Acute Malnutrition in Bangladeshi Children: *levels and determinants*

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Abstract

The main purpose of the study was to identify the levels and determinants of acute malnutrition or wasting in Bangladeshi children. A two-stage stratified random sampling design was used to collect the Bangladesh Demographic and Health Survey data during November 1999 to March 2000, in which 5,333 living children aged 0-59 months and their mothers were weighed and measured to obtain their anthropometric data. The prevalence of wasting was accessed by the Z-scores approach of anthropometric criterion weight-for-height following the WHO guidelines and cut-off points. Results reveal that the prevalence of severe and moderate wasting were more common among children and the overall prevalence of acute malnutrition was about 10%, indicating one of the major public health problems in the country. Multivariate analysis showed that mother's BMI and media exposure; child's age and birth size; and respiratory sickness in childhood were significantly associated with both severe and moderate wasting.

Keywords: Acute malnutrition, Bangladesh, children, severe and moderate, wasting.

Introduction

Malnutrition measured as poor anthropometric status signifies an imbalance between intake and the body's need to ensure optimal growth and function. This imbalance over a long period of time leads to chronic malnutrition and / or undernutrition, whereas, acute malnutrition or wasting reflects an acute imbalance, that has occurred recently. Chronic malnutrition is often related to dietary inadequacy, repeated infections, or both.[1] Undernutrition is also commonly associated with chronic disease in children. These lead to the disturbed growth of children adversely affecting their mental capacity, learning ability, and productivity in future life. The child-survival movement regularly acknowledges the importance of these two forms of malnutrition,[2,3] with a less attention given to acute malnutrition which is an extremely common disorder among preschool children in developing countries and is associated with high rates of mortality and morbidity.[4]

Approximately 12 million preschool children die every year and most of these children live in developing countries.[5] Malnutrition is an associated cause in about half of all deaths occurring among children in developing countries,[6] with severe acute malnutrition associated with 1-2 million preventable child deaths each year.[4,7] Additionally, Pelletier *et al*.[6] demonstrated that even children with moderate malnutrition, not only those with severe malnutrition, had an increased risk of dying. In 2006, global estimates indicate that nearly 60 million children have moderate wasting and 13 million have severe wasting.[4] Almost 15% of South Asian children have acute malnutrition.[8] In India, approximately 28 million (15.5%) preschool children have wasting, with over 5 million children being severely wasted.[9] Rates of acute malnutrition are 10.3% and 9.6% in Bangladeshi and Nepalese preschool children respectively.[10,11] Many studies reveal that acute malnutrition leads to more

severe infection and higher case fatality in Bangladeshi children,[12] and it is one of their major causes of morbidity and mortality.[13,14]

Acute malnutrition is defined as a weight-for-height measurement of Z-scores below -2 standard deviations from the median weight-for-height of the WHO/NCHS reference population.[4,10,15] This measure signifies a low body tissue and fat mass of children relative to their height. It results from either recent weight loss or failure to gain weight due to short term nutritional deficiency and / or some unknown reasons. Different studies demonstrate that a range of variables such as maternal variables that affect fetal growth and birth size are associated with acute malnutrition in children.[16] A study in the Philippines found that smaller birth size was the most significant risk factor for acute malnutrition; with age and infectious illness two other key factors.[1] Studies from Bangladesh have also revealed the effect of household variables such as wealth, education, and occupation.[17] Variations in patterns of dietary intake, morbidity, childcare and feeding practices, access to health care, environmental and socio-cultural settings also deserve specific research into their effects on malnutrition.[1]

This study was designed to document the levels of severe and moderate wasting for Bangladeshi preschool children, to observe their determinants, and to help policymakers to achieve the goal of a two-third reduction in childhood mortality by reducing the overall burden of acute malnutrition.

Methods

Data from the 1999-2000 Bangladesh Demographic and Health Survey (BDHS) were used in this analysis. This nationally representative survey, BDHS collected

information during the period early November 1999 to mid-March 2000 using face-to-face interviews; at which a complete birth history for all live births was taken from 10,544 ever-married women (age 10-49 years), and all living children (5,333) aged up to five years at the date of interview and their mothers were weighed and measured for anthropometric data. A two-stage stratified random sampling design was used to collect the BDHS sample, and the data contain more in-depth information on breast-feeding practices, immunization status, illness history etc for live birth that occurred during a 5-year period before the interview. Details of the survey methodology, sampling design and the principal findings can be found elsewhere.[10] This study is based on a sample of 5,333 Bangladeshi children aged 0–59 months for whom complete and plausible anthropometric measurements were provided.

Anthropometric measurements provide a good indication of the nutritional status of very young children and the resources available to them.[3,15] For anthropometric analysis, the study considers the standard index 'Weight-for-Height' of acute malnutrition or wasting. This is expressed in terms of the Z-scores or the number of standard deviation (SD) units from the median of the NCHS/WHO international reference population. The Z-scores approach has some advantages than other methods - which includes, Z-scores index is linear and sex independent.[3] The prevalence of different levels of acute malnutrition are assessed by the WHO recommended Z-scores approach with the following cut-off points:[10,15]

i) Severe wasting: proportion of children with Z-scores below -3 standard deviations (Z-scores < -3SD) from the median weight-for-height of the WHO/NCHS reference population.

ii) Moderate wasting: proportion of study children with Z-scores in scale -3SD ≤ Z-scores < -2SD from the median weight-for-height of the WHO/NCHS reference population.

Multinomial logistic regression model was applied for estimating regression parameters in multivariate analysis. Besides, a variable - mother's exposures to mass media was created indirectly by using information of whether the respondent usually "read a newspaper", "listen to radio", or "watch television" at least once a week and categorized as: 'no', 'one of three' and 'at least two media'. Generating new variable (that is suitable for the intended research) and recording variables are common limitations of the secondary data analysis.[18] The codes applied in analyses were actual categories from the BDHS data or as usual categories utilized in literatures. Statistical analysis was done by the software package SPSS for Windows.

Results

Table 1 shows the characteristics of the children and their prevalence of wasting. In terms of child attributes, about 20% of children were aged less than one year and the mean age of the study sample were approximately 29 months. Only 16% of children had a birth size larger than average. More than half (52%) of the children had suffered from respiratory sickness with 31% of them had suffered from an episode of both fever and cough. As well, more than three-fifths (62%) of the eligible children had been given measles vaccinations. Almost two-thirds (67%) of the eligible children were breast-fed up to two years of their age; among them 16% of children were breast-fed for less than seven months. Besides, about 42% of mothers had a low BMI and 16% of mothers were at nutritional risk (height ≤145cm). More than half (53%) of the children's mothers had not been exposed to mass media. Moreover, almost one-

thirds (32%) of the children's fathers were in unskilled occupation, and about ninety percent (89%) of children were delivered at home without medical facilities. Nearly a quarter of the children (24%) lived in the Dhaka division, while 13% and 9% resided in the Sylhet and Barisal divisions respectively.

Bivariate analyses (Table1) reveal that the percentage of children with severe and moderate wasting increases with decreasing levels of child's birth size and mother's health status as well as exposure to mass media. For instance, children whose mothers had BMI $\leq$18.50kg/m^2 were altogether 6.7% more prevalently wasted than children whose mother's BMI was more than 20.50kg/m^2, and children whose birth size was less than average were 1.7% more severely as well as 6.2% more moderately wasted compared to their high birth size counterparts. Additionally, the percentages of severe and moderate wasting were the highest among children aged 12-21 months (2.7% and 17.5%). Children who had breast-feeding for 7-24 months have also the highest severe and moderate wasting rates (1.5% and 11.4%). Children who had not been given measles vaccinations have a higher prevalence rate of severe wasting than its counterparts. Else, the prevalence of severe and moderate wasting was the lowest (0.8% and 7.4%) among children who were free from respiratory sickness.

Furthermore, the prevalence of wasting among unskilled father's children was significantly higher than that for the skilled father's children. Respondents whose children were delivered in hospital have a lower percentage of severely and moderately wasted (0.7% and 5.5%) children relative to those whose children were delivered at the respondents' home or at someone else's home. Moreover, households with more than one child have a higher percentage of severely wasted (1.3%) children

compared with households with only one child. The percentage of children with severe wasting is highest in the Barisal division (2.3%) and is lowest in the Sylhet division (0.7%). Results also reveal that, the overall prevalence of acute malnutrition in Bangladeshi children was 10% among them 9% children were moderately wasted. This estimate of total wasting is smaller than the estimate of 18% reported in 1997.[11]

The results of the multivariate analysis are presented in Table 2. In this study, most of the selected child and maternal attributes were significantly associated with severe and moderate wasting. The coefficients show that the likelihood of the child being wasted decreased with increased birth size and especially with maternal health and mass media exposure. For examples - children who had a bigger birth size than average were 80% and 48% less likely to be severely and moderately wasted compared with children who had a smaller than average birth size, the children of mothers had BMI $\leq$18.50kg/m^2 ran a 4.8 times and 1.4 times higher risk of becoming severely and moderately wasted than the children whose mothers had BMI >20.50kg/m^2, and the children whose mothers had not been exposed to mass media were 2.5 times and 1.3 times more likely to be severely and moderately wasted than the children whose mothers had been exposed to at least two media.

Besides, children in age groups 12-21 months, 22-34 months and 35- 59 months were respectively 9.1 times, 3.6 times and 3.4 times more likely to be severely wasted than children in the youngest age group, and a similar pattern was found in the risk of moderate wasting. Children who were free from respiratory sickness (fever and/or cough) were 45% and 41% less likely to be severely and moderately wasted than children who had suffering from both fever and cough. Additionally, children who did

not receive measles vaccinations ran twice higher risk of becoming severely wasted than their counterparts. Also, increased months of breast-feeding and low level of maternal height (≤145cm) sowed the risk of moderate wasting.

Moreover, results indicate that fathers having skilled occupation had a reduction in the likelihood that their children were moderately wasted by 23%. Children delivered at respondents' homes with traditional delivery systems were 1.5 times more likely to be moderately wasted than children born in hospital. Households having only one child under 5 ran a 2.1 times higher risk of becoming severely wasted children than household having two or more under-5 children. Furthermore, children resided in the Barisal division were 4.4 times more likely to be severely wasted than children resided in the Sylhet division.

Discussion

The findings reveal that maternal factors had significant effects on both severe and moderate acute malnutrition in Bangladesh. Lower maternal nutrition level was associated with a higher risk of wasting. Several studies illustrated that nutritional condition of mothers affecting fatal growth and birth size of children.[19,20] Also, children whose mother did not exposure to any mass media had higher risk of becoming acute malnourished. This could be due to the fact that socially and culturally advanced women have exposure to mass media and they can thereby gather more information about nutrition and child care.

Birth size showed significant effects on wasting. The deficient maternal nutrition was strongly related to low birth size,[20] and the acute malnutrition of children. As lower birth size had significantly associated with acute malnutrition into early childhood,[21]

activities to alleviate factors that lead to small birth size, such as inadequate maternal health and the lack of comprehensive antenatal care, might have an impact on reducing the prevalence of wasting in the current population and potentially in future generations by decreasing the prevalence of small maternal size.[1,22] The risk of wasting increased with age and a peak in the prevalence of severe and moderate wasting was observed during the 2nd year of life and downward thereafter.[15] In general, during this period (12-21 months) verity of supplementations with solids were commonly introduced to children that might not contain adequate nutrition for them, and they were more frequently suffered from childhood diseases.[10,15] Besides, the risk of moderate wasting increased with increasing duration of breastfeeding. However, certain aspects of breastfeeding were not practiced in effective manner such as late initiation of breast milk, too late introduction of solids and too early initiation of liquids or bottle feeding - could result in bacterial contamination due to improper sterilization, and a source of infectious diseases like diarrhoea.[23] These might be associated with lower food intakes, and a trend to move wasting. Additionally, poor hygiene and supplementation practices were responsible for infectious diseases, and frequency as well as length of infectious diseases.[12,17]

Although a reciprocal relationship has been postulated with diarrhoea leading to malnutrition and malnutrition predisposing to diarrhea,[12] this study did not find significant effect of diarrhea on wasting. However, wasted children had a greater severity of diarrhea and an increased risk of death from a variety of infectious diseases. Children suffered from respiratory sickness had a significantly higher risk of developing wasting, especially of moderate wasting. In Bangladesh, only 13% children with fever and 27% with cough symptoms were taken to a health facility for

treatment. Also, children with respiratory sickness have a tendency to avoid intakes or have a lower frequency and quantity of food intakes; these might have significant effects of developing acute malnutrition. Children who did not receive measles vaccinations had a higher risk of developing wasting. Hence, vaccination against diseases such as measles is more important to child health and it may depends on parental awareness, as vaccination is free in Bangladesh.

Moreover, children of skilled employees were less likely to be moderately wasted than children of unskilled employees. Unskilled employees were usually illiterate and did not have regular income.

In Bangladesh, most of the children delivered at home under traditional delivery systems and they have a higher risk of wasting than children delivered in hospital under appropriate medical care. It may true that mothers who have sought medical services during pregnancy would prefer to give birth under full medical care in hospital. Also mothers who have sought medical services up to delivery or only during delivery period gather different knowledge about complications, child and maternal nutrition, breastfeeding practices and childcare which might have positive effects on child health and negative effects on maternal and child mortality.[3] In addition, children lived in household having one under-5 child had higher risk of severe wasting than children in households with more than one child. These children might either be dependent on breastfeeding or given improper supplementations. Their mothers might be inexperienced adolescent mothers due to early marriage and most of these mothers have a limited awareness of proper childcare, supplementations and adequate nutrition practices.

Furthermore, children lived in the Barisal division had significantly at a high risk of severe wasting than children lived in the Sylhet division. The Barisal division is frequently affected by natural disasters such as cyclones, floods, rainstorms; whereas Sylhet division is a lower risk of natural disasters. It is also reported that relatively higher percentages of the Sylhet division children who had suffered from fever or respiratory infection or diarrhea were taken to a health facility for treatment than the Barisal division children.[10] Therefore, prevalence of wasting may vary considerably by season,[1,10] natural disasters and lower access rate of health facility during illness.

Conclusion

The study concludes that wasting or acute malnutrition among under-5 children is one of the major public health problems in Bangladesh. Child's age (12-21 months), smaller birth size and an episode of sickness, and poor maternal health and mass media exposure are strongly related to the severe and moderate wasting of children. Therefore, interventions should focus on supporting and educating mothers as well as the household heads on low cost but nutritious locally available foods, antenatal-care with hospital delivery and childcare including feeding, immunization practices, and health facility access for treatment during illness to improve mothers' health status as well as birth size and nutrition of children. Further research should explore diverse impact of acute malnutrition on childhood morbidity and mortality to address it urgency for child-survival programmes in the population.

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TABLE 1
Characteristics of the children and their prevalence of wasting (ages 0-59 months, n=5333)

Characteristic	All children	Wasting (Weight-for-height)		
	n[a] (%)	Severe	Moderate	Total
Child				
Age (in months):[d]				
35 – 59	2147 (40.3)	0.7	7.7	8.4
22 – 34	1138 (21.3)	0.9	9.9	10.8
12 – 21	966 (18.1)	2.7	17.5	20.2
0 – 11[b]	1082 (20.3)	0.5	4.3	4.8
Birth size:[d]				
> Average	851 (16.0)	0.5	7.1	7.6
Average	3469 (65.0)	0.9	8.7	9.6
< Average[b]	1004 (18.8)	2.2	13.3	15.5
Respiratory sickness:[d]				
No	2578 (48.3)	0.8	7.4	8.2
Fever or cough	1111 (20.8)	1.0	8.3	9.3
Fever and cough[b]	1636 (30.7)	1.6	13.0	14.6
Measles vaccinations:[c]				
No	2006 (37.6)	1.3	8.4	9.7
Yes[b]	3325 (62.3)	0.9	9.8	10.7
Months of breast-feeding:[d]				
25+	1724 (32.7)	0.7	8.7	9.4
7– 24	2721 (51.0)	1.5	11.4	12.9
0 – 6[b]	870 (16.3)	0.5	3.8	4.3
Maternal				
BMI (kg/m^2):[d]				
>20.50[b]	1416 (26.6)	0.3	6.9	7.2
18.51-20.50	1637 (30.7)	0.9	7.5	8.4
≤18.50	2249 (42.2)	1.7	12.2	13.9
Height (in cm):[d]				
≤ 145	865 (16.2)	0.7	12.7	13.4
> 145[b]	4455 (83.5)	1.1	8.6	9.7
Exposure to mass media:[d]				
No	2822 (52.9)	1.2	10.7	11.9
One of three	1456 (27.3)	1.3	8.3	9.6
At least two[b]	1025 (19.7)	0.4	6.7	7.1
Household				
Father's occupation:[d]				
Skilled	3575 (67.0)	1.0	8.1	9.1
Unskilled[b]	1728 (32.4)	1.3	11.7	13.0
Place of delivery:[d]				
Respondents home	3503 (65.7)	1.1	10.3	11.4
Other home	1264 (23.7)	1.1	8.2	9.3
Hospital[b]	561 (10.5)	0.7	5.5	6.2
No. of under-5 children:[c]				
1	2667 (50.0)	1.3	9.3	10.6
2+[b]	2666 (50.0)	0.8	9.3	10.1
Division of residence:				
Barisal	470 (8.8)	2.3	10.4	12.7
Chittagong	1163 (21.8)	0.9	8.9	9.8
Dhaka	1283 (24.1)	1.0	8.6	9.6
Khulna	792 (14.9)	0.9	8.8	9.7
Rajashahi	941 (17.6)	1.1	9.7	10.8
Sylhet[b]	684 (12.8)	0.7	10.4	11.1
Overall total	**5333**	**1.0**	**9.0**	**10**

[a]Total number of children may differ due to missing data.
[b]Reference category in the multivariate analysis.
[c]$p<0.05$; [d]$p<0.001$, (based on Chi-square test).

TABLE 2

Effect of child, maternal and household characteristics on severe and moderate wasting of children: ages 0-59 months, Bangladesh, 2000[a]

Characteristic[b]	Severe Wasting		Moderate Wasting	
	Parameter ***(β)***	Odds Ratio (*SE*)[c]	Parameter ***(β)***	Odds Ratio (*SE*)[c]
Child				
Age (in months):				
35–59	1.231	3.43 (*0.657*)	0.515 [d]	1.67 (*0.221*)
22–34	1.278 [d]	3.59 (*0.684*)	0.744 [e]	2.10 (*0.228*)
12–21	2.204 [f]	9.06 (*0.621*)	1.322 [f]	3.75 (*0.214*)
Birth size:				
>average	-1.613 [f]	0.20 (*0.554*)	-0.652 [f]	0.52 (*0.169*)
Average	-1.001 [f]	0.37 (*0.290*)	-0.437 [f]	0.65 (*0.116*)
Respiratory sickness:				
No	-0.596 [d]	0.55 (*0.309*)	-0.537 [f]	0.59 (*0.110*)
Fever or cough	-0.410	0.66 (*0.372*)	-0.444 [f]	0.64 (*0.137*)
Measles vaccination:				
No	0.665 [d]	1.95 (*0.295*)	0.050	1.05 (*0.115*)
Months of breast-feeding:				
25+	-0.144	0.87 (*0.728*)	0.469 [d]	1.60 (*0.250*)
7–24	0.301	1.35 (*0.652*)	0.495 [e]	1.64 (*0.227*)
Maternal				
BMI (kg/m^2):				
18.51-20.50	1.030 [d]	2.80 (*0.577*)	-0.139	0.87 (*0.148*)
≤18.50	1.558 [e]	4.75 (*0.547*)	0.338 [d]	1.40 (*0.133*)
Height (in cm):				
≤ 145	-0.713	0.49 (*0.441*)	0.367 [e]	1.44 (*0.120*)
Exposure to mass media:				
No	0.932 [d]	2.54 (*0.554*)	0.246 [d]	1.28 (*0.152*)
One of three	1.154 [e]	3.17 (*0.566*)	0.079	1.08 (*0.164*)
Household				
Father's occupation:				
Skilled	-0.135	0.87 (*0.284*)	-0.236 [e]	0.77 (*0.103*)
Place of delivery:				
Respondent's home	-0.176	0.84 (*0.564*)	0.414 [d]	1.51 (*0.210*)
Others house	-0.295	0.74 (*0.595*)	0.186	1.20 (*0.224*)
No. of under-5 children:				
1	0.751 [e]	2.12 (*0.294*)	0.082	1.09 (*0.102*)
Division of residence:				
Barisal	1.478 [e]	4.38 (*0.559*)	0.173	1.19 (*0.205*)
Chittagong	0.561	1.75 (*0.554*)	0.037	1.00 (*0.171*)
Dhaka	0.477	1.61 (*0.543*)	0.057	1.01 (*0.169*)
Khulna	0.542	1.72 (*0.611*)	0.133	1.14 (*0.189*)
Rajashahi	0.537	1.71 (*0.562*)	0.078	1.08 (*0.175*)
Model Fitting Information: - 2 Log likelihood		3367.65		
Chi-square value (df)		316.44 (48) [g]		

[a]Reference category of dependent variable is well-nourished children.

[b]Omitted categories are not shown, [c]Standard Error (*SE*) in the parenthesis.

[d]p<0.05; [e]p<0.01; [f]p<0.001; [g]p<0.0000.