

Original Articles

Frequency and outcome of sodium disturbances in children admitted with acute watery diarrhea in a tertiary hospital of Bangladesh

FERDOUS ARA¹, NASIR UDDIN MAHMUD², MOHAMMED MARUF UL QUADER³, MUHAMMAD JABED BIN AMIN CHOWDHURY⁴, GOLAM MOHAMMAD TAYEB ALI⁵, TASNUVA SHARMIN⁶

Abstract

Background: Acute watery diarrhea (AWD) is one of the common causes of hospital admissions in pediatric age group. Majority of children with dehydration suffer from different electrolyte abnormalities which needs to be identified and treated.

Objectives: To investigate the frequency and outcome of sodium disturbances in AWD among children admitted in a tertiary hospital in Bangladesh.

Method: In this prospective observational study, 121 children of 2 months to 5 years of age admitted in the Department of Pediatrics, Chittagong Medical College Hospital with AWD were included. Clinical features and sodium levels on admission were recorded. Patients were followed up during their hospital stay to record the outcomes. Children were grouped in hyponatremia (serum sodium <135mmol/l), hypernatremia (serum sodium >145mmol/l) and normonatremia (serum sodium 135–145mmol/l) and compared.

Results: Of the 121 children, 38.0% and 62.0% had moderate and severe dehydration, respectively. The majority (58.7%) had normal sodium levels. Sodium disturbances was found in 41.3% cases. There were 26.4% cases of hypernatremia and 14.9% cases of hyponatremia among them. Out of 18 hyponatremic patients, 77.8% had mild hyponatremia and the rest 22.2% had moderate hyponatremia. Among 32 hypernatremic children, 62.4% had mild, 18.8% had moderate and 18.8% had severe hypernatremia. The case fatality rate was 2.6% and all of them had hypernatremic dehydration at admission.

Conclusion: Sodium disturbances particularly hypernatremia is more frequent and is associated with high case fatality rate among children hospitalized with acute watery diarrhoea.

Key Words: Children, Diarrhea, hypernatremia, hyponatremia, outcome.

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Introduction

Diarrhea is the second leading cause of infectious deaths worldwide among children under five.^{1,2} In low- and middle-income countries (LMICs), diarrhea is the most common cause of childhood illness and healthcare visits, especially in South Asia.³ As in many other LMICs, diarrhea is one of the major public health problems in Bangladesh, which accounts for 6% of 0.119 million deaths in 2015.⁴ The prevalence of

diarrhea in children under five is accounted for 44.5% and was the highest at age 6-23 months.⁵

The copious fluid loss that follows acute watery diarrhea (AWD) is often associated with complications, such as dehydration, electrolyte derangement, shock, organ failure, and death compared to other types of diarrhea like dysentery and chronic diarrhea.⁶ Electrolyte disturbances are established risk factors for diarrhea-related deaths, which may be unrecognized on admission.^{7,8} Two hospital-based studies from Dhaka and one from India reported that electrolyte disturbances in AWD were associated with increased morbidity, hyponatremia and hypokalaemia being the commonest electrolyte abnormality.^{9,10,20} Timely recognition, a high index of suspicion, and a thorough

1. Jr. Consultant, Pediatrics, CMCH.

2. Director, IPHN.

3. Associate Professor, Pediatric Nephrology, CMC.

4. Assistant Professor, Pediatrics, CMC.

5. Assistant Professor, Pediatrics, CMC.

6. Jr. Consultant, Pediatrics, DMCH.

Correspondence: Dr. Ferdous Ara, Jr. Consultant, Pediatrics, CMCH. Email: faradr77@gmail.com Phone: 01819995943

understanding of common electrolyte abnormalities are necessary to ensure their correction.¹¹

No recent studies from the study site exist regarding the sodium disturbances occurring in a hospitalized child suffering from AWD. It is important to know the pattern to which children with AWD are admitted into our hospital and the outcome to assist in proper planning, prevention and management. The present study was undertaken to ascertain the frequency of different types, severity, and outcome of sodium disturbances among the children admitted with AWD in a tertiary hospital in Bangladesh.

Materials and Methods:

This prospective observational study was conducted at the inpatient department of the pediatric unit, Chittagong Medical College Hospital, Chattogram, from June 2018 to May 2019. Prior approval was obtained from the Ethical and Review Committee of Chittagong Medical College for the study. Written informed consent was obtained from the parents or guardians of the children.

In the study, a sample size of 121 cases was calculated with a 95% confidence level and 9.0% margin of error with the expected frequency of sodium disturbance in AWD of 43.3%.¹² The sampling technique was non-probability convenient sampling. Admitted children with AWD aged between 2 months to 5 years were included in the study. Children with other systemic infections like pneumonia, measles, etc., persistent diarrhea, dysentery, chronic diarrhea, severe acute malnutrition, and non-consenting caregivers were excluded.

After consenting, each child was assessed by taking a history from the mother/caregiver and performing the physical examination. Three ml of venous blood sample was obtained in a clotted vial with the help of a staff nurse before rehydration and sent to a laboratory for analysis of electrolyte. Type of sodium imbalance was assessed as per operational definition. As it was an observational study, the patient's treatment protocol

was not interrupted, and the patient got the treatment as per available hospital protocol. Patients were followed up twice daily during their hospital stay to measure the outcome (Length of Hospital Stay, ICU/HDU admission, need for dialysis, recovery status, and mortality).

The severity of dehydration was labeled as per WHO criteria.¹³ Hypernatremia was defined as serum sodium level over 145 mEq/L (normal range: 135-145 meq/L), and hyponatremia was defined as serum sodium concentration below 135 mEq/l.¹⁴ Mild, moderate, and severe hypematraemic dehydration was defined as serum sodium between 146–159mmol/L, 160–169 mmol/L, and greater than 169 mmol/L, respectively.¹⁵ Mild, moderate, and severe hyponatremic dehydration was defined as serum sodium between 130–135 mmol/L, 125–129 mmol/L, and less than 125 mmol/L.¹⁶ Length of hospital stay was defined as the time from admission to the hospital to the time of the order for hospital discharge or meeting discharge criteria in this study. Criteria for discharge included sufficient rehydration achieved as indicated by clinical status, intravenous or nasogastric fluid not required, oral intake equals or exceeding losses, and good family teaching occurred.¹⁷

The data were analyzed statistically through SPSS version 23.0. This study's qualitative variables, such as hyponatremia, hypernatremia, and isonatremia, have been expressed as frequency and percentage. Association between sodium status and death was tested by the Chi-square test and $p < 0.05$ was considered as statistical significance (Table IV).

Results:

Out of 121 admitted diarrhoeal disease cases, 75 (62%) were males, and 46 (38%) were females with a male-female ratio of 1.63:1. The median age of the study population was 12 (IQR: 2-54) months. Most of the children (61.2%) were <1 year of age. Among them 46 (38.0%) and 75 (62.0%) had some and severe dehydration, respectively. About one third (33.1%) of the child had moderate wasting (Table-I).

Table I
Characteristics of the children on admission (n=121)

Variables		Frequency (percentage)
Age, in month	≤12 months	74 (61.2%)
	>12 months -23 months	44 (36.4%)
	≥24 months	3 (2.5%)
Sex	Male	75 (62.0%)
	Female	46 (38.0%)
Dehydration status	Some dehydration	46 (38.0%)
	Severe dehydration	75 (62.0%)
Nutritional Status (WHZ-score)	>-2 SD	81 (66.9%)
	≤-2SD	40 (33.1%)

The mean (±SD) serum sodium level of the study patients was 143.4±11.39 mmol/L with a range of 127.0 mmol/L to 200 mmol/L. Most of the children, 71(58.7%), were normonatremic, followed by 32 (26.4%) hypernatremic and 18 (14.9%) hyponatremic patients. After categorizing the hyponatremia and hypernatremia according to severity, it was found that out of 18 hyponatremic patients, 14 (77.8%) had mild hyponatremia, and the rest 4 (22.2%) had moderate hyponatremia. Among 32 hypernatremic children, 20 (62.4%) had mild hypernatremia, and 6 (18.8%) had moderate and 6 (18.8%) had severe hypernatremia. (Table II).

Table II
Serum sodium status of the children at admission

Types of sodium disturbance	Frequency (percentage)
Normonatremia	71(58.7%)
Hyponatremia	18(14.9%)
Mild	14 (77.8%)
Moderate	4 (22.2%)
Hypernatremia	32(26.4%)
Mild	20 (62.4%)
Moderate	6 (18.8%)
Severe	6 (18.8%)

Out of 121 admitted children, 3 (2.5%) child died in the hospital. The median length of hospital stay was 43 hours (IQR: 27-51). Five (4.1%) children needed ICU support, and 2 (1.6%) needed peritoneal dialysis (Table-III).

Table III
Outcome of the study patients

Variables	
Improved and discharged with advice	111 (91.7%)
Died	3 (2.6%)
HDU/ICU support given	5 (4.1%)
Peritoneal dialysis given	2 (1.6%)
Length of hospital stay, in hours Median (IQR)	43 (27-51)

Out of 121 children, 7 children left the hospital against medical advice (Dropped out). Among the available 114 children, 3 died in hospital with a case fatality rate of 2.6%. All of these fatal cases had hypernatremia on admission (Table-IV).

Table IV
Association of fatal outcome with sodium status of the patients (n=114)

Sodium status	Survived	Died	P value
Normonatremia	71 (100%)	0 (0%)	0.011
Hyponatremia	18 (100%)	0 (0%)	
Hypernatremia	26 (89.7%)	3 (10.3%)	
Total	111 (97.4%)	3 (2.6%)	

Annex: 1

Sample size:

To estimate the proportion, sample size was determined by following formula:

$$n = \frac{z^2}{d^2}$$

Where,

n=the required sample size,

z=the standard normal deviate set at 1.96 which corresponds to the 95% confidence level.

p = Expected proportion of the events 43.3% or 0.433. The prevalence of Sodium disturbance in watery diarrhoea in young children (≤05 years) (Shahrin et al., 2016).(Hyponatremia 23.8%+ Hypernatremia 19.5% = sodium disturbance 43.3%)

q=1-p = 0.567

d= the degree of accuracy desired, set at 10% = 0.1

$$\text{So, } n = \frac{1.96^2 \times 0.433 \times 0.567}{0.1^2} = 94.15 \quad 94$$

However, as the sample was drawn conveniently sample size was increased 30% to improve the accuracy and finally 121 children were enrolled in the study.

Discussion:

This study found sodium disturbance is common in children admitted with AWD. 41.3% of the study population had sodium disturbance (hyponatremia and hypernatremia) similar to other previous studies, where disturbance of sodium ranges from 27.2%-64.8%.^{12,18,19} Isonatremic dehydration was the commonest type in the present study, similar to other studies.^{12,20}

Different studies have shown a different prevalence of hyponatremia and hypernatremia among children with diarrhea and dehydration. In the present study, hypernatremia was more common than hyponatremia (26.4% versus 14.9%). Two previous studies in icddr, b from Bangladesh^{12,18} & Shah et al²¹ from Nepal showed dissimilarities that is hyponatremia was more common than hypernatremia. However, our results fully agreed with another recent study conducted in Pakistan where hypernatremia is more prevalent.¹¹ Different factors can alter the prevalence of electrolyte disorders among children with diarrhea, and malnutrition is one of these factors. Poor nutritional state is a risk factor for development of hyponatremia and different studies observed a significant relation between serum sodium concentration and nutritional state.^{12,18,23} In our study a conservative eligibility criteria was used, excluding patients with severe malnutrition which could be a reason for getting less frequency of hyponatremia. Afroz et al²⁶ from Bangladesh states that intake of concentrated ORS and diarrhoea during winter season were the most important causes of hypernatremia. Faulty preparation of ORS which might be the cause of the rise in frequency of hypernatremia, was not taken into consideration in this study. Moreover, determination of the aetiological agents was not done, making it impossible to state to what extent it influenced the outcome.

Among the admitted patients, 62% were male, 46% were female, with a male-female ratio of 1.63:1. Shah et al.²¹, Sultana et al.²³, Okposio et al.¹⁹ also found males are more than females among admitted children. Katiyar et al.²⁴ observed that gender discrimination does exist in the rural area at each step of seeking health care for the girl child.

Timely detection and correction of electrolyte disorders are important. Various studies have shown that disorder in sodium levels leads to an adverse effect on the outcome. Similar to Shahrin et al.¹² (12%), in the present study, the fatality rate of hypernatremia was 10.3% and two-thirds were severely hypernatremic. A study by Sultana et al.²³ showed that increasing severity of hypernatremia leads to an increase in mortality rate. Samadi et al.¹⁸ showed that the case fatality rates were higher (10.1%) in hyponatremia than hypernatremia (1.2%). However, the dissimilarities of these case fatality rates among studies could be explained by the individual patient's selection criteria and diversity in diarrhea's etiology.²⁵

Conclusion:

Sodium disturbances is quite common in children admitted with acute watery diarrhea. Compared to hyponatremia, hypernatremia is more frequent and has a high death rate. To improve outcomes, serum electrolyte measurement should be carried out in children with AWD who have been hospitalized. This will allow early detection and effective management of sodium imbalances.

Conflict of Interest: None.

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