned, but are still unable to feed themselves independently. The nutritional problems of 12–23 month old children are only compounded when another child is born soon after them, and that subsequent child begins breast-feeding before the index child has reached his or her second birthday. Therefore, information, education, and communication (IEC) efforts of nutritional, health and family planning programmes should educate mothers not only about the benefits of spacing births farther apart, but also about the special

nutritional vulnerabilities and attention needed for these young children (especially those aged 12–23 months).

In addition to the significant effects of short subsequent birth intervals and age of the index child on the likelihood of suffering from malnutrition, the multivariate analysis also revealed that the index children of uneducated and young teenaged mothers, children in families with large numbers of siblings, children who were female, and children suffering from diarrhoea in the 2 weeks prior to the survey, were also more likely to be suffering from some level of malnutrition (moderate or severe), compared with children having educated or older mothers, children in families with fewer siblings, male children, or children who did not suffer from diarrhoea in the 2 weeks prior to the survey. These other statistically significant findings also have important policy and programme implications that should be addressed through appropriate public health messages and service interventions. Delayed onset of childbearing, limiting family size, improved educational status of women, reduced gender discrimination against female children in feeding practices, and reducing the incidence of diarrhoea and ensuring more rapid recovery from diarrhoea through the use of oral dehydration therapy are messages and interventions that should also help reduce the prevalence of malnutrition.

Although a number of significant factors are identified in this study, it is, of course, also essential that a distribution system exists that ensures the availability of a consistent supply of nutritionally well-balanced foods for all families in the community to reduce the prevalence of malnutrition among young children on a large scale in Bangladesh.

In conclusion, the primary focus of this paper has been on documenting the significant effects of short birth intervals on the prevalence of malnutrition among infants and young children. In addition to the positive benefits family planning programmes have on socioeconomic development through reduced population growth, there are clearly positive health benefits for children. Use of family planning to achieve delayed childbearing, increased birth intervals and reduced family size can result in significant reductions in malnutrition in children and also reduced child mortality. More in-depth and qualitative research would be useful to understand more fully the specific behavioural patterns related to malnutrition in young children in large families with children born close together. The study shows significant findings that should point the way to the development of a number of specific interventions that will help to reduce the still unacceptably high level of malnutrition in Bangladesh, and many other countries of the world.

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