e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(11); 1314-1317

Original Research Article

# Evaluation of Electrolyte Levels in Hypertensive Patients

**Ruby Kumari[1], Lakshman Lal[2], N. K. Gadiya[3], Arvind Kumar[4]**

[1]Tutor, Department of Biochemistry, MGMMCH, Jamshedpur, Jharkhand, India
[2]Professor, Department of Biochemistry, MGMMCH, Jamshedpur, Jharkhand, India
[3]Associate Professor, Department of Biochemistry, MGMMCH, Jamshedpur, Jharkhand, India
[4]Assistant Professor, Department of Biochemistry, MGMMCH, Jamshedpur, Jharkhand, India

**Received: 25-08-2023 / Revised: 28-09-2023 / Accepted: 30-10-2023**
**Corresponding Author: Ruby Kumari**
**Conflict of interest: Nil**

**Abstract:**

**Background:** Hypertension, a prevalent global ailment, manifests as a widespread affliction among the human population. It stands as a prominent contributor to mortality and morbidity in the adult demographic across the globe. It continues to be the primary risk factor for peripheral vascular, coronary, and cerebral disease.

**Aim:** The study aims the evaluate serum potassium and sodium levels in hypertensive patients and compare them with normotensive patients who are coming for electrolyte level testes in Clinical Biochemistry under Clinical Pathology at MGMMCH, Jamshedpur, Jharkhand, India.

**Methods:** The study is a hospital-based comparative analysis that includes a total of 380 patients with hypertension including 190 cases and 190 controls.

Results: The hypertensive patients (190) and healthy controls (190) were included in the study with age above 20 years. The mean level of sodium cases was higher in comparison to the mean level in controls. Whereas the mean potassium levels are lower in comparison to the mean level in controls.

**Conclusion:** It was analyzed that the high sodium and low potassium levels might be the reason for the hypertension risk. Therefore, the dietary management of sodium and potassium intake will be helpful in lowering the risk of hypertension.

**Keywords:** Body mass Index, serum sodium, hypertension, serum potassium.



## Introduction

Hypertension, a condition characterized by elevated blood pressure levels, has a global impact, affecting around the adult population. Projections indicate that its prevalence is expected to rise by, potentially impacting a staggering 1.56 billion individuals [1]. It represents the primary risk factor for the development of cardiovascular disease and is accountable for the majority of global mortality cases. Hypertension is a life-threatening and chronic disease that results in renal failure and CVD. It is a highly prevalent disease, but people are not very aware of the disease because of its non-specific symptoms and are not given utmost attention due to a lack of treatment compliance [1-5]. The complexity of the disease is because of multiple genetic and environmental factors. Electrolytic imbalances represent a fundamental and primary pathological indicator in the majority of diseases and are prevalent among both the general population and individuals receiving medical care [5].

Several recent studies indicate a direct correlation between electrolyte problems and negative consequences, including higher rates of morbidity and mortality [2, 3]. Electrolyte imbalances in the general population are typically characterized by a chronic and mild nature, in contrast to hospitalized patients who frequently experience acute and severe manifestations of such disturbances [1, 3]. However, it is worth noting that electrolytic disruptions have been found to be correlated with adverse health conditions and results. Hence, it is imperative to ascertain the potential correlation between electrolytic imbalances and the risk factors that contribute to specific chronic ailments, ultimately posing a significant threat to one's life. By understanding this information, it is possible to address these risk factors by regulating blood electrolyte levels in order to potentially avoid or delay the onset of certain diseases and alleviate their associated effects.

Several epidemiological studies [1-4] have indicated a substantial association between electrolyte levels and blood pressure as well as between salt consumption and blood pressure. Nevertheless, the relationship between serum electrolyte levels and elevated blood pressure remains uncertain in

populations characterized by heavy salt consumption.

A comprehensive examination of the concentrations of sodium and potassium holds promise in streamlining and optimizing the management approach for the pervasive issue of hypertension. Additionally, it may prove beneficial in elucidating different aspects of the ailment [6-10].

The objective is to evaluate and analyze the concentration of serum sodium and potassium in patients who are diagnosed with hypertension and to study the comparison analysis of the levels in normotensive individuals who are serving as controls.

## Materials and Methodology

**Study Design, Location and Duration:** The study was conducted in the Department of Clinical Biochemistry under Clinical Pathology at MGMMCH, Jamshedpur, Jharkhand, India. A study was designed and analyzed from August 2023 to October 2023. This study included a total of 190 patients with primary essential hypertension aged over 20 years and 190 healthy controls who were willing to participate.

**Selection Criteria:** Patients with primary essential hypertension were included in the study. Patients with secondary hypertension, age below 20 years, pregnant females, females using contraceptives, and diarrheal disease were excluded from the study.

**Data Collection:** The serum levels of sodium and potassium were measured and analyzed in both inpatient and control cases. The Ion selective electrodes were used for studying the serum levels of potassium and sodium.

**Statistical Analysis:** Data analysis was conducted using IBM SPSS 20.0, with quantitative variables reported as mean ± standard deviation and discrete variables presented as percentages. Comparative analyses utilized ANOVA, Mann-Whitney tests, with Fisher exact tests for qualitative variables, or t-tests. Logit regression was used to assess the predisposing factors for CVD and PAD. Significance of the test was established with a P lesser than 0.05.

## Results

All the controls and patients (aged more than 20 years) were involved in this analysis. The mean age value was 50.82 ± 12.39 years (cases), and it was 53.14 ± 11.86 years (controls). In the hypertensive group, 52 males and 43 females were included, and 40 females and 55 males in the control group (Table 1).

**Table 1: Characteristics of the participants according to hypertension status**

| Groups | Hypertensive patients | Healthy controls | T value | P value |
|---|---|---|---|---|
| No. of cases | 190 | 190 | | |
| Age (Years) | 50.82 ± 12.39 | 53.14 ± 11.86 | 1.595 | NS |
| BMI (kg/m$^2$) | 26.70 ± 5.17 | 26.50 ± 5.43 | -0.355 | NS |
| Systolic BP (Mm of Hg) | 167.95 ± 6.48 | 117.95 ± 6.52 | -54.509 | < 0.001 |
| Diastolic BP (Mm of Hg) | 107.39 ± 3.03 | 82.44 ± 2.99 | -59.200 | <0.001 |

The mean BMI for the cases was 26.70 ± 5.17 kg/m$^2$ and for the controls was 26.50 ± 5.43 kg/m$^2$. Whereas 167.95 ± 6.48 mm of Hg was the mean systolic BP in cases and in controls it was 117.95 ± 6.52 mm of Hg. The mean diastolic BP for the cases and the controls were 107.39 ± 3.03 mm of Hg and 82.44 ± 2.99 mm of Hg.

**Table 2: Correlation test results between both groups**

| Groups/Test | Hypertensive Patients | Healthy controls | T value | P value |
|---|---|---|---|---|
| No. of cases | 190 | 190 | | |
| S. Sodium (mmol/L) | 145.86 ± 4.66 | 135.74 ± 4.13 | 16.116 | <0.001 |
| S. Potassium (mmol/L) | 3.64 ± 0.42 | 4.62 ± 0.65 | 13.228 | <0.001 |

Mean sodium level cases were 145.86 ± 4.66 mmol/L and 135.74 ± 4.13 mmol/L in control. The level observed in cases was higher than in controls. The mean potassium levels in cases were 3.64 ± 0.42 mmol/L and 4.62 ± 0.65 mmol/L in controls. The serum potassium levels were lower in cases compared to the controls.

## Discussion

Hypertension, a prevalent ailment among the human population, stands as a paramount contributor to morbidity and mortality in the adult demographic on a global scale [11]. It continues to be the primary risk factor for coronary, cerebral, and peripheral vascular disease. Primary hypertension accounts for over 90% of cases of hypertension. Despite significant advancements in the understanding, management, and mitigation of cardiovascular disease (CVD) within the past ten years, the condition of hypertension is frequently undervalued and inadequately identified [12, 13].

Hypertension has emerged as a significant health concern in the Indian population. Considerable progress has been made in our comprehension of the

mechanisms that underlie the central effects of an excess of sodium ions (Na+) and a deficit of potassium ions (K+) in elevating peripheral vascular resistance. The contrasting impacts of these cations on sympathetic activity and blood pressure have been shown through the implementation of central infusion studies. Currently, there exists a more comprehensive understanding of the identification and manipulation of pertinent signals, as well as the mechanisms responsible for the activation of the sympathetic nervous system and the development of hypertension. However, there is still a significant amount of knowledge that has yet to be uncovered.

The understanding of the sensing process of plasma and cerebrospinal fluid (CSF) sodium concentration (Na+) is still lacking in several aspects. The mechanisms behind the notable effects of alterations in dietary potassium consumption and cerebrospinal fluid (CSF) potassium concentration on sympathetic activity and blood pressure remain enigmatic. The progression of the discipline holds the potential to facilitate innovative strategies in the prevention and management of hypertension diseases [14]. The majority of individuals become aware of their hypertension diagnosis when they have already progressed to an advanced stage, characterized by organ damage such as renal failure, stroke, and myocardial infarction [15, 16]. These three mechanisms may not necessarily exhibit independence or exclusivity from one another.

The putative association between increased sodium consumption and hypertension seems to be restricted to people who have an aberrant natriuretic response to heightened arterial pressure. The atypical reaction observed could potentially be ascribed to a cellular electrolyte abnormality, potentially caused by a substance that inhibits the transport of sodium throughout the body while simultaneously increasing the excretion of sodium in urine. The mean serum sodium level in hypertensive patients is 145.86 ± 4.66 mmol/L and 135.74 ± 4.13 mmol/L in control. A statistically significant difference between values was obtained [17]. Therefore, it was concluded that high sodium levels are associated with hypertension. The mean potassium levels in cases were 3.64 ± 0.42 mmol/L and 4.62 ± 0.65 mmol/L in controls. The serum potassium levels were lower in cases compared to the controls. This study shows similarity with the study by Capoor et al. [18] and Jan *et al.,* [19]. In spite of hereditary predisposition, high sodium, and lower potassium intake also plays important role in the pathogenesis of hypertension. The rarity of the disease in those who are consuming excessive salt might be adapted to the body system for renal clearance [20, 21].

## Conclusion

The study concludes by analyzing that the high level of sodium and decreased level of potassium might be linked with the hypertension risk. In addition, it can be said that restricting the dietary intake of the serum potassium and sodium-rich diet may help in lowering the hypertension risk. If the current study coincides with the present situation and is proven to be statistically important, it can be a prominent tool for the prediction of the future risk of the hypersensitive and its linked different renovascular, coronary, and cerebrovascular ailments.

## References


1. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, Jones DW, Materson BJ, Oparil S, Wright Jr JT, Roccella EJ. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. hypertension. 2003 Dec 1;42(6):1206-52.
2. AlWabel AH, Almufadhi MA, Alayed FM, Aloraini AY, Alobaysi HM, Alalwi RM. Assessment of hypertension and its associated risk factors among medical students in Qassim University. Saudi Journal of Kidney Diseases and Transplantation. 2018 Sep 1;29(5):1100-8.
3. Alwan A. Global status report on noncommunicable diseases 2010. World Health Organization; 2011.
4. Kaplan NM. Primary hypertension: pathogenesis. Clinical hypertension. 1994:47-108.
5. Scobie HM, Ray A, Routray S, Bose A, Bahl S, Sosler S, Wannemuehler K, Kumar R, Haldar P, Anand A. Cluster survey evaluation of a measles vaccination campaign in Jharkhand, India, 2012. PLoS One. 2015 May 26;10(5): e0127105.
6. Capoor S, Khirawari HA, Tank ML, Gothwal V, Mittal C. A Comparative Study of Serum Sodium, Potassium, & Calcium Levels in Primary Essential Hypertensive Cases and Healthy Controls In Mahatma Gandhi Hospital, Jaipur.
7. Jan RA, Shah S, Saleem SM, Waheed A, Mufti S, Lone MA, Ashraf M. Sodium and potassium excretion in normotensive and hypertensive population in Kashmir. JAPI. 2006 Jan; 54:22-5.
8. Visscher TL, Seidell JC, Menotti A, Blackburn H, Nissinen A, Feskens EJ, Kromhout D, Seven Countries Study Research Group. Underweight and overweight in relation to mortality among men aged 40–59 and 50–69 years: the Seven Countries Study. American journal of epidemiology. 2000 Apr 1;151(7):660-6.
9. McPhee SJ, Papadakis MA, Rabow MW, editors. Current medical diagnosis & treatment 2010. New York: McGraw-Hill Medical; 2010 Nov 5.
10. Berglund GO, Andersson O, Wilhelmsen L. Prevalence of primary and secondary

hypertension: studies in a random population sample. Br Med J. 1976 Sep 4;2(6035):554-6.
11. Berkin KE, Ball SG. Essential hypertension: the heart and hypertension. Heart. 2001 Oct 1; 86(4):467-75.
12. Tierney LM, McPhee SJ, Papadakis MA. Current medical diagnosis & treatment. InCurrent medical diagnosis & treatment 2005 (pp. 1887-1887).
13. Kumar A, Prasad SD. Evaluation of serum sodium and potassium levels in newly diagnosed patients of essential hypertension at Rims, Ranchi, Jharkhand, India. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2017; 16(9):16-9.
14. Kawasaki T, Delea CS, Bartter FC, Smith H. The effect of high-sodium and low-sodium intakes on blood pressure and other related variables in human subjects with idiopathic hypertension. The American journal of medicine. 1978 Feb 1;64(2):193-8.
15. Bande US. Prasanth Huballi Study of Serum Calcium in Essential Hypertension. European Journal of Pharmaceutical and Medical Research. 2016;3(6):516-25.
16. Capoor S, Khirawari HA, Tank ML, Gothwal V, Mittal C. A Comparative Study of Serum Sodium, Potassium, & Calcium Levels in Primary Essential Hypertensive Cases and Healthy Controls In Mahatma Gandhi Hospital, Jaipur.
17. Hazari MA, Arifuddin MS, Muzzakar S, Reddy VD. Serum calcium level in hypertension. North American Journal of Medical Sciences. 2012 Nov;4(11):569.
18. Capoor S, Khirawari HA, Tank ML, Gothwal V, Mittal C. A Comparative Study of Serum Sodium, Potassium, & Calcium Levels in Primary Essential Hypertensive Cases and Healthy Controls In Mahatma Gandhi Hospital, Jaipur.
19. Jan RA, Shah S, Saleem SM, Waheed A, Mufti S, Lone MA, Ashraf M. Sodium and potassium excretion in normotensive and hypertensive population in Kashmir. JAPI. 2006 Jan; 54:22-5.
20. Haenni A, Reneland R, Lind L, Lithell H. Serum aldosterone changes during hyperinsulinemia are correlated to body mass index and insulin sensitivity in patients with essential hypertension. Journal of hypertension. 2001 Jan 1;19(1):107-12.
21. 21. Holloway ET, Bohr DF. Reactivity of vascular smooth muscle in hypertensive rats. Circulation research. 1973 Dec;33(6):678-85.