

Prevalence and Patterns of Serum Electrolyte Imbalances Among Patients Attending a Tertiary Hospital in Central Kenya

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ABSTRACT

Serum Electrolyte imbalances (SEIs) have not only been associated with poor prognosis of underlying diseases, but also increased morbidity and mortality rates. Studies have reported a myriad of risk factors associated with occurrence of SEIs, including old age, renal diseases, cardiovascular disease, malignancy, and chronic illnesses. Little remains unknown about prevalence of EIs in Kenya. This study undertook to underpin the prevalence of SEIs at Thika Level 5 Hospital (TL5H), a tertiary hospital in central Kenya. A prospective cross-sectional study was conducted at Thika Level V Hospital in Kiambu County. Data collected was used to compute descriptive and inferential statistics. A total of one hundred and fifty-seven participants were recruited. They had a mean age of 41.05 ± 21.37 , with the majority being males 82(52.2%). 87(55.4%) participants had normal serum electrolyte levels. The mean potassium level was 4.16 ± 0.62 mmol/L, sodium was 147.12 ± 5.63 mmol/L and chloride was 108.27 ± 11.89 mmol/L. Dyschloremia was the most prevalent EI, presenting in 57(36.3%) participants. Female participants were slightly more likely to present with potassium and chloride imbalances, male participants were more likely to present with a sodium imbalance. Patients presenting with dyschloremia were more than two times likely to present with dyskalemia [AOR=2.634, 95%CI (1.104- 6.285), P=0.026]. In conclusion, dyschloremia, particularly hyperchloremia, is the most prevalent electrolyte imbalance. Moreover, despite there being no significant association between gender and EI, females are much likely to present with an EI, compared to the male counterparts. Further research should be conducted to understand causes and risk factors for the increased EI prevalence levels, particularly in females. Treatment should emphasize on fluid and electrolyte replacement management as core in clinical intervention.

KEYWORDS: Serum Electrolyte Imbalances, Thika Level 5 Hospital, Central Kenya.

ARTICLE DETAILS

Published On:
18 April 2025

Available on:
<https://ijpbms.com/>

I. INTRODUCTION

Serum electrolytes are electrically charged molecules that become ions in solution and are required for normal metabolic reactions and homeostasis. They play a critical role in maintenance of cellular structure and function, by sustaining cell membrane functions, neuron conductivity, muscle contractility, hormone action, bone structure, and fluid and acid-base balance¹. The major function of

electrolytes is to control fluid balance between the different compartments of the body, as co-factors for optimal activity of enzymes and maintain acid-base balance. The main electrolytes necessary to maintain homeostasis are Sodium (Na⁺), Potassium (K⁺), Calcium (Ca²⁺), Magnesium (Mg²⁺), Phosphates and Bicarbonates². Serum electrolytes are maintained at balance by physiological mechanisms in the body. However, alterations in these mechanisms lead to

Prevalence and Patterns of Serum Electrolyte Imbalances Among Patients Attending a Tertiary Hospital in Central Kenya

distortion of extracellular osmotic environment, which sequentially alters intracellular osmotic environment leading to a state of electrolyte imbalance³. Electrolytes imbalances (EIs) present in the form of excesses or Deficits. Clinically important EIs include dysnatremia, dyskalemia, dyscalcemia, dysmagnesemia, and dysphosphatemia all which are implicated in many disease processes^{4,5}. Studies have reported a myriad of risk factors associated with occurrence of EIs. Old age, renal diseases, cardiovascular disease, malignancy, and chronic illnesses such as diabetes mellitus and hypertension have been reported as independent risk factors contributing to EIs⁶⁻⁸. Moreover, EIs have not only been associated with poor prognosis of underlying diseases², but also increased morbidity and mortality rates^{6,9,10}.

Literature suggests feasible pathophysiological mechanisms behind EIs include reduced perfusion to the kidney due to hypovolemia or hypotension, stimulation of hormonal systems such as renin-angiotensin-aldosterone system and vasopressin, and also tubular damage due to ischemic or renal damage, including insult caused by a myriad of medications used in the intensive care².

Studies have revealed specifically high incidence and prevalence of EIs in the Emergency Departments (ED) and the Intensive Care Units (ICU)^{6,11,12}. Particularly, dysnatremia is the most common and most prevalent forms of EI, with hyponatremia leading at 44%. Hypocalcemia follows at 25.3%, hypomagnesemia at 20.1%, hypophosphatemia at 20.0%, hyperkalemia at 13.0%, hypernatremia at 4.4%, and hypercalcemia being the least prevalent at 3.0% among hospitalized patients.

Despite the foregoing, little remains unknown about prevalence of EIs in Kenya. Particularly, there exists a glaring dearth of studies reporting on EIs in Central Kenya. In light of this, this study attempted to underpin the prevalence of EIs at Thika Level 5 Hospital (TL5H), a tertiary hospital in central Kenya, as no such study has been conducted in the area previously.

II. METHODOLOGY

This was a prospective cross-sectional study conducted at Thika Level 5 Hospital, a 300-bed capacity government hospital. It is located along General Kago road in Thika town, Kiambu County, approximately 50km north-east of Nairobi, in Central Kenya. It provides medical, surgical, obstetric and pediatric services with a total of seven inpatient wards¹³. Ethical clearance was sought from Mount Kenya University Ethics Review Committee and subsequently from Thika Level 5 Hospital Research Ethics Committee. This study observed all the necessary ethical considerations underpinning human research as outlined in the declaration of Helsinki. Firstly, data collection from a participant would only be commenced after informed consent is provided. Secondly, the researcher observed all

the required protocols in order to avoid violating the participants' rights and privileges. The participants were also assured their right to protection from any risk arising from the study. Besides, the participants were fully informed about the study objectives and that their participation was purely voluntary. Thirdly, the researcher undertook to reiterate that the information taken would be treated with confidentiality and that it would be used solely for research purposes.

The researcher employed the Fishers formula¹⁴ to obtain the sample size. Afterwards, Volunteer sampling method was employed by the researcher to recruit participants, and a total of one hundred and fifty-seven participants who were eligible for the study were recruited. After the participants were consented, a questionnaire was used to collect socio-demographic data information such as age, gender. After the participants signed the consent form and filled the questionnaire, 5ml of venous blood was drawn and sent to the laboratory for processing. The sample was centrifuged to obtain serum. The serum sample was then analysed by HORRON® H900 machine which employed the Iron Selective Electrode (ISE) principle for electrolyte analysis. Furthermore, a data collection sheet was used to record results after specimen analysis.

Quantitative data obtained and recorded in questionnaires and data collection sheet was then coded and exported to Microsoft excel data sheets to aid in analysis. Descriptive statistics were derived from the analysis and were presented in pie charts, graphs and tables. Chi-square tests and independent sample-t test were also conducted using Statistical Packages for Social Sciences (SPSS), version 21 to identify any significant correlation between dependent and independent variables. Statistical significance was set at $p \leq 0.05$.

III. RESULTS

A total of one hundred and fifty-seven participants were recruited in this study with a mean age of 41.05 ± 21.37 , with most of them being in the 30-44 age brackets (28.0%). The majority of participants were male 82(52.2%). The results are summarized in Table 1.

Table 1: Socio-demographic Characteristics of Participants

Characteri- tic	Frequency		Percentage
Age	0-15	15	9.6
	16-29	32	20.4
	30-44	44	28.0
	45-64	40	25.5

Prevalence and Patterns of Serum Electrolyte Imbalances Among Patients Attending a Tertiary Hospital in Central Kenya

	65-100	26	16.6
Gender	Male	82	52.2
	Female	75	47.8

Three electrolytes were analyzed, namely potassium, sodium and chloride. The mean potassium level was 4.16 ± 0.62 mmol/L, sodium was 147.12 ± 5.63 mmol/L, while the mean of chloride was 108.27 ± 11.89 mmol/L. (Table 2). 87(55.4%) participants had normal serum electrolyte levels, while 51(32.5%) participants had at least one electrolyte imbalance. 16(10.2%) participants had two electrolyte imbalances while 3(1.9%) of the individuals had all the three electrolyte imbalances.

Table 2: Mean Serum Electrolyte Levels

Electrolyte	Mean $\pm$ SD
Potassium(mmol/L)	4.16 ± 0.62
Sodium(mmol/L)	147.12 ± 5.63
Chloride(mmol/L)	108.27 ± 11.89

Dyschloremia was the most prevalent EI, presenting in 57(36.3%) participants, while dysnatremia was the least prevalent imbalance in only 10(6.4%) individuals (Figure 1). Of the imbalances, hyperchloremia was the most prevalent, presenting in 41(26.11%) individuals. Hyponatremia was the least prevalent, with only 4(2.5%) individuals. 25(15.9%) were dyskalemic, with the majority of them 15(9.6%) being hypokalemic (Table 3)

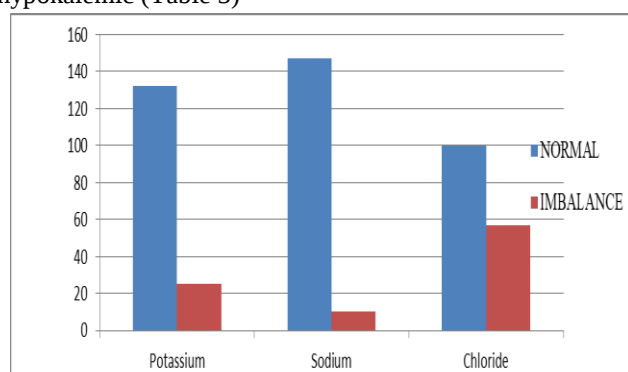


Figure 1: Serum Electrolyte Status

Table 3: Distribution of Serum Electrolyte Status among Participants

Parameter	Serum Electrolyte Status	Frequency	percentage
Potassium	Normokalemic	132	84.1
	Hypokalemic	15	9.5
	Hyperkalemic	10	6.4
Sodium	Normonatremic	147	93.6
	Hyponatremic	4	2.6

	Hypernatremic	6	3.8
Chloride	Normochloremia	100	63.7
	Hypochloremic	16	10.2
	Hyperchloremic	41	26.1

While female participants were slightly more likely to present with potassium and chloride imbalances, male participants were more likely to present with a sodium imbalance. However, there was no statistically significant association between age and gender with electrolyte levels (Table 4). While there was no significant association between socio-demographics and EIs, there existed statistically significant relationship in patients presenting with dyschloremia who were more than two times likely to present with a dyskalemia [AOR=2.634, 95%CI (1.104-6.285), P=0.026].

There was no statistically significant mean difference in electrolyte levels between male and female participants (Table 5).

Table 4: Relationship between Gender and Electrolyte Levels

Electrolyte	Gender	AOR(95%CI)	P-value
Potassium	Male	1	0.184
	Female	1.80(0.754-4.298)	
Sodium	Male	1	0.614
	Female	0.71(0.193-2.634)	
Chloride	Male	1	0.213
	Female	1.52(0.789-2.918)	

Table 5: mean Difference Association between Males and Females

Parameter	Male mean $\pm$ SD (n=82)	Female mean $\pm$ SD (n=75)	P-value
Potassium	4.19 ± 0.56	4.12 ± 0.67	0.925
Sodium	146.99 ± 6.27	147.27 ± 4.88	0.052
Chloride	107.40 ± 11.4	109.21 ± 12.41	0.529

IV.DISCUSSION

In this study, whilst the female gender showed close association with at least potassium and chloride imbalances, age and gender of participants had no significant association with electrolyte outcome. This is in agreement with the findings of a study in Nigeria, reporting the female gender to be more associated with serum dyselectrolytemia¹⁵ and another in Ghana reporting no significant association between age and gender with serum electrolyte levels¹⁶.

Contrary to other studies reporting as low as 13%¹² to 21%¹⁵ total EI prevalence, this study found a relatively high percentage of serum EI at 44.6%. This could be explained by the increased variability of factors in a general population

Prevalence and Patterns of Serum Electrolyte Imbalances Among Patients Attending a Tertiary Hospital in Central Kenya

as opposed to those studies reporting on particular population cohorts.

While most studies have found hyponatremia to be the most common electrolyte imbalance^{3,12,17}, this study found hyperchloremia to be the most prevalent EI. This could be attributed to the fact that, unlike this study focusing on general patients, those studies focused on particular cohorts of patients, including those in ICU, diabetic, dyslipidemic and the critically ill.

The mean electrolyte levels were within normal range, which indicated the parameters outcome were within a normal distribution curve. Moreover, there was no significant difference in electrolyte means between male and female participants. This indicates that their electrolyte values were closely distributed.

V. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this study underpinned a higher prevalence of EI compared to similar reports in Literature. Dyschloremia, particularly hyperchloremia, is the most prevalent electrolyte imbalance. Moreover, despite there being no significant association between gender and EI, females are much likely to present with an EI, compared to the male counterparts. There is also significant association between serum potassium and chloride levels, as patients presenting with a potassium imbalance are likely to have a chloride imbalance.

Further research should be conducted to understand causes and risk factors for the increased EI prevalence levels. Intensive studies focusing on female patients should be undertaken to fully understand the reasons behind their increased odds of presenting with EIs. Due to time and resource limitations of our study, our findings on the significant association between potassium and chloride imbalances should be subjected to further studies. Finally, to help reduce the mortality and morbidity associated with EIs, prompt treatment and management, emphasizing on fluid and electrolyte replacement should be at the core of clinical intervention as quickly as possible.

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Prevalence and Patterns of Serum Electrolyte Imbalances Among Patients Attending a Tertiary Hospital in Central Kenya

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