

## “Electrolyte & Acid-base Status in Children with Dehydration Caused by Acute Diarrhea: A study in a tertiary care Hospital, Dhaka, Bangladesh”

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### Abstract

### Original Research Article

**Introduction:** Diarrhea is a condition in which faeces are discharged from the bowels frequently and in a liquid form. Dehydration is a very common phenomenon of diarrhea. Severe dehydration may cause electrolyte and acid-base imbalance in human body. So electrolyte and acid-base status analysis is a vital part of treating children with acute diarrhea. **Aim of the study:** The aim of this study was to evaluate the electrolyte and acid-base status in children with dehydration caused by acute diarrhea. **Methods:** This was a prospective observational study and was conducted in the Department of Paediatric Medicine of Dr. M R Khan Shishu Hospital & ICH, Dhaka, Bangladesh during the period from January 2017 to June 2017. In total 81 children aged under 5 years admitted to the mentioned hospital with dehydration caused by acute diarrhea were selected as the study population. **Result:** In our study we found 53.09% (n=43) patients had isonatremic dehydration (Na<sup>+</sup>: 135-145 mEq/L) followed by 23 (28.40%) patients who had hyponatremic dehydration (Na<sup>+</sup><135 mEq/L). Among those 28.40% patients 6.17% (n=5) had Na<sup>+</sup><120 mEq/L. On the other hand, 15(18.51%) children had hypernatremic dehydration (Na<sup>+</sup>>145mEq/L). Among those 18.51% children 1.23% (n=1) patients had Na<sup>+</sup><160 mEq/L. Besides these, among total study population hypokalemia (serum K<sup>+</sup><3.5 mEq/l) were in 67.90% (n=55) patients and hyperkalemia (serum K<sup>+</sup>>4.5mEq/l) were in 6.17% (n=5) patients. So 25.93% (n=21) patients had normal serum potassium level. **Conclusion:** Hypokalemia is the most common electrolyte abnormality in acute diarrhoea with dehydration followed by hyponatremia and hypernatremia. Significant number of patients also developed metabolic acidosis.

**Keywords:** Diarrhea Electrolyte Acid-base tertiary.

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## INTRODUCTION

Diarrhea is a condition in which faeces are discharged from the bowels frequently and in a liquid form. Dehydration is a very common phenomenon of diarrhea. Severe dehydration may cause electrolyte and acid-base imbalance in human body. So electrolyte and acid-base status analysis is a vital part of treating children with acute diarrhea. Diarrhea is still one of the leading causes of morbidity and mortality in children around the world [1-3]. Oral rehydration treatment has considerably reduced complications and mortality from diarrheal diseases. Still many children with diarrhea suffer from dehydration and electrolyte imbalance [4]. Presence of different types of electrolyte disorders is associated with significant increase in mortality rates among children with diarrhea<sup>4</sup>. Basically

diarrhea is a disease of fluid loss. Diarrhea is best defined as excessive loss of fluid and electrolyte in the stool. So diarrhea is generally causes dehydration. Acute diarrhea is sudden onset of excessively loose stools of more than 10 ml/kg/day in infants and more than 200g/24hr in older children, which lasts less than 14 days. When the episode lasts longer than 14 days, it is called persistent diarrhea [5]. Diarrheal disorders in childhood account for a large proportion (18%) of childhood deaths, with an estimated 1.5 million deaths per year [6]. Diarrhea results in loss of sodium, chloride, bicarbonate and potassium in addition to water in stool [7]. Because diarrhea is hypotonic, water losses exceed sodium losses, potentially leading to hypernatremia. Metabolic acidosis occurs due to the loss of alkali in the gut and various other factors and

potassium depletion. Besides this, metabolic acidosis causes a shift of potassium out of cells, and renal insufficiency may lead to hyperkalemia. A combination of mechanisms may be present; thus, it may be difficult to predict the child's acid-base status or serum potassium level from the history alone [8]. In India, study by Dastidar RG et al from Kolkata reported prevalence of Hyponatremic dehydration 22.0%, 71.5% of isonatremic dehydration and 6.5% of Hypernatremic dehydration in children fewer than 5 years of age [9]. Clinical features and management of diarrhea and dehydration will depend upon severity of dehydration, type of dehydration (isonatremic, hyponatremic and hypernatremic), nutritional status, and acid-base and electrolyte status. Present study has been planned to study on serum electrolyte and acid base disturbances in acute watery diarrhea with dehydration.

## OBJECTIVES

### a) General objective

- To evaluate the electrolyte and acid-base status in children with dehydration caused by acute diarrhea.

### b) Specific Objectives

- To evaluate the socio-economic status of the guardians of the study participants.

## ETHODOLOGY & MATERIALS

This was a prospective observational study and was conducted in the Department of Paediatric Medicine of Dr. M R Khan Shishu Hospital & ICH, Dhaka, Bangladesh during the period from January 2017 to June 2017. In total 81 children aged less than 5 years admitted to the mentioned hospital with dehydration caused by acute diarrhea were selected as the study population. The caregivers of the study subjects admitted in the pediatric department were interviewed after taking informed written consent. Clinical examination and related laboratory investigation like serum electrolyte, ABG analysis was done. Children with acute diarrhea with gross blood in stool, age more than 5 years and patients with hypersensitivity of drug were excluded from the study. Age, gender, socioeconomic status and nutritional status (as per WHO weight for height classification) were recorded. Detailed examination was done, dehydration was classified and treated as per WHO protocol and severity of illness was classified as per Vesikari scoring system for diarrheal illness. Investigation like ABG analysis, serum electrolytes were done for all study subjects at the time of admission. All necessary data were collected by MS-Excel and analyzed and statistically evaluated using SPSS version 17 software. Quantitative data was expressed in mean, standard deviation while qualitative data were expressed in percentage. Statistical differences between the proportions were tested by chi square test or Fisher's exact test. 'p' value less than 0.05 was considered

statistically significant. All participants were explained about the purpose of the study. Confidentiality was assured to them along with informed written consent from their parents or caregivers. The study was approved by the ethical committee of the hospital previously.

## RESULT

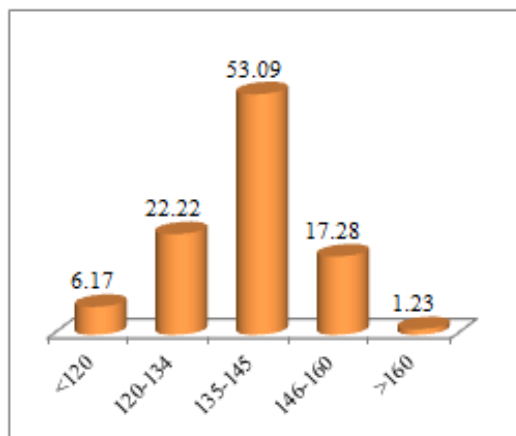
In our study, 81 children 44 (54.32%) were male and 37 (45.68%) were female. So the male-female ratio was 1.19:1. The highest number of patients was from 1 to 2 years' age group which was 26 (32.10%). This trend was followed by 25.93% were from 3 to 4 years' age group, 23.46% were from >4 years' age group and 18.51% were from <1 years' age group. According to the socio-economic status of the participants we found the highest number of patients were from lower class family which was 35.80% (n=29). This trend was followed by 25.93% were from lower middle class, 23.46% were from upper middle class and only 14.81% were from upper class family. According to WHO classification 21 (25.93%) children of this study had severe malnutrition, while 34 (41.98%) had moderate malnutrition and rest of the children were in normal condition. In this study we found 58 (71.60%) patients had "SOME" and 23 (28.40%) had "SEVERE" dehydration as per WHO classification of dehydration. Among all the study people none had mild diarrheal illness as we have included hospitalized children. In this study we found, 11(13.58%) had moderately severe illness, 56 (69.14%) had severe illness and 14 (17.28%) patients had very severe illness as per Vesikari scoring of diarrhoeal illness. In our study we found 53.09% (n=43) patients had isonatremic dehydration ( $\text{Na}^+$ : 135-145 mEq/L) followed by 23 (28.40%) patients who had hyponatremic dehydration ( $\text{Na}^+ < 135$  mEq/L). Among those 28.40% patients 6.17% (n=5) had  $\text{Na}^+ < 120$  mEq/L. On the other hand, 15 (18.51%) children had hypernatremic dehydration ( $\text{Na}^+ > 145$  mEq/L). Among those 18.51% children 1.23% (n=1) patients had  $\text{Na}^+ < 160$  mEq/L. Besides these, among total study population hypokalemia (serum  $\text{K}^+ < 3.5$  mEq/l) were in 67.90% (n=55) patients and hyperkalemia (serum  $\text{K}^+ > 4.5$  mEq/l) were in 6.17% (n=5) patients. So 25.93% (n=21) patients had normal serum potassium level. In our study out of total 81 patients 49.38% (n=40) had normal  $\text{p}^{\text{H}}$  levels (7.35-7.45). We found Acidosis ( $\text{p}^{\text{H}} < 7.35$ ) was present in 34.56% (n=28) of patients and 16.05% (n=13) cases had alkalosis ( $\text{p}^{\text{H}} > 7.45$ ) in the study. Severe acidosis ( $\text{p}^{\text{H}} < 7.15$ ) was present in 14.81% (n=12) patients.

**Table-I: Age distribution of participants (N=81)**

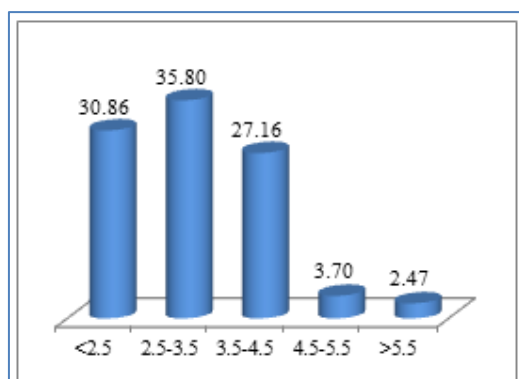
Age (Years)	n	%
<1	15	18.51
1-2	26	32.10
3-4	21	25.93
>4	19	23.46

**Table-II: Socio-economic status of participants (N=81)**

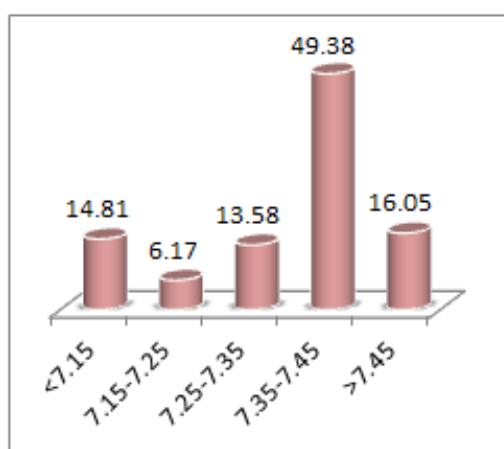
Socio-economic Status	n	%
Upper Class	12	14.81
Upper Middle Class	19	23.46
Lower Middle Class	21	25.93
Lower Class	29	35.80
<b>Total</b>	<b>81</b>	<b>100</b>



**Fig-I: Sodium/Na<sup>+</sup> level in mEq/L distribution of participants (N=81)**



**Fig-II: Potassium/K<sup>+</sup> level in mEq/L distribution of participants (N=81)**



**Fig-III: pH level distribution of participants (N=81)**

## DISCUSSION

The aim of this study was to evaluate the electrolyte and acid-base status in children with dehydration caused by acute diarrhea. In total 81 children aged within 5 years admitted to the mentioned hospital with dehydration caused by acute diarrhea were selected as the study population. In our study among 81 children 44 (54.32%) were male and 37 (45.68%) were female. So the male-female ratio was 1.19:1. The highest number of patients were from 1 to 2 years' age group which was 32.10% (n=26). This trend was followed by 25.93% were from 3 to 4 years' age group, 23.46% were from >4 years' age group and 18.51% were from <1 years' age group. There are some similarities in findings of us with that of another study conducted by Dagar J *et al.* Maharashtra, 2015[10] and Shah GS *et al.* Kathmandu, 2007[11]. According to socio-economic status of the participants in our study, the highest number of patients was from lower class family. This observation was in accordance with study by Phukan AC *et al.* [12]. In our study, we found 25.93% children with severe malnutrition and this observation was in accordance with study by Memon Y *et al.* Hyderabad[13] in which they found that electrolyte changes were commonly seen in grade II and III malnourished patients particularly who presented with diarrhoeal episode of variable duration. As per WHO classification of dehydration in our study we found 58 (71.60%) patients had "SOME" and 23 (28.40%) had "SEVERE" dehydration. Similar observations were found in the study conducted by Okposio MM *et al.* Benin, 2015[14] in which Electrolytes and acid base disturbances were observed in 165 (89.2%) of the children, most of them (114 or 61.6%) were moderately dehydrated, while mild and severe dehydration accounted for 41 (22.2%) and 30 (16.2%), respectively. Another study by Dastidar RG *et al.* [9] reported that out of 200 children 166 cases (83%) had moderate dehydration, whereas 34 cases (17%) had severe dehydration which was also near to our study. In our study we found 53.09% (n=43) patients had isotonic dehydration (Na<sup>+</sup>: 135-145 mEq/L) followed by 15 (18.51%) patients who had hyponatremic dehydration (Na<sup>+</sup><135 mEq/L). Tis findings is compareable with the study conducted by Okposio MM *et al.* [14] where dehydration was the most common type of dehydration (60.5%), while hypokalaemia occurred in 82 (44.3%). Metabolic acidosis was reported in 59.5% children. Dastidar RG *et al.* Kolkata [14] revealed that 71.5% had Isonatremia, 22% had Hyponatremia and 6.5% had Hypernatremia. Hypokalemia was present in 15% (30) cases and 85% (170) cases had Normokalemia. Ahmad MS *et al.* Pakistan, 2012 [15] found that hyperchloremia was the commonest electrolyte disorder (53.8%), followed by hyperkalemia (26.9%) and hypernatremia (17.3%). Hyponatremia, hypokalemia and hypochloremia were present in 10.6%, 7.7%, and 10.6% cases, respectively. In this study hypernatremia was more common than hyponatremia. It may be due to the fact that the author selected participants from birth

to 18 years of age, while in our study we have included subjects till 5 year of age. Other study by Purohit KR *et al.* Andhra Pradesh [16] and Dagar J *et al.* Maharashtra [10] also reported higher incidence of hyponatremic dehydration and metabolic acidosis. During our intervention in article review we found some differences of our findings with that of many published studies conducted on younger children and adolescents. So age may be a potential factor in this issue.

## LIMITATIONS OF THE STUDY

This was a single centered study with a small sized sample. So the findings of this study may not reflect the exact scenario of the whole country.

## CONCLUSION AND RECOMMENDATIONS

Hypokalemia is the most common electrolyte abnormality in acute diarrhoea with dehydration followed by hyponatremia and hypernatremia. Significant number of patients also developed metabolic acidosis.

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