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The Effect of Birth Interval on Malnutrition in Infants and Young Children

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Abstract

This study was undertaken to investigate the independent effect of the length of birth interval on malnutrition in infant and young children aged 6-39 months. Data for this study were drawn from a post-flood survey conducted during October-December, 1988 at Sirajganj and at Gopalpur of Sirajgonj and Tangail districts respectively in Bangladesh. The survey recorded the individual weights of 1,887 study children. The weight-for-age was calculated as a ratio of the child weight to an age-sex adjusted standard of the National Center for Health Statistics. Cross tabulations and logistic regression procedures were applied to analyze the data. The proportion of children whose weight-for-age was below 70 per cent (moderate-to-severely malnourished) and 60 per cent (severely malnourished) was tabulated against various durations of previous and subsequent birth intervals. The odds of being moderately or severely malnourished was 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 two weeks for the index child. Results of the study showed that the proportion of children who were under 60 per cent 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 malnourishment if they were female, their mothers were less educated, they had several siblings, and either previous or subsequent siblings were born within 24 months. They were more likely to be moderate-to-severely malnourished if they had any surviving sibling, their mothers were less educated, they came from a poor family, and subsequent siblings were born within a short birth interval. This study underscores the importance of larger birth intervals in improving the nutritional status of children.

Introduction

Malnutrition is a major public health concern in Bangladesh. It increases the risk of mortality in children by weakening the child's defense mechanism, resulting in the causation of other diseases. The primary victims of malnutrition are infants and young children. In 1993, it was estimated that 67 per cent of children aged 6-59 months were moderately-to-severely malnourished in Bangladesh (1).

Investigators have identified several variables related to infant and child malnutrition. Some of the variables are: low dietary intake, low birth weight, family size, lack of parental education, faulty infantfeeding practices, prevalence of diarrhoea, and delayed weaning (2-5). Inadequate nutrition of the mother is also responsible for malnutrition in breast feeding infants and young children (6). Another important factor is the length of time or time interval between a child's birth and a previous and/or subsequent sibling's birth. Birth intervals may be extended through several ways, 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. Analyzing the data of 19 national demographic and health surveys from around the world, Sommerfelt, 1991 (7) found that children born less than 24 months compared to those born more than 24 months after a previous sibling were shorter, in height, in 11 countries when other variables were controlled. There is disagreement, however, about the effects of birth interval on malnutrition in children. Boerma, 1984 (8), using data from Kenya, found that children with short previous or short subsequent birth intervals are not at higher risk either for mortality or growth retardation, during the perinatal period or first two years of life, compared to 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, however, is rare in Bangladesh. Swenson, 1984 (9) reported that for Bangladesh the proportion of 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 within 12 months of an older sibling. Roy, 1996 (10), using data from Matlab, found that, among other factors, subsequent birth interval has a significant effect on child nutritional status. However, since a special hospital for the treatment of diarrhoea and a well-grounded primary health infrastructure are in existence, generalization from research using Matlab data regarding nutritional indicators should involve a great deal of caution (11).

The present study uses data from the MCH-FP Extension Project sites. The MCH-FP Extension Project (Rural) was originally launched in 1982 to transfer successful elements of the Matlab's 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, maternal and child health and family planning (MCH-FP) services are provided by the government field workers.

Objective

The study was undertaken 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 comes from Sirajgonj 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 northwest of Dhaka – the capital city of Bangladesh. Agriculture dominates the economy, though most households own no arable land. The female literacy rate is lower compared to that of males, and both are below the national figure. Flooding is common in these project sites. The contraceptive prevalence rate (CPR) among the currently married women of reproductive age (MWRA) at the

project sites was, on an average, 31 per cent, during the time of our study. This CPR closely corresponds to the national level for the same time period. Recorded in 1984, the infant mortality rate was as high as 173 per 1,000 live-births – one of the highest in the country (12).

The data for this study are drawn from a post-flood survey conducted during October-December 1988. The survey collected data on the weight of 1,887 children aged 6-39 months. The weights of these children were measured by a team of two well-trained field workers – one female and one male – and a supervisor. The weight was measured to the nearest 100g on a bar scale developed by the Bangladesh National Nutrition Council (BNNC). The BNNC scales have been used in several studies carried by government and non-government organizations in Bangladesh (13). On each day when measurements of weight were taken, the BNNC scales were checked for accuracy against standard weight. The supervisor spot-checked the measurements of a five per cent sample. On the day when the weight measurement was taken, information on the prevalence of diarrhoea during the previous two weeks was also collected. Diarrhoea was defined as three or more abnormal stool movements with or without the presence of blood and mucus in stools within a 24-hour period.

The Sample Registration System (SRS) of the MCH-FP Extension Project (Rural), a longitudinal survey which conducts repeated interviews at every fifth household at three-month intervals, had recorded the exact dates of birth of these children just prior to the post-flood survey (12). All age-appropriate children were selected from these households. Other covariates of interest come from SRS as well.

Method

Weight-for-age was used as a measure of nutritional status in this study. This weight was calculated as a ratio of the child's weight to an age-sex adjusted standard set by the National Center for Health Statistics (NCHS 1977) (14). The weight-for-age index was chosen because the exact birth dates of children were available, and age-dependant 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 (15). Two nutritional classifications (under 60 per cent weight-for-age and under 70 per cent weight-for-age) were used. Use of various nutritional status classifications is not uncommon (4,16). The under 60 per cent measure serves as an indicator of severe malnutrition, while the under 70 per cent cut-off includes both moderate and severely malnourished children.

Cross tabulations and multivariate logistic regression procedures were applied to analyze the data. The proportion of children whose weight-for-age was below 70 and 60 per cent has been tabulated against various lengths of previous and subsequent birth intervals. The odds of being moderate to severe, or severely malnourished is computed for various 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 two 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 (17).

Although some studies have found a reciprocal causal relationship between diarrhoea and malnutrition (18-20), other studies have found an association between diarrhoea and severe malnutrition in children (10). Diarrhoea episodes may inflict temporary depression in the nutritional status of children (20). 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. So, we controlled for the possible effects of diarrhoea on the nutritional status of children 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, as such, they were 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 which preceded this survey may have increased the prevalence of diarrhoea among the children through the contamination of water and food supplies, since one of every two index children had suffered from diarrhoea during the two weeks prior to the weight date. Four-fifths of the women were completely uneducated.

Table 1. Background characteristics of the sample (n = 1,887)

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

Contd...

Table 1 *(Contd.)*

Characteristics	% in category
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 two 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

Table 2 shows that the proportion of children who were under 60 per cent weight-for-age decreased as the length of the subsequent birth interval, maternal education, and housing area increased. Severely (under 60 per cent weight-for-age) and moderate-to-severely (under 70 per cent weight-for-

age) malnourished cases were highly and significantly associated with the shortest subsequent birth interval group. The proportion of children born to mother with no education was significantly higher than proportion of children born to mother with six or more year of schooling. This finding was held, whether the cut-off point of malnutrition was under 60 per cent or under 70 per cent 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 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.

Table 2. Proportion of children aged 7 to 39 months under 70 per cent and 60 per cent of weight-for-age at Sirajgonj 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[b]	28.85[a]
19-24	178	56.18	16.29
25-36	438	47.95	13.47
37+	139	43.88	10.07
No subsequent birth	1,080	47.69	14.26
Sex			
Female	908	50.11	16.41[b]
Male	979	47.70	12.46

Contd.

Table 2. *(Contd.)*

Characteristics	No. of children	Weight-for-age Under 70%	Weight-for-age Under 60%
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[b]	20.54[b]
Maternal age (years)			
≤19	352	51.14	15.34
20-34	1,278	47.26	13.07
35+	257	53.70	19.46
Maternal education			
None	1,493	52.58[a]	15.74[b]
1-5	317	39.12	10.41
6+	77	16.88	3.90
Housing unit area (sq.ft.)			
≤150	874	54.58[a]	16.13
151-300	648	44.14	11.73
301+	134	39.55	13.43
N	1,656*		
Age of index child (months)			
≤11	247	40.08	12.15
12-23	775	52.13[a]	16.00
24+	865	48.44	13.53
Diarrhoea in the last two weeks			
Yes	965	53.26[a]	17.41[a]
No	922	44.25	11.17
N	1,887	48.90	14.40

* Information on housing unit area is missing for 231 cases.

[a] Significantly different ($p < .001$) from the category of interest.

[b] Significantly different ($p < .01$) from the category of interest.

Another factor that was found to increase the likelihood of malnutrition was having diarrhoea during the previous two weeks. Children who had experienced diarrhoea in the previous two weeks were more likely to suffer from moderate-to-severe malnutrition compared to children who had not had diarrhoea. These findings support those of an earlier Bangladesh study (10,21). Among the children who had experienced diarrhoea in the past two weeks, more than 17 per cent were severely malnourished compared to 11 per cent for 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 per cent 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 two weeks. Household living area has been found to be a very good proxy measure for wealth (2,22). For this reason, it has also been included in the logistic regression model. In 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 the 60 per cent of the NCHS standard child, and zero (0), if weight-for-age is 60 per cent or more of the NCHS standard child. In case of moderate-to-severe malnourishment, the dichotomous dependent variable assumes the value of one (1) if weight-for-age is less than 70 per cent of a NCHS standard child, and zero (0), if weight-for-age is 70 per cent or more. The estimated logistic regression coefficients have been exponentiated to show the odds ratios in comparison to the reference categories for each independent variable in the model.

The results of the logistic analysis are shown in Table 3. 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 per cent higher risk of moderate-to-severe malnourishment compared to children who had a sibling born more than 24 months after their (index child's) birth. The risk of severe malnourishment was 66 per cent 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 to 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 breastfeed, due to the presence of younger, breastfed siblings.

Table 3. Odds ratios of logistic regression co-efficients of nutritional status of children (n=1,656) age 6-39 months at the Sirajgonj site of MCH-FP Extension Project: October-December, 1988

Variables	Under 70%	95% C.I	Under 60%	95% C.I
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	-

Contd.

Table 3. *(Contd.)*

Variables	Under 70%	95% C.I	Under 60%	95% C.I
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	-

* $p<.05$; **$p<.01$; ***$p<.001$

[a] RC means reference category

Among other covariates of interest, maternal age and education, age of index child, prevalence of diarrhoea during the previous two weeks, and family's wealth status were significant. Children were at higher risk of moderate-to-severe malnourishment if their mothers were younger compared to children who were born to mothers aged 20 to 34 years. This might be due to the fact that younger mothers are less experienced in rearing children and financially less well-off. Children were 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 38 per cent higher risk of severe malnourishment (weight-for-age under 60 per cent) than male children. Discrimination in the distribution of food between boys and girls within a family may be responsible for this phenomenon (18). 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 per cent respectively.

The age of the index child was a significant factor in determining moderate-to-severe child malnourishment, but not in case of severe child malnourishment. Index children aged 12-23 months were much more likely to be malnourished than children aged less than one 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 lose out nutritionally if their mothers do not get enough time to feed them. Mother may remain busy in breastfeeding their newly born infants. Older siblings may also compete successfully for some of the younger child's food.

Discussion and Policy Implications

Subsequent birth interval emerges as the single most significant factor with regard to malnourishment in infants and young children. Although it is less

indicative in the more severely malnourished children, it is a very strong predictor of moderate-to-severe malnourishment. Spacing between births, then, plays an important role in determining the health of children. The age of a child is another important variable in terms of moderate-to-severe malnourishment. For this reason, nutrition during early childhood, particularly during the second year of life, requires special attention.

This study underscores the need to understand better how increasing birth intervals will help improve the nutritional status of children. This finding has policy implications. While the primary focus for improved childhood survivorship is directed toward growth monitoring, oral rehydration, breast feeding, and immunization (GOBI), the role of family planning should not be underestimated. An intensified family planning programme should not only aim to contain the population growth rate, it should also aim to improve the health status of mothers and their children. The extent to which contraceptive use and breast feeding play a role in lengthening the birth interval and reducing malnourishment in children must further be examined. Once these relationships are more fully understood, we can work toward recommending appropriate policy changes affecting birth intervals, which will ultimately help reduce moderate-to-severe malnourishment in early childhood. This would be accomplished through further research in this area.

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A Brief History of ICDDR,B

1960	Cholera Research Laboratory established
1963	Matlab field station started
	First of a series of cholera vaccine trials launched
1966	Demographic Surveillance System established
1968	First successful clinical trials of Oral Rehydration Solution (ORS)
1969	Relationship between stopping breast-feeding and resumption of menstruation demonstrated
1971	Independence of Bangladesh
1973	Shift from Classical to El Tor cholera identified
1977	Maternal Child Health and Family Planning interventions began in Matlab
1978	Government of Bangladesh Ordinance establishing ICDDR,B signed
1981	New Dhaka hospital built
	Urban Volunteer Programme initiated
1982	Classical cholera returned
	Field testing of cereal Oral Rehydration Solution began
	Clinical sub-centres established in Matlab
	MCH-FP Extension Project began
1983	First issue of the Journal of Diarrhoeal Disease Research
	Epidemic Control Preparedness Programme initiated
1984	ICDDR,B received UNICEF's Maurice Pate award
1985	Full Expanded Programme of Immunization activities tested in Matlab
	WC/BS cholera vaccine trial launched
1987	ICDDR,B received USAID's "Science and Technology for Development" award
1988	Treatment of and research into Acute Respiratory Infection began
1989	The Matlab record keeping system, specially adapted for Government use, extended to the national family planning programme
1990	The new Matlab Health and Research Centre opened
1992	ICDDR,B-Bangladesh Rural Advancement Committee study commenced
1993	New laboratories built and equipped
	New *Vibrio cholerae* 0139, Bengal identified and characterized, work on vaccine development began
1994	Twenty fifth anniversary of ORS celebrated
	ICDDR,B epidemic response team goes to Goma to assist cholera-stricken Rwandan refugees, identifies pathogens, and helps reduce mortality from as high as 48.7% to 11%
1995	Maternal immunization with pneumococcal polysaccharide vaccine shown to protect infants up to 22 weeks