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Original Research Article

FREQUENCY OF HYPERNATREMIA SECONDARY TO ACUTE GASTROENTERITIS IN CHILDREN UNDER FIVE YEARS OF AGE

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ABSTRACT

Background: *Acute gastroenteritis remains a leading cause of morbidity and mortality among children under five years of age in developing countries. Electrolyte imbalances, particularly hypernatremia, can complicate its clinical course and may significantly increase the risk of adverse outcomes if not promptly identified and managed.* ***Objective:*** *To determine the frequency and severity of hypernatremia secondary to acute gastroenteritis in children under five years of age.* ***Study Design:*** *Cross-sectional study.* ***Setting:*** *Pediatric Department of Khyber Teaching Hospital, Peshawar, Pakistan.* ***Duration of Study:*** *Three months, from February 7, 2025, to May 7, 2025.* ***Methods:*** *A total of 121 children under the age of five years presenting with acute gastroenteritis were enrolled using a consecutive sampling technique. Serum sodium levels were measured upon admission. Hypernatremia was categorized into three levels of severity: mild (146–149 mmol/L), moderate (150–169 mmol/L), and severe (≥170 mmol/L). Data were analyzed using SPSS version 25.0. Descriptive statistics were used to calculate frequencies, percentages, means, and standard deviations.* ***Results:*** *The mean age of the participants was 2.50 ± 1.17 years. Of the 121 children, 57.0% were male and 43.0% were female. Hypernatremia was observed in 21 patients (17.4%). Among those with hypernatremia, 14.3% had mild, 52.4% had moderate, and 33.3% had severe hypernatremia.* ***Conclusion:*** *Hypernatremia was present in 17.4% of children under five years of age with acute gastroenteritis, with the majority presenting in the moderate severity category. Early detection and appropriate management of electrolyte imbalances are critical to improving clinical outcomes in pediatric gastroenteritis cases.*

Keywords: Hypernatremia, Acute Gastroenteritis, Pediatric Dehydration, Electrolyte Imbalance, Developing Countries

INTRODUCTION

Acute gastroenteritis (AGE) is an uncommon cause of mortality and morbidity in infants as well as children (1). A child under age of 5 may have between 1 and 5 cases of acute diarrhoea annually. In 2016, it was reported that diarrhoea ranked as the eighth most common cause of death across all age groups, resulting in 1.65 million fatalities as well, and was fifth leading cause of death for children under age of 5. Malnutrition, unsafe water, as well as inadequate sanitation remain significant risk factors for diarrhoea (2). The causes of AGE vary across various regions worldwide and are influenced by a range of host as well as environmental factors. A study has provided extensive data on causes of diarrhoea in low-income countries across Africa as well as South Asia (3-6). Research indicates that rotavirus persists to be a primary contributor to AGE in Colombia, alongside norovirus. The hospitalisation rate has fallen, which can be attributed to the implementation of the monovalent rotavirus vaccine. Research on E. coli diarrheagenic has demonstrated that these agents are responsible for AGE as well as are frequently found as contaminants in food products meant for consumption by humans (7-10).

Hypernatraemia, marked by serum sodium level exceeding 145 mEq/L, occurs frequently in preterm neonates within neonatal intensive care unit and in term infants following discharge from the hospital. Delayed detection and treatment can result in severe as well as prolonged hypernatraemia, which significantly increases the risk of mortality as well as central nervous system complications (11, 12). Extracerebral complications involve acute kidney injury, hyperglycemia, metabolic acidosis, as well as disseminated intravascular coagulation (13). Hypernatraemia has been linked to both morbidity and mortality as well as with improper fluid management. An investigation conducted in Pakistan reported the rate of diverse electrolyte abnormalities, such as hyponatremia 28%, hypernatremia 19%, hypokalemia 12%, as well as hyperkalemia 7% among the pediatric population of gastroenteritis under 5 years of age (14).

By estimating the frequency of hypernatremia in the local population, awareness in the general public can be raised that timely intervention can prevent this particular electro-light imbalance and therefore the complications that may arise from its improper management. The frequency of electrolyte abnormalities among children with AGE is expected to be high but not much local evidence exists. The findings of the proposed study will provide the extent of electrolyte abnormalities in children with AGE so that strategies can be devised for the timely identification and management of children presenting with AGE.

METHODOLOGY

The study was conducted as a cross-sectional study at the Pediatric Department of Khyber Teaching Hospital, Peshawar, Pakistan from 07-Feb-2025 to 07-May-2025. We obtained an ethical certificate from the hospital before conducting the study. A sample of 121 patients was selected using a previous frequency of hypernatremia 19%14, a margin of error of 7%, and confidence level of 95%. A total of 121 children under five years of age presenting with acute gastroenteritis were included in the study, with the sample size determined using a 95% confidence level, 7% margin of error. Children being under five years old with symptoms of acute gastroenteritis which was defined as three or more loose/watery stools within 24 hours, were enrolled

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while those with congenital disorders, seizure history, or age five years and above were not enrolled.

Before data collection, we secured consent from the parents/guardians of the patients. Demographic information such as age, family monthly income, gender, education of parents, residence, and socioeconomic status was recorded. Clinical assessments were performed to document presenting symptoms such as vomiting, oliguria, altered sensorium, and hydration status. A 5 mL venous blood sample was collected from each participant and sent to the institutional laboratory for electrolyte analysis with hypernatremia defined as serum sodium levels exceeding 145 mmol/L and further classified as mild (146–149 mmol/L), moderate (150–169 mmol/L) and severe (≥170 mmol/L).

Data analysis was performed with SPSS 25. Age, duration of illness, and the family's monthly income were assessed using mean and SD. Gender, socioeconomic status, residence, parental education, hydration status, level of hypernatremia and hypernatremia were evaluated using frequency and percentages. Hypernatremia was then stratified with demographics and hypdration status using a chi-square test, with a p-value ≤ 0.05 considered significant.

RESULTS

The mean age of the children was 2.50 ± 1.17 years. The average family monthly income was reported as 66197.73 ± 18834.30 Rs, and the mean duration of illness was 11.98 ± 6.01 hours. Age distribution is presented in Figure 1. Around 69 (57.0%) patients were male while 52 (43.0%) were female. Table 1 presents demographics of the patients.

Hypernatremia was found in 21 (17.4%) children (Table 2). Ninety eight (81.0%) children were classified as hydrated, while 23 (19.0%) were presented with dehydration. Among cases with hypernatremia, the severity grading showed that 3 (14.3%) were mild, 11 (52.4%) were moderate and 7 (33.3%) were severe cases of hypernatremia (Table 3). Stratification of hypernatremia with various parameters is presented in table 4.

Table 1: Demographics

Demographics		N	%
Gender	Male	69	57.0%
	Female	52	43.0%
Socioeconomic status	Low	29	24.0%
	Middle	55	45.5%
	High	37	30.6%
Education of parents	Uneducated	39	32.2%
	Primary	28	23.1%
	Middle	26	21.5%
	Secondary & above	28	23.1%
Area of residence	Urban	68	56.2%
	Rural	53	43.8%

Table 2: Frequency of hypernatremia

Hypernatremia	N	%
Yes	21	17.4%
No	100	82.6%

Table 3: Clinical parameters

Clinical parameter		N	%
Hydration status	Hydrated	98	81.0%
	Dehydrated	23	19.0%
Level of hypernatremia	Mild	3	14.3
	Moderate	11	52.4%
	Severe	7	33.3%

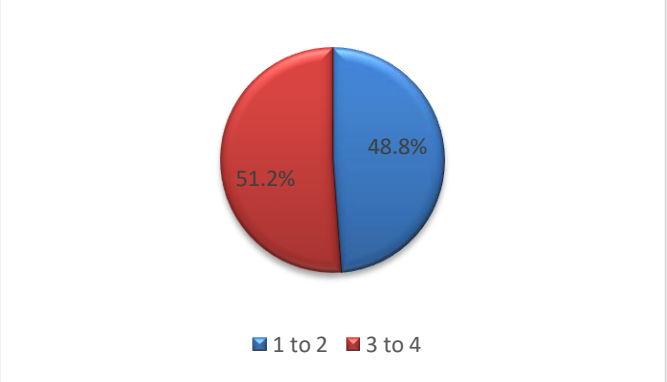

Figure 1: Age distribution (Years)

Table 4: Stratification of hypernatremia with various parameters

Parameters		Hypernatremia				P-value
		Yes		No		
		N	%	N	%	
Age distribution (Years)	1 to 2	10	47.6%	49	49.0%	0.90
	3 to 4	11	52.4%	51	51.0%	
Duration of illness (Hours)	1 to 12	7	33.3%	53	53.0%	0.10
	> 12	14	66.7%	47	47.0%	
Gender	Male	14	66.7%	55	55.0%	0.32
	Female	7	33.3%	45	45.0%	
Socioeconomic status	Low	13	61.9%	16	16.0%	0.0001
	Middle	5	23.8%	50	50.0%	
	High	3	14.3%	34	34.0%	
Education of parents	Uneducated	8	38.1%	31	31.0%	0.67
	Primary	6	28.6%	22	22.0%	
	Middle	4	19.0%	22	22.0%	
	Secondary & above	3	14.3%	25	25.0%	
Area of residence	Urban	10	47.6%	58	58.0%	0.38
	Rural	11	52.4%	42	42.0%	
Hydration status	Hydrated	7	33.3%	91	91.0%	0.0001
	Dehydrated	14	66.7%	9	9.0%	

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DISCUSSION

The frequency of hypernatremia in our study was 17.4% which drops within the range reported in the literature. Though the frequency of hypernatremia was not very high, its severity shows that this disease can have a notable impact on the patients, especially if severely deranged. Hypernatremia, though, is less common than hyponatremia, but it often leads to severe complications such as seizures and brain hemorrhage when left untreated (15).

The demographic profile of our study showed that mean age of the children was 2.50±1.17 years and male patients were the majority in number. Iqbal et al. reported a similar mean age (2.1±1.7 years) and male majority in their cohort (16). This consistency across studies suggests that younger male children may be more susceptible to acute gastroenteritis, possibly due to behavioral factors or immunological differences. Younger children especially in rural setups do not pay attention to hygiene. Socioeconomic status in our study revealed that nearly half of the participants (45.5%) belonged to middle-income families, while 24.0% were from low-income backgrounds, in our study, about 43.8% children belonged to rural backgrounds. This may reflect disparities in access to clean water, sanitation or healthcare factors known to influence the incidence and severity of diarrheal diseases. Dehydration was present in 19.0% of our cases, We observed that among the cases of hypernatremia, about 66.7% patients were dehydrated. This is comparable to the findings of Kamatam et al., who demonstrated that dehydration was associated with a higher chance of hypernatremia (17). Dehydration causes the body to lose water, which in turn increase the sodium levels. Apart from hypernatremia, Riaz et al. reported that hyponatremia can be due to dehydration as well (15).

The frequency of hypernatremia in our study was 17.4% which was similar to 19% observed by Ullah et al (14). Iqbal et al. reported hypernatremia in 17.6% of patients. Our frequency was higher than the 6.9% reported by Zehra et al (18). This variation could stem from differences in study populations, regional dietary practices, or the timing of electrolyte measurement relative to rehydration therapy. In settings where oral rehydration solutions (ORS) are used early, hypernatremia may be less prevalent due to timely correction of fluid losses. Conversely, in communities where traditional home remedies or improper fluid replacement is a common practice, hypernatremia may occur more frequently.

The severity of hypernatremia in our findings showed that over half of cases (52.4%) were moderate and a third (33.3%) severe, this highlights the need for prompt clinical intervention. This is particularly critical given the complications associated with hypernatremia such as neurological disorders (15). Electrolyte disturbances, if not corrected on time, can prolong hospital stays and increase morbidity.

When comparing parental education levels our study found that 32.2% of parents were uneducated, while 23.1% had secondary or higher education. Less educated parents can fall easily for quick home-remedies for dealing with such conditions, which often leads to emergency situations.

CONCLUSION

In conclusion, the frequency of hypernatremia secondary to acute gastroenteritis in children under five years was found to be 17.4%, with more than half of the patients having moderate hypernatremia. These findings underscore the need for early electrolyte monitoring and prompt rehydration.

DECLARATIONS

Data Availability Statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned.

Consent for publication

Approved

Funding

Not applicable

CONFLICT OF INTEREST

The authors declared an absence of conflict of interest.

AUTHOR CONTRIBUTION

HUMA MIR (Trainee Medical Officer)
Data Collection, Data Analysis, Development of Research Methodology Design, Review of manuscript.
SABAHAT AMIR (Professor)
Manuscript revisions, Conception of Study, Critical input, Final approval of draft
ASMA JAHAN
Critical Input
RIMSHA SHAIS (Trainee Medical Officer)
Study Design, Review of Literature.
IQRA ARIF (Trainee Medical Officer)
Literature review, Critical Input
BIBI ZOHRA (Medical Officer)
Literature review.

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