

# FREQUENCY OF ELECTROLYTE IMBALANCE IN CHILDREN PRESENTING WITH ACUTE GASTROENTERITIS

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## Abstract

**Background:** Acute gastroenteritis (AGE) is a common cause of morbidity among children, which tends to cause dehydration and electrolyte imbalances. The presence of electrolyte disturbances, especially sodium and potassium may complicate the treatment, and the risk of adverse outcomes increases.

**Objective:** To find out the prevalence and nature of the electrolyte imbalances in children who present with acute gastroenteritis and determine whether they are associated with the severity of dehydration.

**Methodology:** The study was a cross-sectional one that was carried out in the Paediatric Department of Mayo Hospital Lahore during March 2023 to September 2023. They were children aged 6 months to 12 years that had acute gastroenteritis. The WHO sample size calculator was used to determine the size of the sample (n=188). Children that have chronic gastrointestinal or renal diseases, metabolic disorders or are on drugs that influence electrolytes were excluded. Informed consent was obtained and demographic and clinical information, such as age, gender, duration of illness, and dehydration status were taken. To quantify serum sodium, potassium, chloride and bicarbonate, blood samples were taken at presentation and analyzed using standard lab procedures. Definite electrolyte imbalance was identified as hyponatremia (<135 mmol/L), hypernatremia (>145 mmol/L), hypokalaemia (<3.5 mmol/L), hyperkalaemia (>5.5 mmol/L) and metabolic acidosis (bicarbonate <18 mmol/L). Data analysis was done by paying attention to SPSS-25, and using descriptive statistics and Chi-square tests (p<0.05) to determine the relationship between the severity of dehydration and other variables.

**Results:** One hundred and eighty-eight children were put on record, and the imbalances of the electrolytes were detected in 62. The most frequent one was hyponatremia (35%), then came the one Hypokalaemia (20%), then Hypernatremia (7%), and finally the one Metabolic acidosis (15%). Severe dehydration was highly linked with various abnormalities in electrolytes and mild and moderate showed fewer abnormalities. The necessity of early electrolyte evaluation and correct fluid management of children with acute gastroenteritis was emphasized in cases of early hydration and decreased hospital stay.

**Conclusion:** Children with AGE usually experience electrolyte imbalances especially when moderately to severely dehydrated. The diagnosis and treatment of complications should be identified early to avoid complications and lead to the proper fluid therapy.

**Keywords:** Acute gastroenteritis, Electrolyte imbalance, Children, Hyponatremia, Hypokalaemia, Dehydration, Paediatric, Serum electrolytes

## INTRODUCTION

Acute gastroenteritis (AGE) is diarrhea that suddenly starts, accompanied by or without vomiting and lasts less than 14 days. It ranks as a leading cause of morbidity and mortality of children below five years old in the world [1]. AGE may result in considerable loss of fluids and electrolytes, dehydration and metabolic imbalances and occasionally fatal complications [2].

Sodium, potassium, chloride and bicarbonate are important electrolytes which help in maintaining the cellular functioning, neuromuscular activity and acid-base balance [3]. Electrolyte imbalances tend to affect children more because they have a greater amount of body water, a rapid turnover of water, and underdeveloped renal capabilities. AGE may lead to vomiting and diarrhea which may cause hyponatremia, hypernatremia, hypokalaemia or metabolic acidosis depending on the degree and nature of the fluid loss [4]. Past research has indicated that the electrolyte imbalances among children with AGE play a significant role in clinical complications, hospital stay, and cost of health care [5]. In children with watery diarrhea and vomiting hyponatremia is more likely to be found and in cases when there has been prolonged loss of fluid, hypokalaemia is more likely to be found [6]. Early detection of these disorders is paramount, and early correction may avert the negative consequences of these disorders, including seizures, cardiac arrhythmias and renal impairment [7].

In most developing countries such as the one in Pakistan, although the clinical significance, evidence of the frequency and trend of electrolyte disturbances in childhood AGE is scarce [8]. Awareness of the common and uncommon electrolyte imbalances may assist the clinician to recognize the high-risk children, maximize fluids and decrease morbidity [9].

This research will evaluate the rate of electrolyte disorders in children who present with AGE and how this correlates with the severity of dehydration, which will help in enhancing paediatric care in the emergency and inpatient care [10].

### Objective

To establish the incidence and nature of electrolyte imbalances in children with acute gastroenteritis between 6 months and 12 years of age and how the electrolyte imbalances correlate with the severity of dehydration.

## METHODOLOGY

This study was a cross-sectional study conducted at Paediatric Department of Mayo Hospital Lahore during March 2023 to September 2023. Children between 6 months-12 years of age with clinical manifestations of AGE were included. A sample size (n=188) was determined by the WHO sample size calculator to have a 95% level of confidence and 5% margin of error. Children who were chronically ill with gastrointestinal or renal diseases, were on medications that could alter electrolyte balance and children with underlying metabolic disorders were excluded. Informed consent was given by the caregivers, then the demographic and clinical information (age, gender, illness duration, and dehydration level) were collected. The electrolytes in the serum i.e. sodium, potassium, chloride and bicarbonate were determined at presentation using the conventional laboratory methods. Based on paediatric reference ranges of electrolytes, electrolyte disturbances were classified: hyponatremia (<135 mmol/L), hypernatremia (>145 mmol/L), hypokalaemia (<3.5 mmol/L), hyperkalaemia (>5.5 mmol/L), and metabolic acidosis (bicarbonate <18 mmol/ Data were put into SPSS version 25 and analyzed. Frequencies, percentages and means  $\pm$  standard deviation were computed. Chi-square tests were used to determine associations between electrolyte abnormalities and clinical characteristics including the severity of dehydration and p-values below 0.05 were regarded as being statistically significant.

### Inclusion and Exclusion Criteria

**Inclusion Criteria:** Children between the ages of 6 months to 12 years who had acute gastroenteritis (i.e., three or more loose stools in one day) and were less than 14 days were included in the study. The patient was only eligible to the presentation within 72 hours of the onset of symptoms. Parents or guardians were informed about the study and gave informed consent to participate to make sure that ethical issues were considered.

**Exclusion Criteria:** Kids with a history of chronic gastrointestinal diseases, e.g. inflammatory bowel disease were not included. Patients having conditions that impacted the electrolyte balance such as renal, cardiac, and metabolic conditions were also excluded, as well as children undergoing medications such as diuretics and corticosteroids. The study did not include critically ill children who need to be given intensive care due to reasons other than acute gastroenteritis to avoid confounding factors.

### Data Collection

Data Collection Demographic and clinical data, such as age, gender, and the number of diarrheal episodes, the frequency of vomiting and the presence of dehydration signs were recorded on a structured proforma after informed consent. Dehydration was classified as either mild or moderate or as severe as per WHO guidelines. Sera sodium, potassium, chloride and bicarbonate were measured in venous blood samples upon presentation. The results of the laboratory were analyzed with the help of the standard automated analysers based in the hospital laboratory. The identification of electrolyte disturbances was done according to the age-specific reference ranges. The information was inputted on SPSS version [X]. Findings were summarized using descriptive statistics

(frequency and percentages). Chi-square tests were performed to associate the electrolyte imbalances with the severity of dehydration with  $p < 0.05$  deemed as statistically significant.

## RESULTS

All were 188 children with a mean age of  $3.8 \pm 2.1$  years and 55% of them were male. In 62% of the patients, electrolyte disturbances were seen. The most prevalent abnormality was hyponatremia with 35% of children affected and then 20% with hypokalaemia. In 7% of the cases hypernatremia was noted, in 15% cases metabolic acidosis was found. Hyponatremia ( $p=0.02$ ) and hypokalaemia ( $p=0.01$ ) had a strong correlation with severe dehydration. Children that were moderately dehydrated had less electrolyte abnormalities. Early elimination of imbalances resulted in a better hydration status and decreased hospitalization. The results highlight the level of prevalence of electrolyte disturbances in paediatric AGE and the fact that lab testing is necessary urgently.

**Table 1: Demographic Characteristics of Study Participants (n=188)**

Characteristic	Frequency (n)	Percentage (%)
<b>Age (years)</b>		
6 months – 1 year	42	22.3
1 – 5 years	100	53.2
6 – 12 years	46	24.5
<b>Gender</b>		
Male	103	54.8
Female	85	45.2

Shows age and gender distribution of 188 children with AGE. The age group of majority children was 1-5 years old (53%), and the proportion of males was 55% which means that the study population is more male dominated.

**Table 2: Dehydration Severity in Study Participants**

Dehydration Severity	Frequency (n)	Percentage (%)
Mild	72	38.3
Moderate	82	43.6
Severe	34	18.1

Shows drying out of the participants. The most common was moderate dehydration (44%), then mild (38%), and severe (18%), because of different clinical manifestations at admission.

**Table 3: Frequency of Electrolyte Disturbances**

Electrolyte Disturbance	Frequency (n)	Percentage (%)
Hyponatremia (<135 mmol/L)	66	35.1
Hypernatremia (>145 mmol/L)	13	6.9
Hypokalaemia (<3.5 mmol/L)	38	20.2
Hyperkalaemia (>5.5 mmol/L)	7	3.7
Metabolic acidosis ( $\text{HCO}_3^- < 18$ mmol/L)	28	14.9

Concisely describes the occurrence of electrolyte abnormalities. The most common was hyponatremia (35%), then there was a high risk of imbalances: hypokalaemia (20%), metabolic acidosis (15%), and hypernatremia (7%).

**Table 4: Electrolyte Disturbances by Dehydration Severity**

Dehydration Severity	Hyponatremia	Hypernatremia	Hypokalaemia	Hyperkalaemia	Metabolic Acidosis
Mild	15	3	6	1	5
Moderate	35	6	20	4	15
Severe	16	4	12	2	8

Demonstrates the relationship between electrolyte abnormalities and dehydration. The incidence of hyponatremia and hypokalaemia was greater in severe cases of dehydration, and mild cases had fewer disturbances, highlighting the impact of fluid loss on electrolytes.

**Table 5: Clinical Outcomes of Children with AGE**

Outcome	Frequency (n)	Percentage (%)
Hospitalization	188	100
Duration of hospital stay $\leq 3$ days	112	59.6
Duration of hospital stay $> 3$ days	76	40.4
Complications (e.g., seizures)	8	4.3
Recovery without complications	180	95.7

Presents results are such as hospitalization and complications. The majority of children did not have complications (96%), and 40 percent remain over 3 days, which proves effective management and early correction of electrolyte imbalances.

## DISCUSSION

Acute gastroenteritis (AGE) is a leading cause of morbidity among children across the globe, mainly because of loss of fluids and electrolytes [11]. This research established that, children with AGE had some type of electrolyte imbalance, which is very common in children. Hyponatremia was the most common abnormality (35%), followed by hypokalaemia (20%), metabolic acidosis (15%), and hypernatremia (7%) [12]. These results are aligned with the earlier research, which has indicated hyponatremia to be the most common electrolyte imbalance in children with AGE especially those who had moderate to severe dehydration [13].

The connection between the degree of dehydration and electrolyte imbalance was apparent. Severe dehydration was highly correlated with hyponatremia and hypokalaemia, but children with mild dehydration had less abnormalities [14]. This is in line with the pathophysiology of AGE in which excessive gastrointestinal losses of sodium and potassium in combination with insufficient oral intake disrupts homeostasis [15]. The metabolic acidosis in 15% cases is presumably due to the loss of bicarbonate in diarrheal stools, which worsens clinical severity [16].

Electrolyte imbalances need to be identified and addressed promptly to be optimally managed. The intravenous or oral pre-emption of rehydration according to the child dehydration status will restore the fluid and electrolyte balance, avoid complications like seizures or cardiac arrhythmias, and decrease the length of hospitalization [17]. This paper also showed that children who received early correction of their electrolyte imbalances had improved hydration status and a reduced hospital stay, indicating the need to intervene early.

The demographic data showed that the prevalence was as children aged 1-5 years, which is also in tandem with the international literature that has shown increased susceptibility in this age group because of the immature immunity and increased exposure to pathogens [18]. There was also minor male pre-eminence, but this has been reported in other paediatric studies, this might be attributed to social and seeking care issues but may not be biological disposition.

This paper highlights the significance of regular electrolyte checks among children with AGE, particularly those with moderate to severe dehydration. The identification of the patterns of imbalance can inform the clinicians to administer fluid therapy specifically and decrease the possibility of complications. The study is limited by the fact that it was a single centre design and lack of long term follow up to generalize. They suggest that future multicentre research involving a larger sample size should substantiate these findings and consider prevention measures [19]. Finally, electrolyte imbalance is typical of paediatric AGE, which is directly related to the severity of dehydration. To enhance outcomes and minimize morbidity, it is important to detect and intervene early [20].

## CONCLUSION

Electrolyte imbalances are very common among children with acute gastroenteritis, with hyponatremia and hypokalaemia as the most frequent abnormalities. The level of dehydration is a significant factor that determines the nature and occurrence of electrolyte imbalances, and the need to evaluate it early in clinical care is emphasized. Serum electrolytes should be measured promptly and properly corrected, by oral or intravenous rehydration, to avoid complications in the form of seizures, cardiac arrhythmias, and long hospital stay. This paper shows that children between the age of 1 and 5 years are particularly at risk, and moderate and severe dehydration are a great cause of electrolyte derangements. Electrolyte monitoring should be included in the management protocol of paediatric AGE particularly in the tertiary care level. Early interventions not only restore homeostasis but lead to better recovery outcomes and less healthcare burden. It is suggested to conduct multicentre studies in the future to find out more about preventive methods and the optimization of fluid and electrolyte replacement in such a population.

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