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Research Article

Evaluation of Some Electrolytes on Newly Diagnosed Mycobacterium Tuberculosis Patients Attending Federal Teaching Hospital, Owerri, Imo State

* Ukamaka Edward[1], Festus Chidi Emengaha[2], Eberechi Nwanguma[1] and Nnodim Joseph Chukwuemeka[1]
[1] Department of Medical Laboratory Science, Faculty of Health Science, Imo State University Owerri, Nigeria.
[2] Department of Medical Biochemistry Faculty of Basic Medical Science Imo State University Owerri, Nigeria.

Corresponding author: Ukamaka Edward
Department of Medical Laboratory Science, Faculty of Health Science, Imo State University Owerri, Nigeria.

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Abstract
Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, is a chronic infectious disease that may alter various physiological processes, including electrolyte homeostasis. This study aimed to evaluate serum levels of sodium, potassium, chloride, and calcium in newly diagnosed *Mycobacterium tuberculosis* patients attending Federal Teaching Hospital, Owerri. The study population comprised of twenty-five (25) newly diagnosed TB patients (who had not commenced anti-TB therapy) aged 20 to 60 years and twenty-five (25) age-matched apparently healthy individuals who served as the control group. Sputum samples were collected from suspected TB patients and confirmed for *Mycobacterium tuberculosis* using the GeneXpert MTB/RIF assay. Only confirmed TB-positive patients were selected for blood sampling. Five (5) mls of venous blood was collected aseptically from each subject by venipuncture using sterile needle and syringe. The blood samples were dispensed into plain tubes, allowed to clot and retract, and centrifuged at 3000 rpm for about 5 minutes to yield serum. The supernatant sera were analyzed spectrophotometrically for sodium, potassium, chloride, and calcium concentrations. Data obtained in this study were analyzed using the Statistical Package for Social Sciences (SPSS) version 21. The test of significance was determined by the Student's t-test, and results were expressed as Mean ± standard deviation. Pearson correlation was also determined, and values with $p<0.05$ were considered statistically significant. The results showed that mean levels of serum sodium, potassium, chloride and calcium were significantly lower ($p=0.000$) in newly diagnosed *Mycobacterium tuberculosis* patients (131.11±2.99 mmol/L, 3.47±0.38 mmol/L, 96.30±4.70 mmol/L, and 2.12±0.08 mmol/L, respectively) compared to controls (137.75±3.01 mmol/L, 4.16±0.28 mmol/L, 101.84±3.50 mmol/L, and 2.29±0.11 mmol/L respectively). No statistically significant differences were observed based on sex or age among TB patients. Correlation analysis showed a non-significant negative correlation of calcium with sodium ($r=-0.06$, $p=0.763$) and chloride ($r=-0.01$, $p=0.979$), and a non-significant positive correlation with potassium ($r=0.25$, $p=0.221$) in newly diagnosed *Mycobacterium tuberculosis* patients. In conclusion, the study revealed that newly diagnosed *Mycobacterium tuberculosis* patients exhibited significant reductions in serum sodium, potassium, chloride, and calcium levels compared to healthy individuals, suggesting that TB may be associated with notable disturbances in electrolyte balance.

Keywords: Tuberculosis, Mycobacterium tuberculosis, Electrolytes, Sodium, Potassium, Chloride, Calcium, Serum levels, Electrolyte imbalance, newly diagnosed TB patients.

INTRODUCTION
Tuberculosis (TB) is a long-lasting infectious disease mostly caused by Mycobacterium tuberculosis, an aerobic, acid-fast bacillus that grows slowly and can stay dormant in host tissues. The illness primarily targets the lungs (pulmonary TB), however it may also present in extrapulmonary locations, including lymph nodes, bones, meninges, gastrointestinal tract, and genitourinary system [1]. When an infected person coughs, sneezes, or talks, they release airborne droplets that carry Mycobacterium TB. Once inhaled, the virus can settle in the alveoli, starting a cellular immune response that could cause granuloma formation and a latent infection. TB is still a big problem for public health around the world. It is one of the top

ten causes of death worldwide and the biggest cause of death from a single infectious agent, ranking above HIV/AIDS [2]. In 2023, an estimated 10.8 million people around the world will get TB, and nearly 1.25 million will die from it, not counting people who have HIV and die from TB [3]. Sub-Saharan Africa, Southeast Asia, and some sections of Eastern Europe have the greatest prevalence of the disease. Low- and middle-income nations, like Nigeria, have the most cases of this disease. Social factors like poverty, bad nutrition, crowded living circumstances, and not having enough access to health care make it spread and have a bigger effect [4].

Nigeria is still one of the 30 countries with the highest rates of TB. In 2023 alone, there were a projected 467,000 new cases of TB in Nigeria. This makes it the sixth worst country in the world and the top in Africa for TB cases [5]. This study is based in Imo State, where tuberculosis is still a major public health problem since many individuals are detected at late stages of the disease, when metabolic and biochemical imbalances have already happened. One crucial yet frequently neglected consequence in tuberculosis patients is electrolyte imbalance, which can dramatically influence clinical outcomes and therapy responses [6].

The pathophysiology of tuberculosis is closely associated with metabolic and biochemical disturbances in the host. When inhaled, M. tuberculosis is absorbed by alveolar macrophages, allowing it to resist lysosomal breakdown and survive within phagosomes. This causes chronic granulomatous inflammation and activation of the immune system throughout the body. The metabolic stress of a long-term infection, along with cytokine-mediated catabolism, often leads to cachexia, electrolyte loss, and hormonal imbalances [7]. Electrolyte abnormalities in tuberculosis patients may result from malnutrition, dehydration, heightened renal excretion, adrenal insufficiency, or the syndrome of inappropriate antidiuretic hormone secretion (SIADH). These changes are frequently not noticeable at first, but if they go unnoticed and untreated, they can lead to serious problems, especially in individuals who have just been diagnosed and are not being treated [8].

Electrolytes are charged minerals in body fluids that are very important for many bodily functions, such as nerve impulse transmission, muscular contraction, acid-base balance, osmotic management, and cellular activity. The primary electrolytes pertinent to this study are sodium (Na^+), potassium (K^+), chloride (Cl^-), and calcium (Ca^{2+}). Sodium is the main cation outside of cells that controls blood pressure, fluid volume, and nerve and muscle activity. The normal range for serum sodium is 135 to 145 mmol/L. TB patients often have problems with sodium balance, especially hyponatraemia, which can happen because of things like the syndrome of inappropriate antidiuretic hormone secretion (SIADH), adrenal insufficiency, and fluid retention. [9]. Potassium is the most common cation inside cells. It is very important for keeping the membrane potential, nerve transmission, and heart rhythm stable. The normal level of potassium in the blood is between 3.5 and 5.0 mmol/L. Hypokalaemia and hyperkalaemia can both cause serious heart problems and problems with the nervous system. In tuberculosis, potassium levels may become abnormal due to malnutrition, vomiting, or kidney losses. Chloride, an extracellular anion that usually goes along with sodium, helps keep osmotic pressure, acid-base balance, and electrical neutrality. A typical level of chloride in the blood is between 98 and 106 mmol/L. Hypochloremia in tuberculosis patients may come from metabolic alkalosis or diuretic administration, whereas hyperchloremia may signify acidosis or dehydration [10].

Calcium, another key electrolyte, is crucial for hormone release, coagulation, neuromuscular excitability, and bone metabolism. The normal range for total serum calcium is 8.5 to 10.5 mg/dL. In TB patients, hypocalcaemia may occur due to vitamin D insufficiency, inadequate absorption, or systemic inflammation. These changes in electrolyte levels not only harm the overall health of patients, but they can also make it harder to treat TB, especially if they go unrecognised or are not fixed [11]. Recent investigations indicate that newly diagnosed tuberculosis patients are susceptible to considerable electrolyte imbalances prior to the initiation of anti-tuberculosis treatment. Hyponatraemia was frequently observed in tuberculosis patients due to SIADH and adrenal involvement, whereas hypokalaemia and hypochloremia were common among tuberculosis patients in southwestern Nigeria [12]. Monitoring electrolytes is an important part of the first clinical evaluation of TB patients. Finding and fixing these imbalances early on may improve the prognosis, stop complications, and make anti-TB therapy work better. Because these electrolytes are important for the body and can be messed up by TB, it is both clinically appropriate and necessary to check them often in newly diagnosed TB patients. Tuberculosis is still a big public health problem in Nigeria since it causes a lot of illness and death. Although the infectious characteristics of TB are well recognised, the metabolic and biochemical complications, especially electrolyte imbalances, have garnered relatively insufficient focus.

While the metabolic and biochemical problems, especially electrolyte imbalances, are comprehended, they have garnered relatively diminished focus. These imbalances can make diseases worse, make treatment harder, and harm the chances of a good outcome. For example, hyponatraemia has been linked to higher rates of illness and death in people with TB [13]. In the same way, having too much or too little potassium and calcium can cause major problems with the nervous system and heart, especially if you have other health problems at the same time. much though there are known dangers, there isn't much information about how often and what kinds of electrolyte problems are in newly diagnosed TB patients in Nigeria, and much less in Imo State. Most current research has concentrated on patients undergoing anti-TB treatment, which may influence electrolyte levels via renal and hepatic mechanisms [14]. Local data is necessary to comprehend the distinct clinical requirements of the community, taking into account differences in diet, healthcare accessibility, and comorbidities. If electrolyte imbalances are not found, they can make treatment less effective, slow down recovery, and raise healthcare expenditures because consequences that need immediate treatment. Addressing these imbalances prior to commencing anti-TB therapy should alleviate the demand on overburdened healthcare systems and enhance both the clinical stability of patients and their pharmacological response. This study seeks to fill this significant void by offering baseline data on the serum concentrations of sodium, potassium, chloride, and calcium in newly diagnosed tuberculosis patients at Federal Teaching Hospital, Owerri. The results are anticipated to enhance patient monitoring and facilitate prompt initiatives and informed clinical decision-making in the management of tuberculosis in the region. In the end, this research will help us learn more about how to enhance TB care in Nigeria and places like it.

MATERIALS AN METHODS

Study Area

The study was conducted at the Federal Teaching Hospital, Owerri. Owerri is the capital city of Imo State in Nigeria, located in the southeastern region and set in the heart of Igboland. It is the state's largest urban center, followed by Orlu, Okigwe, and Ohaji/Egbema. The city consists of three Local Government Areas: Owerri Municipal, Owerri North, and Owerri West, with the Federal Teaching Hospital located in Owerri Municipal. Its geographical coordinates are 5.485° North latitude and 7.035° East longitude, and it sits approximately 150 meters above sea level. The estimated population of Owerri as of 2016 was 1,401,873, and the area spans approximately 100 square kilometers. Owerri is bordered by the Otamiri River to the east and the Nworie River to the south.

Ethical approval

The ethical clearance (FTH/OW/HREC/VOL1/157) was obtained from the Ethics Committee of Federal Teaching Hospital, Owerri. Informed consent was obtained from all study participants.

Study Population

A total of fifty (50) individuals between the ages of twenty (20) and sixty (60) years were recruited for this study. Twenty-five (25) of the participants were newly diagnosed Mycobacterium tuberculosis patients who had not commenced anti-tuberculosis therapy. The remaining twenty-five (25) were apparently healthy individuals without any clinical or laboratory evidence of tuberculosis or other chronic illness, and they served as the control group. Both groups were age-matched.

Selection Criteria Inclusion Criteria

Participants included in the study met the following criteria:
Individuals aged between 20 and 60 years.
Newly diagnosed TB patients confirmed through sputum GeneXpert.
Individuals who provided informed consent for participation in the study.
Apparently healthy individuals with no history or symptoms of TB or other chronic diseases served as control.

Exclusion Criteria

The following individuals were excluded from the study:
Individuals below 20 years or above 60 years.
TB patients who had already commenced anti-TB medication.
Individuals with known chronic diseases such as renal failure, HIV/AIDS, cancer, or endocrine disorders.
Individuals who refused to give informed consent.

Study Design

This was a hospital-based cross-sectional study carried out in October 2024 and all eligible individuals who filled the questionnaire and gave a written informed consent for the study period were sampled. The study consisted of two groups. Group A comprised twenty-five (25) newly diagnosed TB patients who had not started treatment, and Group B comprised twenty-five (25) healthy individuals without any symptoms of TB, matched for age and sex, who served as the control group. All participants were sampled only once, and sputum and blood samples were collected under standard aseptic conditions.

Sample Collection

Sputum samples were first collected from all suspected tuberculosis patients for confirmation using the GeneXpert MTB/RIF assay. Each patient was instructed to rinse their mouth with clean water, take several deep breaths, and expectorate sputum into a sterile, pre-labeled sputum cup in a well-ventilated area. Care was taken to avoid contaminating the outer surface of the cup. Collected specimens, with a minimum volume of 1 mL, were sealed tightly, externally disinfected, and transported to the laboratory within 48 hours following standard biosafety protocols. Only patients confirmed to be positive for Mycobacterium tuberculosis by the GeneXpert method were subsequently selected for blood sampling. A total of 5 mL of venous blood was collected aseptically from each subject using a sterile disposable 5 mL syringe and needle through venipuncture. The blood was transferred into pre-labeled plain specimen containers and allowed to clot. Clotted blood samples were centrifuged at 3000 rpm for 5 minutes to separate the serum. The obtained serum was used to assay serum electrolytes (potassium, sodium, chloride, and calcium).

Laboratory Procedures

All reagents used were commercially purchased and the manufacturer's standard operating procedures were strictly followed.

Detection of Mycobacterium tuberculosis and Rifampicin Resistance

The test was done by GeneXpert MTB/RIF Assay Method as modified by Cepheid, USA (Cartridge Lot number: GXMTB/RIF-50).

Determination of Serum Potassium (K^+), Sodium (Na^+), and Chloride (Cl^-)

The test was done by Ion Selective Electrode (ISE) Method as modified by Biowell Medical Enterprise, Philippines (Lot number: 97525).

Determination of Serum Calcium (Ca^{2+})

The test was done by colorimetric Arsenazo III method and modified by Randox Laboratories Ltd, UK (Lot number: 789512).

Statistical Analysis

Data obtained in this study were analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. The student independent T-test was used to determine the mean differences between the two groups. Results were expressed as Mean ± standard deviation. Test with probability of $p<0.05$ was considered statistically significant.

RESULTS

Table 1: Mean±SD Values of Serum Sodium, Potassium, Chloride and Calcium in Newly Diagnosed Mycobacterium Tuberculosis Patients of the Study Population

Parameter	TB Patients (n=25)	Control (n=25)	t-value	p-value (0.05)
Sodium (mmol/L)	131.11 ± 2.99*	137.75 ± 3.01	-7.82	0.000
Potassium (mmol/L)	3.47 ± 0.38*	4.16 ± 0.28	-7.40	0.000
Chloride (mmol/L)	96.30 ± 4.70*	101.84 ± 3.50	-4.73	0.000
Calcium (mmol/L)	2.12 ± 0.08*	2.29 ± 0.11	-6.09	0.000

KEY: *: Statistically significant ($P<0.05$)

Table 1 indicates the serum electrolyte profile of newly diagnosed *Mycobacterium tuberculosis* patients compared with control subjects.

The mean ± SD value of sodium was lower in newly diagnosed *Mycobacterium tuberculosis* patients (131.11 ± 2.99) mmol/L, which was statistically significant ($p = 0.000$) when compared to the mean ± SD value of the control subjects (137.75 ± 3.01) mmol/L.

The mean ± SD value of potassium was lower in newly diagnosed *Mycobacterium tuberculosis* patients (3.47 ± 0.38) mmol/L, which was statistically significant ($p = 0.000$) when compared to the mean ± SD value of the control subjects (4.16 ± 0.28) mmol/L.

The mean ± SD value of chloride was lower in newly diagnosed *Mycobacterium tuberculosis* patients (96.30 ± 4.70) mmol/L, which was statistically significant ($p = 0.000$) when compared to the mean ± SD value of the control subjects (101.84 ± 3.50) mmol/L.

The mean ± SD value of calcium was lower in newly diagnosed *Mycobacterium tuberculosis* patients (2.12 ± 0.08) mmol/L, which was statistically significant ($p = 0.000$) when compared to the mean ± SD value of the control subjects (2.29 ± 0.11) mmol/L.

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Table 2: Mean ± SD Values of Serum Electrolytes in Newly Diagnosed Mycobacterium Tuberculosis Patients Based on Sex

Parameter	Male (n=10)	Female (n=15)	t-value	p-value (0.05)
Sodium (mmol/L)	130.53 ± 2.82	131.49 ± 3.14	-0.78	0.445
Potassium (mmol/L)	3.48 ± 0.35	3.46 ± 0.41	0.13	0.897
Chloride (mmol/L)	96.68 ± 4.69	96.05 ± 4.85	0.32	0.752
Calcium (mmol/L)	2.10 ± 0.09	2.13 ± 0.07	-1.05	0.306

Table 2 indicates the serum electrolyte profile of newly diagnosed *Mycobacterium tuberculosis* patients based on sex.

The mean ± SD value of sodium was lower in newly diagnosed male *Mycobacterium tuberculosis* patients (130.53 ± 2.82) mmol/L, which was not statistically significant (p = 0.445) when compared to the mean ± SD value in females (131.49 ± 3.14) mmol/L. The mean ± SD value of potassium was slightly higher in newly diagnosed male *Mycobacterium tuberculosis* patients (3.48 ± 0.35) mmol/L, which was not statistically significant (p = 0.897) when compared to females (3.46 ± 0.41) mmol/L.

The mean ± SD value of chloride was higher in newly diagnosed male *Mycobacterium tuberculosis* patients (96.68 ± 4.69) mmol/L, which was not statistically significant (p = 0.752) when compared to females (96.05 ± 4.85) mmol/L.

The mean ± SD value of calcium was lower in newly diagnosed male *Mycobacterium tuberculosis* patients (2.10 ± 0.09) mmol/L, which was not statistically significant (p = 0.306) when compared to females (2.13 ± 0.07) mmol/L.

Table 3: Mean±SD Values of Serum Electrolytes in Newly Diagnosed Mycobacterium Tuberculosis Patients Based on Age Groups

Parameter	**Young Adult (n=10)**	**Older Adult (n=15)**	**t-value**	**p-value (0.05)**
Sodium (mmol/L)	130.86 ± 2.51	131.27 ± 3.35	-0.333	0.742
Potassium (mmol/L)	3.38 ± 0.34	3.52 ± 0.40	-0.915	0.370
Chloride (mmol/L)	95.92 ± 4.81	96.56 ± 4.77	-0.327	0.746
Calcium (mmol/L)	2.10 ± 0.08	2.13 ± 0.08	-1.047	0.306

Table 3 indicates the serum electrolyte profile of newly diagnosed *Mycobacterium tuberculosis* patients based on age groups.

The mean ± SD value of potassium was higher in older adults newly diagnosed with *Mycobacterium tuberculosis* (3.52 ± 0.40) mmol/L, which was not statistically significant (p = 0.370) when compared to the mean ± SD value in young adults (3.38 ± 0.34) mmol/L.

The mean ± SD value of sodium was higher in older adults newly diagnosed with *Mycobacterium tuberculosis* (131.27 ± 3.35) mmol/L, which was not statistically significant (p = 0.742) when compared to the mean ± SD value in young adults (130.86 ± 2.51) mmol/L.

The mean ± SD value of chloride was higher in older adults newly diagnosed with *Mycobacterium tuberculosis* (96.56 ± 4.77) mmol/L, which was not statistically significant (p = 0.746) when compared to the mean ± SD value in young adults (95.92 ± 4.81) mmol/L.

The mean ± SD value of calcium was higher in older adults newly diagnosed with *Mycobacterium tuberculosis* (2.13 ± 0.08) mmol/L, which was not statistically significant (p = 0.306) when compared to the mean ± SD value in young adults (2.10 ± 0.08) mmol/L.

Table 4: Pearson Correlation of Serum Calcium with Potassium, Sodium and Chloride in Newly Diagnosed Mycobacterium Tuberculosis Patients

Variable	n	R	p-value
Sodium	25	-0.06	0.763
Potassium	25	0.25	0.221
Chloride	25	-0.01	0.979

Table 4 shows the correlation of serum calcium with sodium, potassium, and chloride in newly diagnosed *Mycobacterium tuberculosis* patients.

There was a non-significant negative correlation of serum calcium with sodium (r = - 0.06, p = 0.763) and chloride (r = - 0.01, p = 0.979) in newly diagnosed *Mycobacterium tuberculosis* patients.

There was a non-significant positive correlation of serum calcium with potassium (r = 0.25, p = 0.221) in newly diagnosed *Mycobacterium tuberculosis* patients.

DISCUSSION

Tuberculosis (TB), caused by Mycobacterium tuberculosis, continues to be a major health issue around the world, especially in developing nations where it causes a lot of illness and death [16]. The condition can cause problems in other parts of the body besides the lungs, such as problems with electrolyte balance. These imbalances are mainly caused by long-term inflammation, not eating well, and the stress that comes with the infection. This study evaluated serum electrolyte values (sodium, potassium, chloride, and calcium) in newly diagnosed tuberculosis patients before the initiation of anti-tuberculosis treatment, contrasting them with levels in ostensibly healthy controls. Table 1 shows that there are big changes in the levels of electrolytes in the serum between people who have just been diagnosed with TB and the control group. TB patients had much lower levels of salt in their blood than healthy controls. This decrease in sodium content is a well-known sign of TB, mostly because of the syndrome of inappropriate antidiuretic hormone secretion (SIADH), adrenal insufficiency, and renal salt-wasting, which are all prevalent problems with the disease [17]. These mechanisms cause the body to hold onto water and lower the sodium level in the blood, which leads to hyponatraemia. This result is consistent with previous research by [18].

Who also found that untreated TB patients had far lower levels of salt in their blood. In the same way, Table 1 shows that the TB group had far lower serum potassium levels than the control group. Hypokalaemia in tuberculosis may result from inadequate nutritional intake, gastrointestinal losses (such as vomiting and diarrhoea), and renal potassium excretion. Furthermore, the commencement of tuberculosis treatment with drugs like rifampicin and aminoglycosides may exacerbate potassium depletion by influencing renal tubular function [19]. This observation supports the findings of [20], who noted reduced serum potassium levels in tuberculosis patients, especially in those who had recently started treatment. The study also showed that TB patients had far lower levels of serum chloride than controls (Table 1). Hypochloremia can occur due to vomiting, fluid depletion, or renal losses, all of which may be aggravated by the systemic infection and inflammation linked to tuberculosis [21]. Chloride is essential for maintaining acid-base equilibrium, and its deficiency may indicate underlying metabolic disorders. These results align with those of [22], which also indicated hypochloremia in tuberculosis patients, attributing it to ongoing fluid and electrolyte imbalances resulting from chronic disease. Table 1 shows that TB patients have much lower levels of calcium in their blood. Hypocalcaemia in tuberculosis has been linked to many mechanisms, including vitamin D insufficiency (attributable to diminished sunshine exposure and poor hepatic conversion), reduced intestine absorption, heightened renal excretion, and the sequestration of calcium in inflammatory granulomatous tissue [23]. This finding is corroborated by analogous investigations conducted by [24], which also identified significant hypocalcaemia in tuberculosis patients, attributing it to the synergistic effects of dietary inadequacies and the inflammatory burden of the disease. Table 2 examined the impact of sex on serum electrolyte concentrations in tuberculosis patients. Although males showed marginally lower mean levels of sodium and calcium, along with marginally greater levels of potassium and chloride compared to females, none of these differences achieved statistical significance. This indicates that sex may not substantially influence electrolyte abnormalities in newly diagnosed tuberculosis patients. This conclusion aligns with the findings of [25], which indicated no significant sex-related changes in electrolyte profiles among TB patients, suggesting that electrolyte abnormalities are mostly influenced by disease pathophysiology rather than biological sex. Table 3 shows how the levels of electrolytes in the blood are different in TB patients of different ages. Older persons exhibited slightly elevated mean levels of sodium, potassium, chloride, and calcium in comparison to younger adults; however, these variations lacked statistical significance. These results suggest that age does not significantly influence electrolyte levels in tuberculosis patients. This aligns with the findings of [26, 27], which indicated no age-dependent variation in electrolyte concentrations among adult TB patients, implying that metabolic responses to TB are rather similar throughout adult age groups. Lastly, Table 4 indicates how serum calcium levels are related to other electrolytes in TB patients, such as sodium, potassium, and chloride. The findings indicate that calcium exhibited a non-significant negative association with sodium and chloride, as well as a non-significant positive correlation with potassium. These results indicate that serum calcium levels vary independently of other electrolyte parameters during the initial phases of TB infection. [28, 29, 30] reached analogous conclusions, indicating contradictory inter-electrolyte correlations in tuberculosis patients, which they ascribed to the multifactorial dynamics of electrolyte regulation during active infection.

CONCLUSION

Patients recently diagnosed with Mycobacterium TB demonstrated notable decreases in serum concentrations of sodium, potassium, chloride, and calcium when compared to seemingly healthy individuals. These data indicate that tuberculosis infection is linked to significant disruptions in electrolyte balance, presumably resulting from the disease's systemic consequences, such as inflammation, dietary deficits, and modified renal function.

REFERENCES

1. Adrogué, H. J., Tucker, B. M., & Madias, N. E. (2022). Diagnosis and management of hyponatremia: A review. *JAMA, 328*(3), 280–291. https://doi.org/10.1001/jama.2022.11287
2. Alsayed, S. S., & Gunosewoyo, H. (2023). Tuberculosis: Pathogenesis, current treatment regimens and new drug targets. *International Journal of Molecular Sciences, 24*(6), 5202. https://doi.org/10.3390/ijms24065202
3. Ayenew, B., Belay, D. M., Gashaw, Y., Gimja, W., & Gardie, Y. (2024). WHO's end of TB targets: Unachievable by 2035 without addressing undernutrition, forced displacement, and homelessness: Trend analysis from 2015 to 2022. *BMC Public Health, 24*(1), 961. https://doi.org/10.1186/s12889-024-17961-3
4. Bal, C., Gompelmann, D., Krebs, M., Antoniewicz, L., Guttmann-Ducke, C., Lehmann, A., Milacek, C. O., Gysan, M. R., Wolf, P., Jentus, M. M., Steiner, I., & Idzko, M. (2022). Associations of hyponatremia and SIADH with increased mortality, young age and infection parameters in patients with tuberculosis. *PLOS ONE, 17*(10), e0275827. https://doi.org/10.1371/journal.pone.0275827
5. Baykan, A. H., Sayiner, H. S., Aydin, E., Koc, M., Inan, I., & Erturk, S. M. (2022). Extrapulmonary tuberculosis: An old but resurgent problem. *Insights into Imaging, 13*(1), 39. https://doi.org/10.1186/s13244-022-01183-4
6. Chang, D. P., & Guan, X. L. (2021). Metabolic versatility of *Mycobacterium tuberculosis* during infection and dormancy. *Metabolites, 11*(2), 88. https://doi.org/10.3390/metabo11020088
7. Chekol Tassew, W., Ferede, Y. A., & Zeleke, A. M. (2024). Major electrolyte disorder and associated factors among patients with chronic disease in Ethiopia: A systematic review and meta-analysis. *BMC Nephrology, 25*(1), 435. https://doi.org/10.1186/s12882-024-03635-9
8. Cioboata, R., Vasile, C. M., Bălteanu, M. A., Georgescu, D. E., Toma, C., Dracea, A. S., & Nicolosu, D. (2023). Evaluating serum calcium and magnesium levels as predictive biomarkers for tuberculosis and COVID-19 severity: A Romanian prospective study. *International Journal of Molecular Sciences, 25*(1), 418. https://doi.org/10.3390/ijms25010418
9. Conradie, F., Diacon, A. H., Ngubane, N., Howell, P., Everitt, D., Crook, A. M., Mendel, C. M., Egizi, E., Moreira, J., Timm, J., McHugh, T. D., Wills, G. H., Bateson, A., Hunt, R., Van Niekerk, C., Li, M., Olugbosi, M., Spigelman, M., & Nix-TB Trial Team. (2020). Treatment of highly drug-resistant pulmonary tuberculosis. *The New England Journal of Medicine, 382*(10), 893–902. https://doi.org/10.1056/NEJMoa1901814
10. Ekenyem, K. C., Nwosu, D. C., Nwadike, C. N., Edward, U. C., & Obeagu, E. I. (2025). Determination of serum electrolyte in newly diagnosed tuberculosis subjects on therapy in two tertiary institutions in Imo State. *European Journal of Biomedical and Pharmaceutical Sciences, 12*(6), 149–152.
11. Engel, N., Ochodo, E. A., Karanja, P. W., Schmidt, B. M., Janssen, R., Steingart, K. R., & Oliver, S. (2022). Rapid molecular tests for tuberculosis and tuberculosis drug resistance: A qualitative evidence synthesis of recipient and provider views. *Cochrane Database of Systematic Reviews, 4*(4), CD014877. https://doi.org/10.1002/14651858.CD014877.pub2
12. Fukunaga, R., Glaziou, P., Harris, J. B., Date, A., Floyd, K., & Kasaeva, T. (2021). Epidemiology of tuberculosis and progress toward meeting global targets – Worldwide, 2019. *Morbidity and Mortality Weekly Report, 70*(12), 427–430. https://doi.org/10.15585/mmwr.mm7012a1
13. Gill, C. M., Dolan, L., Piggott, L. M., & McLaughlin, A. M. (2022). New developments in tuberculosis diagnosis and treatment. *Breathe, 18*(1), 210149. https://doi.org/10.1183/20734735.0149-2021
14. Ilyas, U., Mahmood, A., Pansuriya, A. M., Umar, Z., & Landry, I. (2022). Miliary tuberculosis: A case report highlighting the diagnostic challenges associated with the condition. *Cureus, 14*(9), e29339. https://doi.org/10.7759/cureus.29339
15. Kalaiyarasan, K., Ramkumar, P. P., Mathan, K., Sridhar, R., & Vinodh Kumar, G. (2023). Electrolyte abnormalities in pulmonary tuberculosis – A retrospective analysis of 86 patients. *International Journal of Academic Medicine and Pharmacy, 5*(4), 722–725.
16. Kaur, J., Gupta, G., Chane, R., & Singh, M. K. (2021). Evaluation of serum electrolyte status among newly diagnosed cases of pulmonary tuberculosis: An observational study. *International Journal of Health and Clinical Research, 4*(5), 219–222.

17. Khalil, M. O., Al-Tikrity, M. A., Saffo, H. A., & Yassin, M. A. (2021). Severe hypokalemia as a rare presentation of disseminated tuberculosis. *Oman Medical Journal, 36*(6), e328. https://doi.org/10.5001/omj.2021.116
18. Koleske, B. N., Jacobs, W. R., Jr., & Bishai, W. R. (2023). The *Mycobacterium tuberculosis* genome at 25 years: Lessons and lingering questions. *The Journal of Clinical Investigation, 133*(19), e173156. https://doi.org/10.1172/JCI173156
19. Krueger, G., Faisal, S., & Dorhoi, A. (2025). Microenvironments of tuberculous granuloma: Advances and opportunities for therapy. *Frontiers in Immunology, 16*(3), 1575133. https://doi.org/10.3389/fimmu.2025.1575133
20. Luies, L., & du Preez, I. (2020). The echo of pulmonary tuberculosis: Mechanisms of clinical symptoms and other disease-induced systemic complications. *Clinical Microbiology Reviews, 33*(4), e00036-20. https://doi.org/10.1128/CMR.00036-20
21. Miele, K., Bamrah Morris, S., & Tepper, N. K. (2020). Tuberculosis in pregnancy. *Obstetrics & Gynecology, 135*(6), 1444–1453. https://doi.org/10.1097/AOG.0000000000003830
22. Migliori, G. B., Ong, C. W. M., Petrone, L., D'Ambrosio, L., Centis, R., & Goletti, D. (2021). The definition of tuberculosis infection based on the spectrum of tuberculosis disease. *Breathe, 17*(3), 210079. https://doi.org/10.1183/20734735.0079-2021
23. Mohammadnabi, N., Shamseddin, J., Emadi, M., Bodaghi, A. B., Varseh, M., Shariati, A., Rezaei, M., Dastranj, M., & Farahani, A. (2024). *Mycobacterium tuberculosis*: The mechanism of pathogenicity, immune responses, and diagnostic challenges. *Journal of Clinical Laboratory Analysis, 38*(23), e25122. https://doi.org/10.1002/jcla.25122
24. Neogi, S., Mukhopadhyay, P., Sarkar, N., Datta, P. K., Basu, M., & Ghosh, S. (2021). Overt and subclinical adrenal insufficiency in pulmonary tuberculosis. *Endocrine Practice, 27*(6), 601–606. https://doi.org/10.1016/j.eprac.2021.02.003
25. Ogunniyi, T. J., Abdulganiyu, M. O., Issa, J. B., Abdulhameed, I., & Batisani, K. (2024). Ending tuberculosis in Nigeria: A priority by 2030. *BMJ Global Health, 9*(12), e016820. https://doi.org/10.1136/bmjgh-2024-016820
26. Oladimeji, O., Oladimeji, K. E., Nanjoh, M., Banda, L., Adeleke, O. A., Apalata, T., Mbokazi, J., & Hyera, F. L. M. (2022). Contributory factors to successful tuberculosis treatment in Southwest Nigeria: A cross-sectional study. *Tropical Medicine and Infectious Disease, 7*(8), 194. https://doi.org/10.3390/tropicalmed7080194
27. Palmer, B. F., & Clegg, D. J. (2023). Pathophysiology and clinical management of hyperkalemia in chronic kidney disease. *Minerva Medica, 114*(5), 719–735. https://doi.org/10.23736/S0026-4806.23.08136-8
28. Park, M., & Gupta, R. K. (2023). Central nervous system *Mycobacterium* infection: Tuberculosis and beyond. *Neuroimaging Clinics of North America, 33*(1), 105–124. https://doi.org/10.1016/j.nic.2022.09.007
29. Togun, T., Kampmann, B., Stoker, N. G., & Lipman, M. (2020). Anticipating the impact of the COVID-19 pandemic on TB patients and TB control programmes. *Annals of Clinical Microbiology and Antimicrobials, 19*(1), 21. https://doi.org/10.1186/s12941-020-00363-1
30. Uddin, R., Uddin, F., Mufeed, T., & Jan, F. (2023). Hyponatremia and hypokalemia prevalence in tuberculosis patients receiving anti-tuberculosis drugs in a teaching hospital. *International Journal of Medical Research and Health Sciences, 12*(10), 17–25.

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