



Frequency of Hypokalemia in Children with Acute Watery Diarrhea Admitted to Children Ward Mardan Medical Complex Mardan

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Authors' Contribution

All authors equally contributed to the study and approved the final manuscript

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ABSTRACT

Background: Acute watery diarrhea is a common illness in children in the developing world and is associated with significant fluid and electrolyte loss. Of the electrolyte abnormalities, hypokalemia is common and can cause significant problems if not recognized in the early stages. **Objective:** To determine the frequency of hypokalaemia in children with acute watery diarrhoea admitted in tertiary care hospital. **Study Design:** Cross sectional study. **Duration and Place of Study:** This study was carried out from 1 September 2024 to 1 March 2025 in paediatric department of Mardan Medical Complex, Mardan. **Methodology:** A total of 145 children aged 6 months to 5 years with acute watery diarrhoea were included. Blood samples were taken before starting treatment to measure serum potassium level. Hypokalaemia was labelled when value was ≤ 3.5 mmol per litre. Data was analysed by statistical package for social sciences version 26. **Results:** Mean age of patients was 2.78 ± 1.39 years. Out of 145 children, 68 (46.90%) were found to have hypokalaemia. Hypokalaemia was more common in male children 40 (56.3%) than female 28 (37.8%) with significant association ($p = 0.026$). Longer duration of diarrhoea more than 5 days also showed higher frequency 40 (57.1%) with significant association ($p = 0.017$). **Conclusion:** Hypokalaemia is common problem in children with acute watery diarrhoea and early detection is important to prevent complications.

INTRODUCTION

Acute watery diarrhoea in the pediatric population has emerged as a common clinical issue of concern in the field of pediatrics, especially in developing nations where facilities for sanitation and availability of drinking water are scarce.¹ This condition presents with loose or watery stools occurring more than three times over a period of 24 hours. The common causes of this condition are viral infections, bacterial infections, and sometimes parasitic infections.² Children below the age of five are more prone to this condition due to their immature immune system and poor nutritional status.³ This condition presents with significant fluid loss, and if not treated properly, can lead to dehydration, which can be life-threatening.⁴ The symptoms of this condition are increased episodes of loose stools, vomiting, fever, irritability, and decreased urine output.

Electrolyte imbalance is one of the major complications in pediatric patients with acute watery diarrhea. The loss of fluids through the stool, and sometimes through vomiting, causes the depletion of essential electrolytes like sodium, potassium, chloride, and bicarbonate in the body.⁵ In this condition, hyponatremia or hypernatremia can coexist depending on the type of

fluids lost and the type of fluids replaced. In addition, there is also the occurrence of metabolic acidosis due to the loss of bicarbonate. This condition can manifest with symptoms like lethargy, irritability, and weakness of the muscles, and in severe cases, the patient can have altered consciousness and seizures.⁶ Assessment of the hydration state and the balance of the electrolytes in the body is critical, and the treatment should be well planned with the use of oral or intravenous fluids.⁷

One of the most common electrolyte imbalances seen in pediatric patients with acute watery diarrhea is hypokalemia, which is the consequence of increased potassium loss in the stool and inadequate intake during the illness.⁸ Potassium is a major element for the proper functioning of the smooth, cardiac, and skeletal muscles, and its lack can produce a wide range of clinical manifestations in the patient.⁹ The patient, therefore, can present with weakness, abdominal distension, ileus, and in some cases, cardiac arrhythmias. It can also affect the motility of the intestines, thereby prolonging the diarrhea. The diagnosis of the condition can be made by measuring the serum potassium level, and its prompt correction is essential to avoid complications.¹⁰

Lack of local information is found regarding the incidence and severity of hypokalemia in children who develop acute watery diarrhea in Mardan. Diarrheal diseases impose a significant health burden in this area of Pakistan. Therefore, it is believed that electrolyte imbalance is quite prevalent in this population but often goes unnoticed. Early diagnosis of hypokalemia is critical in order to reduce complications and improve patient outcomes. Thus, this study is needed to assess the extent of this problem in order to develop better patient management practices.

METHODOLOGY

This cross-sectional study was carried out in the Department of Pediatrics, Mardan Medical Complex Mardan from 01 September 2024 to 01 March 2025. Approval for the study was taken from ethical committee of hospital and CPSP before starting the data collection, with ethical certificate number 548/BKMC dated 30/07/2024, and all procedures was done according to ethical standards. Total 145 patients were included in the study. Sample size was calculated by using WHO sample size software with 95% confidence level, 8% margin of error and expected frequency of hypokalemia 40%.¹¹

Inclusion Criteria

Children aged 6 months to 5 years of both genders presenting with acute watery diarrhea was included. Acute watery diarrhea was taken as passage of loose or watery stools with water content more than 75% occurring at least 3 times in 24 hours.

Exclusion Criteria

Children having history of cystic fibrosis, chronic renal disease, dysentery, inflammatory bowel disease, prior use of intravenous fluids or potassium supplements before admission and severe malnutrition was excluded from study.

After taking informed consent from parents, patients were enrolled in study and confidentiality was ensured, also it was explained that there is no risk to patient participation. Baseline demographic variables including age, gender, weight, parent socioeconomic status, parent education level, residential status, dehydration and duration of complaints was recorded. Detailed history and clinical examination were performed in all patients, and dehydration status was assessed clinically by consultant pediatrician.

In all patients, a 2 mL venous blood sample was obtained by the duty physician before the commencement of any intravenous fluid administration and sent to the hospital laboratory for blood potassium level analysis. All procedures were done under the guidance of a consultant pediatrician with more than three years of experience after completion of fellowship. After obtaining blood samples and assessing patients, outcomes were measured. Hypokalemia was defined as a blood potassium level of ≤ 3.5 mmol/L on the laboratory report.

All collected data was entered and analyzed by using SPSS version 26. Quantitative variables like age, duration of complaints and weight was presented as mean \pm standard deviation. Categorical variables like gender, parent socioeconomic status, education level, residential

status, dehydration and hypokalemia was presented as frequencies and percentages. Stratification of hypokalemia was done with respect to age, gender, weight, parent socioeconomic status, education level, residential status, dehydration and duration of complaints. Post stratification chi square test or Fisher exact test was applied and p value ≤ 0.05 was taken as statistically significant.

RESULTS

A total of 145 children with acute watery diarrhoea were included in the study. The mean age of patients was 2.78 ± 1.39 years, with a mean weight of 13.05 ± 3.88 kg, and the mean duration of illness was 5.50 ± 3.01 days. In terms of gender distribution, 71 (49.0%) were male and 74 (51.0%) were female. Majority of the children belong to middle socioeconomic status 66 (45.5%), following by low 45 (31.0%) and high socioeconomic class 34 (23.4%). Regarding mother's education, most of the mothers were having primary level education 57 (39.3%), whereas 48 (33.1%) were uneducated, 28 (19.3%) were educated up to secondary level and only 12 (8.3%) having higher education. In context of residential area, 76 (52.4%) children belong to rural and 69 (47.6%) to urban areas. With respect to dehydration status, majority of children were having moderate dehydration 79 (54.5%), while mild and severe dehydration was noted in 36 (24.8%) and 30 (20.7%) children respectively (Table-I).

Table I

Patient Demographics N=145

Demographics	Mean \pm SD / n (%)
Age (years)	2.78 \pm 1.39
Weight (kg)	13.05 \pm 3.88
Duration (days)	5.50 \pm 3.01
Gender	
Male n (%)	71 (49.0%)
Female n (%)	74 (51.0%)
Socioeconomic Status (SES)	
Low n (%)	45 (31.0%)
Middle n (%)	66 (45.5%)
High n (%)	34 (23.4%)
Mother's Education	
Uneducated n (%)	48 (33.1%)
Primary n (%)	57 (39.3%)
Secondary n (%)	28 (19.3%)
Higher n (%)	12 (8.3%)
Residential Area	
Rural n (%)	76 (52.4%)
Urban n (%)	69 (47.6%)
Dehydration Status	
Mild n (%)	36 (24.8%)
Moderate n (%)	79 (54.5%)
Severe n (%)	30 (20.7%)

Out of total 145 patients, hypokalaemia was observed in 68 children which accounting for 46.90% of the study sample, while remaining 77 (53.10%) children did not had hypokalaemia (Table-II).

Table II

Frequency of Hypokalaemia in Children with Acute Watery diarrhoea N=145

Hypokalaemia	Frequency	% age
Yes	68	46.90%
No	77	53.10%
Total	145	100%

In relation to age, hypokalaemia was present in 46 (51.7%)

children aged ≤3 years and in 22 (39.3%) children aged >3 years, however this difference was not reaching statistical significance (p = 0.145). For gender, hypokalaemia was observed more frequently among male children 40 (56.3%) as compared to female children 28 (37.8%), and this association were found to be statistically significant (p = 0.026). Regarding weight, hypokalaemia was seen in 47 (50.0%) of children with weight ≤15 kg and in 21 (41.2%) of those with weight >15 kg, with no significant association noted (p = 0.309). With respect to socioeconomic status, hypokalaemia proportions were very similar across all three groups, low 21 (46.7%), middle 31 (47.0%), and high 16 (47.1%), with no significant difference being observed (p = 0.999). Regarding mother's education, hypokalaemia was present in 23 (47.9%) children of uneducated mothers, 32 (56.1%) children of mothers with primary education, 8 (28.6%) of secondary educated mothers, and 5 (41.7%) in children of mothers with higher education, but this association did not reach statistical significance as assessed by Fisher Exact Test (p = 0.119). For residential area, hypokalaemia was identified in 36 (47.4%) rural and 32 (46.4%) urban children with no significant difference (p = 0.905). In terms of dehydration status, hypokalaemia was more common in children with severe dehydration 18 (60.0%) and mild dehydration 20 (55.6%), as compared to moderate dehydration 30 (38.0%), though this association were not statistically significant (p = 0.059). Finally, duration of diarrhoea showed a significant association with hypokalaemia, as children having diarrhoea for more than 5 days showing higher frequency of hypokalaemia 40 (57.1%) as compared to those with ≤5 days duration 28 (37.3%), and this difference were statistically significant (p = 0.017) (Table-III).

Table III
Association of Hypokalaemia with Demographic Factors in Children with Acute Watery diarrhoea

Demographic Factors	Subgroup	Hypokalaemia		p-value
		Yes n (%)	No n (%)	
Age (years)	≤3	46 (51.7%)	43 (48.3%)	0.145
	>3	22 (39.3%)	34 (60.7%)	
Gender	Male	40 (56.3%)	31 (43.7%)	0.026
	Female	28 (37.8%)	46 (62.2%)	
Weight (kg)	≤15	47 (50.0%)	47 (50.0%)	0.309
	>15	21 (41.2%)	30 (58.8%)	
Socioeconomic Status	Low	21 (46.7%)	24 (53.3%)	0.999
	Middle	31 (47.0%)	35 (53.0%)	
	High	16 (47.1%)	18 (52.9%)	
Mother's Education	Uneducated	23 (47.9%)	25 (52.1%)	0.119*
	Primary	32 (56.1%)	25 (43.9%)	
	Secondary	8 (28.6%)	20 (71.4%)	
	Higher	5 (41.7%)	7 (58.3%)	
Residential Area	Rural	36 (47.4%)	40 (52.6%)	0.905

Dehydration Status	Urban	32 (46.4%)	37 (53.6%)	0.059
	Mild	20 (55.6%)	16 (44.4%)	
	Moderate	30 (38.0%)	49 (62.0%)	
	Severe	18 (60.0%)	12 (40.0%)	
Duration of diarrhoea	≤5 days	28 (37.3%)	47 (62.7%)	0.017
	>5 days	40 (57.1%)	30 (42.9%)	

*Fissure Exact Test

DISCUSSION

The prevalence of hypokalaemia was found to be 46.90%, indicating that almost half of the children had decreased levels of potassium in the blood. This increased incidence of hypokalaemia may be attributed to the significant loss of potassium through the gastrointestinal tract with diarrhoea and decreased oral intake and increased levels of aldosterone secondary to decreased oral intake and volume depletion. Male gender had a significant association with hypokalaemia; in the hypokalaemic children, 40 (56.3%) were male, while only 28 (37.8%) of the hypokalaemic children were female (p = 0.026). This may be attributed to the increased metabolic demands of the male children and the possible role of androgens in the renal tubular cell potassium balance that may predispose male children to hypokalaemia with diarrhoea and other gastrointestinal disturbances. The duration of diarrhoea had a significant association with hypokalaemia; the children with diarrhoea of more than 5 days had a higher incidence of hypokalaemia—40 (57.1%) compared with the children with diarrhoea of less than 5 days—28 (37.3%) (p = 0.017). This may be attributed to the increased loss of potassium through the gastrointestinal tract with prolonged diarrhoea and the prolonged duration of gastrointestinal potassium loss that depletes the potassium levels in the body.

The frequency of hypokalaemia in the present study were found to be 68 (46.90%), which were indicating a considerable burden of potassium depletion amongst children with acute watery diarrhoea. This finding was closely comparable to Nasrin L *et al.*¹² and Arif M *et al.*¹¹ who were reporting hypokalaemia in 40% of children with acute diarrhoea, and similarly Ali S *et al.*¹³ were observing hypokalaemia in 42.5% of children with diarrhoea, suggesting that potassium depletion is a consistently frequent complication in paediatric diarrhoeal illness across different settings. The scientific basis for this high frequency lies in the fact that diarrhoeal stool contains considerably high concentrations of potassium, and prolonged losses combined with reduced oral intake and secondary hyperaldosteronism due to volume depletion were collectively contributing to hypokalaemia. On the other hand, Ahmad N *et al.*¹⁴ were reporting a notably higher frequency of 62.9% in paediatric ICU patients with diarrhoea, and Zulqarnain A *et al.*¹⁵ were also finding higher frequency of 61.1% in malnourished children, which may be explained by the more severe clinical condition of their study populations as critically ill and malnourished children are having greater nutritional deficits and more severe gastrointestinal losses as

compared to the general paediatric diarrhoea patients enrolled in the present study. In contrast, relatively lower frequencies were reported by Saadia Khan S *et al.* ¹⁶ at 23%, Karim R *et al.* ¹⁷ at 28.6%, Ullah I *et al.* ¹⁸ at 12%, and Ahmad MS *et al.* ¹⁹ at 7.7%, and these differences may be attributable to the differences in patient population characteristics, disease severity, nutritional status and the diagnostic criteria being used for defining hypokalaemia across these studies.

Regarding gender, male children in the present study were showing significantly higher frequency of hypokalaemia 40 (56.3%) as compared to female children 28 (37.8%) ($p = 0.026$), which were being consistent with the predominance of male gender reported by Zulqarnain A *et al.* ¹⁵ Zain-ul-Abadin M *et al.* ²⁰ Nasrin L *et al.* ¹² Ali S *et al.* ¹³ and Ahmad N *et al.* ¹⁴ in their respective study populations, suggesting that male children may be more physiologically vulnerable to electrolyte disturbances during diarrhoeal illness possibly *via* the influence of androgens on renal tubular potassium handling and their relatively higher metabolic demands. Duration of diarrhoea were also found to be significantly associated with hypokalaemia in the present study ($p = 0.017$), which were in agreement with the observations of Zain-ul-Abadin M *et al.* ²⁰ who were concluding that electrolyte

imbalance increases with severity and duration of diarrhoea, and this association is scientifically well justified as prolonged diarrhoea leads to cumulative and sustained faecal potassium losses over time, eventually exceeding the renal compensatory capacity and resulting in clinically significant hypokalaemia.

This study was conducted in a single center, and this might be a limitation in terms of generalizing this study to a wider population, as it might not fully represent all the diverse characteristics of the pediatric population in different regions. The sample size used in this study might be small, and this could influence the reliability of the associations that were noted for all the demographic factors. This study was a cross-sectional study, and this limits one in determining the relationship over a long period regarding the causality of hypokalemia.

CONCLUSION

The research concludes that hypokalaemia is a notably common complication in children who present with acute watery diarrhoea, as nearly half the number of the enrolled patients suffered from the condition. It was observed that only the gender of the patients and the duration of diarrhoea were statistically significant in the occurrence of hypokalaemia.

REFERENCES

- Mengistu, M., Woldemariam, M., Manilal, A., Aklilu, A., Yohannes, T., Idhayadhulla, A., & Alodaini, H. A. (2025). Prevalence of paediatric diarrhoea in arba Minch government health institutions, Southern Ethiopia and associated factors. *Scientific Reports*, 15(1). <https://doi.org/10.1038/s41598-025-16297-7>
- Ketabi, K., Meshkat, Z., Soleimanjahi, H., Teimoori, A., Tanzadepanah, H., & Bakhshi, F. (2023). Distribution of Group A rotavirus circulating in Mashhad, Iran. *Iranian Journal of Microbiology*. <https://doi.org/10.18502/ijm.v15i6.14160>
- Azanaw, J., Malede, A., Yalew, H. F., & Worede, E. A. (2024). Determinants of diarrhoeal diseases among under-five children in Africa (2013–2023): A comprehensive systematic review highlighting geographic variances, socioeconomic influences, and environmental factors. *BMC Public Health*, 24(1). <https://doi.org/10.1186/s12889-024-19962-0>
- Yeasmin, S., Hasan, S. M., Chisti, M. J., Khan, M. A., Faruque, A. S., & Ahmed, T. (2022). Factors associated with dehydrating rotavirus diarrhea in children under five in Bangladesh: An urban-rural comparison. *PLOS ONE*, 17(8), e0273862. <https://doi.org/10.1371/journal.pone.0273862>
- Nalin, D. (2022). Issues and controversies in the evolution of oral rehydration therapy (ORT). *Trop. Med. Infect. Dis.* 2021, 6, 34. *Tropical Medicine and Infectious Disease*, 7(6), 103. <https://doi.org/10.3390/tropicalmed7060103>
- Florez, I. D., Sierra, J., & Pérez-Gaxiola, G. (2020). Balanced crystalloid solutions versus 0.9% saline for treating acute diarrhoea and severe dehydration in children. *Cochrane Database of Systematic Reviews*. <https://doi.org/10.1002/14651858.cd013640>
- Amin, M. A., Manna, R. M., Nahin, S., & Hawlader, M. D. (2023). Multidisciplinary strategies for managing acute watery diarrhea in children with congenital anorectal malformation and colostomy: A case study. *Clinical Case Reports*, 11(10). <https://doi.org/10.1002/ccr3.8012>
- Kinasha, A. A., Pernica, J. M., Banda, F. M., Goldfarb, D. M., Welch, H. D., Steenhoff, A. P., & MacLean, S. A. (2025). Electrolyte abnormalities and clinical outcomes in children aged one month to 13 years hospitalized with acute gastroenteritis in two large referral hospitals in Botswana. *PLOS Global Public Health*, 5(5), e0004588. <https://doi.org/10.1371/journal.pgph.0004588>
- Bamgbola, O. F. (2022). Review of the Pathophysiologic and clinical aspects of Hypokalemia in children and young adults: An update. *Current Treatment Options in Pediatrics*, 8(3), 96-114. <https://doi.org/10.1007/s40746-022-00240-3>
- Witters, P., Segers, H., De Koster, J., Levchenko, E., Vermeersch, P., & Claeysens, C. (2025). An unusual case of neuroblastoma presenting with prolonged watery diarrhea in a pediatric patient. *Biochemia medica*, 35(2), 296-305. <https://doi.org/10.11613/bm.2025.020901>
- Arif, M., Saleem Afridi, A., Ali, F., Abrar Banuri, S. U., Salman, M., & Khan, M. (2021). Frequency of hyponatremia and Hypokalemia in children with acute diarrhea. *Pakistan Journal of Medical and Health Sciences*, 15(9), 2565-2567. <https://doi.org/10.53350/pjmhs211592565>
- Nasrin, L., Islam, M. S., Islam, M. B., Anisuzzaman, S., Anam, A. Z., & Ibrahim, F. (2024). Frequency of hyponatremia & Hypokalemia in children under 5 years with acute diarrhoea. *Saudi Journal of Medical and Pharmaceutical Sciences*, 10(06), 340-343. <https://doi.org/10.36348/sjm.2024.v10i06.003>
- Ali, S., Shahzad, A., Chandio, S., Chandio, S., Chandio, K., Pathan, S., & Fazal, K. (2023). Hypokalemia among children having acute malnutrition with diarrhea. *Pakistan Journal of Health Sciences*, 125-128. <https://doi.org/10.54393/pjhs.v4i02.575>
- Ahmad, N., Chaudhary, A. R., Usman, M., & Ayub, M. R. (2025). Frequency of hypokalemia in pediatric ICU patients with diarrhea and their outcome in a tertiary care pediatric hospital in Lahore, Pakistan. *The Professional Medical*

- Journal*, 32(10), 1388-1395. <https://doi.org/10.29309/tpmj/2025.32.10.8349>
15. Zulqarnain, A., Jaffar, Z., & Iqbal, I. (2015). Malnourished children with diarrhea. *The Professional Medical Journal*, 22(05), 610-614. <https://doi.org/10.29309/tpmj/2015.22.05.1275>
 16. Khan, S., Rubab, Z., Ali, I., Arshad, R., Abbas, A., & Akhtar, E. (2021). The serum electrolyte imbalance in children with severe acute malnutrition. *Journal of Islamic International Medical College (JIIMC)*, 16(1), 10-13. <https://journals.riphah.edu.pk/index.php/jiimc/article/view/1142>
 17. Karim, R., Afridi, J. K., Zaman, A., Zada, U., & Younas, M. (2015). To determine the frequency of hypokalemia in children with persistent diarrhoea. *Khyber J Med Sci*, 8(3), 418-423. <https://kjms.com.pk/old/sites/default/files/%2823%29%20KJMS%20Vol%208%20No%203.pdf>
 18. Ullah, I., Khan, I., Shafiq, M., Sherazi, F., Khan, K., & Ahmad, K. (2020). To Determine the Frequency and Pattern of Common Electrolyte Abnormalities in Children Presenting with Acute Gastroenteritis. In *Medical Forum Monthly* (Vol. 31, No. 9). <https://medicalforummonthly.com/index.php/mfm/article/view/2449>
 19. Ahmad, M. S., Wahid, A., Ahmad, M., Mahboob, N., & Mehmood, R. (2016). Prevalence of electrolyte disorders among cases of diarrhea with severe dehydration and correlation of electrolyte levels with age of the patients. *J Coll Physicians Surg Pak*, 26(5), 394-8.
 20. Zain Ul Abadin, M., Iftikar, M., Arshad, N., Mahmood, Z., Tahira, B., Shafiq, M., & Khawar Butt, T. (2020). Frequency of electrolyte imbalance in children of Pediatric acute diarrhea. *Esculapio*, 16(3). <https://doi.org/10.51273/esc20.251635>