INTERNATIONAL JOURNAL OF
ADVANCED BIOCHEMISTRY
RESEARCH NOOSPHERE

Electrolyte Imbalance as predictors of morbidity and mortality in hospitalized patients

Ogonnaya Chinemerem Cynthia [1*], Ohiagu Franklyn Okechukwu [2]
[1] Department of Pure Chemistry, Imo State University, Owerri, Imo State, Nigeria
[2] Department of Biochemistry, Federal University of Technology, Owerri, Imo State, Nigeria

* Corresponding Author: **Ogonnaya Chinemerem Cynthia**

Article Info

P-ISSN: 3051-3405
E-ISSN: 3051-3413
Impact Factor (RSIF): 8.41
Volume: 02
Issue: 02
Received: 12-05-2026
Accepted: 10-06-2026
Published: 08-07-2026
Page No: 15-19

Abstract
Electrolyte concentrations are carefully maintained to ensure cellular integrity and function while supporting a range of metabolic and physiological functions. Thirty eight (38) hospitalized patients who were diagnosed at Orange Medical Diagnostic Center, Alakahia Rivers State, were the subject of this retrospective case-control study. They were split into two groups: 20 individuals who recovered and discharged (controls) and 18 patients who passed away some days after the laboratory test (cases). Serum concentrations of sodium and potassium were recorded as laboratory data. Potassium and sodium were found to have normal serum values of 3-5.5 mEq/L and 135-150 mEq/L, respectively. Lower values served as the cutoff points for electrolyte depletion that was clinically relevant, while higher levels served as the cutoff points for significant electrolyte concentration increases. The mean age of the 8 (44.4%) females and 10 (55.6%) males in the case group was 54.21 (SD=16.11) years. The control group consisted of 14 (70.0%) males and 6 (30.0%) females, with a mean age of 46.41 (SD=18.51) years. The mean serum sodium levels in patients who were discharged and those who passed away were 140.70 (SD=7.44) mEq/L and 143.11 (SD=14.35) mEq/L, respectively. This difference was not statistically significant, according to an independent t-test (P>0.05). In individuals who passed away, hyponatremia was more prevalent (22.2% vs. 0%). Additionally, individuals who passed away were more associated with hypernatremia (33.3% vs. 0%). Subjects who passed away and those who were discharged had mean serum potassium concentrations of 4.58 (SD=1.16) mEq/L and 3.61 (SD=0.73) mEq/L, respectively. The independent t-test revealed that this difference was not statistically significant (P>0.05). Furthermore, assessing serum potassium levels revealed that hyperkalemia was substantially more prevalent in individuals who passed away (11.1% vs. 0%). The prevalence of hyponatremia, hypernatremia, and hyperkalemia among hospitalized patients that later passed away is demonstrated by the study's findings, which are corroborated by a few other investigations. The severity of serum sodium and potassium concentrations continues to be a major predictor of mortality.

DOI: https://doi.org/10.54660/IJABRN.2026.2.2.15-19

Keywords: Sodium, Potassium, mortality, hospitalized patients, electrolyte imbalance

1. Introduction

Electrolyte concentrations are carefully maintained to ensure cellular integrity and function while supporting a range of metabolic and physiological functions. Energy conversion, cellular metabolism, and the control of cell membrane potentials—particularly those of muscle and nerve cells—all depend on electrolytes like potassium, sodium, magnesium, calcium, and phosphate. The prognosis of severely unwell persons is substantially altered by these electrolytes. Numerous clinical issues, such as neuromuscular dysfunction and severe arrhythmias, can result from the depletion of these electrolytes. Multiple electrolyte deficiencies greatly raise the risk of these conditions (Mousavi *et al*., 2012; Menteş *et al*., 2025) [12, 11].

Elevated or lowered sodium and potassium levels have been identified to be indications that increase the risk of death in some critical illness scenarios. In general, higher mortality rates among medical patients who visit the emergency room have been associated with both extremes of potassium and sodium levels (Menteş *et al*., 2025) [11]. Cardiac arrhythmias are known to be caused by hypokalemia, particularly in people with ischemic heart disease and left ventricular hypertrophy. It is also linked to other negative consequences such as rhabdomyolysis, muscular weakness, hyperglycemia, and renal failure. Furthermore, hyperkalemia can be harmful to critically ill intensive care unit patients if it manifests as significant muscle weakness or paralysis and aberrant cardiac conduction (Mousavi *et al*., 2012) [12].

Furthermore, a common electrolyte imbalance in critically ill patients is hyponatremia (Friedman and Cirulli, 2012; Amin *et al*., 2012; Mannesse *et al*., 2012) [4, 1, 10]. The underlying illness state and clinical conditions have an impact on hospitalized patients' risk of hyponatremia. Acute and severe reductions in plasma sodium concentration are the primary source of the symptoms directly linked to hyponatremia, which are suggestive of neurologic dysfunction brought on by cerebral edema. In this instance, the simultaneous decrease in plasma osmolality creates an osmolal gradient that promotes water entry into the cells, specifically leading to cerebral edema (Mousavi *et al*., 2012) [12]. Hypernatremia, another sodium-related condition, is essentially the opposite of hyponatremia (Lee, 2010). Acute water migration out of the brain is caused by a rise in plasma sodium concentration and osmolality; this reduction in brain volume may result in cerebral vein rupture, which may produce isolated intracerebral and subarachnoid hemorrhages as well as long-term neurologic impairment. Lethargy, weakness, and irritability are the initial symptoms of this illness, which can lead to twitching, seizures, and coma (Mousavi *et al*., 2012) [12].

The impact of electrolyte imbalances on mortality has been specifically studied in patients with chronic obstructive pulmonary disease (COPD) in intensive care units. For example, research on COPD patients undergoing mechanical ventilation due to severe respiratory failure has demonstrated a significant association between high fatality rates and low salt levels (Añón *et al*., 1999) [2]. Additionally, adult individuals with cystic fibrosis and respiratory failure have been found to have metabolic problems as a primary cause of death (Holland *et al*., 2003) [6]. A study by Saha *et al*. (2020) [16] found that anomalies in potassium and sodium were often observed during COPD exacerbations, significantly affecting patient outcomes.

2. Materials and Methods

Thirty eight (38) hospitalized patients who were diagnosed at Orange Medical Diagnostic Center, Alakahia Rivers State, were the subject of this retrospective case-control study. They were split into two groups: 20 individuals who have recovered and discharged (controls) and 18 patients who died some days after the laboratory test (cases).

It should be noted that individuals undergoing elective or nonelective surgical procedures were not included in this study; only patients with internal medical issues and were under medical intensive care were examined.

For every patient, clinical and demographic information was gathered, including age and sex. Serum concentrations of sodium and potassium were also recorded as laboratory data. Potassium and sodium were found to have normal serum values of 3-5.5 mEq/L and 135-150 mEq/L, respectively. Lower values served as the cutoff points for electrolyte depletion that was clinically relevant, while higher levels served as the cutoff points for significant electrolyte concentration increases.

SPSS version 13.5 was used to analyze the data. Every data set was presented as mean ±SD. Independent t-test was used to compare the mean values of quantitative variables. A statistically significant two-sided p-value was defined as less than 0.05.

Table 1: Demographic characteristics and main clinical variables of patients in the two groups

Variable	Case Expired Subjects (n = 18)	Control Healthy Subjects (n = 20)
Age (year)	54.21±16.11	46.41±18.51
Gender (%)		
Male	10(55.6%)	14(70%)
Female	8(44.4%)	6(30%)
Serum Sodium Level (mEq/L)	143.11±14.35	140.70±7.44
Serum Potassium Level (mEq/L)	4.58±1.16	3.61±0.73

3. Results

This study included 38 patients, with a mean age of 50.62 (SD=17.34) years. They were split into two groups: 20 individuals who have recovered and discharged (controls) and 18 patients who expired some days after the laboratory test (cases).

The mean age of the 8 (44.4%) females and 10 (55.6%) males in the case group was 54.21 (SD=16.11) years. The control group consisted of 14 (70.0%) males and 6 (30.0%) females, with a mean age of 46.41 (SD=18.51) years.

Table 1 provides a summary of some of the findings. As can be seen, the mean serum sodium levels in patients who were released and those who died were 140.70 (SD=7.44) mEq/L and 143.11 (SD=14.35) mEq/L, respectively. This difference was not statistically significant, according to an independent t-test ($P>0.05$).

In individuals who had passed away, hyponatremia was more prevalent (22.2% vs. 0%). Additionally, individuals who had died were more associated with hypernatremia (33.3% vs. 0%). Figure 1 shows a qualitative assessment of the two groups' serum sodium levels.

Subjects who died and those who were discharged in good condition had mean serum potassium concentrations of 4.58 (SD=1.16) mEq/L and 3.61 (SD=0.73) mEq/L, respectively. The independent t-test revealed that this difference was not statistically significant ($P>0.05$). Furthermore, assessing serum potassium levels revealed that hyperkalemia was substantially more prevalent in individuals who had passed away (11.1% vs. 0%). Figure 2 shows a qualitative assessment of the two groups' serum potassium level.

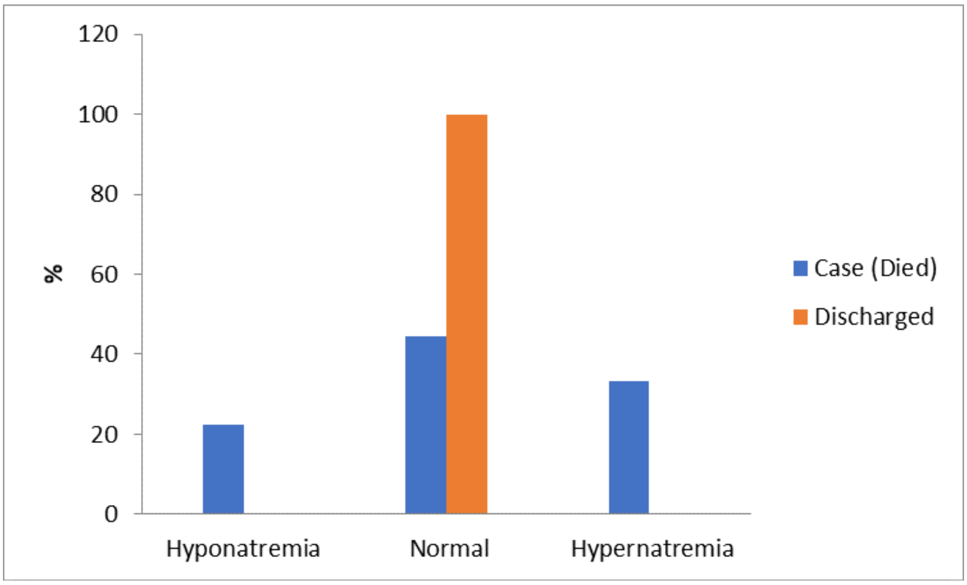

Fig 1: Prevalence of different serum sodium conditions among patients in the two groups

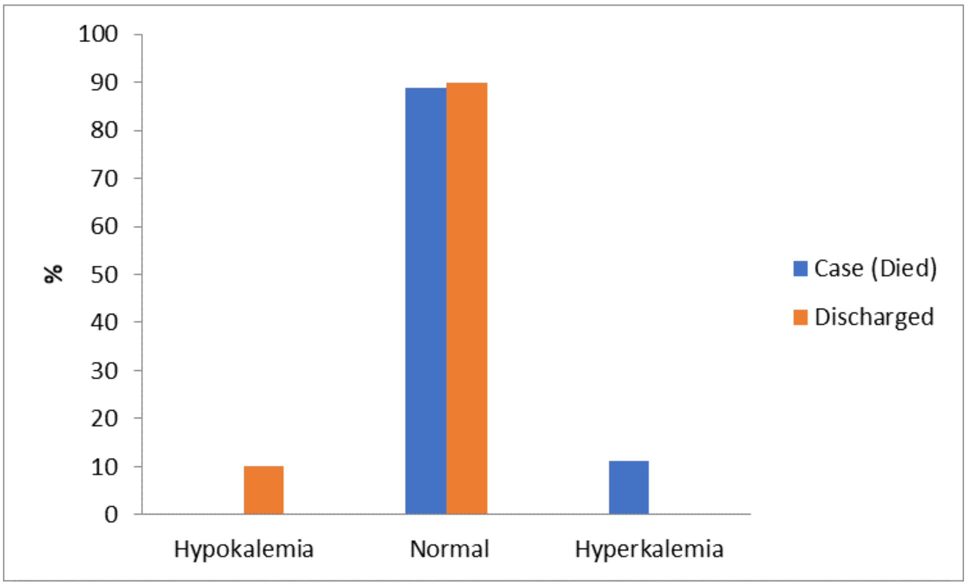

Fig 2: Prevalence of different serum potassium conditions among patients in the two groups

4. Discussion

It is crucial to monitor patients' electrolytes, particularly those in the intensive care unit (ICU). Numerous studies have assessed hospitalized patients' serum electrolytes.

Whelan *et al*. (2009) [18] conducted a study to assess serum sodium as a risk factor for in-hospital mortality in acute unselected general medical patients as well as all emergency medical patients admitted to a hospital connected to laboratory databases and the patient administration system. In every instance where it was considered clinically necessary, the serum sodium was tested at admission. Patients with an average sodium level of 140 mmol/L had the highest death rate.

With a sodium level of 140 mmol/L, the unadjusted OR of dying within 30 days of admission was 4.07 and 3.36, respectively. The association between hyponatraemia and mortality remained significant after adjustment for acute illness score, age, sepsis, ICU admission and blood transfusion requirement, which are all powerful predictors of in-hospital mortality. This data implies that several in-hospital deaths are caused by hyponatremia in and of itself (Whelan *et al*., 2009) [18].

53 studies were assessed in a 2012 systematic review on the prevalence of hyponatremia in geriatric wards compared to other settings across a forty-year period. Between 1976 and 2006, the prevalence of hyponatremia remained constant, however it was greater in elderly wards. In geriatric wards, other hospital wards, and one ICU study, the incidence of moderate hyponatremia (serum sodium < 135 mM) was 22.2%, 6.0%, and 17.2%, respectively; in the same settings, the prevalence of severe hyponatremia (serum sodium < 125 mM) was 4.5%, 0.8%, and 10.3%. 18.8% of residents in nursing homes had mild hyponatremia (Mannesse *et al*., 2012) [10].

Hawkins (2003) [5] examined a massive database of more than 300,000 sodium samples collected over a two-year period from over 120,000 patients receiving care at a 1,200-bed acute care hospital in Singapore as well as the accompanying ambulatory hospital and community-based clinics. The patients in this study were distributed as follows: 20% community-based care, 44% ambulatory hospital care, and 36% acute hospital care. 42.6% of the patients in the acute hospital care group had hyponatremia (serum sodium < 136 mEq/L). 6.2% and 1.2% of the patients had values less than 126 mEq/L and less than 116 mEq/L, respectively. Similarly, a 3-month prospective cohort analysis of 2,907 patients admitted to the Erasmus Medical Center in Rotterdam was published by Hoorn and colleagues (2004) [7] in abstract form; the incidence of hyponatremia (serum sodium < 136 mEq/L) was almost 30%. 2.6% of the patients had values of ≤ 125 mEq/L.

Many antidiuretic factors (e.g., drugs, discomfort, acute nausea, organ failure) might cause or exacerbate a deficiency of water excretion (Upadhyay *et al*., 2006) [17]. When combined with the consumption of electrolyte-free water in quantities greater than the capacity for water excretion plus insensible losses, such a deficiency might cause or worsen hyponatremia. Hospital-acquired hyponatremia (i.e., admission serum sodium > 136 mEq/L) and hospital-aggravated hyponatremia (i.e., admission serum sodium 126 to 136 mEq/L) were found in 16% and 46% of patients, respectively, in a subgroup analysis of hospitalized patients with moderate-to-severe hyponatremia (serum sodium ≤ 125 mEq/L). Hawkins (2003) [5] observed that 28.2% of the patients in the large acute hospital care group had entrance hyponatremia (serum sodium < 136 mEq/L) and 14.4% had hospital-acquired hyponatremia. A variety of factors, such as variations in the case mix and severity of hyponatremia, may account for the inconsistent percentage of hospital-acquired hyponatremia reported in different studies. For instance, compared to patients with hyponatremia overall, the group with moderate-to-severe hyponatremia had a significantly larger percentage of patients with hospital-acquired hyponatremia (Hawkins *et al*., 2003) [5].

Beyond all of these investigations, many studies use different values to define hyponatremia. For the sake of this discussion, however, hyponatremia is primarily associated with a blood sodium level of less than 135 mEq/L (Oh, 2002). According to Patel and Balk (2007) [14], the underlying illness status and clinical conditions also affect the risk of hyponatremia in hospitalized patients.

According to a different study, hypernatremia may serve as a gage of the standard of care provided in the medical intensive care unit (Polderman *et al*., 1999) [15] and is linked to unfavorable outcomes for patients who develop it in the ICU. In this study, the expired subjects also had higher rates of hypernatremia.

One of the most common electrolyte imbalances seen in ICU patients is potassium disruption. Hypokalemia is a common problem since people get potassium from their meals and many ICU patients undergo fasting. Furthermore, hyponatremia and hypomagnesemia are linked to hypokalemia, a multifactorial illness that is typically acquired in a hospital. According to Mousavi *et al*. (2012), one in six patients with hypokalemia goes on to develop hyperkalemia. In the majority of intensive care units (ICUs), the significance of controlling potassium levels is widely acknowledged, and potassium levels are regularly checked, particularly in patients with cardiovascular disease. A study by Crop *et al*. (2007) [3] found that out of 1,178 patients whose serum potassium levels were tested, 140 patients (12%) had hypokalemia and 23 patients (16%) had hyperkalemia (Crop *et al*., 2007) [3].

This study demonstrated that serum potassium concentration may be a predictor of death in severe unhealthy individuals, as the mean value of serum potassium level was considerably higher in the expired subjects.

5. Conclusion

The prevalence of hyponatremia, hypernatremia, and hyperkalemia among hospitalized patients that later passed away is demonstrated by the study's findings, which are corroborated by a few other investigations. The severity of serum sodium and potassium concentrations continues to be a major predictor of mortality.

Competing Interests

Authors declare that there are no conflicts of interests

Authors' Contributions

OCC: conceived and designed the research. OCC/FOO: collected the blood samples, carried out the laboratory work, analyzed the data, and prepared the manuscript. All authors have approved the manuscript in the present form and gave the permission to submit the manuscript for publication.

References

1. Amin A, Deitelzweig S, Christian R, Friend K, Lin J, Belk K, *et al*. Evaluation of incremental healthcare resource burden and readmission rates associated with hospitalized hyponatremic patients in the US. J Hosp Med. 2012;7(8):634-9.
2. Añón JM, García de Lorenzo A, Zarazaga A, Gómez-Tello V, Garrido G. Mechanical ventilation of patients on long-term oxygen therapy with acute exacerbations of chronic obstructive pulmonary disease. Intensive Care Med. 1999;25:452-7.
3. Crop MJ, Hoorn EJ, Lindemans J, Zietse R. Hypokalaemia and subsequent hyperkalaemia in hospitalized patients. Nephrol Dial Transplant. 2007;22(12):3471-7.
4. Friedman B, Cirulli J. Hyponatremia in critical care patients: frequency, outcome, characteristics, and treatment with the vasopressin V2-receptor antagonist tolvaptan. J Crit Care. 2012.
5. Hawkins RC. Age and gender as risk factors for hyponatremia and hypernatremia. Clin Chim Acta. 2003;337(1-2):169-72.
6. Holland A, Wilson JW, Kotsimbos T, Naughton M. Metabolic alkalosis contributes to acute hypercapnic respiratory failure in adult cystic fibrosis. Chest. 2003;124:490-3.
7. Hoorn E, Lindemans J, Zietse R. Hyponatremia in hospitalized patients: epidemiology, etiology and symptomatology. J Am Soc Nephrol. 2004;15:561A.
8. Jenq CC, Tsai MH, Tian YC, Chang MY, Lin CY, Lien JM, *et al*. Serum sodium predicts prognosis in critically ill cirrhotic patients. J Clin Gastroenterol. 2010;44(3):220-6.
9. Lee JW. Fluid and electrolyte disturbances in critically ill patients. Electrolyte Blood Press. 2010;8(2):72-81.
10. Mannesse CK, Vondeling AM, van Marum RJ, van Solinge WW, Egberts TC, Jansen PA. Prevalence of hyponatremia on geriatric wards compared to other settings over four decades: a systematic review. Ageing Res Rev. 2012;12(1):165-73.
11. Menteş O, Çelik D, Yildiz M, Kahraman A, Cirik MÖ, Eraslan Doğanay G, *et al*. Electrolyte imbalance and its prognostic impact on all-cause mortality in ICU patients with respiratory failure. Medicina. 2025;61(4):642.
12. Mousavi SJ, Shahabi S, Mostafapour E, Purfakharan M,

Fereshtehnejad SM, Amini J, *et al*. Comparison of the serum electrolyte levels among patients died and survived in the intensive care unit. Tanaffos. 2012;11(4):36-42.
13. Oh MS. Pathogenesis and diagnosis of hyponatremia. Nephron. 2002;92 Suppl 1:2-8.
14. Patel GP, Balk RA. Recognition and treatment of hyponatremia in acutely ill hospitalized patients. Clin Ther. 2007;29(2):211-29.
15. Polderman KH, Schreuder WO, Strack van Schijndel RJ, Thijs LG. Hypernatremia in the intensive care unit: an indicator of quality of care? Crit Care Med. 1999;27(6):1105-8.
16. Saha SK, Ali MY, Islam MMSU, Arif KM, Hawlader MAR, Quader MR, *et al*. Pattern of serum electrolytes imbalance among patients with acute exacerbation of COPD. Faridpur Med Coll J. 2020;15:24-7.
17. Upadhyay A, Jaber BL, Madias NE. Incidence and prevalence of hyponatremia. Am J Med. 2006;119(7 Suppl 1):S30-5.
18. Whelan B, Bennett K, O'Riordan D, Silke B. Serum sodium as a risk factor for in-hospital mortality in acute unselected general medical patients. QJM. 2009;102(3):175-82.

How to Cite This Article

Ogonnaya CC, Ohiagu FO. Electrolyte imbalance as predictors of morbidity and mortality in hospitalized patients. International Journal of Advanced Biochemistry Research Noosphere. 2026;2(2):15-19.
doi:10.54660/IJABRN.2026.2.2.15-19.