# A study of electrolyte imbalance in patients with essential hypertension: A descriptive cross-sectional study

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## ABSTRACT

**Background:** Essential hypertension accounts for more than 90% of hypertension. It is the main risk factor for coronary, cerebral and peripheral vascular diseases. The etiology of essential hypertension is unknown. To determine the frequency of electrolyte imbalances including sodium, chloride, potassium and magnesium levels present in patients with essential hypertension

**Materials and Methods:** This was a descriptive cross-sectional study conducted in the Department of Biochemistry on 120 (60 cases + 60 controls) patients with essential hypertension in the age group of 31-80 years attending OP Hind Institute of Medical Sciences, sitapur March 2021 to October 2021. All patients underwent detailed history taking, careful physical examination, and biochemical analysis to rule out secondary hypertension.

**Result:** In essential hypertension, reductions in serum sodium and chloride levels were observed to be statistically highly significant (p-value less than or equal to 0.05), while insignificant changes were found in potassium and magnesium. It was also observed that the sodium level decreased with increasing microalbumin urine pattern.

**Conclusion:** Electrolyte imbalance is significantly present in patients with essential hypertension; therefore, serum electrolyte levels should be routinely measured in patients with essential hypertension.

***Keywords:*** *Essential hypertension, Electrolyte imbalance, Body mass index, Serum Sodium, Serum Potassium, Serum Chloride, Serum Magnesium*

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## INDRODUCTION

Hypertension is one of the leading causes of death and disability in adults worldwide. It is a major risk factor responsible for coronary, cerebrovascular and peripheral vascular disease. Primary hypertension accounts for more than 90% of hypertension [(1)].

Hypertension is becoming a new health problem in India [(2)]. By the time most people are aware of their hypertensive status, they have already progressed to the stage of target organ damage—fatal stroke or myocardial infarction or irreversible kidney failure. Unfortunately, even in developed countries like the United States, fifty million people are diagnosed with hypertension. Of these, 70% are aware of it, only 50% are treated, and only 20% are under control [(3)].

Electrolytes play an important role in several body mechanisms, to name a few, they help maintain acid-base balance, membrane potential, muscle contraction, nerve conduction, and body fluid control. Changes in electrolyte homeostasis can lead to physiological disturbances [(4)].

In addition to the primary increase in cardiac function due to an overactive sympathetic nervous system, primary salt and water retention by the kidneys, other factors that contribute to hypertension are hereditary predisposition and high intake and excretion of sodium and potassium. In a country like India, people are used to consuming a diet high in sodium and low in potassium [(5)]. Many studies have shown a positive correlation between serum potassium and blood pressure. They have shown that reduced sodium intake and increased potassium intake, or both together, can be effective in preventing or even treating hypertension. Independent reports on serum sodium and potassium in the Indian hypertensive population were lacking, hence the present study [(6)].

## MATERIALS AND METHODS

This is a retrospective cross-sectional study conducted at Hind Institute of Medical Sciences, Sitapur U.P to study sodium and potassium levels in patients with essential hypertension and to correlate them with blood pressure in newly diagnosed essential hypertension.

***Inclusion criteria:***

-Age over 31 years.

- Hypertension was diagnosed at least three months ago.

***Exclusion criteria:***

i) Hypertension > 1 year duration

ii) Secondary hypertension

iii) Diabetes mellitus, congestive heart failure, history of any atherosclerotic disease, urinary tract infection, any intercurrent disease, strenuous exercise and menstruation to exclude any proteinuria from other causes. All subjects were informed and a consent letter was obtained.

***Evaluation:***

The following data were collected from all patients at study entry: age (years), sex, duration of EH, smokings, history of hypertension, systolic and diastolic blood pressure (mm Hg) were calculated.

***Biochemical analysis:***

Under aseptic precautions, 3 ml of venous blood was collected from the antecubital vein. Samples were centrifuged after 30 minutes; serum was isolated and used for electrolyte measurements.

## STATISTICAL ANALYSIS

All values were expressed as mean ± SD. Statistical analysis was performed using Student's 't' test and Pearson's correlations for comparison between two groups, and a p-value <0.05 was considered statistically significant.

## RESULT

**Table-1:** The study included 60 hypertensive patients. Ages ranged from 21 to 80 years with a mean age of 55.2 ± 11.8 years. 24 of the participants (40%) are females.

| Personal data | No (60) | % |
|---|---|---|
| **Age in years** | | |
| 31-40 | 4 | 6.66 |
| 41-50 | 22 | 36.66 |
| 51-60 | 26 | 43.33 |

| | | |
|---|---|---|
| 60+ | 08 | 13.33 |

**Table 2: Gender wise distribution of cases and controls**

| Sex | Case | | Control | |
|---|---|---|---|---|
| | **No** | **%** | **No** | % |
| **Male** | 36 | 60 | 36 | 60 |
| **Female** | 24 | 40 | 24 | 40 |
| **Total** | 60 | 100 | 60 | 100 |

**Table 3 Distribution of cases and controls with respect to BMI**

| | Case | | Control | |
|---|---|---|---|---|
| | **No** | **%** | **No** | **%** |
| **Underweight < 18.5** | 6 | 10 | 10 | 17 |
| **Healthy Weight 18.5-24.9** | 12 | 20 | 36 | 60 |
| **Over Weight 25 – 29.9** | 35 | 58 | 10 | 17 |
| **Obesity 30-39.9** | 07 | 12 | 04 | 6 |
| **Total** | 60 | 100 | 60 | 100 |

58% of the cases were overweight and 07% cases were obese, whereas only 17% of controls were overweight and 6% cases were obese.

**Table 4: Distribution of systolic and diastolic blood pressure**

| Blood Pressure | Case | | Control | | p-value |
|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | |
| **Systolic** | 142.75 | 6.83 | 127.81 | 7.88 | <0.0001 |
| **Diastolic** | 86.06 | 4.91 | 78.63 | 4.78 | <0.0001 |

The mean systolic blood pressure for the cases was 142 ± 6.83 mm Hg. Similarly the mean diastolic blood pressure for the cases was 127 ± 7.88 mm Hg. Since the systolic and diastolic blood pressure was elevated in cases and it was due to the nature of the disease taken into study.

**Table 5: Distribution of electrolyte parameters**

| Electrolyte balance | Case | | Control | | p-value |
|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | |
| **Serum sodium** | 147 | 3.19 | 138 | 1.8 | 0.062 |
| Serum potassium | 3.79 | 0.18 | 4.25 | 0.22 | 0.001* |
| **Serum Chloride** | 101.9 | 5.9 | 103.2 | 5.4 | 0.580 |
| **Serum Magnesium** | 1.9 | 0.33 | 1.7 | 0.28 | 0.487 |

This table clearly shows that the serum sodium level and serum chloride was significantly more among hypertensive population studied. And this also table clearly shows that the serum Potassium level was significantly lower among the hypertensive population studied. However, there was no significant change in serum magnesium levels.

## DISCUSSION

Electrolyte imbalance is commonly present in patients with essential hypertension. The cause is usually multifactorial. This study demonstrated a significant decrease in serum sodium and chloride levels with increasing blood pressure and an increase in serum potassium levels. However, there was no significant change in serum magnesium levels.

Our study was supported by Jan et al (2006), Srinagar, Kashmir. In his study, one hundred and thirty-five hypertensive patients and an equal number of age- and sex-matched healthy controls were recruited for the study. Serum sodium in the hypertensive group was 140 ± 2.90, while in the control group it was found to be 138.5 ± 1.12. Serum sodium was higher in the hypertensive group than in the control group and was considered a factor responsible for causing or maintaining blood pressure[(7)]. Similarly, a study was conducted at the National Institute of Public Health and Environmental Protection, Bilthoven, The Netherlands. Relationships between serum sodium, potassium, calcium and magnesium cations and blood pressure were investigated in a population-based sample of 182 Dutch subjects aged 20-59 years. In the combined analysis, a weak inverse relationship was found between serum potassium and diastolic blood pressure; this relationship was also found in women [(8)]. other studies have shown significant variations in serum potassium levels, many studies found a negative correlation between serum magnesium and DBP, which contradicts our study results [9,10,11]

## CONCLUSION

The current study demonstrated the importance of measuring serum electrolytes in patients with essential hypertension. As blood pressure rises, electrolytes, especially sodium, chloride, and potassium, are severely disrupted. Elevated blood pressure also impairs kidney function, as shown by increased levels of microalbumin in the urine. Serum sodium levels change indirectly in our study and can be used as a predictor of nephropathy. Therefore, measurement of serum electrolyte parameters in essential hypertension should be performed as part of routine patient care.

## REFERENCES

1. Berglund G, Anderson O, Wellebonsa L. Prevalence of primary and secondary hypertension studies in a random population sample. Br. Med Jr 1976; 2: 554.
2. Flack, J.M.; Calhoun, D.; Schiffrin, E.L. The New ACC/AHA Hypertension Guidelines for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. Am. J. Hypertens. 2018, 31, 133–135.
3. MCPhee SJ, Masse BM. In: Tierney LM et al. ed. Current medical diagnosis & reatment. McGraw Hill company USA, 2006;11: 419-445
4. Kaplan NM: Primary hypertension: Pathogenesis. In clinical hypertension.Baltimore, WilliamsWilkins, 1998: 41 – 101.
5. Fisher NDL, Williams GH. In: Kasper DL et al. ed. Harrison's Principles of Internal Medicine. McGraw Hill, USA, 2005; 230: 1463 – 1481.
6. Zhang, X.; Li, Y.; Del Gobbo, L.C.; Rosanoff, A.; Wang, J.; Zhang, W.; Song, Y. Effects of Magnesium Supplementation on Blood Pressure: A Meta-Analysis of Randomized Double-Blind Placebo-Controlled Trials. Hypertension 2016, 68, 324–333.

7. Jan RA, Shah S, Saleem SM et al. sodium and potassium excretion in normotensive and hypertensive population in Kashmir: JAPI 2006; 54: 22-26.
8. Dyer AR, Elliot P. The INTERSALT study: relations of body mass index to blood pressure. INTERSALT Co-operative Research Group. J Hum Hypertens. 1989; 3(5): 299-308.
9. Touyz, R.M.; Milne, F.J.; Seftel, H.C.; Reinach, S.G. Magnesium, calcium, sodium and potassium status in normotensive and hypertensive Johannesburg residents. S. Afr. Med. J. 1987, 72, 377–381.
10. Abbasi, I.R.; Salim-ul-Haque; Kausar, M.W.; Karira, K.A.; Zubari, N.A. Correlation of divalent Cat ions (Ca++, Mg++) and Serum Renin in pateints of essential hypertension. J. Pak. Med. Assoc. 2012, 62, 134–138.
11. Guerrero-Romero, F.; Rodríguez-Morán, M.; Hernández-Ronquillo, G.; Gómez-Díaz, R.; Pizano-Zarate, M.L.; Wacher, N.H.; Mondragón-González, R.; Simental-Mendia, L.E.; Salinas Martínez, A.M.; Álvarez Villaseñor, A.S.; et al. Low Serum Magnesium Levels and Its Association with High Blood Pressure in Children. J. Pediatr. 2016, 168, 93–98.e1