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Frequency of Hypokalemia in Children Presenting with Acute Diarrhea at Bacha Khan Medical Complex Swabi

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ABSTRACT

Acute diarrhea is a leading cause of morbidity and mortality among children, especially the low- and middle-income countries of the globe. There are common complications such as electrolyte imbalances, notably, hypokalemia, which severely deteriorates clinical outcomes in case of the delay in their detection and prevention. This research was done in order to establish the prevalence of hypokalemia in children presenting with acute diarrhea at Bacha Khan Medical Complex, Swabi. The study followed a cross-sectional design and the participants were enrolled by using consecutive sampling across six months (August 2024 - February 2025) with 145 children (1-12 years) being enrolled. The data on demographics, clinical, and laboratory was gathered using a structured proforma. Hypokalemia was considered serum potassium levels less than 3.5 mmol/L. Data were analyzed with SPSS v23, applying stratification and Chi-square tests to evaluate associations.The mean age of participants was 5.4 ± 3.1 years, with males comprising 59.3%. Hypokalemia was identified in 56 children, yielding a frequency of 38.6%. The condition was significantly more common in the 1–5 years age group (48.4%, p=0.021) and among children from low socioeconomic backgrounds (47.6%, p=0.031). Muscle weakness, fatigue, and cramps were the predominant symptoms associated with hypokalemia. No significant differences were observed regarding gender or urban–rural distribution. Although hypokalemia was more frequent in children with vomiting and fever, these associations did not achieve statistical significance. The findings underscore hypokalemia as a common and clinically relevant complication of pediatric diarrhea, especially in younger and socioeconomically disadvantaged children. Routine electrolyte monitoring and tailored fluid therapy with potassium supplementation are essential to mitigate adverse outcomes and improve pediatric diarrheal disease management in resource-limited settings.

INTRODUCTION

Acute gastroenteritis (AGE) has been called one of the most prevalent causes of morbidity and mortality in children across the world, especially in low- and middle-income countries (LMICs) (Abate, Robbins-Hill, Lawler, Assefa, and Reid, 2024; Das et al., 2024; Stanyevic et al., 2022). It contributes to significant part of hospital admission among children and diarrheal diseases are the second leading causes of death among children below the age of five, second only to pneumonia (WHO, 2023) (Cohen et al., 2022; Apanga and Kumbeni, 2021; Hartman et al., 2023). Though there is progress in preventive levels, oral rehydration therapy, and better sanitation practices, diarrheal illnesses remain a significant health burden, especially in resource-constrained environments that have insufficient clean water and health infrastructure provision (Chan et al., 2021).

The pathophysiology of diarrheal disease is primarily mediated by two mechanisms: disruption of the intestinal villous brush border and toxin-mediated secretory processes (Elsasser & Faulkenberg, 2024; Garcia & Haddad, 2022). These mechanisms lead to excessive intestinal fluid production, overwhelming the absorptive capacity of the gastrointestinal tract and resulting in fluid and electrolyte losses (Keely & Barrett, 2022; Do et al., 2022). Among affected children, common clinical manifestations include vomiting, fever, and dehydration, which, if not recognized and managed promptly, can lead to life-threatening complications (Chavda et al., 2024). A recent study demonstrated that dehydration was observed in nearly half of children with acute diarrhea, while vomiting and fever were reported in 66.6% and 60.6% of patients, respectively.

One of the most concerning consequences of diarrheal illness in children is electrolyte imbalance (Hassan et al.,

2022; Abadin et al., 2023). Fluid and electrolyte disturbances—most notably hypokalemia, hyponatremia, and metabolic acidosis—are frequently observed due to disproportionate gastrointestinal losses and inadequate replacement (Li, Wang, & Qian, 2022). Potassium, an essential intracellular cation, plays a vital role in maintaining neuromuscular function, cardiac rhythm, and acid–base homeostasis. Hypokalemia, defined as a serum potassium concentration below 3.5 mmol/L, can precipitate severe complications, including muscle weakness, paralytic ileus, cardiac arrhythmias, and, in extreme cases, death. Children with acute diarrhea are particularly vulnerable, as their physiological reserves are limited and compensatory mechanisms underdeveloped (Das, Padhani, & Bhutta, 2021).

The management of diarrheal diseases hinges not only on volume replacement but also on the correction of electrolyte imbalances (Alharbi et al., 2024). Oral rehydration solutions (ORS) have revolutionized diarrheal disease outcomes by addressing both dehydration and sodium–potassium losses simultaneously (WHO, 2023). However, in severe cases requiring hospitalization, intravenous (IV) rehydration remains the cornerstone of therapy. Notably, studies have reported that children exclusively treated with IV fluids are at increased risk of hypernatremia due to inadequate free-water replacement. Furthermore, insufficient attention to potassium supplementation during fluid therapy predisposes patients to hypokalemia, highlighting the need for vigilant monitoring of serum electrolytes in pediatric diarrheal illness (Zieg, Ghose, & Raina, 2024).

Global estimates suggest that hypokalemia complicates approximately 20–40% of pediatric diarrhea admissions, with significant geographic variation depending on nutritional status, hydration practices, and local disease epidemiology. In Pakistan, diarrheal diseases remain a leading cause of childhood mortality, with the frequency of hypokalemia reported as high as 40% among hospitalized children with acute diarrhea. These findings underscore the urgent need for context-specific data to inform clinical guidelines, optimize treatment strategies, and prevent adverse outcomes.

Given the paucity of local data from Khyber Pakhtunkhwa, this study aims to determine the frequency of hypokalemia in children presenting with acute diarrhea at Bacha Khan Medical Complex, Swabi. By documenting the burden of hypokalemia in this population, the findings will provide evidence to improve case management, guide fluid therapy protocols, and strengthen pediatric care in the region.

MATERIALS AND METHODS

The Department of Pediatrics, Bacha Khan Medical Complex, Swabi, carried out this cross-sectional study during six months of accurate dates, 16 August 2024 to 16 February 2025 after the approval of the research synopsis by the College of Physicians and Surgeons Pakistan (CPSP). The calculation was based on a hypothetical 40% prevalence of hypokalemia in acute diarrhea, sample size calculator of WHO was used to estimate the required sample size of 145 children, with a Weakness of level of confidence of 95 and margin of error of 8. Participant recruitment was done by use of a non-probability consecutive sampling technique.

Children aged between 1–12 years of both sexes who reported acute diarrhea, or the passing of more than 3 liquid stools in 24 hours with a maximum duration of 14 days, were inclusive. The study excluded patients who experienced gastrointestinal bleeding, Clostridioides difficile infection, or inflammatory bowel disease.

This research was initiated with a permission of the institutional ethical review board. Parents or other legal guardians gave informed written consent following an elaborate account of the study objectives, procedure and the possible advantages. Structured pro forma was used to capture demographic data such as age, sex, weight, socioeconomic status and area of residence. A clinical-based audit directed at determining the symptoms relevant to hypokalemia, including muscle cramps, weakness and fatigue. The trained individuals collected venous blood aseptically using standard phlebotomy procedures. The level of serum potassium was determined in the laboratory of the hospital, and hypokalemia was considered a serum potassium level that is below 3.5 mmol/L. Any evaluation was done under observation of a consultant pediatrician who had not less than three to five years of experience beyond the fellowship stage.

The SPSS 23 was used to analyze the data. Descriptive statistics were used, where the frequencies and percentages were given on categorical variables e.g. gender, socioeconomic status, residence, hypokalemia status, and features related to hypokalemia (fever, vomiting, abdominal pain). Mean and standard deviation were used in expressing the continuous variables such as age, weight, and serum potassium levels. Normality was tested by the ShapiroWilk test. The modifiers (age, weight, sex, socioeconomic status, residence, and clinical presentation) were stabilized by means of stratification. The Chi-square or Fisher-exact tests were calculated using data to study associations post-stratification where a p under 0.05 was regarded as significant. The findings were presented in a table to make them understandable.

RESULTS

A total of 145 children fulfilling the inclusion criteria were enrolled during the study period. The mean age of the study population was 5.4 ± 3.1 years, with the majority (42.8%) belonging to the 1–5 years age group. Of the participants, 86 (59.3%) were male and 59 (40.7%) were female, yielding a male-to-female ratio of 1.45:1. The mean weight of enrolled children was 17.2 ± 5.6 kg.

Hypokalemia was observed in 56 children, giving a frequency of 38.6%. Among those with hypokalemia, muscle weakness and fatigue were the most frequent presenting symptoms (67.8%), followed by cramps (51.7%). The majority of children with hypokalemia were from lower socioeconomic backgrounds and rural areas.

Stratified analysis revealed that the frequency of hypokalemia was significantly higher in younger children (1–5 years) compared to older age groups ($p = 0.021$).

Similarly, hypokalemia was more frequent among children with associated vomiting (45.7%) and fever (41.3%) compared to those without these features, although these differences did not reach statistical significance. No

significant gender difference was noted in hypokalemia frequency (p = 0.58).

Table 1

Baseline Characteristics of Children with Acute Diarrhea (n=145)

Variable		Frequency (%) / Mean ± SD
Age (years)		5.4 ± 3.1
1–5 years		62 (42.8%)
6–9 years		49 (33.8%)
10–12 years		34 (23.4%)
Gender	Male	86 (59.3%)
	Female	59 (40.7%)
Weight (kg)		17.2 ± 5.6
Socioeconomic status	Low	84 (57.9%)
	Middle	45 (31.0%)
	High	16 (11.0%)
Residence	Rural	91 (62.8%)
	Urban	54 (37.2%)

Table 2

Frequency of Hypokalemia in Children with Acute Diarrhea

Hypokalemia Status	Frequency (n)	Percentage (%)
Present	56	38.6%
Absent	89	61.4%

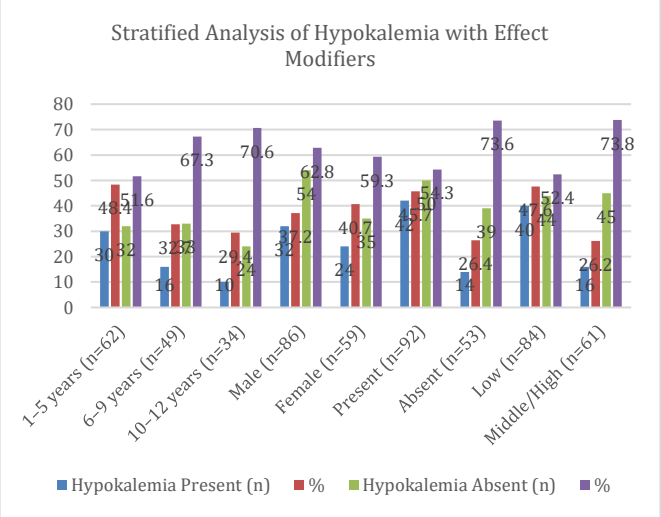
Table 3

Stratified Analysis of Hypokalemia with Effect Modifiers

Variable		Hypokalemia Present n (%)	Hypokalemia Absent n (%)	*p*-value
Age group	1–5 years (n=62)	30 (48.4%)	32 (51.6%)	0.021*
	6–9 years (n=49)	16 (32.7%)	33 (67.3%)	
	10–12 years (n=34)	10 (29.4%)	24 (70.6%)	
Gender	Male (n=86)	32 (37.2%)	54 (62.8%)	0.58
	Female (n=59)	24 (40.7%)	35 (59.3%)	
Vomiting	Present (n=92)	42 (45.7%)	50 (54.3%)	0.09
	Absent (n=53)	14 (26.4%)	39 (73.6%)	
Socio-economic	Low (n=84)	40 (47.6%)	44 (52.4%)	0.031*
	Middle/High (n=61)	16 (26.2%)	45 (73.8%)	

*Significant at p < 0.05

Figure: 1



DISCUSSION

In the present study, the frequency of hypokalemia among children presenting with acute diarrhea was 38.6%, a finding that underscores the considerable burden of electrolyte imbalance in this vulnerable population. This prevalence is broadly consistent with previously reported figures from regional and international studies, where the frequency of hypokalemia in pediatric diarrheal illness has ranged between 30% and 45% depending on case severity, age distribution, and nutritional status of the study cohorts. Such variability reflects differences in healthcare access, laboratory capacity, and definitions of hypokalemia, but consistently highlights the importance of early recognition of potassium disturbances in diarrheal disease.

The higher frequency of hypokalemia in younger children, particularly those aged 1–5 years, aligns with physiological susceptibility in this group due to smaller total body potassium reserves and greater risk of rapid depletion during diarrheal episodes. Similar age-related associations have been documented in multicenter studies from South Asia and sub-Saharan Africa, supporting the notion that younger children not only experience more severe dehydration but are also less able to compensate for electrolyte loss. This finding emphasizes the need for age-targeted preventive strategies, including prompt oral or intravenous rehydration with potassium supplementation in high-risk groups.

Our analysis also revealed an association between hypokalemia and low socioeconomic status. This observation is consistent with evidence suggesting that children from disadvantaged households are more likely to present with advanced dehydration, inadequate dietary intake, and delayed healthcare access, all of which increase the likelihood of electrolyte derangements. Addressing these disparities requires a public health approach that integrates nutritional education, improved sanitation, and equitable access to pediatric care.

Interestingly, while hypokalemia was more frequent in children with vomiting and fever, these associations did not reach statistical significance. Vomiting is a well-established risk factor for electrolyte depletion, particularly hypokalemia, due to direct gastric losses; however, our findings suggest that diarrheal fluid loss remains the predominant contributor in this cohort. The absence of a significant gender difference further reinforces that biological sex is unlikely to play a major role in determining hypokalemia risk in pediatric diarrheal illness.

Our findings have a colorful clinical implication. Unrecognized, hypokalemia may trigger complications, such as arrhythmias, muscle paralysis and intestinal ileus, which can complicate the outcome of acute diarrhea in children. Considering the prevalence noted in our research, serum electrolytes, specifically potassium, must be taken into routine to manage pediatric diarrhea in hospitals. In addition, health workers in the frontline care are expected to be educated on how to pick up the initial signs of potassium deficiency, such as muscle weakness, fatigue, and cramps, particularly among those children at rural and socioeconomically disadvantaged backgrounds.

Among the strengths of this study, the population is defined, sampling is systematic and the laboratory analysis of the potassium level was standardized. Nevertheless, certain constraints should be admitted. The first one is that the cross-sectional design prohibits using causal conclusions and it is not possible to assess the time

dependence between the duration of diarrhea and hypokalemia. Second, it was a single center study and transference of the results to other regions with dissimilar dietary, environmental or health conditions ought not to be accepted. Third, we failed to evaluate the extent of dehydration or unreliant nutritional deficiencies that could have affected the noted associations.

Despite these limitations, our study provides valuable evidence on the burden and determinants of hypokalemia in children with acute diarrhea in Pakistan. The findings underscore the importance of routine electrolyte monitoring and highlight high-risk subgroups that warrant prioritized intervention. Future multicenter prospective studies incorporating nutritional status, severity of dehydration, and long-term outcomes will be essential to further delineate risk factors and guide evidence-based management protocols.

CONCLUSION

This study demonstrates that hypokalemia is a frequent complication of acute diarrhea in children, with a prevalence of 38.6% among those admitted at Bacha Khan Medical Complex, Swabi. Younger children, particularly those aged 1–5 years, and those from low socioeconomic backgrounds were disproportionately affected, reflecting their greater vulnerability to electrolyte disturbances during diarrheal illness. The presence of symptoms such as muscle weakness and cramps further highlights the clinical importance of early recognition. Although gender and urban–rural differences were not significant, the consistent association with poverty and younger age underscores the role of socioeconomic and physiological factors in determining risk. Given the potential for life-threatening complications, routine electrolyte monitoring and incorporation of potassium supplementation into rehydration protocols should be prioritized in pediatric diarrhea management. Strengthening awareness among healthcare providers can further improve outcomes in high-risk populations.

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