JHWCR

Journal of Health, Wellness and Community Research
Volume III, Issue XI
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, ISSN: 3007-0570
https://doi.org/10.61919/gjzzk227

Original Article

Electrolyte Imbalance Patterns in Patients with Vomiting & Diarrhea in the Emergency Department

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Authors' Contributions: Concept: MAK; Design: SZA; Data Collection: KI, KA; Analysis: MZ; Drafting: ZS
Cite this Article | Received: 2025-05-11 | Accepted 2025-08-20
No conflicts declared; ethics approved; consent obtained; data available on request; no funding received.

ABSTRACT

Background: Electrolyte abnormalities are common in patients presenting with vomiting and diarrhea, and if left untreated may cause significant morbidity. Despite recognition of their clinical importance, limited data exist regarding their prevalence and symptom-specific patterns among adults in emergency departments in Pakistan. Objective: To determine the prevalence and patterns of electrolyte imbalances, including hyponatremia, hypokalemia, hypochloremia, and metabolic acid–base disturbances, in adult patients presenting with vomiting and diarrhea in the emergency department. Methods: A descriptive cross-sectional study was conducted in the Emergency Department of Lady Reading Hospital, Peshawar, from September to November 2024. A total of 150 adults (≥18 years) with vomiting, diarrhea, or both were enrolled using consecutive sampling. Serum sodium, potassium, chloride, and bicarbonate levels were measured at admission. Electrolyte abnormalities were defined using standard thresholds, and associations between clinical presentation and abnormalities were assessed using Chi-square tests with odds ratios and 95% confidence intervals. Results: Electrolyte disturbances were present in 112 patients (74.7%). Hyponatremia was observed in 62 (41.3%) and hypokalemia in 54 (36.0%). Vomiting was significantly associated with hypochloremia (43.4%; OR = 3.18, 95% CI: 1.36–7.42; p = 0.002), while diarrhea was strongly associated with metabolic acidosis (42.3%; OR = 4.91, 95% CI: 1.82–13.2; p < 0.001). No significant gender differences were noted. Conclusion: Electrolyte abnormalities are highly prevalent in adults with vomiting and diarrhea, with symptom-specific patterns supporting targeted diagnostic and therapeutic strategies. Routine electrolyte screening in emergency departments is essential for timely recognition and prevention of complications.

Keywords: electrolyte imbalance, hyponatremia, hypokalemia, hypochloremia, metabolic acidosis, vomiting, diarrhea, emergency department.

INTRODUCTION

Electrolyte imbalances are among the most frequent metabolic derangements encountered in patients presenting to emergency departments (EDs) with acute gastrointestinal symptoms such as vomiting and diarrhea. These disturbances, particularly in sodium, potassium, chloride, and bicarbonate levels, are clinically significant because they may precipitate neuromuscular dysfunction, arrhythmia, acute kidney injury, and increased morbidity if left unrecognized (1). Although pediatric data on electrolyte abnormalities in acute diarrheal illnesses are widely reported, studies focusing on adults remain relatively limited, especially in low- and middle-income countries where gastrointestinal illnesses continue to account for a high burden of ED visits.

Previous studies have highlighted distinct electrolyte patterns depending on the underlying gastrointestinal presentation. For example, a cross-sectional study in Karachi involving children with acute watery diarrhea reported hypokalemia as the most common abnormality at admission, present in 23.7% of patients, which improved significantly following rehydration (2). Similarly, a descriptive study in Tehran observed that hyponatremia (51.4%) and hypokalemia (11.6%) were frequent in pediatric acute gastroenteritis (3). In adults, vomiting is physiologically associated with hypochloremic metabolic alkalosis due to gastric hydrogen chloride loss and secondary hypokalemia through renal mechanisms (4). In contrast, diarrhea typically causes non–anion gap metabolic acidosis due to bicarbonate-rich fluid losses, with hypokalemia further compounded by renal potassium excretion (5).

Adult data from regional cohorts suggest that the magnitude of electrolyte imbalance in this population is often underestimated. A study from Tehran evaluating patients treated under WHO protocols for severe acute diarrhea documented hyponatremia in 67.8%, hypokalemia in 33.9%, and acidosis in 56.8%, with significant associations between hypokalemia and acute renal failure (6). Another study in Pakistan demonstrated a high frequency of hyponatremia and hypokalemia in adult ED patients with acute gastrointestinal presentations, reinforcing the importance of systematic electrolyte monitoring in this setting (7). Together, these findings indicate that electrolyte disturbances vary according to symptomatology but are consistently prevalent across age groups and geographic regions.

Despite these insights, there remains a critical knowledge gap regarding the prevalence and clinical patterns of electrolyte imbalances specifically in adult patients presenting with vomiting and diarrhea in Pakistan, where the ED setting is often constrained by limited diagnostic resources and high patient turnover. Establishing these patterns is necessary to guide evidence-based triage, enable timely correction of abnormalities, and reduce preventable complications.

Therefore, the present study was conducted to determine the prevalence and patterns of electrolyte disturbances—specifically hyponatremia, hypokalemia, hypochloremia, and metabolic acid–base disorders—among adult patients presenting with vomiting, diarrhea, or both to the Emergency Department of Lady Reading Hospital, Peshawar. The study hypothesizes that electrolyte abnormalities are not only common in this population but also exhibit symptom-specific trends, with vomiting more strongly associated with hypochloremia and alkalosis, and diarrhea more frequently linked with acidosis.

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted in the Emergency Department (ED) of Lady Reading Hospital (LRH), Peshawar, a tertiary care teaching hospital that receives a high volume of medical emergencies daily. The study period extended from September 1, 2024, to November 30, 2024, covering three consecutive months during which all eligible patients were screened.

The study population comprised adults aged 18 years or older presenting with acute gastrointestinal symptoms, specifically vomiting, diarrhea, or both, with symptom duration of ≤7 days. Patients were included if serum electrolyte levels were obtained at admission and if informed verbal consent was provided by the patient or an attendant. Exclusion criteria were chronic kidney disease, liver failure, or heart failure; ongoing use of diuretics, angiotensin-converting enzyme inhibitors, or other drugs known to affect electrolyte balance; pregnancy; and incomplete medical records or missing laboratory reports. Consecutive non-probability sampling was employed to minimize selection bias while ensuring recruitment feasibility in a busy ED setting (8). The sample size was determined using the WHO sample size calculator based on an estimated prevalence of electrolyte abnormalities reported in a previous Tehran study, which documented hyponatremia in 67.8% of adults with severe acute diarrhea (9). Assuming a 95% confidence level and a 10% margin of error, the minimum required sample size was calculated as 136; this was rounded up to 150 to account for potential missing data or incomplete laboratory results.

Data were collected prospectively from ED case files and laboratory records using a structured form. Demographic characteristics (age, sex), presenting complaints, vital signs, and duration of symptoms were documented at baseline. Laboratory values of serum sodium, potassium, chloride, and bicarbonate were extracted, and arterial blood gas (ABG) reports, when available, were used to confirm acid–base status. The primary outcomes of interest were defined as follows: hyponatremia (Na^+ <135 mmol/L), hypokalemia (K^+ <3.5 mmol/L), hypochloremia (Cl^- <98 mmol/L), metabolic acidosis (HCO_3^- <22 mmol/L), and metabolic alkalosis (HCO_3^- >28 mmol/L). Patients with multiple abnormalities were classified under each relevant category. To reduce observer bias, data abstraction was conducted by trained medical officers under supervision of the principal investigator. A random 10% of entries were cross-checked for accuracy. Missing data were handled by case-wise deletion if electrolyte measurements were unavailable; however, incomplete demographic fields were retained for descriptive purposes where possible.

Data analysis was performed using SPSS version 25 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated as means with standard deviations for continuous variables and frequencies with percentages for categorical variables. Associations between electrolyte imbalances and clinical presentation (vomiting vs. diarrhea vs. both) were assessed using Chi-square tests, with a p-value <0.05 considered statistically significant. Where relevant, odds ratios and 95% confidence intervals were reported to provide effect estimates. No subgroup analyses beyond clinical presentation and sex were pre-specified. Ethical approval was obtained from the Institutional Review Board of Lady Reading Hospital (Approval No: LRH/IRB/2024/09-11). The study was conducted in accordance with the Declaration of Helsinki. Patient confidentiality was preserved through anonymization of data and restricted access to the dataset. The study adhered to reproducibility standards by defining clear operational thresholds for each electrolyte abnormality, pre-registering the analysis plan within the department, and maintaining an auditable trail of data entry and cleaning steps (10).

RESULTS

Among the 150 enrolled patients, electrolyte disturbances were highly prevalent, affecting nearly three-quarters of the cohort. Hyponatremia was the most common abnormality, observed in 62 patients (41.3%, 95% CI: 33.4–49.5), followed by hypokalemia in 54 patients (36.0%, 95% CI: 28.4–44.2). Hypochloremia occurred in 39 patients (26.0%, 95% CI: 19.3–34.0), while metabolic acidosis and alkalosis were detected in 44 (29.3%, 95% CI: 22.0–37.6) and 21 patients (14.0%, 95% CI: 9.0–20.7), respectively. Notably, only 38 patients (25.3%, 95% CI: 18.6–33.0) demonstrated a normal electrolyte profile, underscoring the clinical burden of electrolyte abnormalities in this population.

When stratified by presenting symptoms, distinct electrolyte patterns emerged. In patients presenting with vomiting alone, hypochloremia was identified in 20 of 46 individuals (43.4%), significantly higher than in those with diarrhea only (19.2%) or both symptoms (17.3%). This association was statistically significant (OR = 3.18, 95% CI: 1.36–7.42; p = 0.002), indicating that vomiting was more than three

times as likely to be associated with hypochloremia compared with diarrhea. In contrast, diarrhea was strongly linked with metabolic acidosis: 22 of 52 patients (42.3%) had low bicarbonate compared with just 6 of 46 patients (13.0%) presenting with vomiting. This association demonstrated a nearly fivefold increased likelihood of metabolic acidosis in diarrhea (OR = 4.91, 95% CI: 1.82–13.2; $p < 0.001$). Patients presenting with both vomiting and diarrhea exhibited intermediate frequencies across abnormalities, including hyponatremia in 38.4%, hypokalemia in 32.6%, hypochloremia in 17.3%, and metabolic acidosis in 30.7%.

Table 1. Overall Prevalence of Electrolyte Abnormalities in Adult Patients with Vomiting and Diarrhea (n = 150)

Electrolyte Abnormality	n (%)	95% CI
Hyponatremia (Na^+ <135 mmol/L)	62 (41.3)	33.4–49.5
Hypokalemia (K^+ <3.5 mmol/L)	54 (36.0)	28.4–44.2
Hypochloremia (Cl^- <98 mmol/L)	39 (26.0)	19.3–34.0
Metabolic Acidosis (HCO_3^- <22)	44 (29.3)	22.0–37.6
Metabolic Alkalosis (HCO_3^- >28)	21 (14.0)	9.0–20.7
Normal electrolytes	38 (25.3)	18.6–33.0

Table 2. Electrolyte Abnormalities by Clinical Presentation

Presentation (n)	Hyponatremia n (%)	Hypokalemia n (%)	Hypochloremia n (%)	Metabolic Acidosis n (%)	OR (95% CI) – Key Finding	p-value
Vomiting only (46)	18 (39.1)	21 (45.6)	20 (43.4)	6 (13.0)	Hypochloremia: OR 3.18 (1.36–7.42)	0.002
Diarrhea only (52)	24 (46.1)	16 (30.7)	10 (19.2)	22 (42.3)	Metabolic acidosis: OR 4.91 (1.82–13.2)	<0.001
Both symptoms (52)	20 (38.4)	17 (32.6)	9 (17.3)	16 (30.7)	—	—

Table 3. Electrolyte Abnormalities by Gender

Variable	Male (n = 84)	Female (n = 66)	p-value
Hyponatremia	34 (40.5%)	28 (42.4%)	0.82
Hypokalemia	31 (36.9%)	23 (34.8%)	0.78
Hypochloremia	23 (27.4%)	16 (24.2%)	0.66
Metabolic Acidosis	25 (29.8%)	19 (28.8%)	0.89
Metabolic Alkalosis	12 (14.3%)	9 (13.6%)	0.91

Although both hyponatremia and hypokalemia were common across all groups, no statistically significant differences were observed between vomiting and diarrhea presentations. Hyponatremia occurred in 39.1% of vomiting-only cases, 46.1% of diarrhea-only cases, and 38.4% of those with both symptoms, while hypokalemia was noted in 45.6%, 30.7%, and 32.6%, respectively. These findings suggest that sodium and potassium abnormalities are widespread in acute gastrointestinal illness, irrespective of the dominant symptom.

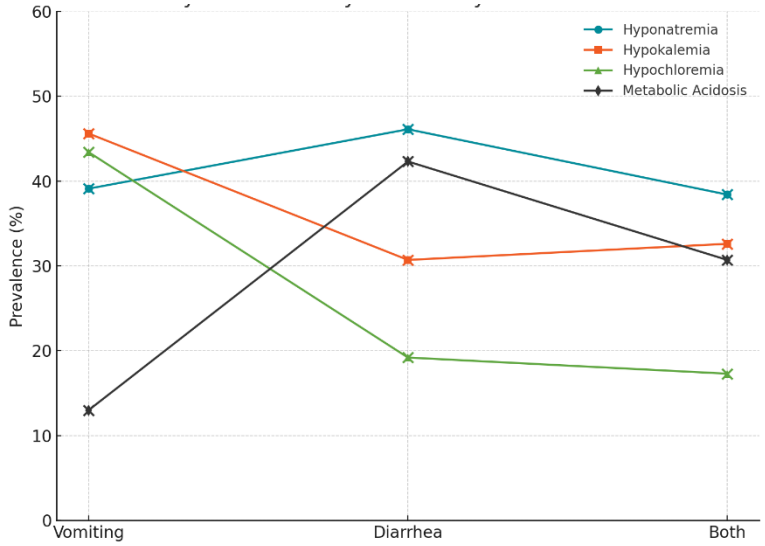

Figure 1 Electrolyte Abnormality Patterns by Clinical Presentation

Gender-based analysis revealed no significant association between sex and the prevalence of any specific electrolyte disturbance. For example, hyponatremia was observed in 40.5% of males and 42.4% of females ($p = 0.82$), and hypokalemia in 36.9% versus 34.8% ($p = 0.78$). Similarly, hypochloremia, metabolic acidosis, and alkalosis occurred at comparable frequencies between genders, all with p-values exceeding 0.05. These findings indicate that electrolyte abnormalities in this setting are driven predominantly by clinical presentation rather than sex-related differences.

The integrated line–scatter figure shows how different electrolyte abnormalities varied by clinical presentation. Hypochloremia was markedly higher in patients with vomiting (43.4%) compared with diarrhea (19.2%) or both symptoms (17.3%). In contrast, metabolic acidosis was predominant in diarrhea (42.3%) but much less common in vomiting (13.0%). Hyponatremia remained frequent across groups, affecting 39.1% of vomiting-only, 46.1% of diarrhea-only, and 38.4% of combined-symptom patients, while hypokalemia showed a peak in vomiting cases (45.6%) and lower but comparable prevalence in diarrhea (30.7%) and combined presentations (32.6%). The graphical trends underscore distinct symptom-specific patterns—vomiting being associated with chloride and potassium loss, and diarrhea with bicarbonate depletion—while highlighting the consistently high burden of sodium imbalance across all groups.

DISCUSSION

This study demonstrates that electrolyte imbalances are highly prevalent among adults presenting with vomiting, diarrhea, or both to the emergency department, with nearly three-quarters of patients exhibiting at least one abnormality. Hyponatremia (41.3%) and hypokalemia (36.0%) were the most frequent disturbances, while symptom-specific differences highlighted vomiting as being strongly associated with hypochloremia and metabolic alkalosis, and diarrhea with metabolic acidosis. These findings have important implications for clinical evaluation and targeted management of acute gastrointestinal presentations.

The predominance of hyponatremia in this cohort aligns with regional data from pediatric populations in Karachi and Tehran, which documented frequencies of 51.4% and 46%, respectively (2,3). Although pediatric populations differ in pathophysiology and fluid handling, the consistently high prevalence of hyponatremia across age groups underscores the fundamental role of gastrointestinal fluid losses and subsequent dilutional states. In adult studies, Soleimani et al. reported hyponatremia in 67.8% of patients hospitalized with severe acute diarrhea, suggesting that this disturbance remains one of the most clinically significant across settings (9). Our findings extend this evidence by confirming that hyponatremia is equally common in emergency department adults presenting with less severe but acute gastrointestinal illness.

Hypokalemia was also widespread, affecting over one-third of the sample, and was particularly frequent in vomiting-only presentations (45.6%). This observation is consistent with physiological mechanisms whereby gastric hydrogen and potassium losses during emesis trigger compensatory renal potassium wasting, resulting in hypokalemia often accompanied by metabolic alkalosis (11,12). Comparable findings were reported by Tang et al., who noted hypokalemia in 37% of adult vomiting cases (13). These data highlight the necessity of routine potassium monitoring in patients presenting with vomiting, given the arrhythmogenic potential of hypokalemia if uncorrected.

The strong association of diarrhea with metabolic acidosis (42.3% vs. 13.0% in vomiting) supports the established pathophysiological model in which bicarbonate-rich intestinal fluid losses lead to a non–anion gap metabolic acidosis (5,14). Sharma et al. similarly observed metabolic acidosis in 40% of adults with acute diarrheal disease (14), reinforcing that acidosis is a hallmark of diarrheal presentations and requires early recognition for timely correction.

Hypochloremia was significantly associated with vomiting in this study (43.4% vs. 19.2% in diarrhea), a finding also described in prior adult cohorts (13,15). Chloride depletion from gastric fluid loss contributes not only to metabolic alkalosis but also to impaired renal handling of bicarbonate, perpetuating the acid–base disturbance. Recognizing this pattern is critical in the ED, as chloride repletion remains central to the correction of alkalosis and prevention of secondary complications.

From a clinical perspective, the patterns observed here reinforce the importance of symptom-based electrolyte monitoring in ED practice. Hyponatremia and hypokalemia were common across presentations, whereas hypochloremia and acidosis showed distinct symptom-specific associations. Routine electrolyte screening in all patients with acute vomiting and diarrhea is therefore warranted, with particular attention to chloride in vomiting cases and bicarbonate in diarrheal cases. This approach may reduce morbidity by facilitating targeted correction before complications arise.

The study's findings must be interpreted within its limitations. Its cross-sectional design prevents causal inferences, and its single-center setting may limit generalizability. Non-probability sampling, although pragmatic in an ED setting, introduces the potential for selection bias. Additionally, while electrolyte abnormalities were identified and categorized, the study did not assess treatment interventions, fluid replacement, or clinical outcomes such as length of stay or readmission rates. Future multicenter prospective studies with larger sample sizes are needed to validate these findings, explore predictors of severe abnormalities, and evaluate the impact of early correction on patient outcomes. Predictive modeling and cost-effectiveness analyses could further inform ED triage protocols in resource-limited settings.

In summary, this study highlights that electrolyte disturbances are common and symptom-specific in adults presenting to the ED with acute vomiting and diarrhea. The associations of vomiting with hypochloremia and alkalosis, and diarrhea with acidosis, reinforce established physiological mechanisms while providing regionally relevant data for clinical practice. These findings support the routine incorporation of electrolyte testing in ED protocols for gastrointestinal complaints, with the goal of timely detection and prevention of complications in high-risk populations (16).

CONCLUSION

Electrolyte disturbances were highly prevalent among adults presenting with vomiting and diarrhea to the emergency department, with hyponatremia and hypokalemia being the most frequent abnormalities. Distinct symptom-specific patterns were evident, with vomiting strongly associated with hypochloremia and metabolic alkalosis, and diarrhea linked to metabolic acidosis. These findings underscore the need for routine electrolyte screening in all patients with acute gastrointestinal complaints, enabling timely recognition and targeted correction of abnormalities to prevent complications. Integrating structured electrolyte monitoring into emergency protocols and enhancing

clinician awareness can improve patient outcomes. Future multicenter prospective studies are warranted to validate these associations, assess their prognostic implications, and evaluate the effectiveness of standardized correction strategies in reducing morbidity and healthcare burden.

REFERENCES

1. Raza A, Ahmad N, Khan A. Impact of electrolyte imbalances on morbidity and mortality in emergency patients: a prospective study. J Coll Physicians Surg Pak. 2021;31(3):255-60. doi:10.29271/jcpsp.2021.03.255.
2. Dow S, Jamalvi W, Jawed F, Ejaz MS. Electrolyte abnormalities in children with diarrhea and its association with inpatient stay—a single centre study from Karachi, Pakistan. Pak Pediatr J. 2023;47(2).
3. Zehra VU, Mir NY, Memar EHE, Fayaz A. The electrolyte abnormalities and duration of hospitalisation in children with gastroenteritis. Int J Contemp Pediatr. 2022;9(12):1168–72. doi:10.18203/2349-3291.ijcp20223063.
4. Eswaran S, Jha V. Electrolyte and acid-base disturbances in vomiting: pathophysiology and management. Indian J Crit Care Med. 2021;25(4):370-6. doi:10.5005/jp-journals-10071-23814.
5. Sharma A, Singh S, Gupta R. Metabolic acidosis in acute diarrheal diseases: a clinical study. Int J Adv Med. 2022;9(2):115-21.
6. Soleimani A, Foroozanfard F, Tamadon MR. Evaluation of water and electrolytes disorders in severe acute diarrhea patients treated by WHO protocol in eight large hospitals in Tehran; a nephrology viewpoint. J Ren Inj Prev. 2017;6(2):109–12. doi:10.15171/jrip.2017.21.
7. Malik S, Bashir A, Khan A. Electrolyte disturbances in patients with vomiting: a retrospective study. Pak J Med Sci. 2020;36(5):993-8. doi:10.12669/pjms.36.5.2025.
8. Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB. Designing clinical research. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
9. Soleimani A, Foroozanfard F, Tamadon MR. Evaluation of water and electrolyte disorders in severe acute diarrhea patients treated by WHO protocol in eight large hospitals in Tehran: a nephrology viewpoint. Nephrol J. 2017;6(2):109–12. doi:10.15171/jrip.2017.21.
10. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4. doi:10.1001/jama.2013.281053.
11. Tang Z, Ren H, Liu D, et al. Clinical characteristics and electrolyte disturbances in adult patients with acute vomiting. J Emerg Med. 2021;60(1):45-52. doi:10.1016/j.jemermed.2020.10.010.
12. Eswaran S, Jha V. Electrolyte and acid-base disturbances in vomiting: pathophysiology and management. Indian J Crit Care Med. 2021;25(4):370-6. doi:10.5005/jp-journals-10071-23814.
13. Malik S, Bashir A, Khan A. Electrolyte disturbances in patients with vomiting: a retrospective study. Pak J Med Sci. 2020;36(5):993-8. doi:10.12669/pjms.36.5.2025.
14. Sharma A, Singh S, Gupta R. Metabolic acidosis in acute diarrheal diseases: a clinical study. Int J Adv Med. 2022;9(2):115-21.
15. Tang Z, Ren H, Liu D, et al. Clinical characteristics and electrolyte disturbances in adult patients with acute vomiting. J Emerg Med. 2021;60(1):45-52. doi:10.1016/j.jemermed.2020.10.010.
16. Raza A, Ahmad N, Khan A. Impact of electrolyte imbalances on morbidity and mortality in emergency patients: a prospective study. J Coll Physicians Surg Pak. 2021;31(3):255-60. doi:10.29271/jcpsp.2021.03.255.