

Risk Factors of Severe Acute Malnutrition among Under-five Children: A Hospital-based Study in Bangladesh

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ORIGINAL ARTICLE

ABSTRACT

Background: Malnutrition is a major public health problem of developmental concern with both health and socioeconomic consequences. The study was aimed to determine the risk factors of severe acute malnutrition among under-five children.

Material and Methods: This hospital-based case control study was conducted from December 2015 to April 2016 whereby a total of 196 children under 5 years (98 cases and 98 controls) whose age ranged from 6 to 60 months were included in the study, data were collected retrospectively using a questionnaire, and mid-upper arm circumference (MUAC) was taken using standard procedures. SPSS statistical software version 19 was used to analyze the dataset.

Results: The mean \pm standard deviation (SD) age of the cases and controls was 18.34 ± 14.6 and 16.93 ± 14.1 months, respectively, and the mean \pm SD MUAC of the cases and controls was 9.36 ± 1.1 and 14.59 ± 2.2 cm, respectively. Risk factors associated with severe acute malnutrition were lack of taking balanced diet more than 3 times/day (adjusted odds ratio [AOR] = 5.355, 95% confidence interval [CI] = 1.162–24.690), irregular hand washing with soap or other cleaning agents before feeding child (AOR = 0.317, 95% CI = 0.139–0.723), and father's education level 0–8 class (AOR = 0.190, 95% CI = 0.054–0.676).

Conclusions: Severe acute malnutrition was found to be associated with father's education level, lack of taking balanced diet, and irregular hand washing. Interventions to reduce malnutrition and address the factors contributing to malnutrition should be a policy priority.

KEY WORDS: Bangladesh, diarrhea, malnutrition, nutrition, public-health, under-five children

Introduction

Childhood undernutrition still remains one of the most serious public health problems in many countries, more especially low- and middle-income countries, and it has been reported that annually death of children in developing countries is about 1.7–3.6 million due to severe acute malnutrition (SAM) and moderate acute malnutrition, respectively.^[1] Globally, it contributes to almost close to half of all child deaths, i.e., above 3 million children yearly.^[2] SAM, which includes wasting (low weight-for-height

or low mid-upper arm circumference [MUAC]) and nutritional edema, affects a small portion of numbers of children but is of particular concern as a result of high case fatality.^[3,4]

Recent estimation indicated that 8.5 million infants <6 months of age throughout the world are wasted by the World Health Organization (WHO) growth standards, which define wasting as a weight-for-length Z score (WFLz) of < -2 .^[5] In children aged 6–60 months, the MUAC, with simple cutoffs, is at least as predictive of death as WFLz.^[6] MUAC can be measured easily, quickly, and affordably. Values below the cutoffs of 125 and 115 mm are used to define moderate and SAM, respectively.^[7]

Rates of malnutrition in Bangladesh are among the highest worldwide, with 6 million children estimated to be chronically undernourished. The decline in chronic malnutrition seen previously from three-fifth

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(60%) in 1997 to little above two-fifth (41%) in 2011 now appears to be slowing down. Policies and practice in Bangladesh need to have a greater focus on nutrition, at large scale and across different sectors, to accelerate progress on tackling the country's substantial malnutrition burden of 41% stunting and 16% wasting across a population of 156.5 million.^[8]

Despite a decline in the prevalence of chronic malnutrition among children under-five from 60% in 1997 to 41% in 2011, the trend is now slowing. Prevalence of chronic malnutrition remains well above the WHO "very high" severity thresholds. Undernutrition in Bangladesh is a national multisector development problem. In Bangladesh, close to 50% of children under-five are stunted due to poor nutrition.^[9] It is reducing Bangladesh's chances of reaching its goal of achieving middle-income country status by 2021 and is preventing millions of children from reaching their potential.^[10]

According to UNICEF Bangladesh, malnutrition is caused by multiple factors. The immediate causes are diseases and inadequate intake of food. The underlying causes of malnutrition include the inability of households to grow and/or purchase sufficient food for their needs, poor, maternal and child-care practices, including inadequate breastfeeding and complementary feeding for infants and young children and inadequate provision of food for adolescent girls and pregnant and lactating women.^[11] These are compounded by delays in recognizing the signs of malnutrition or disease and in seeking care for children and women, inadequate access to quality health services, including family planning, immunization, and medical services, and poor access to sanitary facilities and potable water. Given the fact that many studies on the risk factors of SAM among under-five children have been conducted in many developing countries, there is a need to examine if the same factors are responsible for SAM among children under 5 years in Bangladesh, hence forming the research question. In general, this research is aimed to find whether socioeconomic factors such as fathers education level, region of residence, child age, child sex, and family income or environmental factors such as source of water, household food security, household sanitation, or direct factors that can lead to SAM such as child health status (diarrhea), time of initiation of breastfeeding, and dietary intake can lead to SAM in Bangladesh.

The results of this study may be used as a part of evidence for coming up with programs that would

help to come up with better interventions on how management of malnourished children can be improved and maintained. The study was aimed to determine the risk factors of SAM among under-five children: This was a hospital-based study in Bangladesh.

Methodology

Target population and study site

The study was conducted from December 2015 to April 2016 in Dhaka Shishu hospital which is a specialized hospital in Bangladesh for the treatment of sick children. The hospital is located in the capital city of Dhaka. As of 2011, it has a bed capacity of 557. At present, it serves about 400 outdoor patients daily.

We conducted a hospital-based case-control study which was used to determine the risk factors associated with SAM among 6–60 months children admitted in protein-energy malnutrition ward at Dhaka Shishu Hospital, Bangladesh. Using MUAC measurement, the children were screened for their nutritional status. Cases were severely malnourished children with MUAC <115 mm and/or bilateral pitting edema, and the controls were defined as children of similar age (i.e., within ± 3 months) to the case with a MUAC ≥ 125 mm without bilateral pitting edema. Cases with chronic illnesses such as TB, HIV, and congenital abnormality that can affect feeding pattern of the child like congenital heart disease were excluded from the study.

Sample size determination

The study sample size was determined using two population proportion formula. The assumptions used for the sample size calculation are desired power (typically 0.84 for 80% power), level of statistical significance (typically 1.96), ratio of controls to cases (1:1), proportion of cases exposed (assuming odds ratio [OR] = 2.0), and proportion of controls exposed (40%). Therefore, the required sample size was 96 cases and 96 controls.

Data collection and sampling technique

The study samples were selected by convenient sampling technique for the sample of respondents.

Information regarding the place of residence, sex, age, and date of birth were collected retrospectively using a structured questionnaire. Diarrhea in terms of nature, frequencies, and duration of 2 weeks before the study was considered.

A non-stretch measuring tape was used to the nearest 1 mm to measure MUAC. The child stood straight with the arms alongside the body. One arm was bent at the elbow. The distance of the upper arm between the point of the bent elbow and the knob at the top of the shoulder was measured. The middle point of this distance was calculated and a mark made on the skin of the upper arm. At this mark, the circumference of the upper arm was measured. The measuring tape fitted tightly but did not make a dent in the upper arm.^[12] The arm was kept in a relaxed position along the side of the body.

Data management and analysis plan

After collection of data, all interviewed questionnaires were checked for completeness, correctness, and internal consistency to exclude missing or inconsistent data and those were discarded. Corrected data were entered into the computer. SPSS statistical software version 19 was used for the analyses. For normally distributed continuous variables, means were compared using unpaired *t*-tests. For continuous variables not normally distributed, the Mann–Whitney *t*-test was performed. Differences in proportions were compared by the Chi-square test or Fisher's exact test if the expected number in any cell was ≤ 5 . A probability of <0.05 was considered statistically significant. The strength of the association of selected associated/risk factors for acute malnutrition was determined by estimating ORs and their 95% confidence intervals (CIs). All independent variables, for example, source water, hand washing, household food security, and dietary intake were analyzed initially in univariate models, and the attributes that were significantly associated with SAM (dependent variable) were included in logistic regression models.

Ethical clearance

The Ethical Clearance was obtained from North South University Ethical Review Committee. Permission from Dhaka Shishu Hospital was obtained, then verbal consent was obtained from the caregivers of the child under study, and confidentiality of the information given by the respondent was maintained.

Results

Relationship between sociodemographic factors and SAM among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

A total of 196 children were selected with an aim to determine the risk factors associated with SAM,

among the children selected, 98 were cases and 98 were control. The mean \pm SD age of the cases and controls was 18.34 ± 14.6 and 16.93 ± 14.1 months, respectively, and the mean \pm SD MUAC of the cases and controls was 9.36 ± 1.1 and 14.59 ± 2.2 cm, respectively. Among the 196 children included in the study, 65.8% were males and 34.2% were females, 111 (56.6%) were in the age group 6–12 months, followed by 45 (23.0%) were 13–24 months and 40 (20.4%) were 25 months and above age group. However, there was no significant difference among the cases and controls associated with age groups 6–12, 13–24, and 25 and above months (*P* value 0.887 and 0.764, respectively) and sex of children (*P* = 0.500). Among the cases, 67.6% were living rural areas while only 32.4% of the controls were found to be living in rural area. There was a significant difference among case and control with regard to the region of residence (OR = 0.2, 95% CI = 0.1–0.4). Majority of the mothers, 58 (62.4%) of the cases and 35 (37.6%) of the controls, were housekeepers (day laborers). The main paternal occupation is rickshaw pullers (day laborers) in both the cases and controls (60.8% and 39.2%, respectively). There was a significant difference on the child SAM in cases and controls in relation to the mothers and fathers occupation (OR = 7.4, 95% CI = 1.5–36.5 and OR = 5.1, 95% CI = 1.8–14.2, respectively). Furthermore, mother of children with lower education (0–8 class) was significantly associated with SAM compared to those of mothers with degree and above education level (OR = 0.1, 95% CI = 0.03–0.7) [Table 1].

Relationship between environmental factors and SAM among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

Majority of households got water from the public tap. There was no difference among the cases (47.8%) and the controls (52.2%) with regard to the source of water (OR = 0.6, 95% CI = 0.3–1.3; *P* = 0.210). Moreover, 48.6% households of the cases and 51.4% households of controls make use of sanitary devices, and there was no significant difference among the cases and controls associated with the use of sanitary devices (OR = 0.5, 95% CI = 0.2–1.4; *P* = 0.178). Food insecurity was found to be associated (*P* < 0.001) with SAM as only 31.7% of cases and 68.3% of controls were found to be food secured (OR = 0.2, 95% CI = 0.1–0.4). There was a significant difference among the cases 28.9% and controls 71.1% associated with regular hand washing before feeding children (OR = 0.2, 95% CI = 0.1–0.4; *P* < 0.001). Majority of cases 70.7%

Table 1: Relationship between sociodemographic factors and severe acute malnutrition among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

Risk factors	Nutrition status		Unadjusted	
	Cases n=98 (%)	Controls n=98 (%)	OR (95%CI)	P value
Child age (month)				
6–12 months	54 (48.6)	57 (51.4)	0.9 (0.4–2.0)	0.887
13–24 months	24 (53.3)	21 (46.7)	1.1 (0.5–2.7)	0.764
25 months and above	20 (50)	20 (50)	1	
Child sex				
Male	65 (50.4)	64 (49.6)	1.0 (0.6–1.9)	0.500
Female	33 (49.3)	34 (50.7)	1	
Residence				
Urban	29 (30.9)	65 (69.1)	0.2 (0.1–0.4)	<0.001
Rural	69 (67.6)	33 (32.4)	1	
Monthly income				
Below TK.14,500	79 (56.0)	62 (44.0)	2.4 (1.3–4.6)	0.005
TK.14,501 and above	19 (34.5)	36 (65.5)	1	
Father's education				
0–8 class	55 (77.5)	16 (22.5)	0.1 (0.03–0.3)	<0.001
S.S.C/H.S.C level	35 (36.8)	60 (63.2)	1.6 (0.6–3.9)	0.305
Degree and above	8 (26.7)	22 (73.3)	1	
Mother's education				
0–8 class	72 (62.6)	43 (37.4)	0.1 (0.03–0.7)	0.015
SSC/HSC level	24 (33.8)	47 (66.2)	2.0 (0.4–10.3)	0.381
Degree and above	2 (20.0)	8 (80.0)	1	
Father's occupation				
Government/NGO services	6 (23.1)	20 (76.9)	1	
Business person	15 (44.1)	19 (55.9)	2.6 (0.8–8.2)	0.090
Day laborer	48 (60.8)	31 (39.2)	5.1 (1.8–14.2)	<0.001
Unemployed	29 (50.9)	28 (49.1)	3.4 (1.2–9.8)	0.017
Mother's occupation				
Government/NGO services	2 (18.2)	9 (81.8)	1	
Business person	5 (29.4)	12 (70.6)	1.8 (0.3–11.9)	0.668
Day laborer	58 (62.4)	35 (37.6)	7.4 (1.5–36.5)	0.007
Unemployed	33 (44.0)	42 (56.0)	3.5 (0.7–17.4)	0.187

OR: Odds ratio, CI: Confidence interval

wash their hands occasionally before feeding their children [Table 2].

Relationship between proximal factors and SAM among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

Concerning the morbidity status of the children, 66.0% of the cases and 34.0% of the controls had diarrhea

2 weeks before the study. There was a significant association ($P < 0.001$) between severe wasting and the morbidity status by diarrhea (OR = 4.1, 95% CI = 2.2–7.4). With regard to daily dietary intake, 72.7% of the cases had <3 dietary intakes/day compared to 27.3% of controls group. There was a significant association ($P = 0.001$) between severe wasting and dietary intake <3 times/day (OR = 3.6, 95% CI = 1.6–8.0).

However, most of the mothers had mentioned that they took their child to the health facilities for treatment, only 33.3% of the mothers of cases and 66.7% of mothers of the controls were used to visit health facilities within 24 h of the onset of symptom. Children whose mothers do not take their children to the health facilities within 24 h of the onset of the symptom were associated ($P <$

0.001) with severe wasting of the child (OR = 3.7, 95% CI = 2.0–6.7). However, 40% of the cases and 60% of controls had practised optimal frequency of complementary feeding (≥ 3 times in a day). Suboptimal frequency of complementary feeding was also seen significantly associated ($P = 0.001$) with severe wasting of the children (OR = 2.5, 95% CI = 1.4–4.5) [Table 3].

Table 2: Relationship between environmental factors and severe acute malnutrition among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

Risk factors	Nutrition status		Unadjusted	
	Cases <i>n</i> =98 (%)	Controls <i>n</i> =98 (%)	OR (95%CI)	<i>P</i> value
Source of water				
Tap water	75 (47.8)	82 (52.2)	0.6 (0.3–1.3)	0.210
Others	23 (59.0)	16 (41.0)		
Food security				
Yes	33 (31.7)	71 (68.3)	0.2 (0.1–0.4)	<0.001
No	65 (70.7)	27 (29.3)		
Hand washing				
Regularly	28 (28.9)	69 (71.1)	0.1 (0.1–0.3)	<0.001
Occasionally	70 (70.7)	29 (29.3)		
Use of sanitary devices				
Yes	85 (48.6)	90 (51.4)	0.5 (0.2–1.4)	0.178
No	13 (61.9)	8 (38.1)		

OR: Odds ratio, CI: Confidence interval

Table 3: Relationship between proximal factors and severe acute malnutrition among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

Risk factors	Nutrition status		Unadjusted	
	Cases <i>n</i> =98 (%)	Controls <i>n</i> =98 (%)	OR (95%CI)	<i>P</i> value
Dietary intake/day				
<3	56 (72.7)	21 (27.3)	3.6 (1.6–8.0)	0.001
3	25 (31.6)	54 (68.4)	0.6 (0.3–1.3)	0.241
>3	17 (42.5)	23 (57.5)		
Complementary feeding/day				
<3 times	54 (62.8)	32 (37.2)	2.5 (1.4–4.5)	0.001
>3 times	44 (40.0)	66 (60.0)		
Diarrhea				
Yes	68 (66.0)	35 (34.0)	4.1 (2.2–7.4)	<0.001
No	30 (32.3)	63 (67.7)		
Use of health facilities				
>24 h	67 (65.0)	36 (35.0)	3.7 (2.0–6.7)	<0.001
Within 24 h	31 (33.3)	62 (66.7)		

OR: Odds ratio, CI: Confidence interval

The results of logistic regression showed that the risk of SAM was independently associated with lack of taking balanced diet >3 times/day (adjusted OR [AOR] = 5.355, 95% CI = 1.162–24.690), lack of regular hand washing with soap or other cleaning agents before feeding child (AOR = 0.317, 95% CI = 0.139–0.723), and father's education level 0–8 class (AOR = 0.190, 95% CI = 0.054–0.676) after

the effects of other significant risk factors were controlled [Table 4].

Discussion

In this study, the educational level of the parents had a direct impact on the nutritional status of children. In the present study, it was observed that parent education had a significant effect on nutritional

Table 4: Adjusted OR for risk factors significantly associated with severe acute malnutrition among under-five children admitted to Dhaka Shishu Hospital, Bangladesh

Risk factors	Reference	Adjusted OR	95% CI		P value
			Lower	Upper	
Region of residence					
Urban	Rural	0.475	0.209	1.081	0.071
Father's education					
0–8 class		0.190	0.054	0.676	0.010
SSC/HSC	Degree and above	0.672	0.212	2.130	0.500
Mother' education					
0–8 class		0.272	0.033	2.250	0.227
SSC/HSC	Degree and above	0.470	0.066	3.321	0.449
Father's occupation					
Business person	Govt./NGO services	0.705	0.137	3.631	0.676
Day laborer		0.722	0.148	3.518	0.687
Unemployed		0.566	0.118	2.710	0.476
Mother's occupation					
Business person	Govt./NGO services	0.863	0.084	8.816	0.901
Day laborer		0.409	0.047	3.517	0.415
Unemployed		0.427	0.058	3.170	0.406
Monthly income					
<14,500	14,500 and above	0.429	0.084	2.193	0.309
Diarrhea					
Yes	No	1.371	0.596	3.154	0.458
Food security					
Yes	No	0.603	0.209	1.741	0.350
Dietary intake/day					
<3	More than 3	5.355	1.162	24.690	0.031
3		2.596	0.477	14.141	0.270
Use of health facilities					
More than 24 h	Within 24 h	0.275	0.477	3.407	0.627
Comp. feeding					
<3 times/day	More than 3 times	1.550	0.708	3.392	0.273
Hand washing					
Regularly	Occasionally	0.317	0.139	0.723	0.006

OR: Odds ratio, CI: Confidence interval

status of children. A parent who had higher education might have more knowledge of a balanced dietary intake for the family in regard to improving the nutritional status of their children. Educational levels of parents in Ghana and India with severely malnourished children were lower than that of parents with healthy children.^[13] Christiaenson and Alderson in 2001 found that female education had a positive and statistically significant effect on a child's nutritional status. Education builds this consciousness among mothers, which increases the mothers and child healthcare seeking behavior. Mothers with post-secondary schooling had fewer malnourished children than mothers with primary and secondary schooling. Mother's that were better educated fed their children better.^[14]

Father's education is found to be associated with a higher risk of SAM. This is observed in studies done in North Wollo, Ethiopia,^[15] in African,^[16-18] Southeast Asian,^[13,19,20] and Latin American countries.^[21]

In this study, it was indicated that children who were taken to health institution within 24 h are less likely to be severely wasted than those who were not taken. Lack of maternal access to health service facilities significantly affected children's nutritional status. This factor is associated with behavioral attributes of the majority of the rural mothers. The odds of exposure to the risks of SAM were higher among the children whose mothers had no access to the health service facilities than their counterparts. This is similar to the findings of other studies in which the expansion of healthcare infrastructures has significantly reduced the risk of child undernutrition.^[22,23] This finding supports that taking sick children to health facilities within 24 h of the onset of the symptoms is advisable to prevent further disease progression and early detection of the problem.

In a study by Saito *et al.* (1997) in Tamil Nadu, India among children younger than 4 years old, poor nutritional status was directly associated with the gender of the child.^[24] In most studies, more males are malnourished. In a study in Bangladesh on malnutrition in children 6–60 months old, there were an equal number of males and females (240 males and 239 females)^[25] and a study in Nairobi, Ethiopia, found that, in the malnourished group of children 3–36 months old, 51.2% were males and 48.8% were female.^[26]

Sex of child is not statistically significant in this study similar to other studies which showed no association between malnutrition and sex of child.^[27,28] However, according to Guerrero (2009), there is no difference in weight-for-age or weight-for-height between boys and girls in Iraq.^[29]

Morbidity status of the child with diarrhea preceding 2 weeks before the onset of SAM is significantly associated with severe wasting of the children. Cases had more history of diarrhea than the controls. This can be due to excessive loss of fluids and electrolytes, loss of appetite, and lack of absorption of food in the intestine due to high motility of the intestine during diarrhea episodes. Similar finding was seen in another study.^[30]

This study showed that children whose frequency of food intake was <3 times/day were more than 5 times as likely to be acutely malnourished. The mother's knowledge and attitude regarding child feeding might play an important role in child's eating frequency and behavior. Studies from Cambodia and Kenya suggest parallel results.^[31,32] Dietary intake <3 times is associated with SAM, and this is consistent with the findings that optimum feeding of infants and young children is important for health, growth, and development. Good feeding practices prevent malnutrition and early growth retardation and reduce the severity of infections.^[33]

The result of this study showed that children mothers who wash their hands regularly with soap or other cleaning agents before feeding their children were less likely to be severely malnourished than their counterparts. Hand washing of the caregiver is critically important to break the link between foods and drink intake and development of infection. Caregivers need to wash their hand with clean water and soap before preparing food, before feeding baby and after visiting of the toilet or disposing of child feces.^[34-36]

Conclusion

SAM is found to be associated with lack of taking balanced diet >3 times/day, irregular hand washing with soap or other cleaning agents before feeding child, and father's education level.

In this study, MUAC was found to be a very good screening tool. Thus, MUAC should be routinely measured as part of the clinical assessment of all

children admitted to hospitals to find references/cutoffs for different age groups.

Interventions to reduce malnutrition and address the factors contributing to malnutrition should be a policy priority.

Limitations

- There were a few mothers who were reluctant to sign the consent form, and therefore, their children could not be included in the study.
- In a number of cases, the mothers were not available at the hospital for the duration of the stay of the child in the ward, and the child could not be included.
- Due to the language barrier, the questionnaire was filled by the researcher often interpretation of the questionnaire from English to Bangla, and therefore, some important factors have to be excluded from the study questionnaire due to time constraint.

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