**Original research article**

# Study the Association between 24 Hours Urinary Sodium, Potassium Excretion and Blood Pressure in Patients With Primary Hypertension

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## Abstract

**Background:** High blood pressure or Hypertension is a very serious problem now a days. Directly intake of sodium in the form of sodium salt helping to trigger prevalence of hypertension, at the same time intake of potassium decreasing the blood pressure level. **Aim and Objective**: Present study aimed to study the association between 24 hours urinary sodium and Potassium excretion and blood pressure in patients with primary hypertension. **Material and Methods**: This randomized prospective study conducted between May 2019 and July 2020, in which each of 30 patients with hypertensive and non-hypertensive admitted to Department of General Medicine, MNR Medical College and Hospital, Sangareddy, as per the as per JNC VI report-BP – 140/90 mmHg least at three different occasions after refraining from anti-hypertensives and diuretics included in the study and blood pressure, biochemical parameters in the blood, anthropometric measurements, and 24-hour urine samples were obtained. Data was collected and analyzed by statistical software SPSS V 25. **Result**: Total population of 60 patients aged between 18 to 75 years distributed between cases and control as per the criteria. Average age of the patients were 49.45 ± 8.91 Years. The overall mean sodium and potassium excretion was 164.70 ± 18.85 mmol/day) and 53.68 ± 7.78 mmol/day, respectively. The average ratio of systolic/diastolic blood pressure was 139.47 ± 25.89/87.40 ± 11.12 mmHg. Age, gender, BMI and serum cholesterol had significant influence on 24 hour urinary sodium excretion. Urinary sodium was positively significant correlated with systolic and diastolic blood pressure. Present study showed that SBP and DBP were significantly associated with sodium intake among primary hypertensive and showed inversely associated with potassium. These associations were mainly driven by the hypertensive group. **Conclusion**: From overall analysis study conclude that in order to decline the prevalence of essential hypertension and resist to go at hypertensive crisis stage, reduction in salt intake for long term would be beneficial and also morbidity and mortality due to cardiovascular disease and stroke can be reduced.

***Keywords***: Hypertension, Urinary sodium, Potassium, Blood Pressure

## Introduction

A Muscular organ about the size of a fist, which is located just behind and slightly left of the breastbone called as heart. It is designed to pumps constant supply of blood through the network of arteries and veins to regulate cardiovascular system of the body. In order to regulate proper functioning of the body pumping of heart plays very important role. Thus,

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measurement of the force of the blood is common procedure to know the proper functioning of heart, Measurement of this force of the blood against the walls of the arteries called as blood pressure. This blood pressure measured in mmhg. To asses this pressure there are two numbers generally used called as systolic blood pressure and diastolic blood pressure. Systolic Blood Pressure is that maximum pressure on the arteries during the contraction of ventricles, normally that pressure is 120mmhg. Diastolic Blood Pressure is that minimum arterial pressure during relaxation and expansion of the ventricles filled with blood of the heart, normally it is 80mmhg . Person having normal blood pressure when these two numbers are in the range of 120/80mmhg , but when these numbers goes beyond the 140/90mmhg or elevation of pressure of blood on the arteries of heart called high blood pressure or Hypertension, it is the primary risk factor for the disturbance of cardiovascular system, leading to the cardiovascular disease.

In India prevalence of hypertension is now increasing day by day, currently it is 21.1% among population. Every one among three is suffered with hypertension. [1] Among the hypertensive, 85% people they don't know secondary cause of hypertension called as primary or essential hypertension and remaining 15% of the people have known secondary cause.[2] Risk factors for hypertension incidence include genetic predisposition, age, sex, BMI, smoking, alcoholism and lifestyle factors. Among lifestyle factors, high dietary sodium and low potassium intakes were found to be associated with blood pressure in many studies. [3 4] "Prevalence of essential hypertension increases with age, and individuals with relatively high blood pressure at younger ages are at increased risk for the subsequent development of hypertension"[5] High intake of sodium is directly related to the Blood pressure and cardiovascular events and that of low potassium intake is inversely proportional. But some studies shows that there is positive correlation between urinary $Na^+/K^+$molar ratio and blood pressure. [6] Thus to develop primary hypertension, interaction between these nutrients plays a dominant role. "The average global sodium intake among adults has remained stable over the years at ∼4000 mg/day (∼10 g/day of salt). As a strategy to reduce population BP levels and prevent cardiovascular disease, the World Health Organization has recommended a sodium intake of <2000 mg/day (equivalent to 5 g/day of salt)." [7]

There are many studies available to show the association between the sodium or potassium intake with overall BP or hypertension in the population, but to show the association between 24 hour urinary sodium and potassium excretion with primary hypertension are limited, thus we have undertaken this to study association between 24 hour urinary sodium and potassium excretion with primary hypertension.

**Material and Methods**

This randomized prospective study was conducted in the Department of General Medicine, MNR Medical College and Hospital, Sangareddy. Total 60 patients were included in the study between May 2019 and July 2020.

**Inclusion Criteria:**

1. Age between 18 and 75 years.
2. Hypertension as per JNC VI report-BP – 140/90 mmHg.

**Exclusion Criteria:**

1. Patients with secondary hypertension.
2. Patients on NSAIDs, anti-hypertensives, diuretics.
3. Patients with congestive cardiac failure.

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4. Patients with malignant hypertension.
5. Females on oral contraceptive medications.

Data were collected by detailed history, anthropometric measurements, Blood pressure measurements, Complete hemogram, Urine analysis, Serum sodium and potassium, 24 hours urinary sodium and potassium excretion. $Na^+/K^+$ molar ration was calculated.

**Statistical Analysis:** Collected data were entered in the Microsoft excel 2016. Baseline characteristics between cases and controls were compared using student t test for quantitative variables and chi square test for qualitative variables. Relationship between different variables were analyzed by partial correlation. P value <0.05 was considered significant.

**Results:**
Present study conducted with 60 samples (30 each in cases and controls) in the Department of General Medicine MNR Medical College and Hospital, Sangareddy from the data analysis we found the results discussed below. Observation and results of data shown bellow.

**Table 1: Distribution of Socio-Demographic data.**

| Parameters | Cases(n=30) | Controls (n = 30) | P-value | Chi-square/t-value |
|---|---|---|---|---|
| | n(%) / Mean ±SD | | | |
| Male | 17(56.70) | 16(53.30) | 1.00 | 0.067(NS) |
| Female | 13(43.30) | 14(46.70) | | |
| Age | 49.9 ±9.282 | 49 ±8.67 | 0.699 | 0.388(NS) |
| BMI | 24.37 ±2.60 | 23.351 ±1.89 | 1.744 | 0.087(NS) |
| <25 | 19(63.30) | 24(80) | 0.152 | 2.025(NS) |
| ≥25 | 11(36.70) | 6(20) | | |
| Systolic Blood Pressure | 163.8 ±10.324 | 115.13 ±5.746 | <0.001 | 22.56(Sig) |
| Diastolic Blood Pressure | 97.47 ±4.577 | 77.33 ±4.589 | <0.001 | 17.05(Sig) |

Above table shows the distribution of socio-demographic variable, in hypertensive group, there were 17(56.70%) males and 13(43.30) females that of in the normotensive group, there were 16(53.30%) males and 14(46.70%) females. Gender, age, Body mass index were non-significant between hypertensive and non-hypertensive group. But the systolic blood pressure and Diastolic blood pressure between hypertensive and normotensive were statistically highly significant (P-value<0.01) shown in the above table 1.

**Table 2: Mean Distribution of various blood and urinary parameters**

| **Parameters** | **Cases (Mean ±SD)** | **Controls (Mean ±SD)** | **P-value** | **t-value** |
|---|---|---|---|---|
| Serum Cholesterol | 194.47 ±16.186 | 181.6 ±9.782 | 0.001 | 3.726 (Sig) |
| Serum Sodium | 140.1 ±4.147 | 138.5 ±2.726 | 0.09 | 1.766 |
| Serum Potassium | 3.9 ±0.4009 | 3.79 ±0.3089 | 0.24 | 1.191 |
| Blood Sugar | 103.23 ±9.651 | 102.57 ±6.579 | 0.313 | 0.756 |
| Urinary Sodium | 172.7 ±15.914 | 156.7 ±18.378 | 0.001 | 3.605(Sig) |
| Urinary Potassium | 52.3 ±7.571 | 55.07 ±7.882 | 0.171 | -1.386 |
| Na/K Ratio | 3.37 :1 | 2.9:1 | 0.01 | Significant |

Table shows the mean distribution of blood and urinary parameters between hypertensive and normotensive, among the parameters serum cholesterol, serum sodium, serum potassium, blood sugar and urinary potassium there were no significant difference between mean distribution cases and controls, but urinary sodium and Na/K ratio showed statistically significant difference.

In systolic blood pressure out of all, 11 subjects had primary hypertension and sodium and potassium level were 163.63 and 49.72 respectively, and 19 subjects had moderate to severe hypertension and sodium and potassium level were 177.94 and 53.78 respectively. There is significant difference observed between these two levels for sodium only, other parameters urinary potassium and Na/K ratio were non significant.

In diastolic blood pressure out of all, 21 subjects had primary hypertension and sodium and potassium level were 167.95 and 51.61 respectively, and 9 subjects had moderate to severe hypertension and sodium and potassium level were 183.77 and 53.88 respectively. There is significant difference observed between these two levels for sodium only, other parameters urinary potassium and Na/K ratio were non significant.

**Table 3: Mean Distribution of Urinary parameter between systolic and diastolic blood pressure level**

| Parameters | Systolic Blood Pressure Levels | | t-value | P-value |
|---|---|---|---|---|
| | Mild(n=11) | Moderate to Severe (n=19) | | |
| Hypertensive cases | | | | |
| Urinary Sodium | 163.63±13.00 | 177.94±15.32 | -2.598 | 0.015 |
| Urinary Potassium | 49.72±6.24 | 53.78±8.01 | -1.44 | 0.16 |
| Na /K | 3.35±0.544 | 3.38±0.60 | -0.138 | 0.891 |
| Diastolic Blood Pressure Levels | | | | |
| | Mild(n=21) | Moderate to Severe (n=9) | | |
| Urinary Sodium | 167.95±12.01 | 183.777±18.97 | -2.768 | 0.01 |
| Urinary Potassium | 51.61±7.81 | 53.88±7.14 | -0.747 | 0.46 |
| Na /K | 3.33±0.59 | 3.45±0.555 | -0.509 | 0.615 |

Correlation co-efficient between 24-hour urinary sodium excretion and systolic blood pressure and Diastolic blood pressure were 0.565 and 0.598 respectively, and p-value was less than 0.01 means it was statistically significant. But at same time correlation co-efficient between 24-hour urinary Potassium excretion and systolic blood pressure and Diastolic blood pressure were -0.133 and -0.183 respectively and p-value was more than 0.01 means it was statistically not significant. Shown in table no. 4

**Table 4: Correlation between sodium and potassium with blood pressure**

| | Systolic Blood Pressure, r(P-value) | Diastolic Blood Pressure, r(P-value) |
|---|---|---|
| Urinary Sodium | 0.565(<0.001) | 0.598(<0.001) |
| Urinary Potassium | -0.133(0.311) | -0.183(0.162) |

**Discussion:**

Hypertension is very big and serious problem globally now a day, out of all these hypertensive patients essential hypertension accounts for about 85% [3]. It is also observing that direct sodium intake is helping to trigger prevalence of hypertension, and because of this morbidity and mortality are increasing due to cardiovascular diseases and stroke.

There are multiple factors are responsible for the development of hypertension. One of the causal factors proposed is high sodium intake along with low potassium intake and excretion. [2] Our present study was conducted to test this causal relationship between sodium, potassium intake and hypertension by measuring 24 hour urinary sodium and potassium excretion.

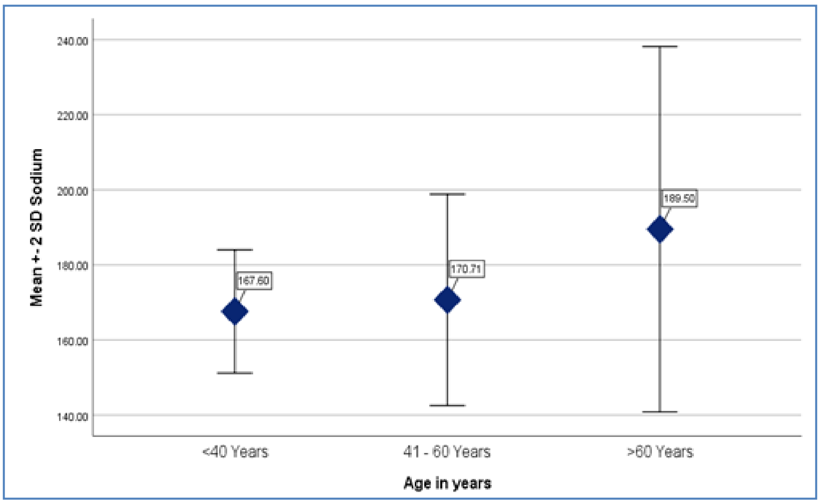


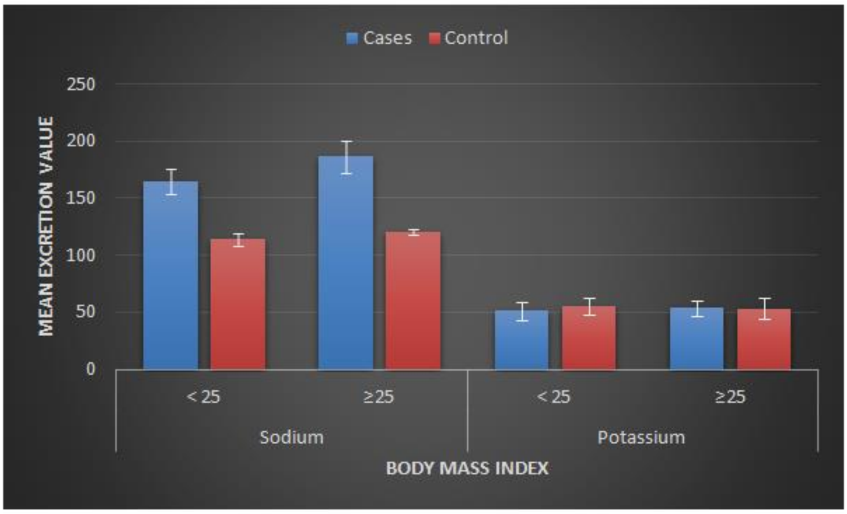

**Figure 1: 24 hour's urine excretion in advancing age**

**Age**:

In the present study, mean age of the study group was 49.9 ± 9.282 years and minimum age was 36 years, age is the first factor associated with the blood pressure. Because of low glomerular filtration rate and an increase of renal disease in increasing age factor, conservation capacity of sodium in kidneys increases and due to which urinary sodium excretion in elderly people increases observed in our results. Our results are supported by study conducted by **AI, Ayus JC et al. and Soiza RL et al.** [8, 9]

**Gender:**
In the present study, in study group male is to female ratio was 1.30:1. In this study it is observed that 24 hours urinary sodium excretion was higher and statistically significant in female compared to male, but it contradicts the study conducted by Simpson et al in 1978 found that mean 24-hour urinary sodium excretion at all ages was significantly higher in males when compared to females.[10]

**Body Mass Index:**




Our study demonstrated a significant impact of BMI on 24 hour urinary sodium excretion. In both hypertensive and normotensive groups,24 hour urinary sodium excretion increased significantly with high BMI. There was no association between urinary potassium excretion and BMI in either group. Simpson et al in 1978 also proved similar relationship of BMI with urinary sodium excretion and hypertension as observed in our study. [10]

**Serum Cholesterol:**
Serum cholesterol is also one of the risk factor significantly associated with the high blood pressure (p-value<0.001), supported the study conducted by P., Libby et al [11]

**Correlation between 24-hours sodium and potassium excretion and Blood pressure:**
In hypertensive patients, systolic and diastolic blood pressure was significantly correlated (P-value <0.01) with 24 hours urinary sodium excretion but potassium excretion was not correlated with systolic and diastolic blood pressure (P-value > 0.05) supported by B.M.Y. Cheung et al in Chinese population.[12]

**Mean distribution of Sodium and Potassium in prehypertension**
Mean distribution of 24 hours sodium excretion in systolic blood pressure of study group was less in prehypertensive patients compared to the moderate to severe patients, and that difference between mean sodium was statistically highly significant (p-value < 0.01). Similarly in diastolic blood pressure of the same group excretion of sodium was less in hypertensive patients compared to the moderate to severe patients, and that difference between mean sodium was statistically highly significant (p-value<0.01).
But potassium excretion and Sodium to potassium ratio were statistically not significant between the prehypertensive and moderate to severe levels in systolic and diastolic blood pressure, these results were supported by study conduced by ZHAO et al[13] found that,

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"increased urinary Na- K ratios and urinary sodium levels are associated with an increased risk of CVD and hypertension in patients with prehypertension."

**Conclusion:**
From overall analysis and discussion, we can conclude that, triggered 24-hour urinary sodium excretion and low potassium excretion in our study suggests that both very high sodium intake and low potassium intake play a significant role individually and combinedly, thus in order to decline the prevalence of essential hypertension and resist to go at hypertensive crisis stage, reduction in salt intake for long term would be beneficial and also morbidity and mortality due to cardiovascular disease and stroke can be reduced.

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**Ethical Approval:** Approved by Institutional ethical committee.

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