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Frequency of Hypernatremia among Children below 2 Years Presenting with Acute Gastroenteritis

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Declaration
Authors' Contribution
Rimsha Hameed: Concept & Design of Study.
Hafiz Abdullah: Drafting.
Attaullah Bizenjo, Mohammad Iqbal: Data Analysis.
Saima Rayaz: Critical Review.
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ABSTRACT

Background: Acute gastroenteritis functions as a primary reason for hospital admissions and death among children less than two years old within developing nations. The complications that frequently affect patients include dehydration together with electrolyte disturbances. Clinical risks from hypernatremia remain serious because this condition affects young infants more than hyponatremia does through severe neurological consequences. **Objectives:** A study was conducted to measure hypernatremia rates among children younger than two who visit medical facilities due to acute gastroenteritis. This evaluation determined demographic and presentation-related factors linked to hypernatremia status. **Study design:** A cross-sectional study. **Place and duration of study:** From 19 Oct 2023 to 18 April 2024 in Paediatrics Department, Bolan Medical College/ Hospital Quetta. Balochistan. **Methods:** A six-month data collection took place at the Department of Paediatrics within Bolan Medical College/ Hospital Quetta. Sixty-six children beneath the age of two-faced acute gastroenteritis during the study and received enrollment through consecutive sampling. The medical staff obtained sodium measurements from blood plasma when patients joined the study. The study utilized two criteria for identifying patients with hypernatremia: serum sodium greater than 145 mmol/L. Data evaluation took place with SPSS version 24.0. The studiers computed mean results alongside standard deviation and p-values as they established $p<0.05$ as their significance threshold. **Results:** Among 166 enrolled children, 38 (22.9%) had hypernatremia. The study participants averaged 11.2 ± 5.4 months in age. The children who had hypernatremia mostly came from two groups: prolonged diarrhea cases of more than three days and improper feeding practices as well as no use of oral rehydration. The study data indicated a positive statistical link between hypernatremia and prolonged diarrhea duration ($p = 0.016$) together with inadequate fluid choices at home ($p = 0.032$). The study results failed to identify any meaningful relationship between gender and hypernatremic conditions ($p = 0.412$). The study results demonstrate that improper home care and slow hospital attendance contribute to the development of hypernatremia in children. **Conclusion:** Acute gastroenteritis in children under two years causes substantial hypernatremia while remaining unrecognized as an electrolyte imbalance in most cases. Patients who have hypernatremia show a direct connection to both extended sickness and erroneous fluid treatment before hospital admission. Regular serum sodium tests along with proper water replacement education for caregivers protect children from major complications. The timely identification and treatment of this condition leads to better medical results and decreases suffering from complications.

INTRODUCTION

Acute gastroenteritis (AGE) stands as the primary reason behind morbidity and mortality affecting children under five years old especially throughout low- and middle-income nations. This condition produces diarrhea together with vomiting and the inadequate management can result in dehydration problems and disturbances in electrolytes. World Health Organization data indicates diarrheal diseases claim the lives of 525,000 children under five years annually and many of these fatalities happen to children under two years [1]. Electrolyte imbalances together with diarrhea complications directly affect how affected children will fare throughout their treatment. The potentially fatal health problem of acute gastroenteritis in

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infants mostly results from hyponatremia but hypernatremia with serum sodium levels above 145 mmol/L occurs less frequently [2]. The severe neurological complications of hypernatremia dehydration consist of irritability and seizures and cerebral enema followed by death in fatal instances. In addition to limited thirst expression Infants face higher insensible water loss and larger surface area than mass ratio which makes them susceptible to hypernatremia [3]. Multiple elements play a role in making children with gastroenteritis develop hypernatremia. Four main factors at home and reduced oral fluid intake with long-lasting illness episodes drive the development of this condition according to study [4]. The risk becomes greater because of cultural feeding practices together with parents' incorrect knowledge about oral rehydration therapy and their delayed visit to healthcare facilities [5]. Proper identification and immediate treatment of hypernatremia remains vital to minimize complications because of the condition. The frequency of hypernatremia among pediatric gastroenteritis patients is lower than other electrolyte disorders but its medical importance stays significant because it intensifies disease severity and death risks [6]. Existing study shows that hospitalized children who experience acute diarrhea have 10–25% presentation of hypernatremia particularly infants show higher rates of this condition [7]. About 10–25% of pediatric gastroenteritis cases develop hypernatremia but the occurrence together with risk factors depends on local climate and healthcare systems and socioeconomic backgrounds. The occurrence of hypernatremia along with its specific clinical patterns remains poorly documented among young children below two years who suffer from acute gastroenteritis throughout Pakistan. The local prevalence of this health issue represents a fundamental requirement for planning proper interventions and caregiver-focused educational approaches as well as patient treatment protocols. The purpose of this study is to establish the frequency of hypernatremia in children below two years of age who experience acute gastroenteritis in a tertiary care hospital and to evaluate how demographic details and clinical characteristics relate to this condition.

MATERIALS AND METHODS

The investigation ran from 01 November 2023 to 30 April 2024 at the Department of Paediatrics within Bolan Medical College/ Hospital Quetta. The institutional review board granted permission for this ethical study before its start. Doctors collected 166 children below 24 months with acute gastroenteritis through consecutive non-probability sampling. The study received signed consent documentation from parent figures who oversaw all recruited participants. Medical staff diagnosed acute gastroenteritis by collecting clinical signs which involved diarrhea with three or more loose stools during a 24-hour period along with vomiting or without vomiting. Serum sodium measurements took place through blood sample collection immediately upon admission to the hospital. The study identified participants with hypernatremia when their serum sodium levels exceeded 145 mmol/L. A structured proforma collected supplementary information about patient demographics and meal practices as well as illness duration and previous treatments. The patient care followed the diarrhea management protocol established by WHO.

Ethical Approval Statement

The study titled *"Frequency of Hypernatremia Among Children Below 2 Years Presenting with Acute Gastroenteritis"* was reviewed and approved by the Study and Ethical Review Committee of the College of Physicians and Surgeons Pakistan (CPSP). Ethical approval was granted under Reference No: **CPSP/REU/PED-2022-0016852,** dated **October 19, 2023.** Informed consent was obtained from the parents or legal guardians of all participating children. The study adhered to the principles outlined in the Declaration of Helsinki.

Inclusion Criteria

The study included children under 24 months old who experienced signs of acute gastroenteritis with diarrhea and/or vomiting along with consenting parent participation.

Exclusion Criteria

Children who already had congenital or acquired renal diseases or metabolic disorders or persistent diarrhea or experienced hospitalization for their current illness received exclusion from the study.

Data Collection

Studiers compiled a predesigned structured questionnaire for data collection that contained demographic information alongside clinical manifestations and feeding practices of diarrhea patients alongside their ORT usage history and test results. Staff in the certified hospital laboratory conducted serum sodium level measurements through automated biochemical analysis anytime the patient arrived for medical attention.

Statistical Analysis

The study data was processed through SPSS version 24.0. Statistical calculations involved descriptive methods for obtaining frequencies as well as means alongside standard deviations. Chi-square test evaluated the relationships between categorical variables and independent t-test evaluated relationships between continuous variables. A statistical significance occurred when the p-value reached less than 0.05.

RESULTS

Study included 166 children who suffered from acute gastroenteritis below the age of 2 years. The overall distribution revealed 54.8% male participants while 45.2% consisted of female participants. The study participants had an average age of 11.2 ± 5.4 months. The evaluation showed that 38 children had hypernatremia which made up 22.9% of the total participants. The duration of diarrhea exceeded three days in children with hypernatremia and their caregivers provided improper fluid replacement at home ($p = 0.016$ and $p = 0.032$ respectively). The gender distribution of hypernatremia did not produce a noticeable difference between male and female patients ($p = 0.412$). Normonatremic children presented fewer symptoms of neurological distress which

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included irritability and lethargy than patients with hypernatremia. Hospitalized patients with hypernatremia received inappropriate oral rehydration solution at home before their admission in sixty-three percent of cases. Study showed that the average serum sodium level in patients with hypernatremia was 150.7 ± 3.2 mmol/L which emphasizes why doctors should test sodium levels in children with acute gastroenteritis who delay hospital visits.

Figure 1

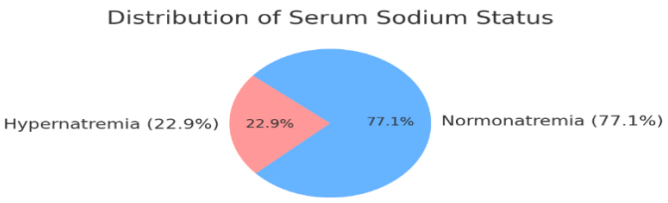

Table 1
Demographic Characteristics

Variable	Value
Total Patients	166.0
Mean Age (months)	11.2
Standard Deviation	5.4
Gender - Male	91.0
Gender - Female	75.0

Table 2
Serum Sodium Status Distribution

Sodium Status	Frequency	Percentage
Hypernatremia (>145 mmol/L)	38	22.9
Normonatremic (135–145 mmol/L)	128	77.1

Table 3
Clinical Associations with Hypernatremia

Clinical Variable	Hypernatremia (%)	p-value
Prolonged Diarrhea (>3 days)	68.4%	0.016
Inappropriate Fluid Replacement	63.2%	0.032
Neurological Symptoms	47.4%	0.041
Male Gender	55.3%	0.412

DISCUSSION

Study showed that hypernatremia with serum sodium above 145 mmol/L presented in 22.9% of children under two years old who had acute gastroenteritis. Multiple regional and international study supports the medical importance of hypernatremia dehydration among children who suffer from diarrheal illnesses. The prevalence of hypernatremia in pediatric patients with gastroenteritis varies widely between 10% and 30% based on population background and climate alongside healthcare preferences from developing nations [8,9]. The prevalence of hypernatremic children admitted due to gastroenteritis was 19.5% according to the study conducted by Ahmad et al. in Lahore, Pakistan [10]. Hypernatremia affected 24% of children with diarrhea according to Shah et al.'s Indian study but was most frequently detected in infants under one year old [11]. In accordance with prior study on hypernatremia risk in infants the mean child age in our study was 11.2 months which exposed them to this condition because of renal immaturity and their inability to communicate thirst and higher levels of insensible water loss [12]. A significant association existed between hypernatremia and both prolonged diarrhea course along with inappropriate home fluid use according to our results similar to data in Musa et al. and Iqbal et al. [13,14]. Study shows that patients typically receive their fluids from caregivers who give inappropriate fluids like teas or incorrect solutions which leads to sodium salts accumulating in their bodies. Patients with hypernatremia often displayed neurological symptoms of irritability together with lethargy during our study observations. Kaplan et al. discovered central nervous system problems occur from osmotic demyelination and cerebral enema in patients with hypernatremia dehydration [15]. Our study data confirm previous study which demonstrates that gender does not act as a risk factor for hypernatremia in children [16]. Recent Western studies detected fewer cases of hypernatremia in this patient population because of how caregivers efficiently respond to dehydration and how easily they access medical assistance [17]. The Canadian study conducted by Freedman et al. through retrospective analysis discovered that hypernatremia occurred in 8.2% of children who received gastroenteritis hospital admission [18]. Studies demonstrate the need for local public health solutions to address this difference in findings. Standard electrolyte testing for pediatric patients in hospital with gastroenteritis helps identify and treat hypernatremia immediately which reduces both hospital complications and patient death rates [19,20]. This study confirms the incidence rates of hypernatremia which matches previous findings from other developing regions. Community-level education along with early intervention and standard clinical protocols for managing dehydration in infants becomes essential due to the established strong links between prolonged diarrhea and suboptimal fluid management.

CONCLUSION

Acute gastroenteritis causes hypernatremia as a major complication in young children under two years of age. Rapid identification combined with suitable fluid treatment along with community education help decrease the mortality risks in this condition. Medical establishments should start monitoring serum sodium levels during diarrheal cases because this practice enables prompt identification of complications with effective treatment solutions.

Limitations

The study's generalization could be limited because it conducted study at a single center within a short duration. The evaluation of nutritional status and co-existing

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infections with hypernatremia development and clinical outcomes failed to take place in this study.

Future Findings

Additional future study needs to examine neurological outcomes among infants who develop hypernatremic dehydration through multiple study centers using bigger population sizes. Study which examines caregiver hydration patterns and public health awareness as well as low-cost home fluid treatment approaches would support preventive measures in underserved settings.

Abbreviations

AGE	Acute Gastroenteritis
WHO	World Health Organization
CPSP	College of Physicians and Surgeons Pakistan
SPSS	Statistical Package for the Social Sciences
CNS	Central Nervous System
ORS	Oral Rehydration Solution

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