

Does BMI Plays a Role in the Association Between Salt Intake and Blood Pressure? A Cross Sectional Study Among the Rural Population of Puducherry

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Abstract

Context: Hypertension is considered to be a lifestyle disorder with previous studies showing a direct association between salt intake and hypertension, also between overweight, obesity and hypertension. **Aims:** To assess the amount of salt intake in normotensive and hypertensive subjects 2. To determine whether the association between salt intake and blood pressure is correlated by body mass index. **Settings and Design:** A community based cross-sectional descriptive study. **Methods and Material:** House to house enumeration survey among 1347 individuals was conducted from September 2016- June 2017 and from adults in the enumerated houses, information on socio-demographic factors and salt intake were collected and the blood pressure, height, weight were measured by standard protocols. **Statistical analysis used:** Quantitative variables were summarised using mean and standard deviation, qualitative variables were summarised using frequency percentage. Partial correlation was used to find the association of BMI in Salt intake and blood pressure. **Results:** The mean age group of our study population was 33.64 (+19.53) years and majority (53.4%) of them were females. The mean Body Mass Index (BMI) was 25.33 + 5.57 and 23.4 % had high BMI. The average salt intake of our study population was 10.87 + 6.57 gms/day. The association between salt intake and prehypertension is mediated by high BMI with a significant correlation coefficient of 0.33. **Conclusions:** The association between salt intake and blood pressure is related to body weight and measures on weight reduction especially among prehypertensive and high salt in takers will help to reduce further complications.

Keywords: Salt intake; Blood pressure; Body mass index.

Key messages: Hypertension being considered as a lifestyle disorder, repeated emphasis is always made on reduction of salt intake around the world by the physicians. Our study arrays that the association of salt intake and blood pressure is mediated by the Body mass Index

Introduction

WHO depicts hypertension as a "Silent, invisible killer" affecting one billion population around the world, leading to heart attacks and strokes and there by killing 9.4 million people around the world. When high income countries have started reducing the burden of hypertension in their population,

many developing countries have been witnessing increased burden of cardiovascular diseases due to undiagnosed and uncontrolled hypertension.¹

High dietary salt is one of the major global health risks. More than 300 million are estimated to have hypertension caused due to high dietary salt. The World Health Organization (WHO) has indicated that reducing the dietary salt is the best

way to improve health.² As per the systemic review by George Institute of Global Health. An average Indian consume 10.98 gm per day of salt which is 119% higher than the 5 gm per day recommended by the WHO.³ It is estimated that around the world 62% of the cerebrovascular disease and 49% of the ischemic disease are attributed by elevated blood pressure and it has been evident from the various studies that high salt intake is associated with elevated blood pressure and globally 1.65 million deaths from cardiovascular disease that is 1 in every 10 deaths are attributed by high sodium intake of more than 2 gm per day.^{4,5}

On the other hand Obesity is an independent risk factor for causing hypertension and India is in a procedure of rapid economic development and modernization with changing way of life factors has an increasing trend of hypertension especially among urban population. It is predicted that compared to 2000 by 2025 the adults with hypertension will be increased to 60% contributing 1.56 billion of the population and the relevance of hypertension and obesity as a important public health challenge is increasing worldwide.⁶

Thus High blood pressure is a double edged sword with one edge being High salt intake and the other being obesity. But there has not been much research in exploring does the high salt intake and high blood pressure is mediated by body mass Index (BMI). Thus the present study try to explore the BMI as a mediator in the association between salt Intake and Blood pressure.

Materials and Methods

The study was a cross-sectional analytical study conducted among the adult population in rural Puducherry. Puducherry is an union territory situated in the Bay of Bengal is an enclave of Tamil Nadu. Four villages (Bahour, Kuruvintham, Pillaiyarkuppam and Irulansandai) located closer to our institute were selected conveniently, all the houses in selected villages were enumerated and all the individuals of more than age eighteen years were included through non-probability sampling. Thus 448 households and 1347 individuals were included for the present study

A semi-structured interview using electronic form epicollect v 5.0 was used and variables such as socio-demographic factors (age, gender, education, occupation, socio-economic status, marital status, caste) and salt intake was captured. A sample size of 316 was calculated by taking prevalence as

29.8% from systematic review by anchala *et al.*⁷ for measurement of blood pressure, height and weight. A standardised protocol was followed and blood pressure, height and weight were measured for 333 individuals

Each house in the selected village were enumerated and Interviews were conducted by trained MBBS students under the supervision of faculties and post graduates, among those individuals who are available and information of those are not available was extracted from the available individuals. If the house is locked during the first visit one more attempt was made to cover the whole population.

Data entry and Analysis: Data was entered using epidata v3.0 and was analysed using STATA 12 software. Percentage was used to summarize the categorical variables. Regression analysis was used to find the association between the sociodemographic factors and the risk of hypertension and Partial correlation was used to find the mediation of BMI in the association of salt intake and hypertension.

Results

In a total of 448 households 1347 individuals were included and the Mean age of the population was 33.64 (± 19.3) out of which nearly half of the population was female (53.4%). The average salt intake of the population was 10.87 ± 6.57 and more than 840 (62.4%) of the population had a salt intake of more than 5 gm per day. Height, weight and blood pressure of 333 people were recorded. The mean Body Mass Index (BMI) was 25.33 ± 5.57 and 23.4% had high BMI. Around 33% of the population are pre-hypertensive and 13% are hypertensives.

Three-fourth (75.6%) of the elderly population (>60 years) had a salt intake of more than 5 gms. The association of socio-demographic factors as per salt intake and blood pressure was analysed and nearly 75.6% of the people more than 60 years were found to take a salt intake of >5 gm per day and the association was found to be statistically significant ($p < 0.05$). Nearly half (54.7%) of the population have had formal school education and the majority 1022 (75.9%) of the population belongs to Type IV Socio Economic class. The prevalence of pre-hypertension and hypertension was high among Socio-economic class III. Almost 5% of the people with no formal school education are hypertensive and nearly 9.6% of the people are pre hypertensive (Table 1).

Table 1: Distribution of socio-demographic factors as per salt intake and blood pressure among adults in rural areas of Puducherry N=333

| | Association with salt intake | | p-value | Association with Blood pressure | | | p-value |
|----------------------------|------------------------------|--------------|---------|---------------------------------|------------------|--------------|---------|
| | <5 gm | >5 gm | | Normal | Pre-Hypertension | Hypertension | |
| Age | | | | | | | |
| 0-20 | 150 (42.0%) | 207 (58.0%) | | 349 (97.8%) | 8 (2.2%) | 0 | |
| 20-40 | 213 (39.3%) | 329 (60.7%) | | 464 (85.6%) | 67 (12.4%) | 11 (2.0%) | |
| 41-60 | 115 (35.0%) | 214 (65.0%) | .004 | 260 (79.0%) | 50 (15.2%) | 19 (5.8%) | <0.01 |
| >60 | 29 (24.4%) | 90 (75.6%) | | 85 (71.4%) | 20 (16.8%) | 14 (11.8%) | |
| Socioeconomic Class | | | | | | | |
| Class II | 118 (86.1%) | 19 (13.9%) | 0.00 | 117 (85.4%) | 15 (10.9%) | 5 (3.6%) | <0.01 |
| Class III | 40 (21.4%) | 147 (78.6%) | | 135 (72.2%) | 38 (20.3%) | 14 (7.5%) | |
| Class IV | 349 (34.1%) | 673 (65.9%) | | 905(88.6%) | 92 (9.0%) | 25 (2.4%) | |
| Education | | | | | | | |
| No formal Education | 141 39.8% | 213 60.2% | | 305 86.2% | 34 9.6% | 15 4.2% | |
| School education | 290 39.5% | 443 60.4% | .000 | 626 85.4% | 83 11.3% | 24 3.2% | .714 |
| Graduate | 65 31.7% | 140 68.3% | | 182 88.8% | 20 9.8% | 3 1.5% | |
| Occupation | | | | | | | |
| Not Employed | 319 (38%) | 519 (61.9%) | | 711 (84.8%) | 97 (11.5%) | 30 (3.5%) | |
| Unskilled | 52 (35.1%) | 96 (64.8%) | | 122 (82.4%) | 20 (13.5%) | 6 (4%) | |
| Semi-Skilled | 1 (11.1%) | 8 (88.9%) | | 7 (77.8%) | 1 (11.1%) | 1 (11.1%) | |
| Skilled | 129 (39.3%) | 199 (60.6%) | | 300(91.4%) | 22 (67%) | 6 (1.8%) | |
| Professional | 0 | 16 (100%) | .024 | 12 (75.0%) | 4 (25.0%) | 0 | .025 |

On analysis of distribution of salt-intake as per BMI and blood-pressure it was found that the prevalence of hypertension (13.4) was high among those who consume salt of more than 5 gm (Fig. 1) and the distribution of salt intake as per BMI is

illustrated through a Box and Whisker plot (Fig. 2) which reveals obese people tend to have higher amount of salt intake with a Median of 2 gm per day (IQR 1-3 gm).

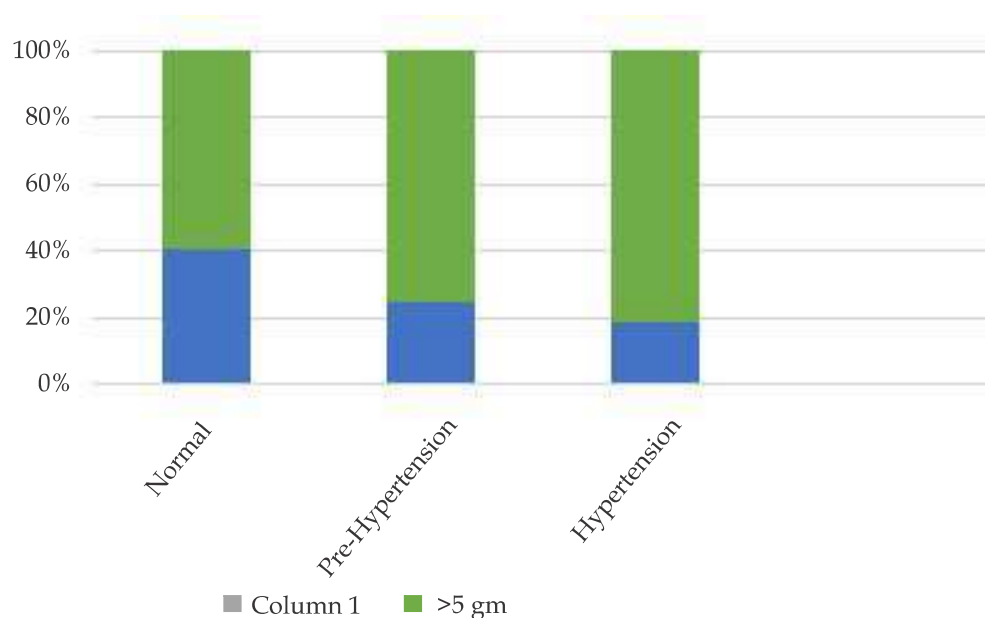


Fig. 1: Distribution of salt Intake as per Blood pressure N=333

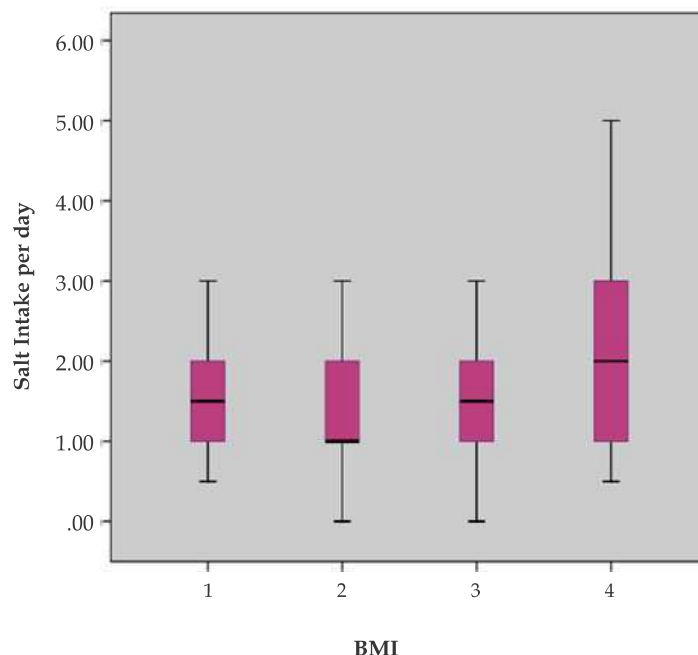


Fig. 2: Distribution of Salt intake as per BMI N=333

Odd's Ratio for risk of hypertension was calculated through Ordinal Regression reported in Table 2 revealed that People of Age >60 are 7.9 times of higher chance of being hypertensive and

People who are obese are 2.6 times higher chance of being hypertensive. Further people who consumes salt of >5 gm per day are 2.2 times risk of being hypertensive.

Table 2: Odds Ratio for Risk of Hypertension among the adult population in rural area of Puducherry N=333

| | | Risk of Hypertension | |
|----------------------------|--------------|----------------------|-------|
| | | Odds Ratio* 95 % CI | Sig |
| Age | Age <20 | Ref | |
| | Age 20-40 | 1.94 (0.7-4.7) | 0.150 |
| | Age 41-60 | 3.11 (1.2-7.7) | 0.015 |
| | Age >60 | 7.99 (2.8-22.4) | 0.000 |
| Socioeconomic class | Class II | 1.45 (0.6-3.1) | 0.447 |
| | Class III | 1.64 (0.5-1.5) | 0.884 |
| | Class IV | Ref | |
| Occupation | Not employed | 0.29 (0.01-4.8) | 1.586 |
| | Unskilled | 0.57 (0.03-10.1) | 2.318 |
| | Semi skilled | 0.46 (0-7.9) | 2.079 |
| | Skilled | 0.28 (0.02-8.1) | 2.093 |
| BMI | Professional | Ref | |
| | Underweight | Ref | |
| | Normal | 2.5 (1.1-5.8) | |
| | Overweight | 4.0 (2.0-8.2) | 0.248 |
| | Obese | 2.6 (1.3-5.2) | 0.589 |
| Salt Intake | Salt <5 gm | Ref | |
| | Salt >5 gm | 2.28 (1.5-3.2) | .000 |

The Partial correlation between Salt Intake and Systolic blood pressure was in significant after controlling for BMI (Salt Intake $r=0.09$ $p=0.08$) while

the uncontrolled Partial correlation turned out to be significant for both BMI and Salt Intake (Salt Intake $r=0.11$ $p=0.04$, BMI=0.04, BMI $r=0.13$ $p=0.02$) (Table 3)

Table 3: Depicting the partial correlation of BMI as a mediator in the correlation between salt intake and hypertension

| Unadjusted | Systolic Blood Pressure | |
|-----------------|-------------------------|------|
| | r | p |
| Salt Intake | 0.11 | 0.04 |
| BMI | 0.13 | 0.02 |
| Adjusted | | |
| Salt Intake | 0.09 | 0.08 |

p-value <0.05 significant

Discussion

The average salt intake of the population in our study was 10.87 ± 6.57 and it was nearly the same of the national average calculated in the systemic review conducted by George Institute of Global health in 2014.⁴ The prevalence of hypertension and pre-hypertension was 13% and 33% in our population which was significantly lower than the survey done by Tripathy *et al.* based WHO Steps survey in North India which was 40.1% and 40.8% respectively.⁸ India in a multistage stratified sample of 5127 individuals. The study subjects were administered the WHO Steps-questionnaire and also underwent anthropometric and blood pressure measurements. Results Overall prevalence of HTN among the study participants was found out to be 40.1% (95% CI: 38.8–41.5%)

In the present study it was identified that the prevalence of hypertension (13.4) was high among those who consume salt of more than 5 gm and the salt was high among the obese persons, This can be compared with the study by Deekala *et al.* in Tirupati were they have found 23.8% of the people who consume additional salt intake are hypertensives but the results are not significant.⁹ Similarly our study found that the people who are obese are 2.6 times risk of developing hypertension this is lower than the study done in Varnasi by Singh *et al.* were they have found that obese are 3.57 times risk of developing hypertension. Similarly in their study people of Age 55–64 are 6.49 times risk of developing hypertension while in our study people of age >60 are 7.9 times at the risk of being hypertension.¹⁰

In our study the partial correlation of Systolic Blood pressure of Salt Intake and Body Mass Index showed significant results while after controlling for BMI the correlation of Salt Intake and SBP were insignificant. This implies that the BMI has a influence over the relation of salt intake and blood pressure which is similar to the Iranian study done by Haghghatdoost *et al.* and have also concluded that the association between salt intake and blood pressure is related to BMI.¹¹

Thus, the present study concludes that the Body Mass Index plays as a mediator in the association between the Salt Intake and Blood pressure. Thus appropriate measures need to be taken for the reduction of weight especially among pre-hypertensives and also reduction of salt intake measures need to be carried out for the further reduction of complications. Integrated programmes targeting both weight reduction and salt intake can be carried out for the control of burden of hypertension.

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