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Effects of Wealth on Nutritional Status of Pre-school Children in Bangladesh

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ABSTRACT

This paper explores the relationship between household wealth and nutritional status of pre-school children in Bangladesh using the nationally representative 2007 Bangladesh Demographic and Health Survey data. Chronic malnutrition was measured by *z*-score of height-for-age and the effect of household wealth on adverse childhood growth rate was assessed by multivariate logistic regression analyses. Overall, 43% of the children were stunted. The multivariate binary logistic regression analysis yielded significantly increased risk of stunting among the poorest (OR=2.26, 95% CI=1.77-2.89) as compared to the richest. The multivariate multinomial logistic regression produced elevated risk of moderate stunting (OR=1.98, 95% CI=1.50-2.61) and severe stunting (OR=2.88, 95% CI=2.00-4.14) of children in the poorest category compared to their richest counterparts. Children's age, duration of breastfeeding, mother's education, body mass index, mother's working status and place of region were also identified as important determinants of children's nutritional status. The findings suggest that apart from poverty reduction, maternal education, and strengthening of child and maternal health care services are important to improve health and nutritional status of the children.

Keywords: Bangladesh, nutritional status, pre-school children, wealth index,

INTRODUCTION

Globally, nutritional status is considered as the best indicator of the well-being of young children and a parameter for monitoring progress towards the Millennium Development Goals (MDGs), especially MDG 1. Hunger and malnutrition are devastating problems in the developing countries, particularly for the poor and under-privileged groups. Despite impressive advances in health sectors in recent decades, many in developing countries remain vulnerable to food insecurity, under-nutrition, and ill health (World Bank, 2001).

Malnutrition remains one of the most common causes of morbidity and mortality among children throughout the world. It has been responsible directly or indirectly for 60% of the 10.9 million deaths annually among children under-five. Over two-thirds of these deaths, which are often associated with inappropriate feeding practices, occur during the first year of life (WHO, 2002; WHO, 2003). Based on the 388 national surveys from 139 countries, a recent study

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indicates that maternal and child under-nutrition is the underlying cause of 3.5 million deaths, and 35% of the disease burden among children younger than 5 years (Black *et al*., 2008).

Bangladesh is the most densely populated country in the world and one of the poorest where millions of children and women suffer from various forms of malnutrition including low birth weight, stunting, underweight, deficiency of iodine, iron and vitamin. Though significant progress has been made in recent years to reduce the incidence of poverty and malnutrition, the fact remains that nearly half of its citizens live in deprivation, while a significant number of children under 6 years show evidence of chronic malnutrition (World Bank, 2003). In 2007, under-five mortality rate was 65 per 1000 live births. The infant mortality rate declined by 40% from 87 deaths per 1000 live births to 52 per 1000 between the periods 1989-1993 and 2002-2006 (NIPORT *et al.,* 2009).

Bangladesh has made considerable progress in alleviating poverty in the 1980s and 1990s (World Bank, 2001; Sen, 2003). Despite this, more than two-fifths of its people live below the poverty line (BBS, 2004; BBS, 2006). Recent improvements in economic conditions are believed to have benefited the rich more than the poor, and the effects of this wide and apparently growing economic inequality on health and nutrition are poorly understood (Larrea & Kawachi, 2005; Thang & Popkin, 2003).

A hospital based study on children under-five conducted in 2000-2005 showed that the prevalence of severely underweight, stunted and wasted was 16.0%, 11.0% and 3.0% respectively (Chisti *et al*., 2007). Several studies and reports suggested substantial improvement in nutritional status of children over the decades. The prevalence of underweight among under-five children has been reduced from 69.3% in 1985 to 47.0% in 20 years. For the same period, the proportion of stunted children has reduced from 55.7% to 30.8% (Faruque *et al*., 2008). Between 1990 to 2005, constant reducing trends have been observed in the prevalence of both underweight and stunting among under-five children in rural Bangladesh where the prevalence of underweight has been reduced by 25.2% and stunting by 29.1 %. In the early 1990s, severe under-nutrition accounted for about half of the total underweight and stunting; however, it accounted for about a quarter in 2005. The reduction of severe under-nutrition has been attributed to the overall reduction in stunting and underweight (HKI, 2006).

Nutritional status of children has a great impact on their health and development. Therefore, physical, mental, social as well as other characteristics related to malnutrition should be evaluated periodically to monitor malnutrition, thereby enabling appropriate preventive measures to be implemented (Hien & Kam, 2008; Taguri *et al*., 2008; Kariuki *et al*., 2002). The prevalence, types and determinants of under-nutrition such as socio-economic factors can provide useful health education and policy information. This study was conducted to address these gaps. In particular, the study aims to investigate the effect of household wealth and other socioe-conomic and demographic factors on nutritional status of under-five children in Bangladesh.

METHODOLOGY

The study used data from the nationally representative 2007 Bangladesh Demographic and Health Survey (BDHS). The survey gathered demographic, socio-economic and health related information from 10,996 ever married women aged 15-49 and 3,771 men aged 15-54 years from 10,400 households. The sampling design allowed for national estimates. The master sampling frame for the BDHS was based on the 2001 national population census. Multistage cluster sampling consisting of 361 primary sampling units, 134 from urban

areas and 227 from rural areas was performed. The details of the sampling design are provided in the main DHS report (NIPORT *et al.*, 2009). The survey maintained all protocol of the global DHS programme and verbal consent was obtained from all respondents.

Data from a weighted sample of 5,312 children aged between 0-59 months were collected in the BDHS survey. However, this study is based on 5,242 children with valid information on weight and height. A total of 70 children were excluded from the analyses due to various missing information. To assess the physical growth and nutritional status of the children, measurements of height and weight were obtained. Details of these measurements are available in the DHS report (NIPORT *et al.*, 2009).

The nutritional status of children was measured by *z*-score of height-for-age, which measures linear growth, thus reflecting long-term effects of malnutrition in a population. Ratio of height and age serves as a good proxy for the state of chronic under-nutrition among children and does not vary appreciably according to recent dietary intake. A child who was below the minus two standard deviation (-2SD) from the median of the WHO reference population in terms of height-for-age was considered as 'stunted'. A child who was below the minus three standard deviation (-3SD) from the reference median, was considered to be 'severely stunted' (NIPORT *et al.,* 2009). Stunting reflects a failure to receive adequate nutrition over a long period of time and is worsened by recurrent and chronic illness.

The principal independent variable of this study was household 'wealth index'. The wealth index used in this study was constructed from data on household assets, including ownership of durable goods (such as television and bicycle) and dwelling characteristics (such as source of drinking water, sanitation facilities and construction materials). To create the wealth index, each asset was assigned a weight (factor score) generated through principal component analysis, and the resulting asset scores were standardised in relation to a normal distribution with a mean of zero and a standard deviation of one. Each household was then assigned a score for each asset, and the scores were summed for each household; individuals were ranked based on the total score of the household in which they resided. The sample was then divided into quintiles from one (lowest) to five (highest). The details of the measurement of household wealth index are described in the BDHS main report (NIPORT *et al.*, 2009)

In data analyses, we used two outcome variables: 'normal' and 'stunted'. The 'stunted' children were later subdivided into 'moderately stunted' and 'severe stunted'. To examine the relationship between 'stunted' and various socio-demographic characteristics, we used chi-square tests. The net effects of socio-demographic and cultural factors on children's stunting were analysed by binary logistic regression. The model fitting process of the binary logistic regression analyses involved three stages of estimation. The first model (Model I) included only wealth index to assess the gross effect of the factor. Model II included children's individual as well as mother's background characteristics along with wealth index, while Model III included all contextual variables. The ratio for height-for-age for all children was made a dichotomous variable for binary logistic regression. A child was coded '1' if he/she was below the minus two standard deviation (-2SD) and '0' for otherwise. In addition to these, we employed a multivariate multinomial logistic regression analysis to assess the effect of the selected socio-demographic factors on 'moderately stunted' and 'severely stunted' as against of 'normal'. The results of the logistic regression analyses have been presented by odds ratios (ORs) with 95% confidence interval (CI). The data have been analysed by the SPSS version 17 software.

RESULTS

Profile of the children and their mothers

More than one in every five children aged 0-59 months lived in the poorest households and less than one out of five children lived in the richest households (Table 1). The children were equally distributed by age and sex. Almost one in three was the first child in the family and slightly over one fourth were second in birth order. More than half were breastfed less than two years. The mean duration of any breastfeeding was 32.5 months, while the mean duration of exclusive breastfeeding was only 3.3 months and of predominant breastfeeding was 4.8 months.

Regarding mother's profile, more than one-fourth had no formal education and slightly over one-fifth was working. The majority of them were Muslims and over one-fifth were urban residents. With regard to mother's age, 61.3% of the children were born to younger women aged 13-24 years. Almost one-third of the mothers were underweight (BMI$\leq$18.5 kg/m^2 and the mean height and weight of the women was 150.4 cm (SD$\pm$6.0) and 45.7 kg (SD$\pm$8.0) respectively.

Prevalence of stunting

Overall, 43.0% of the study children were stunted. Nutritional status was significantly (p<0.001) inversely associated with wealth index (Table 2). Among the poorest and poorer households, more than half of the children aged 0-59 months were stunted. Stunting of the children was associated significantly (p<0.001) with their age where the prevalence of stunting was less in the first six months and then increased with age. There was no significant difference in stunting by sex of children. Results also showed that stunting among children was positively associated with child's birth order, where more than half of the children with fourth and higher birth order were found to be stunted.

The prevalence of stunting increased significantly with duration of breastfeeding. Mother's age at childbirth was found to be significantly positively associated with stunting where more than half of the children born to mothers aged 35 years and above were found to be stunted. Maternal level of education was significantly inversely associated with children's stunting. Only one-fourth of the children were stunted among mothers with a higher level of education, compared to mothers with no formal education where more than half of their children were noted to be stunted. The prevalence of stunting was significantly higher among those whose mothers were working. A highly significantly (p<0.001) negative association was found between mothers' BMI and children's nutritional status where almost half of the children of underweight mothers were stunted. Findings showed a significant association between place or residence and region and children's nutritional status. Rural children were significantly more stunted than their peer urban counterparts. The prevalence of stunting among children was significantly lowest in the Khulna division compared to other regions of the country.

Effect of household wealth on nutritional status of children

Table 2 shows the effect of wealth status as well as other socio-economic and demographic factors on stunting of the children. Findings revealed that the risk of stunting significantly (p<0.001) decreased monotonically with increase in wealth status of households. For instance, the probability of stunting was 3.25 times more among children living in the poorest households than those of the richest, while the children from fourth wealth quintile households were 1.75 times more stunted than those of the richest (Model I, Table 2). The pattern of risk of stunting among the children remained the same with slightly reduced odds when some other characteristics of mothers' and

Table 1. Percentage distribution and prevalence of stunting among pre-school children aged 0-59 month(s) by household wealth quintile and selected characteristics, Bangladesh 2007

Background characteristics	*Children (weighted)*		*% stunted*	*Height-for-age z-score*	
	N	*%*		*Mean*	*Standard deviation*
Wealth quintile			*p*<0.001		
Poorest	1172	22.4	53.8	-2.06	1.34
Poorer	1131	21.6	50.3	-1.96	1.31
Middle	1018	19.4	41.9	-1.74	1.31
Richer	989	18.9	38.6	-1.63	1.25
Richest	932	17.8	26.4	-1.24	1.36
Age (in month) of children			*p*<0.001		
0-5	455	8.7	18.8	-0.93	1.34
6-11	591	11.3	24.4	-1.07	1.41
12-23	1075	20.5	40.4	-1.65	1.34
24-35	1058	20.2	53.3	-2.05	1.25
36-47	1018	19.4	54.2	-2.14	1.28
48-59	1045	19.9	45.3	-1.91	1.15
Sex of children			*p*=0.363		
Male	2600	49.6	43.6	-1.74	1.37
Female	2641	50.4	42.3	-1.76	1.32
Birth order of children			*p*<0.001		
First	1725	32.9	38.6	-1.64	1.30
Second	1388	26.5	40.1	-1.69	1.30
Third	901	17.2	44.0	-1.73	1.34
Fourth	561	10.7	49.5	-1.83	1.44
Fifth+	668	12.7	53.3	-2.12	1.39
Duration of breastfeeding (month)				*p*<0.001	
0-11	1280	24.5	25.5	-1.16	1.44
12-23	1523	29.1	43.4	-1.75	1.32
24-35	1663	31.8	50.8	-2.03	1.21
35-59	764	14.6	54.2	-2.12	1.17
Mother's age (year) at childbirth			*p*<0.001		
13-24	3214	61.3	42.0	-1.73	1.31
25-34	1741	33.2	43.4	-1.75	1.38
35-49	287	5.5	50.7	-1.98	1.45
Maternal education			*p*<0.001		
No education	1405	26.8	51.3	-1.98	1.42
Primary	1658	31.6	48.7	-1.95	1.27
Secondary	1840	35.1	35.5	-1.54	1.26
Higher	338	6.4	20.7	-.98	1.35
Mother's working status			*p*<0.001		
Not working	3842	73.3	41.5	-1.72	1.36
Working	1399	26.7	46.9	-1.84	1.30

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Table 1. Continued

Background characteristics	*Children (weighted)*		*% stunted*	*Height-for-age z-score*	
	N	*%*		*Mean*	*Standard deviation*
Mother's (kg/m^2) BMI			$p<0.001$		
<18.50	1669	31.9	48.9	-1.94	1.33
18.50-24.99	3160	60.4	42.4	-1.73	1.32
≥25.0	399	7.6	21.7	-1.10	1.32
Religion			$p=0.867$		
Islam	4791	91.4	42.9	-1.76	1.34
Others	450	8.6	43.4	-1.69	1.33
Place of residence			$p<0.001$		
Urban	1102	21.0	36.3	-1.53	1.34
Rural	4139	79.0	44.7	-1.81	1.34
Region			$p<0.001$		
Barisal	338	6.4	47.3	-1.90	1.36
Chittagong	1145	21.8	45.2	-1.81	1.39
Dhaka	1664	31.8	43.8	-1.74	1.37
Khulna	504	9.6	34.9	-1.49	1.33
Rajshahi	1151	22.0	41.5	-1.74	1.20
Sylhet	440	8.4	43.9	-1.84	1.42
Total	5242	100.0	43.0	-1.75	1.34

children, such as child's age, birth order, duration of breastfeeding, mother's age at child's birth, maternal education and mother's working status were included in the model.

Model II of Table 2 shows that the children belonging to the poorest, poorer, middle and richer wealth index quintile were 2.07, 2.04, 1.47 and 1.44 times respectively more likely to be stunted compared to those of the richest. Additionally, the full model (Model III), controlling for contextual variables further sharpened the effect of wealth status on stunting of the children. In the full model (Model III), where mothers' characteristics as well as place of residence and geographic region were controlled, the effect of household wealth status on stunting remained large and statistically highly significant ($p<0.001$). After controlling for other factors, children of the poorest household wealth status were more than twice as likely to be stunted compared to those of the richest.

Table 3 shows multinomial logistic regression estimates of household wealth status along with other socio-demographic characteristics on moderate and severe stunting separately. The findings revealed a strong significant ($p<0.001$) effect of household wealth status on both moderate and severe stunting. The effect was noted to be stronger on severe stunting (OR=2.88; 95% CI=2.00-4.14) compared to moderate stunting (OR=1.98; 95% CI=1.50-2.61).

Effect of other socio-demographic factors on nutritional status of children

Children's age showed the most single significant effect on stunting after controlling

Table 2. Logistic regression odds ratio showing the risk of stunting of pre-school children by background characteristics

Background characteristics	*Odds ratio (95% confidence interval)*		
	Model I	*Model II*	*Model III*
Wealth quintile			
Poorest	3.25*** (2.70-3.91)	2.07*** (1.67-2.58)	2.26*** (1.77-2.89)
Poorer	2.83*** (2.35-3.41)	2.04*** (1.65-2.52)	2.17*** (1.72-2.75)
Middle	2.01*** (1.66-2.44)	1.47*** (1.19-1.81)	1.55*** (1.23-1.95)
Richer	1.75*** (1.45-2.13)	1.44*** (1.17-1.78)	1.50*** (1.20-1.87)
Richest			
Age (month) of children			
0-5			
6-11		1.42** (1.04-1.92)	1.43** (1.05-1.94)
12-23		2.73*** (1.81-4.10)	2.80*** (1.86-4.21)
24-35		4.59*** (3.12-6.76)	4.65*** (3.15-6.84)
36-47		4.29*** (2.94-6.27)	4.24*** (2.91-6.20)
48-59		3.00*** (2.05-4.38)	2.96*** (2.02-4.33)
Birth order of children			
First			
Second		1.01 (0.85-1.17)	0.99 (0.85-1.16)
Third		1.07 (0.88-1.29)	1.06 (0.87-1.28)
Fourth		1.23** (0.98-1.56)	1.20‡ (0.95-1.52)
Fifth+		1.28*** (0.99-1.64)	1.22‡ (0.95-1.57)
Duration of breastfeeding			
0-11			
12-23		1.12 (0.82-1.53)	1.09 (0.79-1.49)
24-35		1.14 (0.85-1.53)	1.15 (0.85-1.54)
35-59		1.35* (0.99-1.86)	1.45** (1.05-1.99)
Mother's age at child birth			
13-24			
25-34		0.91 (0.78-1.08)	0.92 (0.79-1.07)
35-49		0.98 (0.73-1.32)	0.99 (0.73-1.33)
Maternal education			
No education			
Primary		1.07 (0.91-1.24)	1.09 (0.93-1.27)
Secondary		0.77*** (0.64-0.91)	0.79** (0.66-0.94)
Higher		0.52*** (0.38-0.73)	0.54*** (0.39-0.75)
Mother's working status			
Not working			
Working		0.95 (0.83-1.09)	0.97 (0.85-1.12)
Mother's (kg/m^2) BMI			
<18.50			
18.50-24.99		0.87** (0.77-0.99)	0.87** (0.76-0.99)
≥25.0		0.45*** (0.34-0.60)	0.45*** (0.34-0.59)

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Table 2. Continued

Background characteristics	*Odds ratio (95% confidence interval)*		
	Model I	*Model II*	*Model III*
Place of residence			
Urban			
Rural			0.92 (0.78-1.09)
Region			
Barisal			
Chittagong			1.17 (0.90-1.52)
Dhaka			0.99 (0.77-1.28)
Khulna			0.69** (0.51-0.93)
Rajshahi			0.86 (0.67-1.12)
Sylhet			0.90 (0.66-1.22)

Note: Level of significance *** $p<0.001$; ** $p<0.01$; * $p<0.05$ and ‡ $p<0.10$.

for other variables in multinomial logistic regression. Results revealed that the children aged 24-47 months were significantly the most vulnerable to be stunting and severe stunting compared to others (Table 2 and Table 3). Birth order of children showed a significant ($p<0.01$) strong effect on stunting (Model II) after controlling for wealth status as well as other socio-economic characteristics. However, its effect appeared to be weaker in the final model (Model III).

Duration of breastfeeding was found to have little influence on children's stunting. Mother's age at child's birth, working status and religion did not have a significant effect on nutritional status. Mother's BMI demonstrated an inverse relationship with child's stunting. Maternal education showed a higher significant effect on overall stunting status where the higher the mother's level of education, the lesser was the risk of stunting in their children (Table 2: Model II and Model III). When stunting was grouped into three categories: normal, moderate and severe, the effect of mothers' education appeared to be less effective for moderate stunting but remained high for severe stunting (Table 3).

DISCUSSION AND CONCLUSION

In this study, we examined the relationship between household wealth and nutritional status of pre-school children in Bangladesh using nationally representative data. The findings revealed pervasive chronic childhood under-nutrition in Bangladesh. Children of the poorer households were at a higher risk of being chronically undernourished than those of the better-off households. Findings of the independent analysis, when other socio-economic and demographic characteristics were not included in the regression model, showed the children of the poorest wealth quintile households to be more than thrice at risk of suffering from childhood growth-stunting than the children of the richest wealth quintile households. These results remained consistent with slight attenuation even when other socio-demographic variables were held constant. The effect was noted to be more prominent in severe stunting as compared to moderate stunting when analysed separately. These findings are consistent with earlier studies conducted in other developing countries including

Table 3. Multinomial logistic regression odds ratio showing the risk of moderate and severe stunting verses normal among pre-school children in Bangladesh

Background factors	*Moderate vs. normal*			*Severe vs. normal*		
	Odds ratio	*95% CI*		*Odds ratio*	*95% CI*	
		Lower	*Upper*		*Lower*	*Upper*
Wealth quintile (ref: richest)						
Poorest	1.98***	1.50	2.61	2.88***	2.00	4.14
Poorer	1.99***	1.53	2.60	2.55***	1.79	3.63
Middle	1.49***	1.14	1.93	1.68***	1.18	2.40
Richer	1.52***	1.19	1.95	1.42*	1.00	2.02
Age (month) of children (ref: 0-5)						
6-11	1.42*	0.99	2.02	1.44	0.86	2.41
12-23	1.99**	1.23	3.23	4.69***	2.58	8.50
24-35	3.10***	1.95	4.93	8.90***	5.08	15.60
36-47	2.73***	1.73	4.30	8.59***	4.97	14.87
48-59	2.16***	1.37	3.40	4.82***	2.77	8.39
Sex of child (ref: female)						
Male	0.94	0.82	1.07	0.94	0.80	1.11
Birth order of child (ref: first)						
Second	0.99	0.83	1.18	1.01	0.81	1.27
Third	1.20‡	0.97	1.49	0.83	0.63	1.10
Fourth	1.32*	1.01	1.72	1.02	0.73	1.41
Fifth+	1.16	0.87	1.55	1.28‡	0.92	1.79
Duration of breastfeeding (ref: 0-5 months)						
12-23	1.47*	1.00	2.15	0.71‡	0.47	1.07
24-35	1.49*	1.04	2.14	0.80	0.55	1.16
35-59	1.87***	1.27	2.74	1.01	0.67	1.51
Mother's age at childbirth (ref: 13-24 y)						
25-34	0.88‡	0.73	1.04	1.00	0.81	1.24
35-49	0.96	0.68	1.35	1.05	0.71	1.56
Maternal education (ref: illiterate)						
Primary	1.16‡	0.97	1.38	1.00	0.82	1.23
Secondary	0.93	0.76	1.13	0.59***	0.46	0.75
Higher	0.66**	0.46	0.95	0.36***	0.21	0.63
Women's working status (ref: not working)						
Working	1.00	0.86	1.17	0.93	0.77	1.13
Mother's (kg/m^2) BMI (ref: <18.50)						
18.50-24.99	0.90	0.78	1.04	0.81**	0.68	0.96
≥25.0	0.54***	0.39	0.73	0.28***	0.17	0.46
Religion (ref: Islam)						
Non-Muslim	1.07	0.84	1.36	1.07	0.80	1.44
Residence (ref: urban)						
Rural	0.94	0.78	1.14	0.89	0.70	1.14

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Table 3. Continued

Background factors	*Moderate vs. normal*			*Severe vs. normal*		
	Odds ratio	*95% CI*		*Odds ratio*	*95% CI*	
		Lower	*Upper*		*Lower*	*Upper*
Region (ref: Barisal)						
Barisal	1.14	0.84	1.55	1.23	0.87	1.73
Chittagong	1.13	0.85	1.52	0.79	0.57	1.11
Dhaka	0.82	0.58	1.15	0.49***	0.32	0.75
Khulna	0.99	0.74	1.35	0.67**	0.47	0.95
Rajshahi	0.89	0.62	1.27	0.90	0.60	1.33

Note: Level of significance *** $p<0.001$; ** $p<0.01$; * $p<0.05$ and ‡ $p<0.10$.

Bangladesh (Hong, Banta & Betancourt, 2006; Hong & Mishra, 2006; Wang, Monteiro & Popkin, 2002; Doak *et al*., 2002). Thus household economic status is an important determinant of childhood under-nutrition in developing countries.

The finding of the study revealed that the risk of malnutrition increases with age. The lower risk among lower aged children may be due to the protective effect of breastfeeding, since almost all children in Bangladesh are breastfed and most of them continue to be breastfed throughout the first six months and even one year of their life. Breastfeeding in Bangladesh is universal and 98.0% of the children were breastfed at some point (NIPORT *et al,* 2009). Consistent with other studies (Samson & Lakech, 2000; Adair & Guilkey, 1997), the results of this study indicated that the highest risk of stunting was among children aged 24-47 months. The high rates of stunting observed after 12 months are linked to inappropriate food supplementation during the weaning period due to premature discontinuation of breastfeeding, earlier than the suggested 24 months (Hien & Kam, 2008).

There was no sex differential in stunting in our study. This finding indicates that intra-household sex bias in feeding and health care for children in Bangladesh has been diminished. An increasing pattern of stunting by age is a typical outcome of nutritional status of children in developing countries. This may be partly due to the beginning of feeding solid foods to a child around 6 months of age, which increases the likelihood of consuming contaminated foods and removes the inherent protection provided by breast milk. Additionally, children begin crawling around this age and are more likely to be carried outdoors, which exposes them to additional infections (Hong *et al*., 2006). The high prevalence of stunting among children aged two years and more enhances the chronicity of under-nutrition among the studied children. Deterrence of physical growth demonstrated by stunting is also associated with deterrence of other dimensions of growth. This issue should be looked into seriously in order to nurture a competitive and resilient future generation.

Consistent with past research, children of multiple-birth status are more likely to be undernourished than children who are single-births (Hien & Kam, 2008; Jaffar, 1998). However, the results of this study also indicate a relationship between low family income and a large number of children. This finding suggests that children of low-income families often only have a limited range of food sources, which results in more competition for available food when the family contains many children. Children from families with three or more children were more likely to be underweight, stunted

and wasted than children from families with two or less children (Hien and Kam, 2008). This may be partly attributed to the fact that mothers with many children have less time overall to devote to childcare than those who have fewer children. Hence, the importance of family planning is undeniable. This study highlights the need for an extensive family planning programme in promoting an optimum number of children for each family especially among the poor.

There is a higher proportion of stunting among children who were breastfed for more than one year. Supplemental feeding and nutritious weaning food along with breast milk is very important for children during this growing period. Our findings may be partly attributed to the fact that poorer mothers are more likely to continue breastfeeding as a substitute for supplemental feeding, resulting in the increased risk of stunting among the children. This finding is also in line with a review done by Black *et al.* (2008) which relates suboptimal breastfeeding to childhood stunting, severe wasting and underweight. Another possible reason is because of the poor nutritional status of the breastfeeding mothers themselves where almost a third of the mothers were underweight. These shows the effect of trans-generational under nutrition as shown in another study (Rahman *et al.*, 1993), which again needed serious attention in ensuring the improvement of the children's nutritional status and breaking of the vicious cycle.

Several studies found that mother's level of education is associated with more efficient management of limited household resources, greater utilisation of available health care services, better health promoting behaviours, lower fertility and more child-centred caring practices, all of which are associated with better child health and nutrition (Shah *et al.*, 2003; Felice, 1999). Our finding is also consistent with a study conducted on children in Nicaragua (Pena, Wall & Persson, 2000).

The insignificant relationship between stunting and place of residence, suggests that in the presence of important socio-economic variables, area of residence alone is not a predictor of nutritional status of children. This finding is also consistent with that conducted in Ethiopia (Girma & Genebo, 2002). However, with regard to regional location, the risk of stunting was significantly lowest amongst children of Khulna division as compared to other regions. In addition, the children of Khulna and Dhaka were significantly less likely to showsevere stunting. This is probably because these regions are more industrialised compared to the others, offering significant difference in socio-economic status than other regions of the country.

Another difference between the results of this study and those of other studies is that no association was found between underweight, stunting or wasting and the mother's age at birth. Previous studies have reported a 'U shaped' association between maternal age and child malnutrition where the prevalence of malnutrition is highest among younger mothers (<25 years) and older mothers (≥35 years) (World Bank, 2005). It was suggested that this increased risk in younger mothers is due to a lack of readiness to take care of a child and the common delivery complications while the increased risk of malnutrition in older mothers (≥35 years) is due to the increased likelihood of giving birth to babies with a low birth weight. However, in Bangladesh, the children of young mothers are usually taken care by their grandmothers, which may explain why the results of this study differed from those of previously conducted studies.

In conclusion, the study found a strong relationship between nutritional status of children under-five and household wealth status, children's age, duration of breastfeeding, mother's education, body mass index and mother's working status. The findings suggest that under-nutrition

of children may be reduced by improving mother's education, mother's nutrition and child feeding practices. Awareness should be created among women regarding the hazardous effect of large family size and childbirth at teen ages because of their interrelationship with nutritional status of children. The interventions for improving girls' education should be strengthened since maternal education is a powerful weapon to reduce child malnutrition. Poverty reduction strategic programme (PRSP), comprehensive child and maternal health programmes together with reliable and acceptable family planning initiatives should be strengthened to improve the general health and wellbeing of the family which eventually will improve the health and nutritional status of children in Bangladesh.

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