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Nutritional Status of Children Associated with Socio-Demographic Variables and Food Security in Rural Bangladesh

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ABSTRACT

Objective: The study was undertaken to investigate the nutritional status of children and its association with their socio-demographic variables and food security status in disadvantaged rural Bangladesh. **Methods:** A cross-sectional study was conducted in fifteen villages of three different ecological zones. Three anthropometric indicators, namely stunting, underweight and thinness were measured among children aged 2-10 years. Six child-referred questions were used to construct the children's food security scale. Simple and multiple binary logistic regression analyses were used to assess the likelihood of children's nutritional and food security level. **Results:** A total of 156 children aged 24-59 months and 246 children aged 5-<10 years (60-119 months) were included in the study. Among the younger children, the prevalence of severe stunting and thinness were 14.1% and 31.4% respectively, while in the older age group, the respective prevalence was 17.5% and 22.3%. Among the children aged 24-59 months, boys were 73% more likely to stunt, 27% less likely to thin and 21% more likely to face food insecurity. Maternal education, number of children in the family and household income were the strong predictors of child nutritional status. Food insecure children aged 60-119 months were 39% more likely to stunt but 3.5 times more likely to thin than the food secured children. **Conclusion:** Children of the studied population are at high risk of malnutrition. Awareness, availability and accessibility to family planning should be strengthened to limit number of children in the family and increase female education including nutritional knowledge. A Nutrition Rehabilitation Programme (NRP) should be formulated for the children under 5 years. It is suggested that the Government starts free nutritious food for rural disadvantaged school going children during school hours.

Keywords: Anthropometric measurements, children, disadvantaged region, food security, nutritional status

INTRODUCTION

Malnutrition is one of the main public health problems that affects large numbers of children in developing countries where an estimated 50.6 million children aged less than five years are malnourished (Best *et al.*, 2007). Statistics on the prevalence of protein-energy malnutrition in these countries indicate that, on average, stunting (low

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height-for-age), underweight (low weight-for age) and wasting (low weight-for-height) affect about 30%, 27% and 8% of the child population respectively (WHO & UNICEF, 2004). Malnutrition lowers the body's ability to resist infection by undermining the functioning of the main immune-response mechanism. This leads to longer, more severe and more frequent episodes of illness. Also it increases a child's risk of contracting respiratory infections, diarrhoea, measles and other diseases that often kill children or permanently harm their physical, psycho-social and cognitive development (UNICEF, 1999).

Bangladesh has one of the highest prevalence of childhood underweight rates in the world with underweight and stunting of the under five children being 41% and 43%, respectively in 2007 (BDHS, 2007). These children are naturally vulnerable, often suffering from malnutrition with above 50% of them being moderate or severely malnourished (Rayhan & Khan, 2006), which is a major risk factor for childhood mortality. Underweight and stunting appears to be a major problem among the low income children aged 2-10 years. Globally, nutritional status is considered as the best indicator of the well-being of young children and parents for monitoring the progress towards the millennium development goals (Rahman, Mostofa & Nasrin, 2009).

The prevalence of malnutrition due to food insecurity is well recognised in the world, especially in the developing countries. Household food insecurity is closely related to children's undernutrition (Saha *et al.*, 2009). 'Hilly', 'coastal', and 'river-flooded' areas are the most vulnerable dis-advantaged regions in Bangladesh and which are inhabited by vast populations who are extremely poor. Children in these areas suffer from food deficiency and malnutrition and these are the serious problems in children under 10 years. In order to reduce malnutrition and food insecurity of children, a careful examination of various socio-demographic determinants like child's sex and age group, mother's education, number of children in the family, household income etc. is required. Children's food insecurity may also be associated with low income (Tingay *et al.*, 2003) and large numbers of children in the family. The socio-demographic characteristics and the food security scale of children are interrelated, and their effects are, therefore, better associated in a multivariate context. Hence, understanding the consequences of food insecurity on the nutritional outcomes is crucial to addressing the public health risk of food insecurity in children of these areas through more effective nutritional and health services.

Factors associated with nutritional status of children in Bangladesh have been studied in the population of a nationally representative survey (Rayhan & Khan, 2006), Dhaka city (Begum & Nessa, 2008), industrial area (Islam, Islam & Ahsan, 2003) and *monga* phenomenon - the yearly cyclical phenomenon of poverty and hunger in Bangladesh (Islam, Alam & Buysse, 2012). But, the nutritional and food security status of children in disadvantaged communities like hilly, coastal and river-flooded areas remains unreported where prevalence of food insecurity and malnutrition are supposed to be higher than the national level. Thus, to develop a national policy for solving the malnutrition problem of children in these areas, the present study was undertaken to (a) investigate the health, nutritional and food security status among the dis-advantaged rural Bangladeshi children and (b) explore the relationship of their nutritional outcomes with socio-demographic factors and food security status.

METHODS

Study design and sample

A community based, cross-sectional study was conducted in three ecologically contrasting disadvantaged regions (river

flooded, hilly/ forest and coastal) from January to June 2009. Regions were selected by using a purposive sampling procedure keeping in view the operational feasibility. Fifteen villages (6 from two different river flooded areas, 3 from hilly areas, 3 from forests areas and 3 from coastal areas) were selected. Three adjacent villages from each location were selected. A complete listing of households having children aged 24-119 months residing in each selected village was carried out. A total of 310 households (10% of aggregate 3096 households in fifteen villages) were selected randomly through house-to-house visits. There were 115 households from river flooded areas, 63 from hilly, 60 from forest and 72 from coastal areas selected based on total number of households having children aged 24-119 months in different regions. Only one child was selected from each age group and from each household and hence 156 children aged 24-59 months and 246 children aged 60-119 months were selected for the study. The mothers of the children or household head were interviewed with a structured interview schedule regarding socio-demographics and food intake level of the children. Also the interview schedule included qualitative information on health condition of children, treatment facilities, level of curing, immunisation coverage etc. Those were measured / classified as self-reported by the respondents.

Socio-demographic variables

In order to estimate dependency of nutritional status and food security status of children some socio-demographic variables which have direct influence on these outcomes were considered. After reviewing all the explanatory variables, the following socio-demographic variables were anticipated to have an impact on the likelihood of nutritional status and food security scale of the children: sex, age, number of children in the family, mother's education and household monthly income. Children were categorised as poor whose family income was less than the average income of all households and non-poor, otherwise.

Measurement of child nutritional status

Age of a child was determined in months from the available records. Height was measured to the nearest 1 cm and weight to the nearest 0.1 kg. Three anthropometric indicators, height-for-age, weight-for-age and body mass index, were used to assess the nutritional status of children (Alderman, 2000). These indicators were interpreted by using the Z-score classification system which is the most appropriate descriptor of malnutrition and health. Reference value of median and standard deviation were used from the data of the World Health Organization (WHO, 2007). Z-score = (Observed value – Median value of the reference population) / Standard deviation value of reference population. For population-based assessment, the Z-score is widely recognised as the best system for analysis and presentation of anthropometrics because of its advantages compared to other methods (Cogill, 2003). Malnutrition level of children based on height-for-age and weight-for-age Z-scores were classified as (i) mild: -1 SD > Z-score >= -2 SD, (ii) moderate: -2 SD > Z-score >= -3 SD and (iii) severe: Z-score < -3 SD (Bomela, 2009). Thinness of children was determined by calculating Body Mass Index (BMI) = kg / m^2 and classified as ((i) normal (healthy weight): 18.5 >= BMI < 25.0; (ii) underweight (mild thinness): 16.0 >= BMI < 18.5; (iii) severely underweight (moderate thinness): 15.0 >= BMI < 16.0; and (iv) very severely underweight (severe thinness): BMI < 15.0.

Child food security scale

To accurately measure the food security scale of children in a household survey, a tool has been developed by the US Department of Agriculture (Nord & Bickel, 2002). In this study, six child-referred questions were used

to construct the children's food security scale. The scale provided the framework for a corresponding categorical measure of children's hunger. Household head and / or mother of the children were asked the questions on food intake level of the children in the past 12 months. The mothers or household head were briefed about the questionnaire, especially, technical terms to rate their children's food intake in the past 12 months. The six-item short form of questions were as follows: (i) children often relied on a few kinds of low-cost food or imbalanced meal because parents could not afford proper and balanced food; (ii) children were not eating enough because they just could not afford enough food; (iii) size of the children's meals was reduced because there was not enough money for food; (iv) children were skipping meals once or twice in most of the days; (v) children were hungry but they could not afford more food; and (vi) children were not eating for the whole day. Each question had four response options: never, rarely, sometimes and often, which were coded in order of increasing frequency from 0-3. A child was classified as food insecure if the family reported experiencing any of the six conditions within the recall period (i.e., if the answer to any of the questions was rarely, sometimes or often), otherwise he or she was classified as food secure. A pre-test was done with 15 respondents who were included in the final survey for the extent to which the child food security scale is consistent over time and an accurate representation of the study sample. The scale's consistency was assessed by correlating the individual items with the total scale score. Further, the reliability statistic of the Cronbach's alpha was calculated.

Statistical analysis

Logistic regression analysis was carried out to determine the chances of stunted, underweight and wasted children included in the study. Nutritional status (stunting, underweight and wasting) of children was the dependent variable which took a value of 1 for those children who were moderately or severely malnourished and 0 for those who were normal or mildly malnourished. Also, logistic regression was used to estimate the association between socio-demographic variables and food security status. In this analysis, food insecurity status was considered as a dependent variable (dichotomous: 1 for food insecure children and 0 for food secure children). As such, the binary logit model fits the current study, as it can predict the probabilities that lie in the unit interval. The logistic regression model is

$$P = P(Y = 1/X) = \frac{e^{\beta_0+\beta_1 X}}{1+e^{\beta_0+\beta_1 X}}$$

and $$1-P = P(Y = 0/X) = \frac{1}{1+e^{\beta_0+\beta_1 X}}$$

Then, a transformation of P known as the logit transformation and defined as

$$g(X) = \text{logit } P = \log\left[\frac{P}{1-P}\right] = \beta_0 + \beta_1 X$$

where, P is the probability of malnutrition (one of the nutritional outcomes) or probability of food security status and β_1 is the coefficients for the explanatory variables X_i.

Firstly, simple logistic regression was used to explore the association between one outcome (dichotomous) and one exposure (categorical) variable with the odds ratio termed as crude odds ratio. Secondly, multiple logistic regression was used to explore the association between one dichotomous variable and all of the socio-economic variables. Odds ratios for outcome categories, taking into account the ordering of outcomes categories and 95% confidence intervals, were calculated to test the significance of odds ratios. Association between food security level and nutritional status of children was estimated from the contingency table, using the chi-square statistic to verify the significance of

association. Data analyses were performed with the Statistical Package for Social Science (SPSS) for Version 16.

RESULTS

Of the total 310 households surveyed, 156 households had children aged 24-59 months and 246 households had children aged 5-<10 years. An average household income was Tk.4542 (US$ 1=Tk.69.5 in 2009) per month (SE = 4447 and range Tk.900-Tk.50000) and 231 households had below average income.

One hundred and eighty five mothers (59.7%) were found illiterate (Table 1). Only 16.4% of the mothers had schooling above primary level. While 34.8% households had 1-2 children, 50% had 3-4 children and 15.2% had more than 4 children.

Only 11% of the households stated that their children were healthy; more than 50% were sick sometime while 37% were sick often or very often. Two-thirds of the households claimed that treatment facilities around their locality were absent or insufficient. About 41% of the respondents stated that their children became well if they received treatment when sick.

Nutritional status

Figure 1 shows that the mean height-for-age Z scores for both boys and girls were below minus 2SD from 24 months until the children were 5 years and above.

Among children aged 24-59 months, the prevalence of stunting, underweight and thinness was 48.1%, 71.8% and 60.2%, respectively in this age group (Table 2). Severe stunting was higher among the boys (20.2%) compared to the girls (6%). However, the prevalence of moderate and severe underweight was higher in girls (31.3% and 46.3%, respectively) than among the boys (24.7% and 43.8%, respectively).

By income, the prevalence of severe stunting was higher in children from households with below average income (15.7%) than children from above average income (8.6%). Severe underweight and severe thinness were found in 48.8% and 40.2% children from below average income households, respectively; these values were higher than those of children from above average income households (31.4% and 10.8%, respectively).

Based on literacy of mothers, severe underweight and severe thinness were found in 49.3% and 38.0% of children among illiterate mothers, respectively and these values were higher than those of literate mothers (38.6% and 25.0%, respectively).

Children aged 5-<10 years)

As for the prevalence of stunting and thinness, they were 28.9% and 47.1%, respectively. Also, the percentages of stunting and thinness were relatively higher in households with below average income and illiterate mothers compared to their counterparts.

Food security level

Nearly three-quarters (73.7%) of the children aged 24-59 months and 69.1% of children aged 5-<10 years were from food insecure households (Table 3). There was a higher prevalence of boys than girls from food insecure households. Based on odds ratios, families with more than two children and with below average income were more likely to be food insecure. Based on regions for young children aged 24-59 months, the likelihood of food insecurity was higher in the hills/ forests and coastal regions respectively, compared to river-flooded regions.

Associations of nutrition status

Based on odds ratio, children of both the age groups with educated (both primary and above primary) mothers were less likely to experience stunting and thinness compared to children with illiterate mothers. Children aged 24-59 months with below average household income were more likely to be

Table 1. Background information on mothers and children

	All (N = 310)	*Percent*
Household characteristics		
Maternal education		
Illiterate	185	59.7
Primary	74	23.9
Above primary	51	16.4
Number of children per family		
0 – 2	108	34.8
3 – 4	155	50.0
5 and above	47	15.2
Age group 24-59 month		
Boys	89	57.0
Girls	67	43.0
Mean age (month)	40.7	
Age group 5-<10 years (60-119 months)		
Boys	140	57.0
Girls	106	43.0
Mean age (month)	92.2	
Overall prevalence of food insecure		70.9
Age group 24-59 months		73.7
Age group 5-<10 years		69.1
Mother's response about health of child		
How often is child sick?		
Healthy	34	11.0
Sometime	161	51.9.
Often	99	31.9
Very Often	16	5.2
Treatment facilities available		
Sufficient	102	32.9
Insufficient	124	40.0
Absent	84	27.1
Level of wellness after treatment		
Almost well	113	41.0
Sometimes well	157	57.0
Not well	06	2.0
Immunisation coverage		
Regular	304	98.0
Irregular	06	2.0
Visit hospital when sick		
Almost always	59	19.0
Sometime	205	66.1
Never	46	14.9
Bath taken regularly		
Yes	254	81.9
No	56	18.1

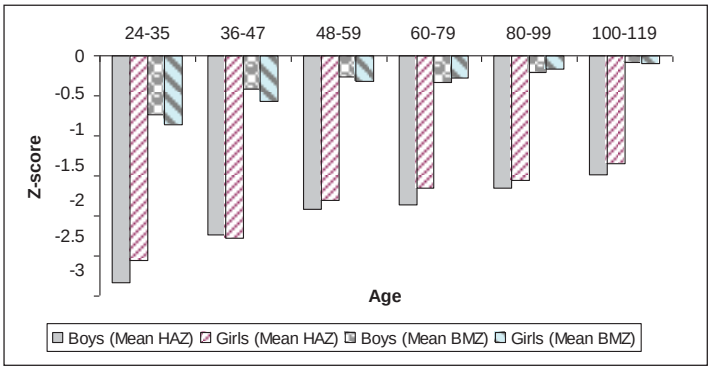

Figure 1. Mean values for HAZ and BMZ by gender and age groups

Table 2. Prevalence of malnutrition among children aged 24-59 and 5-<10 years

Level of severity	*Children aged 24-59 months*			*Aged 5-<10 yrs*	
	Stunting	*Underweight*	*Thinness*	*Stunting*	*Thinness*
All Children*					
Mild	21.8	10.9	25.6	30.9	38.6
Moderate	34.0	26.9	28.8	11.4	24.8
Severe	14.1	44.9	31.4	17.5	22.3
Boys					
Mild	23.6	15.7	23.6	46.4	31.4
Moderate	33.7	24.7	28.1	7.1	25.0
Severe	20.2	43.8	31.5	20.7	25.0
Girls					
Mild	19.4	7.5	22.4	14.1	41.5
Moderate	34.3	31.3	31.3	13.2	29.2
Severe	6.0	46.3	35.8	13.2	20.7
Below average income					
Mild	24.0	10.7	21.0	27.2	42.8
Moderate	34.7	28.9	27.7	13.7	26.4
Severe	15.7	48.8	42.0	21.2	22.5
Above average income					
Mild	14.3	17.1	40.5	34.7	26.5
Moderate	31.4	20.0	18.9	10.9	20.3
Severe	8.6	31.4	10.8	7.5	21.9
Illiterate mothers					
Mild	22.8	7.3	21.7	26.3	35.8
Moderate	46.7	32.2	28.3	15.3	32.1
Severe	12.0	49.3	38.0	21.9	28.5
Literate mothers					
Mild	25.0	16.1	29.7	31.2	42.2
Moderate	23.0	19.3	28.1	10.1	15.6
Severe	15.6	38.6	25.0	13.7	14.6
By regions**					
River-flooded	40.4	70.2	56.1	24.4	46.7
Hills/ Forests	57.4	70.5	60.7	33.0	43.0
Coastal	44.7	76.3	65.8	28.6	55.4

Figures indicate percentages
* Children with z-score >= -1.0 and BMI >= 18.5 are excluded.
**Only the total of moderate and severe prevalence is shown for regional data.

Table 3. Prevalence of food insecurity and crude odds ratio of children among socio-demographic variables.

Socio-demographic variables	*Age 24-59 months*		*Age 5-<10 years*		*All children*	
	Food insecurity (%)	*Odds ratio (95% CI#)*	*Food insecurity (%)*	*Odds ratio (95% CI#)*	*Food insecurity (%)*	*Odds ratio (95% CI#)*
Sex of children						
Girls *	71.6	1.0	68.9	1.0	69.9	1.0
Boys	75.3	1.21 (0.59-2.47)	69.3	1.02 (0.59-1.76)	71.6	1.08 (0.70-1.67)
Age of children						
24 – 35 months*	70.2	1.0			73.7[1]	1.0
36 – 47 months	81.8	1.91 (0.76-4.83)			69.1[2]	0.80 (0.51-1.25)
48 – 59 months	68.5	0.92 (0.40-2.16)				
60 – 79 months*			71.4	1.0		
80 – 99 months			74.0	1.14 (0.57-2.27)		
100 -119 months			61.3	0.63 (0.32-1.26)		
Maternal education						
Illiterate*	95.7	1.0	91.2	1.0	93.0	1.0
Primary education	52.6	0.05 (0.02-0.17)	46.2	0.08 (0.04-0.18)	48.5	0.07 (0.04-0.13)
High school and above	26.9	0.02 (0.01-0.06)	34.1	0.05 (0.02-0.12)	31.4	0.03 (0.02-0.07)
Children per household						
1 or 2 children*	49.2	1.0	50.6	1.0	50.0	1.0
More than 2 children	91.2	10.69 (4.47-25.6)	78.5	3.57 (2.02-6.31)	83.1	4.91 (3.09-7.77)
Household income						
Above average income*	28.0	1.0	18.8	1.0	22.8	1.0
Below average income	95.3	51.9 (17.5-154)	86.8	28.5 (13.3-61.0)	89.9	30.2 (16.9-54.0)
Regions						
River-flooded	69.5	1.0	70.4	1.0	67.9	1.0
Hills/ Forests	74.2	1.31 (0.94-5.56)	69.8	0.97 (0.29-2.33)	70.2	1.12 (0.56-3.74)
Coastal	73.3	1.20 (0.35-3.16)	67.5	0.83 (0.22-1.92)	68.5	1.05 (0.41-2.21)

* indicates reference category, CI# – confidence interval

[1] indicates children aged 24-59 months and [2] indicates children aged 60-119 months

stunting, underweight and thinness compared to children with above average household income.

Food insecure children aged 24-59 months ware more likely to experience stunting, underweight and thinness compared to food secured children. Food insecure children aged 5-<10 years were 1.4 times more likely to be stunting and 3.5 times more likely to expereince thinness compared to food secured children (Table 4). Modified form of Table 4 is given in the following page.

Table 4. Adjusted odds ratio of children among **s**ocio-demographic variables and food security level.

Socio-demographic variables	*Children aged 24-59 months*			*Children aged 60-119 months*	
	Stunting	*Underweight*	*Thinness*	*Stunting*	*Thinness*
Female*	1.0	1.0	1.0	1.0	1.0
Male children	1.65 (0.70-3.88)	0.19 (0.03-1.26)	0.59 (0.20-1.75)	1.37 (0.77-2.41)	1.03 (0.43-2.49)
Age: 24 - 35 months*	1.0	1.0	1.0	1.0	1.0
Age: 36 – 47 months	0.61 (0.21-1.80)	3.81 (0.49-29.6)	0.45 (0.10-2.04)	1.19 (0.62-2.28)	1.53 (0.50-4.65)
Age: 48 – 59 months	0.20 (0.06-0.64)	1.47 (0.15-14.36)	0.26 (0.06-1.10)	0.37 (0.17-0.80)	0.94 (0.33-2.71)
Illiterate mother*	1.0	1.0	1.0	1.0	1.0
With primary education	0.47 (0.15-1.43)	0.04 (.0.01-0.45)	0.35 (0.07-1.82)	0.62 (0.29-1.30)	0.32 (0.08-1.22)
Above primary education	0.09 (0.06-0.55)	0.02 (0.01-0.22)	0.21 (0.04-1.19)	0.58 (0.23-1.48)	0.07 (0.02-0.26)
1-2 children *	1.0	1.0	1.0	1.0	1.0
More than 2 children	8.94 (3.23-24.76)	0.49 (0.08-3.08)	0.32 (0.07-136)	1.08 (0.58-2.01)	1.13 (0.45-2.83)
Above average income	1.0	1.0	1.0	1.0	1.0
Below average income	5.54 (1.27-24.10)	67.54 (7.86-580)	1.16 (0.21-6.32)	2.17 (0.88-5.39)	1.11 (0.36-3.44)
Food secured	1.0	1.0	1.0	1.0	1.0
Food insecure	9.67 (1.88-49.7)	6.82 (0.98-47.24)	11.50 (1.86-71.12)	1.39 (0.58-3.39	3.47 (1.01-11.92)

* Indicates reference category and figures in the parentheses are the 95% confidence intervals

DISCUSSION

The study was conducted on children of disadvantaged rural areas. The socio-demographic profile indicates that the households are poor depending mainly on agricultural production activities. The education level of mothers is behind the national average levels. Around 60% of the mothers are illiterate, with the remaining percent of mothers having an education up to primary level. Consequently, the health and nutritional status of the children of these regions is poor

The prevalence rates of malnutrition of the study children are high compared to the national levels of malnutrition (BDHS, 2007). The prevalence of underweight and thinness was relatively higher compared to stunting indicating serious malnutrition problems. Presence of severe stunting among the boys indicates they had been exposed to under-nutrition for a longer term, especially those from low income households. Similar findings have been reported by others (Sichieri *et al.*, 1996; Hackett, Melgar-Quinonez & Alvarez, 2009).

Compared to the older children, the children aged 24-59 months had a very high prevalence of stunting, underweight and wasting. A similar prevalence of stunting, slightly lower prevalence of underweight and a lower prevalence of wasting in this age group have been reported by the

Bangladesh Bureau of statistics (BBS, 2001). Likewise, a high prevalence of stunting and underweight but a lower prevalence of wasting was reported in a Dhaka slum (Pryer, Rogers & Rahman, 2003). This study finding also agrees with other studies on low income households in less developed countries, indicating that shortness-for-age is a common nutritional problem among the preschool age group (Sichieri, Mathias & Moura, 1996; Stoltzfus, Albonico & Tieslch, 1997; Bomela, 2009)

In this study, a higher prevalence of stunting was found in families with three or more children. Similar results were found in Ethiopia and Congo (Yimer, 2000; Delpeuch *et al.*, 2000). Maternal education also showed a significant association with nutritional status of children, consistent with other studies in India and Nepal (Mishra & Rutherford, 2000; Sah, 2004; Islam *et al.*, 2003; Kamiya, 2011). Literate mothers might have a better knowledge of food preparation, child care practices and be more prepared to introduce new feeding practices (Ifeanyi, Victor & Anthony, 2009).

Although food insecurity affects people of all ages, it is of particular concern for children, elderly persons and other nutritionally vulnerable subgroups (Nord & Bickel, 2002; Furness *et al*., 2004; Nord, Andrews & Carlson (2003). In this study, food insecure children were significantly more stunted, underweight and thin than the food secured children. Likewise, in Pakistan, household food insecurity was statistically associated with child stunting (Baig-Ansari *et al.*, 2006). The observation of stunting and underweight being significantly associated with food insecurity among young children has been shown in other resource constrained areass (Hackett *et al.*, 2009; Mukhopadhay & Biswas, 2011).

Child care, feeding practices and dietary habits of the hills and forests are different from the coastal and river-flooded regions. The latter displayed more favourable outcomes on food security than the other areas but food insecurity remains a big problem in all the regions. Such a trend could be due mainly to socioe-conomic, political and natural calamities. The higher extent of food insecurity in the hills and forests regions is mainly due to lower levels of agricultural production and income sources, as well as less accessibility to foods and safety net interventions compared to other regions.

CONCLUSION

Findings of this research confirm the importance of programmes to improve child nutritional status, especially, in light of the high levels of underweight status among rural children aged 2-10 years in Bangladesh. The results also suggest that much more attention needs to be accorded to raising female education, and reducing household poverty and number of children per family to enjoy better child healthcare and nutritional status. A Nutrition Rehabilitation Programme (NRP) should be formulated and accelerated especially for children under 5 years.

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