

Frequency Of Hyponatremia In Children Admitted To The Pediatric Intensive Care Unit In A Tertiary-Care Hospital: A Cross-Sectional Study

Ammar Yasir Khan¹, Arooba Idris², Asad Shabbir³, Sobia Rashid⁴, Asad Iqbal Danish⁵, Syeda Mamoona Qudrat⁶

Abstract

Objective: Hyponatremia is relatively common in children with acute diarrhoea, occurring in around 10-15% of cases. This study aimed to determine the prevalence of hyponatremia in children with acute diarrhoea.

Methods: A facility-based cross-sectional study was conducted at the Department of Pediatrics, Benazir Bhutto Hospital, Rawalpindi from April 2023 to September 2023. A total of 335 pediatric patients of both genders, aged up to 5 years, who were presented with acute diarrhoea and admitted to the pediatric intensive care unit (PICU) were enrolled in the study. Each child was assessed by taking a detailed history from the mother/caregiver regarding the frequency and duration of diarrhoea of the patient. A blood sample for serum electrolyte (Na) was taken under aseptic measures and was sent to the hospital's laboratory. Patients were labelled as having hyponatraemia or normal serum sodium and results were confirmed by a consultant pathologist. Appropriate entries were made in the structured study proforma. Data were analyzed using SPSS version 22. Statistical significance was set at $p < 0.05$.

Results: In this study, out of 335 cases, 28.96% ($n=97$) were between 0-2 years of age whereas 71.04% ($n=238$) were between 3-5 years of age. Mean $\pm$ SD was calculated as 3.29 ± 1.40 years, 69.25% ($n=232$) were male and 30.75% ($n=103$) were females. The frequency of hyponatremia in children with acute diarrhoea was recorded in 4.18% ($n=14$) whereas 95.82% ($n=321$) had no findings of morbidity.

Conclusion: This study concluded that the frequency of hyponatremia in children with acute diarrhoea is not very high, however, other national and international studies are varied and need early management of this morbidity.

MeSH Keywords: Children, Acute Diarrhea, Hyponatremia.

¹ Consultant Pediatrician, Mother and Child Hospital, Mianwali; ^{2,4} Consultant Pediatrician, Al-Khidmat Raazi Hospital, Rawalpindi; ³ Assistant Professor, Department of Pediatrics, Rawalpindi Medical University; ⁵ Medical Officer, THQ Hospital, Taxila, Rawalpindi; ⁶ Senior Registrar, Department of Pediatrics, Benazir Bhutto Hospital, Rawalpindi.

Correspondence: Dr. Arooba Idris, Consultant Pediatrician, Al-Khidmat Raazi Hospital, Rawalpindi. Email: a4arooba@gmail.com

Cite this Article: Khan AY, Idris A, Shabbir A, Rashid S, Danish AI, Qudrat SM. Frequency Of Hyponatremia In Children Admitted To The Pediatric Intensive Care Unit In A Tertiary-Care Hospital: A Cross-Sectional Study. JRMCM. 2024 Sep. 27;28(3).400-403. <https://doi.org/10.37939/jrmc.v28i3.2473>.

Received December 07, 2023; accepted June 13, 2024; published online September 26, 2024

1. Introduction

Patients who suffer from watery diarrhoea often struggle to function normally because of their disease, which presents diagnostic and treatment challenges. Although infection is most likely to cause acute diarrhoea, the root causes of chronic diarrhoea (lasting more than four weeks) are not as well understood.¹ It is a significant issue affecting public health all around the world. It is estimated that 1.5 billion cases of diarrhoea cause around 5% of the total number of disability-adjusted life years lost yearly throughout the globe. In impoverished nations, it is common to find bacterial and parasite agents such as vibrio cholera, salmonella, shigella, and so on.²

In infants and young children, the clinical issue of diarrhoea is caused by the loss of more water and electrolytes than are taken in via the stools. This occurs when the child's fluid and electrolyte intake is inadequate. Electrolytes, such as sodium, potassium, and bicarbonate, are crucial ions present not only in the bloodstream but also in various tissues and cells in the body. Sodium and chloride are particularly

abundant in the extracellular fluid, playing essential roles in maintaining fluid balance, nerve function, and acid-base equilibrium.³ Electrolyte loss in diarrhoea leads to different types of dehydration – isotonic, hypertonic, and hypotonic—due to imbalances in water and electrolyte levels. Severe dehydration poses a risk, especially in children, making serum electrolyte measurement crucial for managing electrolyte imbalances and preventing complications.⁴

The mortality rates of children with diarrhoea are significantly higher when various types of electrolyte abnormalities are present. Early detection and management of hyponatraemia in diarrhoea patients with intravenous fluids or oral rehydration salts recommended by the World Health Organisation (WHO) can substantially lower the risk of mortality and morbidity.⁵ There is a greater probability of mortality for all patients who report to the hospital with diarrhoea. Serum electrolyte estimation is a quick, low-cost, and economical way to identify children who are more likely to experience mortality or suffer from morbidity, and it also assists physicians in coming up with treatment plans and implementing



them quickly. This current study was planned to determine the frequency of hyponatremia in children with acute diarrhoea.

2. Materials & Methods

A facility-based cross-sectional study was conducted at the Department of Pediatrics, Benazir Bhutto Hospital, Rawalpindi from April 2023 to September 2023. A total of 335 pediatric patients of both genders, aged up to 5 years, who were presented with acute diarrhoea and admitted to the pediatric intensive care unit (PICU) were enrolled in the study. Exclusion criteria were children under the age of one month (neonates) or above 5 years, suffering from hyponatremia due to meningitis, water intoxication and adrenocortical insufficiency, those with congenital anomalies and with known congenital diseases like cystic fibrosis (as such conditions can affect serum electrolytes), those with cardiac diseases, with chronic diarrhoea (diarrhoea for more than two weeks), children with blood in stools and those who were given intravenous fluids within 6 hours before presentation or before taking of blood samples. The study was approved by the institutional ethics committee (Ref. R-36/ERC/RMU/2023). Parents were briefed about the risks and benefits of the study and written informed consent was obtained for their children's examination and intervention according to the guidelines of the Helsinki Declaration.

Acute diarrhoea was defined as the passage of more than 3 watery stools per day for more than 3 days. The serum electrolytes assessed were sodium (Na^+). Hyponatraemia was defined as a serum concentration of sodium less than 135mmol/L ; normal reference range: $135\text{--}145\text{mmol/L}$.

Demographic data was collected including the patient's age, gender and address. Each child was assessed by taking a detailed history from the mother/caregiver regarding the frequency and duration of diarrhoea of the patient. A blood sample for serum electrolyte (Na) was taken under aseptic measures and was sent to the hospital's laboratory. Patients were labelled as having hyponatraemia or normal serum sodium and results were confirmed by a consultant pathologist. Appropriate entries were made in the structured study proforma.

Additionally, the degree of dehydration at presentation was clinically assessed, ranging from mild to severe, through physical examination findings such as decreased skin turgor, dry mucous membranes, sunken eyes, and reduced urine output. These indicators guided the management and treatment of dehydration in our pediatric patients with acute diarrhoea. Calculations were made to determine the frequency and percentage of

a categorical variable, such as gender and the presence or absence of hyponatremia. To control the impact modifiers, stratification was done according to age, gender, length of diarrhoea, and socioeconomic position. To determine the significance of the data, a post-stratification chi-square test was carried out. A p -value of less than 0.05 was used to indicate statistical significance.

3. Results

In this study, out of 335 cases, 28.96% ($n=97$) were between 0-2 years of age whereas 71.04% ($n=238$) were between 3-5 years of age, and Mean $\pm$ SD was calculated as 3.29 ± 1.40 years. Gender distribution shows that 69.25% ($n=232$) were male and 30.75% ($n=103$) were females. Socioeconomic status reveals that 73.13% ($n=245$) had lower, 22.99% ($n=77$) had middle, and 3.88% ($n=13$) had higher socioeconomic status of the patients. Duration of diarrhoea was recorded as 78.21% ($n=262$) with 1-2 days and 21.79% ($n=73$) had >2 days of duration of diarrhoea.

The frequency of hyponatremia in children with acute diarrhoea was recorded in 4.18% ($n=14$) whereas 95.82% ($n=321$) had no findings of the morbidity and stratified for age, gender, duration of diarrhoea, and socioeconomic status was done to control the effect modifiers.

Table 1: Frequency of hyponatremia in children with acute diarrhoea about age

Variables			Hyponatremia		p-value
			Yes	No	
Age (in years)	0-2		3	94	0.53
	3-5		11	227	
Gender	Male		10	222	0.86
	Female		4	99	
Socioeconomic status	Lower		8	237	0.16
			6	84	
	Middle		6	71	0.07
			8	250	
Higher			0	13	0.44
			14	308	
Duration (in days)	1-2		12	250	0.48
	>2		2	71	

4. Discussion

In children aged one month and older, diarrhoea ranks as the second most prevalent cause of mortality, making it one of the most common causes of death overall. Many studies have shown that the incidence of hyponatremia and hypernatremia in dehydrated children varies greatly from one another.

The purpose of this research was to find out how common a condition called hyponatremia is among children who are experiencing severe diarrhoea. If paediatricians treating patients with acute diarrhoea are given an estimate of the likelihood of their patients developing hyponatremia, this may be beneficial. This resulted in improved patient care, most notably in terms of a reduction in the number of problems due to hyponatremia.

In this study, out of 335 cases, 28.96% (n=97) were between 0-2 years of age whereas 71.04% (n=238) were between 3-5 years of age, Mean±SD was calculated as 3.29±1.40 years, 69.25% (n=232) were male and 30.75% (n=103) were females. The frequency of hyponatremia in children with acute diarrhoea was recorded in 4.18% (n=14) whereas 95.82% (n=321) had no findings of the morbidity. The findings of this study are in agreement with a survey conducted at Quetta recorded that 5.7% of the children under 5 years of age with acute diarrhoea had hyponatremia.⁶

Children hospitalised with diarrhoea were included in the research conducted by Samadi and colleagues. This demonstrated that hyponatremia was present in 20.8% of patients, whilst hypernatremia was found in 6.4% of cases.⁷ According to a previous study carried out by Shah and colleagues, hyponatremia was present in 56 per cent of patients brought to the hospital with diarrhoea and dehydration, whereas hypernatremia was found in only 10 per cent of patients.⁸ In neonatal age, hypernatremia may also lead to dehydration, which is another major concern. A rapid loss of weight in neonates is associated with an increased likelihood of developing hypernatremia. Some of these instances have been shown to have long-term effects on the nervous system.⁹⁻¹³ However, our attention was solely directed to hyponatremia.

The study by Korsipati Ankireddy and colleagues,¹⁴ involved 250 instances of acute diarrhoea in children; 57.6% were male and 42.4% were female. The researchers were interested in the various biochemical abnormalities and electrolyte disturbances that occur in these patients. The most frequent age range was 1 month to 5 years (33.6%), with a mean age of 11.48±2.4 years. The average frequency of passage of loose movements throughout time was 8.12 days per year. The bulk of the patients (63%) had solo hyponatremia, whereas 33% had a combination of hyponatremia and hypokalemia. They concluded that diarrhoeal diseases may be readily avoided by water disinfection, health education

campaigns, improved hand washing, and more frequent breastfeeding. Major electrolyte abnormalities in diarrhoea include hyponatremia, hypokalemia, and mixed hyponatremia and hypokalemia.

Hyponatremia was the most common electrolyte disturbance (seen in 56%), followed by hypokalemia (46%) and mixed electrolyte disturbances (37%).¹⁵ Hyponatremia and hypokalemia were found to be 27.8% and 47.5% prevalent in another research conducted in Bangladesh.¹⁶ This is because salt is lost by diarrhoea, whereas potassium is lost through bicarbonate. Only 4.18 per cent of participants in the current research had isolated hyponatremia, whereas the study conducted by Lu and colleagues showed that the prevalence of overall hyponatremia was 32.5% [95% confidence interval (CI), 31.3–33.6%], while the prevalence of persistent hyponatremia among hospitalizations with admission hyponatremia (AH) and hospital-acquired hyponatremia (HAH) was 33.7% (31.7–35.8%).¹⁷

The main limitation of this study is the cross-sectional nature of the study which may restrain the interpretation of information since such studies only provide a snapshot of data at a specific point in time. Moreover, the data on rehydration fluid used at home could not be retrieved, which could contribute more to the findings. Finally, this study reflects the data from one tertiary care hospital that primarily provides care for children with diarrheal disease so this may not be generalizable to all patients admitted elsewhere.

5. Conclusion

In conclusion, the incidence of hyponatremia fluctuates in children who have acute diarrhoea. Even though our data demonstrate a lower prevalence of hyponatremia, the rate might grow in the future as indicated by the findings of another research. The results of this study have important clinical implications for the development of research hypotheses for the targeted detection of hypo- and hypernatremia as well as early management to lower the number of deaths in developing countries connected to diarrhoea.

INSTITUTIONAL REVIEW BOARD

00291116MMANA Dated 30-11-2016

CONFLICTS OF INTEREST- None

Financial support: None to report.

Potential competing interests: None to report

Contributions:

A.Y.K - Conception of study

- Experimentation/Study Conduction

A.I, A.S, S.R, A.I.D, S.M.Q -

Analysis/Interpretation/Discussion

A.Y.K, A.I, S.R, A.I.D, S.M.Q - Manuscript Writing

A.Y.K, A.I, A.S, S.M.Q - Critical Review

All authors approved the final version to be published & agreed to be accountable for all aspects of the work.

References

- Black CJ, Drossman DA, Talley NJ, Ruddy J, Ford AC. Functional gastrointestinal disorders: advances in understanding and management. *Lancet*. 2020;396(10263):1664-1674. doi: 10.1016/S0140-6736(20)32115-2.
- Rahmat ZS, Zubair A, Abdi I, Humayun N, Arshad F, Essar MY. The rise of diarrheal illnesses in the children of Pakistan amidst COVID-19: A narrative review. *Health Sci Rep*. 2023;6(1):e1043. doi: 10.1002/hsr.2.1043.
- Bernal A, Zafra MA, Simón MJ, Mahía J. Sodium Homeostasis, a Balance Necessary for Life. *Nutrients*. 2023;15(2):395. doi: 10.3390/nu15020395.
- Nadeem MF, Butt AM, Ashraf W, Matti N, Farooq MA, Nasim M bin, et al. The Impact of Fluid and Electrolyte Imbalance on the Severities of Diseases and Their Management in Developing Countries. In: Al-Worafi YM, editor. *Handbook of Medical and Health Sciences in Developing Countries : Education, Practice, and Research* [Internet]. Cham: Springer International Publishing; 2023. p. 1–20. Available from: https://doi.org/10.1007/978-3-030-74786-2_30-1
- Nalin D. Issues and Controversies in the Evolution of Oral Rehydration Therapy (ORT). *Trop Med Infect Dis*. 2021;6(1):34. doi:10.3390/tropicalmed6010034.
- Babar H, Ullah S, Rahim M. Serum Electrolyte Disturbances in Acute Diarrhoea among Children Less Than 5 Years of Age. *Pak J Med Health Sci*. 2016;10(4):1231-4.
- Samadi AR, Wahed MA, Islam MR, Ahmed SM. Consequences of hyponatraemia and hypernatraemia in children with acute diarrhoea in Bangladesh. *Br Med J (Clin Res Ed)*. 1983;286(6366):671-3. doi: 10.1136/bmj.286.6366.671.
- Trepiccione F, Capasso G, Unwin R. Electrolytes and acid–base: common fluid and electrolyte disorders. *Medicine*. 2023;51(2):102–9. doi:10.1016/j.mpmed.2022.11.001.
- Durrani NUR, Imam AA, Soni N. Hyponatremia in Newborns: A Practical Approach to Management. *Biomed Hub*. 2022;7(2):55-69. doi: 10.1159/000524637.
- Tomarelli G, Arriagada D, Donoso A, Diaz F. Extreme Neonatal Hyponatremia and Acute Kidney Injury Associated with Failure of Lactation. *J Pediatr Intensive Care*. 2020;9(2):124-127. doi: 10.1055/s-0039-3400469.
- Del Castillo-Hegyi C, Achilles J, Segrave-Daly BJ, Hafken L. Fatal Hypernatremic Dehydration in a Term Exclusively Breastfed Newborn. *Children (Basel)*. 2022 Sep 13;9(9):1379. doi: 10.3390/children9091379.
- Gervais AS, Luu TM, Viennet A, Milette AA, Vallée J, Cloutier A, et al. Neurodevelopmental consequences of early plasma sodium changes in very preterm infants. *Pediatr Res*. 2022;92(5):1350-1356. doi: 10.1038/s41390-022-02164-y.
- Ogbe Z, Andegiorgish AK, Zeraf AH, Zeng L. Neonatal Hypernatremic Dehydration Associated with Lactation Failure. *Case Rep Crit Care*. 2020;2020:8879945. doi: 10.1155/2020/8879945.
- Ankireddy K, Kumar TR. A prospective study on biochemical disturbances among cases of acute diarrhoea in children attending a tertiary care hospital of South India. *Int J Contemp Pediatr*. 2019;6(1):73-6. <https://doi.org/10.18203/2349-3291.ijcp20185092>
- Naseem F, Saleem A, Mahar IA, Arif F. Electrolyte imbalance in critically ill paediatric patients. *Pak J Med Sci*. 2019;35(4):1093-1098. doi: 10.12669/pjms.35.4.286.
- Chisti MJ, Ahmed T, Bardhan PK, Salam MA. Evaluation of simple laboratory investigations to predict fatal outcome in infants with severe malnutrition presenting in an urban diarrhoea treatment centre in Bangladesh. *Trop Med Int Health*. 2010;15(11):1322-5. doi: 10.1111/j.1365-3156.2010.02619.x.
- Lu H, Vollenweider P, Kissling S, Marques-Vidal P. Prevalence and Description of Hyponatremia in a Swiss Tertiary Care Hospital: An Observational Retrospective Study. *Front Med (Lausanne)*. 2020 Sep 11;7:512. doi: 10.3389/fmed.2020.00512.