

## Original research article

## An observational research to determine the range of co-morbidities associated with extreme acute malnutrition and unexpected dyselectrolytemia in diarrhoea

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### Abstract

**Aim:** To evaluate the spectrum of co-morbidities in severe acute malnutrition with unexpected dyselectrolytemia in diarrhea.

**Methods:** The study was an observational study which was carried in the Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, and Bihar, India for 18 months. Total 90 Children below 6 year age were include in this study. Various co morbid conditions in study population were identified. All the laboratory examination were done with standard method.

**Results:** Out of these 90 patients, 59 (65.56%) were males and remaining 31(34.44%) were females. Maximum numbers of patients were in the age group of more than 1-3 year which constituted 37(41.11%) cases. Majority of children with SAM were having co-morbidity in the form of Anaemia (85.56%), Diarrhoea (63.33%) followed by pneumonia (26.67%), Rickets (25.56%), Tuberculosis (13.33%), Otitis media (12.22%), UTI (11.11%), Celiac (5.56%), Hypothyroidism (2.22%), & HIV (1.11%). 57(63.33%) SAM children presented with diarrhea of which Hyponatremia in 38 cases (69.09%) & Hypernatremia in 1 cases No statistically significant difference was found with hyponatremia in diarrheal or non-diarrheal cases of SAM. It was found that 20% SAM children were having hypokalemia. Hypokalemia was found in 21.05% of diarrheal cases & 6.67% in non- diarrheal cases.

**Conclusion:** Anaemia, Diarrhea, Vomiting, Respiratory tract infections and vitamin A deficiency are the most common co morbid conditions in admitted severe acute malnourished children in this region. Co-morbidities identification and treatment in SAM children is key step in reducing morbidity and mortality associated with SAM.

**Keywords:** Co-morbidities, NRC, Severe Acute Malnutrition, Hypothyroidism, Celiac disease, Diarrhea, HIV

### Introduction

Severe Acute Malnutrition affects nearly twenty million under-five children, and contributes to one million child deaths yearly.<sup>1</sup> The mortality rate of children with complicated SAM that receive treatment in inpatient set ups has remained unacceptably high. Such high mortality in in-patient units has been attributed to co-morbidities such as infections and micronutrient deficiencies.<sup>2</sup>

In malnutrition various abnormalities occur in body electrolytes which become more pronounced with diarrheal incidence since electrolytes conduct an electrical current, helps to

balance pH and facilitate the passage of fluid between and within cells through process of osmosis imparting in regulation of the function of neuromuscular, endocrine and excretory systems.<sup>3,4</sup> Children with SAM are categorized into “complicated and uncomplicated cases” based on clinical criteria. SAM children with complications require inpatient management and those without complications can be treated on a community basis. World Health Organization (WHO) states this as a strong recommendation with low-quality evidence.<sup>5</sup> As per the WHO, serum electrolytes are measured and supplemented (potassium and magnesium) only in SAM children with complications. SAM children without complications are managed in community with Ready to Use Therapeutic Food (RUTF) which is enriched with minerals and micronutrients.<sup>6</sup> In our country, as RUTF is not available, children are advised home-based energy dense food along with micronutrient supplements. Hence, their diet may still be deficient in minerals. Diarrhea and pneumonia accounts for approximately half the under-five deaths in India and malnutrition is believed to contribute to 61% of diarrheal deaths and 53% pneumonia deaths. Malnutrition increases the risk and worsens the severity of infections.<sup>7</sup> SAM children are more prone to severe infections that culminates into different co-morbid conditions and consequentially leads to electrolyte derangement due to reductive adaptation  $\text{Na}^+$ ,  $\text{K}^+$ , ATPase systems of the body begin to ‘shut down’. Regulation of  $\text{Na}^+/\text{K}^+$  depends upon excretion, intake, absorption occurs through gastro intestinal system. Disorders of  $\text{Na}^+/\text{K}^+$  homeostasis can occur due to excessive loss, gain or retention of the  $\text{Na}^+/\text{K}^+$  or  $\text{H}_2\text{O}$ . A vigorous imbalance of these two ions causes hyponatremia/hypokalemia and hypernatremia/hypokalemia. Remarkably, hypokalemia and hyponatremia are seen more frequently in diarrheal population than non-diarrheal. Hence the aim of the study to evaluate the range of co-morbidities associated with extreme acute malnutrition and unexpected dyselectrolytemia in diarrhoea

### Material and methods

The observational study which was carried in the Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, and Bihar, India for 18 months. after taking the approval of the protocol review committee and institutional ethics committee.

#### Methodology

Total 90 Children below 6 year aged, admitted in Nutritional Rehabilitation Centre of Department of Paediatrics, were include in this study. Various co morbid conditions in study population were identified. All the laboratory examination were done with standard method.

### Data Analysis

Statistical analysis was done, using the statistical package for social science (SPSS 20) for Windows Software. Continuous variables were expressed as means, standard deviation (SD), confidence intervals (95%CI), frequency and range. Chi Square was applied and P value of < 0.05 was considered significant.

### Results

Out of these 90 patients, 59 (65.56%) were males and remaining 31(34.44%) were females. Male to female ratio was 1.90:1. Table 1 shows maximum numbers of patients were in the age group of more than 1-3 year which constituted 37(41.11%) cases. This was followed by below 1 year age group which constituted 27(30%) cases. Total 90 cases were included in study of which 89% were associated co-morbid conditions in SAM. Table 2 showed that majority of children with SAM were having co-morbidity in the form of Anaemia (85.56%), Diarrhoea (63.33%) followed by pneumonia (26.67%), Rickets (25.56%), Tuberculosis (13.33%), Otitis media (12.22%), UTI (11.11%), Celiac (5.56%), Hypothyroidism (2.22%), & HIV (1.11%).

**Table 1: Age distribution of children**

Sex	Number of cases=90	(Percentage
Male	59	65.56
Female	31	34.44
<b>Age</b>		
Below 1 year	27	30
1-3 years	37	41.11
3-6 years	26	28.89

**Table 2: Comorbid conditions in SAM**

Co-morbidity	No. of cases	% Percentage
Diarrhea	57	63.33
Tuberculosis	12	13.33
Pneumonia	24	26.67
Otitis media	11	12.22
UTI	10	11.11
Rickets	23	25.56
Anaemia *	77	85.56
Celiac disease	5	5.56
Hypothyroidism	2	2.22
HIV	1	1.11

Mean age (SD) of the diarrheal cases was 3.8 months (95% C.I. 22.9- 25.8) of which 37 were male (64.91%). Mean age (SD) of non-diarrheal cases was 3.3. (95% C.I. 18.6 – 21.8) of which 75.76% were male. Table 3 shows that 57(63.33%) SAM children presented with diarrhea of which Hyponatremia in 38 cases (69.09%) & Hypernatremia in 1 cases No statistically significant difference was found with hyponatremia in diarrheal or non-diarrheal cases of SAM(P value of 0.09)

**Table 3: Dysnatremia in SAM children in diarrheal & non diarrheal groups**

Serum Sodium	No diarrhea (%)	Diarrhea (%)	Total (% of the total cases)
Hyponatremia	17 (30.90%)	38 (69.09)	55 (61.11%)
Normonatremia	15 (45.46%)	18 (54.54%)	33 (36.67%)
Hypernatremia	1 (50%)	1 (50%)	2 (2.22%)
Total cases	33	57	90

Serum Potassium levels of 90 SAM children were analysed. It was found that 20% SAM children were having hypokalemia. Hypokalemia was found in 21.05% of diarrheal cases & 6.67% in non- diarrheal cases. Table 4 shows that Potassium levels of children with diarrheal & non diarrheal children with SAM. A statistically significant difference was found with hypokalemia in SAM (P value of 0.027) between Diarrheal & Non diarrheal cases.

**Table 4: Hypokalemia in SAM children**

Serum Potassium	No diarrhea	Diarrhea	Total
Normokalemia	27	45	72
Hypokalemia	6	12	18
Total	33	57	90

## Discussion

Mean age of children reporting with malnutrition are similar to other studies and there were no significant sex predominance in malnourished children. Diarrhea and Anaemia were two most common co morbid diseases followed closely by Vomiting and ARTI in malnourished children admitted in our hospital. Previous studies have also reported that malnourished children suffer in greater proportion from bacterial gastrointestinal and respiratory infections. Absence of a comparative group, no biochemical evaluation for micronutrient deficiencies and non-assessment of contributing factors for these deficiencies were the main lacunae of the study.<sup>8</sup>

In the present study Out of these 90 patients, 59 (65.56%) were males and remaining 31(34.44%) were females. Male to female ratio was 1.90:1. maximum numbers of patients were in the age group of more than 1-3 year which constituted 37(41.11%) cases. This was followed by below 1 year age group which constituted 27(30%) cases.

Majority of children with SAM were having co-morbidity in the form of Anaemia (85.56%), Diarrhoea (63.33%) followed by pneumonia (26.67%), Rickets (25.56%), Tuberculosis (13.33%), Otitis media (12.22%), UTI (11.11%), Celiac (5.56%), Hypothyroidism (2.22%), & HIV (1.11%).

In present study anaemia was found in 85.56% which is higher than 51% from Columbia as reported by Bernal C et al 2008.<sup>9</sup> It was further observed that children with SAM was having 51.95% moderate anaemia followed by 39.67% severe anaemia in present study which is contrary to the study from Delhi as reported by Thakur et. al.<sup>10</sup> This can be contributed to nutritional deficiency as majority of the patients had dietary deficiency. 63.33% of children with SAM in present study was admitted with diarrhea as a co morbid state which is in accordance with 60% from Bangladesh as reported by Khanum et. al 1998<sup>11</sup> but lower than 67% from Zambia as reported by Irena et. al 2011,<sup>12</sup> 68% from Columbia as reported by Bernal C. et al 2008,<sup>9</sup> 70% from Kenya as reported by Nzioki et. al 2009<sup>13</sup> which may be due to geographical factor while higher than 54% from Madhya Pradesh as reported by Kumar et al 2013,<sup>14</sup> 49% from Kenya as reported by Talbert et.al 2005<sup>15</sup> and 11% from Bangladesh as reported by Hossain et.al 2009.<sup>16</sup> It may be because of low socioeconomic status, bottle feeding & unhygienic feeding can be contributed to this high prevalence of diarrhea in present study. In our study hypokalemia was found associated with diarrhea and hyponatremia was found not associated which is comparable to other studies.<sup>17-19</sup> This dyselectrolytemia may present with significant neurological outcomes.<sup>17,20,21</sup> Further studies are needed establish the exact understanding of electrolyte changes in SAM. 26.67% of children with SAM in present study was admitted as a pneumonia based on the clinical findings & Chest X Ray which is higher than 10% in Ethopia as reported by Berti et. al 2008<sup>22</sup> which may be because of late admission in NRC. However it is lower than 33% and 58% from Bangladesh as reported by Hossain et al<sup>16</sup> and Kahnum et al 1998<sup>11</sup> respectively.

13.33% of Children with SAM were diagnosed as a Pulmonary tuberculosis in a present study which is higher than 2%, 5.6%, 6.6%, 9% and 9.3% from Karnataka, Madhya Pradesh, Ethiopia, Bangladesh and Uttar Pradesh as reported by Bhat et al,<sup>23</sup> Gangaraj 2013,<sup>24</sup> Berti et al 2008,<sup>22</sup> Hossain M et al,<sup>16</sup> & Kumar et al<sup>25</sup> respectively. The high prevalence tuberculosis in present study may be because of children with SAM are belonging to low socio economic class. The high prevalence can be contributed to the more cases having history of contact positive. So screening of all SAM children with Tuberculosis is a must to find the actual disease burden in SAM.

11.11% of children with SAM were diagnosed UTI in present study which is lower than 11%, 17%, 30%, 31% from Nigeria, Delhi, Turkey and Mexico as reported by Rabasa et al 2002,<sup>28</sup> Bagga et al 2003,<sup>29</sup> Caksen et al 2000,<sup>27</sup> Berkowitz et al 1983<sup>26</sup> respectively.

5.56% of children with SAM were diagnosed with Celiac disease in the present study based on clinical features suggestive of celiac disease, which is lower than 13% from Delhi as reported by Kumar et al 2012.<sup>25</sup>

25.56% SAM children in our study had ricketic features, and this is comparable with the previous reports.<sup>30</sup> This can be contributed to dietary deficiency and Vitamin D supplementation in early period of life. 2.22% of children with SAM were diagnosed with hypothyroidism in the present study based on clinical features suggestive of hypothyroidism. Exact prevalence of hypothyroidism was not found because selected cases were investigated.

1.11% of children with SAM were diagnosed HIV positive in the present study which is lower than found in previous studies.<sup>25,31</sup> This may be because of low prevalence of HIV in present study. However high prevalence of HIV infection in children with SAM in African country may be associated with nutritional deficiencies secondary to decreased nutrient intake, impaired nutrient absorption, increased nutrient losses and increased nutrient demand. This is due to direct effect of HIV and the myriad of opportunistic infections precipitated by HIV induced immunodeficiency.

### Conclusion

Anaemia, Diarrhea, Vomiting, Respiratory tract infections and vitamin A deficiency are the most common co morbid conditions in admitted severe acute malnourished children in this region. Co-morbidities identification and treatment in SAM children is key step in reducing morbidity and mortality associated with SAM.

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