

Role of Selected Clinical Signs in Predicting Fatal Outcome in Severely Malnourished Children Admitted in Hospital

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Abstract

Original Research Article

Introduction: Nutritional deficiency constitutes a major public health problem worldwide and often associated with fatal outcome [1]. The malnutrition scenario presented by UNICEF in 2011 showed that 52 million children under 5 years of age were moderately or severely wasted, More than 29 million under 5, an estimated 5 percent suffered from severe wasting, Bangladesh has a very high prevalence of malnutrition-above 15 per cent[2]. However, a recent hospital-based systematic surveillance study in a diarrhoea treatment centre in Dhaka, Bangladesh revealed that severe wasting, severe stunting and severe under-nutrition in under 5 children were 3%, 11% and 16% respectively[3]. Every year over 4 million children are born in Bangladesh and nearly 289,000 of them die before reaching their fifth birthday. **Aim of the study:** To determine the role of four clinical signs (bradycardia, low volume pulse, impaired consciousness and delayed capillary refilling time) in predicting the death of severely malnourished children admitted in the hospital. **Materials & Method:** All the cases of severe acute malnutrition in age group of 3 months to 59 months were included during the study period of March 2016 to September 2016. History, physical findings and particularly four clinical signs- bradycardia, low volume pulse, impaired consciousness and capillary refill time > 3 sec were recorded for all the children. They were treated as per WHO guideline with prevention and treatment of hypoglycemia, hypothermia, dehydration, electrolyte imbalance, treatment of infections and other problems including shock and severe anaemia. Feeding was started with F-75 formula for one week, then replaced by F-100. They were also given multivitamin, folic acid and zinc. Outcome particularly death of the patients were recorded, co-morbidities, duration of their hospital stay were also recorded. Children who had any one or more of the four clinical signs were then considered as case and rest as control. The death as outcome was then compared in the two groups to see whether the four clinical signs predicting the outcome. **Results:** A total of 116 children with age range of 3 months to 59 months were included. Male: female ratio was 1.42:1. Among them 59 children(case) had one or more of the 4 clinical signs- bradycardia, weak low volume pulse, impaired consciousness and capillary refilling time >3sec and 57 children(control) had no such signs. The odds ratio for death was 11.53 (95% CI= 3.21 – 41.37) for children who had one or more of the 4 clinical signs. Of the secondary outcome odds ratio of hypoglycemia, lethargy, dehydration, shock, hypothermia and convulsion were 2.86, 91.86, 7.36, 97.3, 4.35 and 4.57 respectively. Odds ratio of hyponatraemia, hypokalaemia, severe anaemia, severe acidosis and elevated serum creatinine were 5.6, 1.96, 4.07, 5 and 4.2 respectively. Odds ratio of hypoglycemia, hypothermia, lethargy, dehydration and shock were statistically significant and among laboratory findings only hyponatraemia was statistically significant. The odds ratio of convulsion, hypokalaemia, severe anaemia, severe acidosis and elevated serum creatinine were not statistically significant. **Conclusion:** The study identified four clinical features (impaired consciousness, low volume pulse, capillary refilling time (CRT) > 3 sec and bradycardia) that could define a high-risk group to target aggressive treatment. However, large-scale multicentre study will be needed to validate the findings of the present study.

Key words: Clinical Signs, Predicting Fatal, Severely, Malnourished Children.

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INTRODUCTION

Nutritional deficiency constitutes a major public health problem worldwide and often associated

with fatal outcome [1]. The malnutrition scenario presented by UNICEF in 2011 showed that 52 million children under 5 years of age were moderately or

severely wasted, More than 29 million under 5, an estimated 5 percent suffered from severe wasting, Bangladesh has a very high prevalence of malnutrition-above 15 per cent [2]. However, a recent hospital-based systematic surveillance study in a diarrhoea treatment centre in Dhaka, Bangladesh revealed that severe wasting, severe stunting and severe under-nutrition in under 5 children were 3%, 11% and 16% respectively[3]. Every year over 4 million children are born in Bangladesh and nearly 289,000 of them die before reaching their fifth birthday. More than half of these deaths are somehow associated with malnutrition [4, 5]. Severe malnutrition is thought to be responsible, at least in part, for a large proportion of the many millions of deaths every year among these children. Children under one year of age who are malnourished have an increased risk of severe disease and of dying [6]. The mortality rate of severely malnourished children in many hospitals in sub-Saharan Africa is still high (over 20%)[7]. The World Health Organization (WHO) regards this high mortality as unacceptable. These high case fatality rates are often attributed to insufficient staff training and poor compliance with the recommended protocol for management of severely acute malnourished children admitted in hospital, resulting in faulty case management [9-12, 14]. The WHO has developed a consensus management guideline and suggests that, with strict protocol adherence, mortality should be less than 5% [13]. The management guideline includes 1) a stabilization phase in which life-threatening problems are identified and treated, 2) a staged introduction of milk-based nutritional rehabilitation, micronutrient and vitamin supplementation, and 3) empiric use of antimicrobial and antihelminthic treatment [13]. Over the last decade, some centers have reported reduced case fatality rates by strict compliance to the treatment recommendations [16]. Two studies conducted in African hospitals examining the feasibility and sustainability of WHO severe malnutrition management guidelines have reported that inpatient case fatality rates of up to 46% had been reduced to 18%, at best, following implementation[9,12]. A group of researchers, at this context, decided to identify those children who were most likely to die. They studied all severely malnourished children over three months of age who were admitted to the Kilifi District Hospital between September 2000 and June 2002 and collected data on signs and symptoms at admission and their outcome after treatment. They found that out of 920 children, 176(19%) died in hospital. Experience of the researchers suggest that death commonly occurs during the first 48 h after hospital admission and four clinical features, which could be easily ascertained at the bedside on admission, were attributed with a large proportion of the early deaths [15]. These four signs were slow heart rate, weak pulse volume, depressed consciousness level, and a delayed capillary refilling time. They proposed that these findings, together with a number of other features that were associated with the

deaths could be used to identify three groups of patients differing in their need for emergency care: a high-risk group (with any of the four signs listed above, or hypoglycemia, and among whom mortality was 34%); a moderate-risk group (among whom mortality was 23%); and a low-risk group (mortality 7%) [15]. The present study was, therefore, intended to determine whether the four bed-side features (bradycardia, weak pulse volume, depressed consciousness and a delayed capillary refilling time) identified earlier in other studies are associated with poor outcome in the context of our population, especially for those dying early after admission.

OBJECTIVES

a) General objective

- To determine the selected clinical signs in predicting the death of severely malnourished children admitted in the hospital.

b) Specific objectives

- To see the association of death with four clinical signs- bradycardia, weak low volume pulse, impaired consciousness and capillary refilling time >3 sec.
- To find out the association of co-morbidities among SAM children.

MATERIALS & METHODS

This was a retrospective case-control study design was considered suitable for the present study. The study was carried out in the Department of Pediatrics in Shaheed Ziaur Rahman Medical College Hospital, Bogra during the period of March 2016 to September 2016. Children aged 3 months to 5 years diagnosed case of SAM during the period from March 2016 to September 2016 at Shaheed Ziaur Rahman Medical College Hospital, Bogra were enrolled. We retrospectively analyzed 116 patients diagnosed as SAM and searched for the four clinical signs- impaired consciousness, low volume pulse, capillary refilling time (CRT) > 3 sec and bradycardia. Those who had any of these four signs were considered as case and those who did not have these signs considered as control. During the study period a total of 116 patients were admitted and all were taken in the study. Prior permission was taken from Institutional Review Board (IRB), Shaheed Ziaur Rahman Medical College Hospital, Bogra to carry out this study. Data were collected from the hospital records.

INCLUSION CRITERIA

- WHZ/WLZ less than -3SD for age & sex
- MUAC less than 11.5 cm or
- symmetrical oedema involving at least the feet to define oedematous malnutrition

EXCLUSION CRITERIA

- Severely malnourished children whose data were incomplete.
- Height, weight and clinical data were not available.

RESULTS

Nearly two-third (64.7%) of the children was 3-12 months old. Male -female ratio was 1.42:1. About 80% of the children's family income was Tk 10,000 or more with mean income being 9078(range: 5000-15000). Majority (75.8%) of the children belonged to large family of 4 or more members. Three-quarters (75%) of the children were 2nd or 3rd birth order (Table I). In table II- Show Predominant clinical features observed were lethargy and hypoglycemia (48.3% and 38.7% respectively). Other prominent features were dehydration (32.8%), weak low volume pulse (30.2%), capillary refilling time (> 3 sec) (23.3%) and shock (23.3%). Bradycardia & hypothermia were observed (both 22.4%). Less significant features observed in these children were deep breathing (12.9%) and convulsion (4.3%). The laboratory features were hyponatraemia (10.3%), hypokalaemia (2.6%), severe anaemia (4.3%), severe acidosis (0.9%) and elevated serum creatinine (4.3%). Among the 116 patients one sign was present in 29 patients (25%), two signs were

present in 6 patients (5.2%), three signs were present in 12 patients (10.3%), four signs were present in 12 patients (10.3%) and none of the clinical signs was present in 57 patients (49.1%) Fig 1A. Among 23 deaths in case group patients with three clinical signs, death was 11 out of 12 and patients with four clinical signs, death were 12 out of 12 Figs 1B. Remaining 3 deaths were in control group. (Fig-1) Of the 116 children admitted, 26(22.4%) died of the disease; of them 18(69.2%) died within 48 hours of admission and the rest 8(30.8%) died after 48 hours (Fig-1B). When we assessed for primary outcome as a death, then odds of being death in case group in relation of control was 11.53 with 95% CI (3.21 – 41.37) which is statistically significant. (Fig-3). Odds ratio of hypoglycemia, lethargy, dehydration, shock, hypothermia and convulsion were 2.86, 91.86, 7.36, 97.3, 4.35 and 4.57 respectively and corresponding 95% CI were (1.3-6.31), (26-31.9), (3.1-17.3), (5.7-118.7), (1.5-11.8) and (0.45-37.6) respectively. Odds ratio of hyponatraemia, hypokalaemia, severe anaemia, severe acidosis and elevated serum creatinine were 5.6, 1.96, 4.07, 5 and 4.2 respectively. Odds ratio of hypoglycemia, hypothermia, lethargy, dehydration and shock were statistically significant and among laboratory findings the odds ratio of only hyponatraemia was statistically significant. (Table-IV)

Table-I: Distribution of children by their socio-demographic features (n= 116)

Socio demographic feature	Frequency	Percentage	Mean ± SD(range)
Age (month)			13.8±12.7 (3-60)
3-12	75	64.7	
13-36	34	29.3	
37-60	7	6.0	
Sex			
Male	68	58.6	
Female	48	41.4	
Family income (Tk/month)			9077.6 ± 2555.9 (5000-15000)
<10000	24	20.7	
≥ 10000	92	79.3	
No of family member			6 ± 2 (3-13)
≤4	28	24.1	
> 4	88	75.9	
No. of siblings (persons)			2 ± 1 (1-5)
< 2	16	13.8	
≥ 2	100	86.2	
Birth order of the child			2 ± 1 (1-5)
1	29	25	
≥ 2	87	75.0	
Maternal nutritional status			
Below average	55	47.4	
Average	61	52.6	

Table-II: Important clinical & laboratory characteristics of children at admission (n = 116)

Features	Frequency	Percentage
Clinical features		
Weak low volume pulse	35	30.2
Capillary refilling time > 3 sec	27	23.3
Bradycardia (heart rate < 80 beats / min)	26	22.4
Impaired consciousness	24	20.6
Lethargy	56	48.3
Hypoglycemia(blood glucose < 3mmol/l)	45	38.7
Dehydration	38	32.8
Shock	27	23.3
Hypothermia	26	22.4
Deep breathing	15	12.9
Convulsion	5	4.3
Laboratory features		
Hyponatraemia (sodium < 135 mmol/l)	12	10.3
Hypokalaemia (potassium < 3.5 mmol/l)	3	2.6
Severe anaemia (Hb < 5 g/dl)	5	4.3
Severe acidosis (base deficit > 10 mmol/l)	1	0.9
Elevated serum creatinine	5	4.3

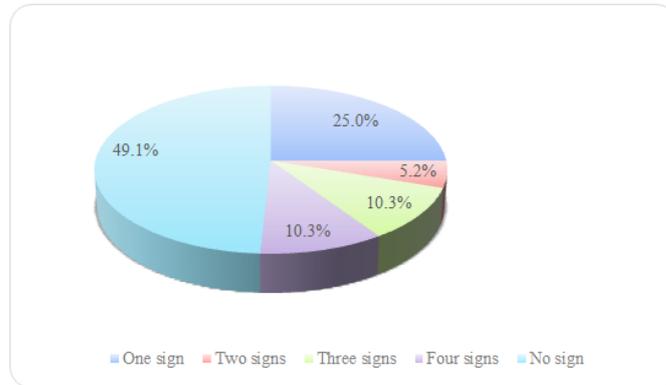


Fig-I: Presence of four studied clinical signs and their percentage



Fig-II: Presence of studied four clinical signs

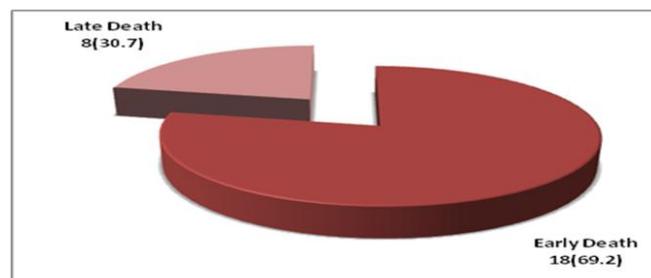


Fig-III: Distribution of dead children by early and late mortality

Table-III: Primary outcome of the study population

	Group		Odds Ratio(95% CI of OR)
	Case (any of 4 clinical features) (n=59)	Control (with none of 4 features) (n=57)	
Primary outcome			
Death n (%)	23(39%)	3(5.3%)	11.53(3.21-41.37)
No death n (%)	36(61%)	54(94.7%)	

Table-IV: Secondary outcome of the study population

Secondary outcome	Group		
	Case (n=59)	Control (n=57)	Odds ratio (95% CI of OR)
Lethargy n (%)	53(89.83%)	3(5.26%)	91.86(26-31.9)
Hypoglycemia n (%)	30(50%)	15(26.3%)	2.86(1.3-6.31)
Dehydration n (%)	36(6.10%)	2(3.50%)	7.36(3.1-17.3)
Shock n (%)	27(45.76%)	0(0%)	97.3(5.7-118.7)
Hypothermia n (%)	20(33.8%)	06(10%)	4.35(1.5-11.8)
Convulsion n (%)	4(6.77%)	1(1.75%)	4.57(0.45-37.6)
Hyponatraemia n (%)	10(16.9%)	02(3.5%)	5.6(1.17-26.8)
Hypokalaemia n (%)	02(3.3%)	01(1.7%)	1.96(0.17-22.2)
Severe anaemia n (%)	04(6.7%)	01(1.7%)	4.07(0.44-37.6)
Severe acidosis n (%)	1(1.69%)	0(0%)	5.0(0.23-10.35)
Elevated s.creatinine n (%)	4(6.77%)	1(1.75%)	4.2(0.45 -39.04)

DISCUSSION

In the present study, children with severe acute malnutrition admitted in a tertiary care hospital managed as per WHO guideline, case fatality rate was about 26 out of 116 (22.4%). Nearly 69.2% of these death occurred within 48 hours of admission. Our primary outcome of interest was death which showed that odds of being death in case group were 11.53 with 95% CI (3.21 – 41.37) which is statistically significant. So presence of any of the 4 clinical signs can predict high mortality than absence of signs. SAM children with 3 or 4 of the 4 studied signs had very high mortality- 11 of 12 with 3 signs and 12 of 12 with 4 signs died. Nearly two-third (64.7%) of the children was 3-12 months old. Male-female ratio was 1.42:1 (Male-68, Female-48). In this study among the 116 patient's predominant clinical features observed were lethargy and hypoglycemia (48.3% and 38.7% respectively). Other prominent features were dehydration (32.8%), weak low volume pulse (30.2%), capillary refilling time (> 3 sec) (23.3%) and shock (23.3%). Bradycardia and hypothermia were observed (both 22.4%). Less significant features observed in these children were deep breathing (12.9%) and convulsion (4.3%). The laboratory features were hyponatraemia (10.3%), hypokalaemia (2.6%), severe anaemia (4.3%), severe acidosis (0.9%) and elevated serum creatinine (4.3%) Of the secondary outcome odds ratio of hypoglycemia, lethargy, dehydration, shock, hypothermia and convulsion were 2.86, 91.86, 7.36, 97.3, 4.35 and 4.57 respectively and corresponding 95% CI were (1.3-6.31), (26-31.9), (3.1-17.3), (5.7-118.7), (1.5-11.8) and (0.45-37.6) respectively. Odds ratio of hyponatraemia, hypokalaemia, severe anaemia, severe acidosis and elevated serum creatinine were 5.6, 1.96, 4.07, 5 and 4.2 respectively. Odds ratio of

hypoglycemia, hypothermia, lethargy, dehydration and shock were statistically significant and among laboratory findings the odds ratio of only hyponatraemia was statistically significant. Consistent with our findings, a large case series of severe malnutrition presenting to a district hospital in Kenya, managed according to WHO protocol, the case fatality rate was 19% [15]. However only one-third (34%) of those deaths occurred within 48 hours of admission [15] which is much lower than that found in our study (69.2% of the deaths occurred within 48 hours). The four bedside features which we intended to investigate including those associated with shock, can be easily identified with minimal training to delineate a high-risk group to target emergency treatment and monitoring. The triage parameters associated with early mortality suggest that many children had cardinal features of shock including bradycardia, weak pulse volume, deep acidotic breathing, impaired consciousness, and hypoglycemia [15]. The urgent correction of intravascular volume deficits by rapid volume expansion management using isotonic crystalloidal or colloidal solutions is central to contemporary pediatric critical care practice and would seem a logical treatment for children with severe malnutrition presenting with shock. Nevertheless, current guidelines do not include either of these solutions [16]. Hypotonic solutions generally are not advocated for the correction of shock until the circulating volume has been restored with isotonic solutions or colloids [59]. Altered pulse rate, altered body temperature, shock, hypoglycemia were independent predictors of mortality among severely malnourished children <5 years of age [17]. A study showed that altered body temperature (hypothermia and hyperpyrexia) significantly increased the risk of mortality among children with SAM. The risk of earlier

death was seven times higher for children who had altered body temperature than children who had normal temperature [60]. Hypothermia increased the hazard of mortality by threefold [18]. In our study odds of hypothermia was 4 fold than the control group. A study found that the risk of death in children who had altered pulse rate was four times higher than those who had normal pulse rate. They also found that presence of imperceptible pulse increased the risk of death in children by 3.9 times [19]. Another study found that hypothermia; clinical septicaemia and bronchopneumonia were identified as the major risk factors of mortality among the severely malnourished children with diarrhoea. They also found that low pulse rate (<90) or imperceptible pulse and bronchopneumonia were important causes of death [20]. Hypoglycemic children were significantly more likely to die during treatment compared to their normoglycemic counterparts who were more likely to have a successful outcome. The finding of the study that hypoglycemia is a risk factor for poor outcome among severely malnourished children agreed with those previously reported by other authors [21]. But in our study we did not assess the outcome of death with hypoglycemia rather we compared association of hypoglycemia with 4 clinical signs which was higher in case group.

LIMITATION OF THE STUDY

This was a single centered observatory study with a small sample size. So the findings of this study may not reflect the exact scenarios of whole country. Overall, the present study, like any other scientific study has several limitations, which deserve mention the sample was small compared to the calculated sample size and as such, the findings obtained from the study could not be generalized to reference population.

CONCLUSION AND RECOMMENDATIONS

Over half of the SAM children at admission possess at least one of the four bed-side features (impaired consciousness, weak low volume pulse, bradycardia and capillary refilling time > 3 sec) and the presence of any of these four signs carries > 12-fold higher risk of mortality. The death rate among hospitalized SAM children could be high even if management of these children is done with WHO guideline. The identification of four “bedside signs” as predictors of poor outcome did not improve the outcome which might be due to lacking in aggressive management. The indicators proposed here would need further evaluation with large sample and multicenter study.

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