

A Prospective Study of Sodium and Potassium Imbalance in Newly Diagnosed Hypertension

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Abstract: Introduction: Primary hypertension accounts for more than 90% of hypertension. It is the major risk factor for coronary, cerebral and peripheral vascular diseases. Etiology for primary hypertension is not known. The present study attempts to focus the serum sodium and potassium level among newly diagnosed primary hypertensives that were free from any other illnesses or under any medication and to correlate with the blood pressure.

Methodology: Thirty five newly diagnosed primary hypertensive patients attending the Medicine OP of M.G.M Medical College for the period of six months from March 2018 to August 2018 were studied. Fifteen healthy people were kept as controls. The control group comprises of normotensive individuals who were the attendants of the patients with primary hypertension living in the same environment other than their own siblings. Serum sodium and potassium levels were estimated (flame photometer) in thirty five hypertensives (m-17, f-18; mean age 53.1 ± 5.37) and fifteen controls (m-5, f-10; mean age 51.5 ± 5.38). Efforts were also made to find out an association between body mass index with the systolic and diastolic blood pressure.

Results: The age of the subjects in the study group ranged from thirty to eighty years. The mean and standard deviation for the age of the cases and controls were 56.2 ± 11.6 years and 49.6 ± 10.8 years respectively. The study group and the control group did not differ from each other statistically with reference to age.

Conclusion: Mean serum sodium level was significantly elevated among hypertensives (147.94 ± 2.88) where as mean serum potassium level was significantly lower among them (3.55 ± 0.29) when compared to healthy controls (mean serum sodium level of 138.86 ± 3.44 and a mean serum potassium level of 4.67 ± 0.22). The blood pressure also correlated positively with serum sodium, body mass index where as negatively correlated with serum potassium. Changing lifestyle has modified the food habits, making people to consume food rich in sodium but low in potassium. As a result, genetically susceptible populations when exposed to high sodium coupled with low potassium in their diet, hypertension becomes overt.

Keywords: Primary Hypertension, Body mass index, serum sodium, serum potassium

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I. Introduction

Hypertension is one of the world's leading causes of death and disability among adults. It is the major risk factor responsible for coronary, cerebral and peripheral vascular disease. Primary hypertension comprises for more than 90% of hypertension.¹

Hypertension is becoming an emerging health problem in India. When the majority of people are aware of their hypertension status, they have already advanced into a stage with target end organ damage a fatal stroke or myocardial infarction or irreversible renal failure. Unfortunately even in developed countries like the United States, fifty million people are diagnosed to have hypertension. Among these, 70% are aware of it, only 50% are receiving treatment for the same and only 20% are under control.²

In addition to a primary increase in cardiac function as a result of overactive sympathetic nervous system, primary retention of salt and water by the kidney, other factors that contributes to hypertension are hereditary predisposition and high sodium and low potassium intake and excretion.³

In a country like India, people are used to consuming a diet rich in sodium and poor in potassium. Many studies have shown to have a positive correlation between serum potassium and blood pressure. They have shown that a decreased intake of sodium and an increased intake of potassium or both together may be effective in the prevention or even in the treatment of hypertension. Independent reports were lacking on serum sodium and potassium among the Indian hypertensive population, and hence the present study was conducted.⁴

II. Materials And Methods

Setting: The work was carried out in the outpatient Medicine department and NCD (Non Communicable diseases) OP of M.G.M Medical College, Jamshedpur.

Design of the study: Cross sectional Study (Analytical Study)

Period of the Study: Six months – March 2018 to August 2018

Sample size: 50 cases (35 cases and 15 controls)

Inclusion criteria:

1. Patients with newly diagnosed primary hypertension.
2. Patients above 20 years.
3. Both males and females.

Exclusion Criteria:

1. Patients below 20 years.
2. Patients with diabetes mellitus.
3. Patients with renal failure.
4. Pregnancy.
5. Females on oral contraceptive pills.
6. Patients with secondary hypertension.
7. Females on non-steroidal anti-inflammatory drugs, anti-hypertensives
8. Patients with peripheral vascular disease.
9. Patients with acute diarrhoeal diseases.

Consent:

The study group thus identified by the above criteria (inclusion and exclusion criteria) were first instructed about the nature of the study. Willing participants were taken up after getting a written informed consent from them.

Study Subjects and Controls:

Thirty five newly diagnosed primary hypertensive patients attending the medicine OPD or NCD OPD of M.G.M Medical College, Jamshedpur for the period of six months from March 2018 to August 2018 formed the study group. Fifteen healthy people were kept as controls. This control group comprised of normotensive individuals who were attendants of patients with primary hypertension living in the same environment other than their own siblings.

Details of the Study Subjects:

All the patients were subjected to detailed history taking, careful physical examination and biochemical analysis to exclude secondary hypertension. Patient's height and weight were measured. The body mass index was calculated using the formula weight (kg) / height (m²). All the peripheral pulses were checked with special attention to carotid and the femoral to detect evidence for early atherosclerosis. An ocular fundus examination was done to detect hypertensive retinopathy. Patients were informed to refrain from smoking or drinking tea or coffee for at least thirty minutes before measuring blood pressure.

Statistical Analysis: The collected data was entered in Microsoft excel spread sheet and analysed statistically using GraphPad Prism version 5 software. Unpaired 't' test, Fisher's Exact test, and TWO way ANOVA test were applied for statistical significance. Significance was considered if the 'p' value was below 0.05

III. Results

The total number of subjects included in this study was 50. Among these 50 subjects, 35 were cases (Hypertensive) and 15 were controls (Normotensive).

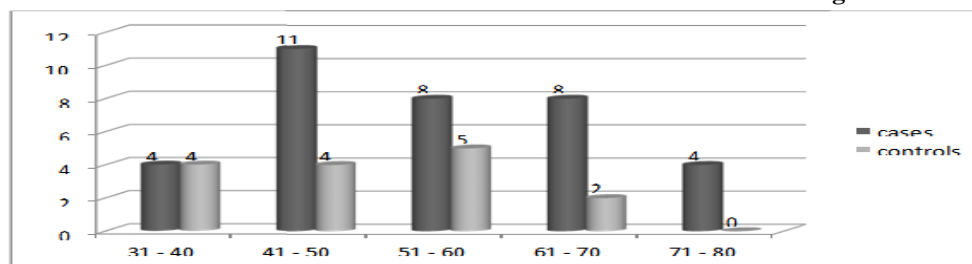
Analysis of cases and controls with respect to age:

The age of the subjects in the study group ranged from thirty to eighty years. The mean and standard deviation for the age of the cases and controls were 56.2± 11.6 years and 49.6 ± 10.8 years respectively. The study group and the control group did not differ from each other statistically with reference to age. The distribution of the cases and controls in relation to age is provided in the Table 1 given below and in Figure – 1.

Table 1: Distribution of cases and controls in relation to age

Age group	Cases		Controls	
	No.	%	No.	%
31 – 40	4	11.4	4	26.7
41 – 50	11	31.4	4	26.7
51 – 60	8	22.8	5	33.3
61 – 70	8	22.8	2	13.3
71 – 80	4	11.4	-	-
Total	35	100	15	100
Mean	56.2		49.6	
S.D.	11.6		10.8	

FIGURE 1: Distribution of cases and controls in relation to Age

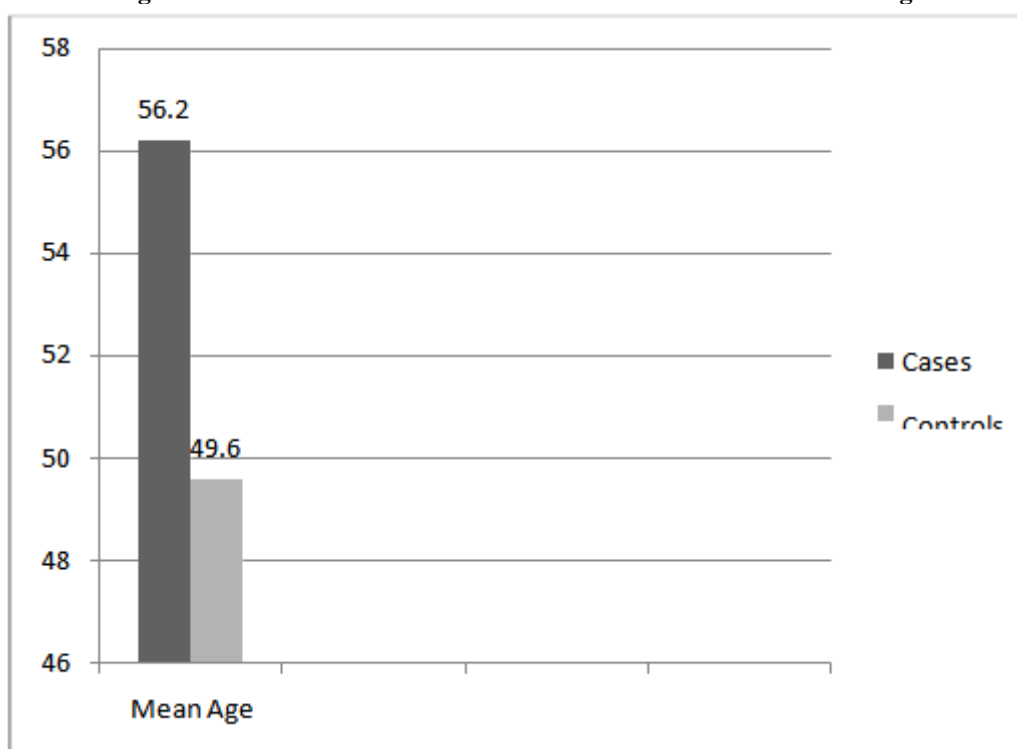


Majority of the patients in both the study and control group lie between 31 and 70 years. The mean age group in both the case and control groups are 56.2 ± 11.6 and 49.6 ± 10.8 respectively. There was no significant difference in the age composition of those with and without hypertension in this study with a 'p' value of 0.066. The details are shown in the Table V below and in Figure 2.

Table 2: Distribution of cases and controls in relation to the Mean Age

	Cases (n = 35)		Controls (n = 15)		P value	Statistical test
	Mean	SD	Mean	SD		
Age	56.2	11.6	49.6	10.8	0.066	Unpaired 't' test

Figure 2: Distribution of cases and controls in relation to the Mean Age



Gender : Among the 35 cases studied, there were 17 males and 18 females. Among the controls, there were 5 males and 10 females. The details are given in the Table 3 provided below and shown in Figure – 2.

Table 3: Distribution of cases and controls in relation to gender

Age	Cases		Controls		P value	Statistical test
	No.	%	No.	%		
Male	17	48.6	5	33.3	0.36	Fisher's Exact test
Female	18	51.4	10	66.7		
Total	35	100	15	100		

There was no significant difference in the gender when compared in those with and without hypertension in this study with a 'p' value of 0.36. The details are given in the Figure – 3 below:

Table 4: Serum Sodium levels in cases and controls

Serum Sodium	Cases		Controls		P value	Statistical test
	Mean	SD	Mean	SD		
	147.94	2.88	138.86	3.44	<0.0001	TWO way ANOVA

Data are expressed as mean and standard deviation. This table above clearly shows that the serum sodium levels was significantly more among hypertensives with a 'p' vale of <0.0001.

Serum sodium in relation to gender :

The mean value of serum sodium was 148 ± 3.65 meq / L in males and 147.88 ± 2.22 meq / L in females among cases. The mean value of serum sodium was 137.6 ± 1.67 meq / L in males and 139.5 ± 3.97 meq / L in females among controls. This is shown in Table – XVI given below and in Figure – 12.

Table 5: Serum Sodium values in relation to gender

Sex	Cases	Controls
Male	148 ± 3.65	137.6 ± 1.67
Female	147.88 ± 2.22	139.5 ± 3.97

Data are expressed as mean and standard deviation.

Distribution of cases and controls in relation to serum potassium :

Serum potassium in the study population varied from 3.1 to 5.2 mmol / L and in the control from 3.8 to 4.8 mmol / L. The mean and standard deviation of serum potassium among cases was 4.03 ± 0.49 mmol / L while in the control group it was 4.29 ± 0.33 mmol / L respectively. This table clearly shows that the serum potassium level was significantly lower among the hypertensive population studied.

Table 6: Serum potassium level in cases and controls

Serum Potassium	Cases		Controls		P value	Statistical Test
	Mean	SD	Mean	SD		
	3.55	0.29	4.67	0.22	<0.0001	TWO way ANOVA

Data are expressed as mean and standard deviation. This table above clearly shows that the serum potassium levels was significantly lower among the hypertensive population with a 'p' vale of <0.0001.

Serum potassium in relation to gender :

The mean value of serum potassium was 3.62 ± 0.32 meq / L in males and 3.48 ± 0.26 meq / L in females among cases. The mean value of serum potassium was 4.68 ± 0.16 meq / L in males and 4.67 ± 0.25 mmol / L in females among controls. This is shown in Table – XVIII given below and in figure – 14.

Table 7: Serum potassium values in relation to gender

Sex	Cases	Controls
Male	3.62	4.68
Female	3.48	4.67

Urinary analysis was not contributory. Blood glucose, serum urea and serum creatinine of the cases were well within acceptable limits and did not differ from healthy controls.

Electrocardiogram revealed left ventricular hypertrophy in about 17 percent of study group. Chest X ray showed cardiomegaly in about 17 percent of cases. Ocular fundus examination revealed hypertensive retinopathy in about 14 percent of the study group. On statistically analysing the above factors using Fisher's Exact test, it was found to be statistically insignificant.

IV. Discussion

Hypertension is one of the leading causes of death and disability among adults all over the world. Hypertension is the most common form of cardiovascular disease and is present in nearly 25% of adults and increases in prevalence with increasing age. It remains the major risk factor responsible for coronary, cerebral and peripheral vascular disease. Primary hypertension comprises more than 90% of hypertension.⁵

Patients were studied on the basis of clinical parameters and simple biochemical investigations. Serum sodium and potassium was done for all the patients.

Serum sodium among Hypertensives: In our part of the country, there is excessive intake of dietary salt. But in spite of that not everyone has primary hypertension. The rarity of hypertension among those consuming large amount of salt may probably be related to chronic adaptation of body system towards renal clearance of sodium. However this aspect of chronic adaptation of sodium handling by kidneys requires further molecular studies. So in addition to the hereditary predisposition and high sodium intake and lower potassium intake, the renal handling of these captions also play an important role in the pathogenesis of essential hypertension.⁶

Salt intake was more in the tropical countries by and large in order to overcome sodium loss through sweating. In modern days the consumption of salt is more than earlier days in view of various food preparations or a combination of them, as man is tuned more to taste of the food. Combination of food materials requires additional salt. As a result, people consume more than actually required (2 vs. 8-10 g /day / person). Such an amount of salt consumption contributes for the development of hypertension in a genetically susceptible population. In our study the mean serum sodium was estimated in the control and study groups. Results were compared with other studies. Serum sodium was higher in the hypertensive group than the control group even though both were within the normal range. The mean and standard deviation of serum sodium among cases was 147.94 ± 2.88 meq/L while in the control group it was 138.86 ± 3.44 meq/L respectively.^{7,8}

Our study was supported by Jan et al (2006), Srinagar, Kashmir. In his study, one hundred thirty five hypertensive patients and equal number of age and sex matched healthy controls were taken 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 .⁹

Serum sodium was higher in the hypertensive group than the control group and considered to be a factor responsible for the causation or perpetuation of blood pressure.¹⁰

A study was carried out by Lever et al of arterial pressure and body content of electrolytes in 91 patients with essential hypertension and 121 normal controls.

V. Conclusion

The following conclusions were derived from our study.

1. Serum sodium was significantly more among the hypertensive population and it was independent of the gender.
2. Serum sodium level also correlated positively with the level of blood pressure.
3. Serum potassium was significantly less among the hypertensive population and it correlated negatively with the level of blood pressure.
4. Overweight and obesity also plays a role in the development of primary hypertension.
5. In view of the significant changes in the serum sodium and potassium levels among the hypertensive population, community must be motivated to reduce their intake of common salt and encouraged to consume potassium rich nutrients diets as a form of primary prevention for primary hypertension.

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