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Correlation Study of Nutrient Intake to the Blood Pressure of Selected Hypertensives from India

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Abstract—*Hypertension (HTN) regarded as the "Silent Killer" has been recognized as a major risk factor for several common cardiovascular diseases. Keeping in view the epidemicity of the disease, the present study was planned and executed with the specific objectives to assess the nutritional status of selected hypertensive subjects (54.61% male and 45.39%). The mean energy intake of all the subjects i.e. 3156.03±28.60 Kcal (of male) and 2695.33±10.90 Kcal (of female) and visible fat was found to be significantly (P<O.01) higher than the RDAs. Correlation studies showed a positive correlation of systolic as well as diastolic BP with the energy intake, total fat intake. sodium intake. whereas, a negative correlation was found of systolic BP as well as diastolic BP with potassium intake by all the hypertensive subjects. A negative correlation was found of SBP and DBP with the intake of protein, Ca and Na: K ratio of the male subjects. Public health approaches such as reducing calories, saturated fat and salt reduction in the food supply should be encouraged to achieve downward shift in population's BP towards normal ranges.*

1. INTRODUCTION

Hypertension (HTN) or elevated arterial blood pressure (HBP) or simply high blood pressure is regarded as the **"Silent Killer"** because it generally causes no symptoms or very few, if any. One of the most dangerous aspects of the Hypertension is that it lurks silently in the circulatory system and strikes suddenly [15]. It is estimated that only 30 per cent of the individuals who have the disease are aware of their condition [7].It does not hurt and usually does not make a person feel sick, but if not detected or left uncontrolled, high blood pressure increases the risk of life threatening complications like heart disease, stroke, kidney problem and blindness over a course of years [21]. The epidemiological surveys conducted in India indicate that a large majority of patients are either unaware of their disease or they are not properly treated [15]. In upto 95 per cent of cases, no clear cause of Hypertension can be identified. This type of blood pressure is known as "**Essential Hypertension**" and genetic factors play a role in its development. In about 5 per cent of cases HBP develops as a result of other medical or dietary disorders. This type of HBP is known as "**Secondary Hypertension".**

Modern chronic diseases, including cardiovascular diseases are the leading killers in westernized societies and are increasing rampantly in developing nations all over the globe [16] . Cardio vascular diseases (CVD) caused 2.3 million deaths in India in the year 1990; this is projected to double by the year 2020. Hypertension has been recognized as a major risk factor for several common cardiovascular diseases. The relationship between blood pressure (BP) and risk of CVD events is continuous, consistent and independent of other risk factors[19]. Hypertension accelerates the atherosclerotic process especially when hyperlipidemia is also present, contributes significantly to CVD and thereby associated with high mortality and morbidity [3]. Hypertension is directly responsible for 57 per cent of all stroke deaths and 24 per cent of all coronary heart disease deaths and moreover, affecting 25 million Indians [5]. Hypertension is epidemic affecting 50 million US people, and 25 per cent of the world's population [10].It was found that about 33% urban and 25% rural Indians are hypertensive. Of these, 25% rural and 42% urban Indians are aware of their hypertensive status. Only 25% rural and 38% of urban Indians are being treated for hypertension. One-tenth of rural and one-fifth of urban Indian hypertensive population have their BP under control [14].

2. MATERIALS AND METHODS

2.1 Domain of the study

The present study was undertaken in the Department of Food Science and Nutrition, College of Home Science, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, H.P. India. The present study was conducted on a total of one hundred thirty hypertensive subjects of age 30 years and above, selected randomly from Palampur region of Kangra District (H.P.).

2.2 Development / construction of Questionnaire/ interview schedule

Firstly a preliminary survey of few subjects was conducted to investigate their dietary habits and other baseline information for further investigation. A well structured and exhaustive questionnaire was formulated after consulting literature to collect the relevant information specifically keeping in mind the objectives of the study. Pre-testing of questionnaire was done by hypertensive patients other than the selected subjects and then evaluated for responses of the subjects. On the basis of collected information and difficulties faced, necessary improvements / modifications were incorporated to make it more functional and the finalized questionnaire.

2.3 Collection of data

Data was collected through personal interview method. An effort was made to develop a rapport with the subjects to extract correct information as far as possible. Cross checking and indirect queries were also raised to help ascertain the authenticity of data. In order to meet the objectives of the study.

2.4 Blood pressure measurement

Blood pressures (BP) of the subjects were determined during the course of the study using a mercury sphygmomanometer and the stethoscope. Blood pressure was reported as systolic / diastolic mm of Hg. A set of two blood pressure readings were recorded each time with a random zero sphygmomanometer reading to reduce the indeterminate type of errors. Mean of all the readings was taken as the final blood pressure of the subjects. [24,9].

	Blood pressure (mm Hg)		
Degree of Hypertension	**SBP**		**DBP**
Pre Hypertension	120-139	**or**	80-89
Stage I Hypertension	140-159	**or**	90-99
Stage II Hypertension	>/= 160	**or**	>/= 100

2.5 Nutrient intake

A 24-hour recall method for three consecutive days was used to collect information regarding food intake. Standard measures including glasses, *katoris,* serving spoons were used to record the amount of food consumed by the subjects. Detailed information about the ingredients used and the method of cooking was also recorded. The amount of cooked food consumed was converted into raw ingredients and the nutrient intake was calculated by using the value per 100 g of edible portion using Food Consumption Table [4]. Nutrient intake for three consecutive days was taken and the calculated mean values were used for further analysis. The mean nutrient intake by the subjects was compared with RDA [4,2]. and furthermore, correlation of nutrient intake with the blood pressure was also calculated.

2.6 Data analysis

2.6.1 Tabulation of the data

After collection of field data, the information was coded on the master sheets and then tabulated into master tables. Depending upon the objectives, different modes of classification i.e. sex wise, age wise and according to degree of Hypertension (HTN) were made to get maximum information from the data.

2.6.2 Statistical analysis

The tables were quantified using frequency tables and also calculated the percentages, standard errors and means for studying variables. The data was statistically analysed to find out various differences and associations among variables using x^2, correlation and t-tests (paired 't' test for nutrition education) [20].

3. RESULTS AND DISCUSSION

3.1 Number of the subjects

A total of 130 hypertensive subjects were selected randomly for the purpose, out of which, Out of the total hypertensive subjects 54.61 per cent were male and 45.39 per cent were female subjects Table 1and Figure 1.

Table 1: Gender wise distribution of Hypertensive subjects

Gender	Frequency (N=130)	Percentage
Male	71	54.61
Female	59	45.39

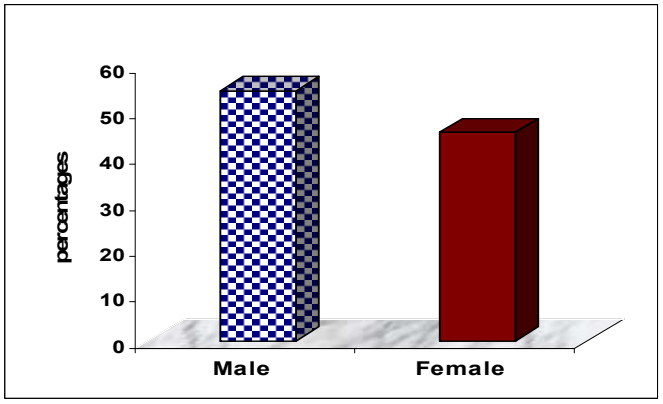

Figure 1: Gender wise distribution of Hypertensive subjects

3.2 Age wise distribution of the subjects

Majority of the subjects (50.77%) were of age ≥50 years followed by 37.69 per cent in the age group 40-50 years (26.76% of male; 50.85% of female) and the remaining (11.54%) were in the age group 30-40 years (Table 4.2). Unl and Farrel (1983) also reported higher prevalence of Hypertension in myocardial patients of age above 40 years of

age (45%) than in subjects below 40 years (29%) of age. According to Walia (1996) age of the hypertensive subjects ranged from 41 to 60 years with the mean age 51±5.0 years and reported positive correlation of age with the blood pressure. Moreover, a positive correlation was found between age and BP (SBP & DBP) of male subjects, however, a negative of SBP and positive of DBP with the age of the female subjects (Table 2 and Figure 2).

Table 2 Age wise distribution of Hypertensive subjects

Age (years)	Male (N=71)	Female (N=59)	Total (N=130)
30-40	8 (11.27)	7 (11.86)	15 (11.54)
Mean±SE	37.63±1.50	33.40±3.13	
40-50	19 (26.76)	30 (50.85)	49 (37.69)
Mean±SE	44.80±2.30	44.70±3.20	
50 & above	44 (61.98)	22 (37.29)	66 (50.77)
Mean±SE	55.27±5.24	57.90±6.70	

Figures in parentheses indicate percentages

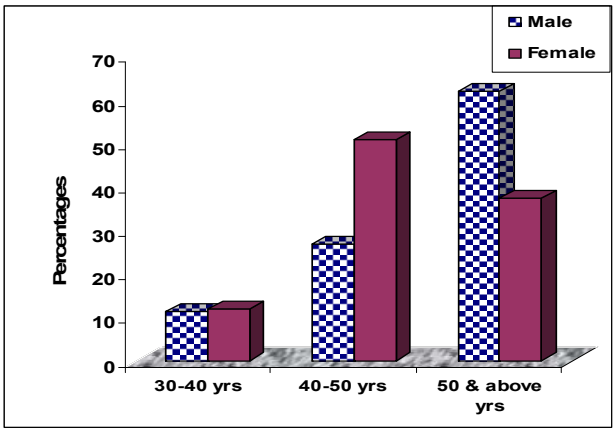

Figure 2 Age wise distribution of Hypertensive subjects

Whereas, the number of female subjects was found to be 7 (11.86%), 30 (50.85%) and 22 (37.29%) in the age group I, II, and III, respectively. The mean ± standard error age of male subjects was found to be 37.63 ± 1.50, 44.80± 2.30 and 55.27±5.24 years, in the age group 1, II and III respectively. On the other hand, the mean ± standard error age of female subjects were found to be 33.40±3.13, 44.70±3.20 and 57.90± 6.70 years in the age group I, II and III, respectively.

3.3. Degree of Hypertension:

On an average mean ± standard error systolic blood pressure of the subjects was recorded as 141.31± 0.54 mm Hg of male and 138.00±0.45 mm Hg of female subjects. A significant (P<0.01) difference was found between mean systolic blood pressures of male and female subjects.

Table 3 Age wise distribution of degree of Hypertension (HTN)

Age Groups / Degree of HTN / Sex	30-40 Years	40-50 Years	≥50 Years	Total
Male				
Pre HTN	5 (62.50)	8 (42.10)	14 (31.82)	27 (38.03)
Stage I	3 (37.50)	9 (47.37)	24 (54.54)	36 (50.70)
Stage II	-	2 (10.53)	6 (13.64)	8 (11.27)
x^2 = **188.02****				
Female				
Pre HTN	4 (57.14)	15 (50.00)	13 (59.09)	32 (54.24)
Stage I	3 (42.86)	11 (36.67)	7 (31.82)	21 (35.59)
Stage II	-	4 (13.33)	2 (9.09)	6 (10.17)
x^2 = **17.45****				

Figures in parentheses indicate percentages
* Significant at P<0.01

Mean± standard error diastolic blood pressures of male subjects was recorded as 86.50±1.67, 87.80±1.50 and 92.28±1.33 mm Hg, whereas, 86.60±1.84, 90.00±1.53 and 88.40±1.03 mm Hg that of female subjects at age group I, II and III, respectively. Moreover, a non-significant difference was found between male and female diastolic BP at all the age groups.More precise distribution of hypertensive subjects on the basis of degree of Hypertension is given in Table 3 and Figure 3

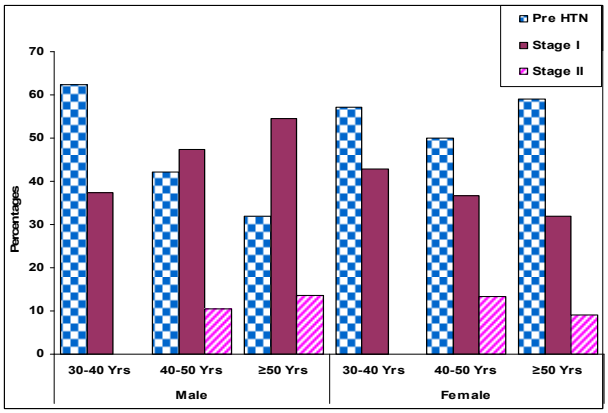

Figure 3: Age wise distribution of degree of Hypertension (HTN)

The date revealed that half of the total male subjects (50.70%) were at I stage degree of Hypertension (140 -159 and /or 90 - 99 mm Hg), 11.27 per cent at II stage Hypertension (BP≥160 and / or ≥100 mm Hg) and the remaining 38.03 per cent were found at pre Hypertension (BP120–139 and /or 80-89 mm Hg) stage. Moreover, degree of Hypertension was found to increase significantly (P<0.01) with the age of male subjects. On the other hand, among female subjects, 54.24 per cent

were at pre Hypertension, 35.59 per cent at stage I and the remaining 10.17 per cent at stage II degree of Hypertension.

Majority of the male subjects (50.70%) were at I stage degree of Hypertension, followed by 38.03 per cent had pre Hypertension and 11.27 per cent were at II stage Hypertension. However, majority (54.24%) of the female subjects, had pre Hypertension, followed by 35.59 per cent at stage I and the 10.17 per cent at stage II degree of Hypertension.

3.4 Nutrient Intake

Data on the nutrient intake i.e. proximate principles and minerals content by the hypertensive subjects in comparison with RDA are presented in Table 4.37a, b & c.

3.4.1 Proximate Principles

Nutrient intake by hypertensive subjects revealed that among proximate constituents, the intake of energy, protein, total fat, visible fat and fibre constituents was found to be the highest by male subjects of age group 30-40 years, whereas, by the male subjects of age group 40-50 years for carbohydrate intake. On the other hand, the intake by female subjects of age group 40-50 years was found to be the highest for energy, protein, total fat and fibre, however, by female subjects of age 30-40 years for visible fat and carbohydrate constituents and was found to be higher than the RDA. In a study, significantly ($P<0.05$) higher calories intake was found by hypertensive subjects than normotensives and moreover, reported that a reduction of total energy intake from 2652.8±83.4 Kcal to 2463.9±45.5 Kcal during the intervention period lowered blood pressure from 163.8±3.2/ 95.4±0.29 to 128.0±1.3/ 81.5±1.30 mm Hg and also reported to be higher than the RDA [23]. In a study, it was concluded that increasing the intake of fiber in Western populations, where intake is far below recommended levels, may contribute to the prevention of hypertension[12].

The most important factor necessary to control the obesity-related HTN pandemic and its CVD and CKD consequences is to prevent and treat obesity and to treat HTN to goal [11].

Table 4: Distribution of hypertensive subjects on the basis of intake of proximate principles

Age group Activity type / Sex	30-40 Years	40-50 Years	≥50 Years	Mean	RDA
Energy (Kcal)					
Male	3406.70 ±126.75	3135.40 ±121.73	2926.00 ±95.08	3135.03 ±28.60	2875 Kcal
Female	2652.80 ±163.35	2800.80 ±58.44	2632.50 ±66.67	2695.37 ±11.96	2225 Kcal
t-value	**3.693****	**2.759****	**2.054**	**13.861****	
Protein (g)					
Male	76.90± 4.37	76.30± 3.66	68.30± 1.56	73.83± 0.57	60g
Female	62.40± 2.83	62.70± 1.58	58.37± 0.98	61.16± 0.31	
t-value	**2.692****	**3.872****	**4.275****	**18.423****	
Total fat (g)					
Male	56.80±3 .71	49.06±1 .70	52.30±1 .26	52.72±0 .28	-
Female	52.08±5 .17	58.90±1 .78	48.82±2 .45	52.67±0 .67	
t-value	**0.756**	**2.230***	**1.401**	**1.147**	
Visible fat (g)					
Male	35.62±1 .94	32.80±1 .11	31.63±1 .02	33.35±0 .24	20g
Female	38.98±2 .16	33.41±1 .08	28.77±1 .05	33.72±0 .66	
t-value	**1.161**	**0.375**	**1.766***	**0.558**	

Values are Mean ± standard error

* Significant at $P<0.05$ ** Significant at $P<0.01$

3.4.2 Mineral Intake

Among mineral constituents, the intake of Na, K, Mg, P and Fe was found to be the highest by the male subjects of age group 40-50 years, whereas, by the subjects of age group 30-40 years for Ca and Na : K ratio. On the other hand, the intake of K, Mg, P and Fe was found to be the highest by female subjects of age group 30-40 years, however, by female subjects of age group 40-50 years for Na, Ca and Na: K ratio.

Table 5: Distribution of hypertensive subjects on the basis of mineral intake

Age group Activity type /Sex	30-40 Years	40-50 Years	≥50 Years	Mean	RDA
Sodium (mg)					
Male	3532.61±11 5.11	3835.43±13 3.86	3279.87±6 1.65	3549.30±3 3.01	111 0-330 0 mg$^{\#}$
Female	4567.04±20 1.77	5269.43±11 6.80	3975.47±8 5.33	4603.98±8 4.33	
t-value	**4.121****	**7.904****	**6.559****	**12.418****	
Potassium (mg)					
Male	1679.00±11 4.36	2177.92±69 .61	2002.73±6 1.65	1953.21±3 0.04	187 5-562 5 mg$^{\#}$
Female	2220.35±12 0.43	1904.56±40 .78	1878.31±8 5.33	2001.07±2 4.78	
t-value	**3.256****	**3.628****	**6.559**	**1.197**	
Calcium (mg)					
Male	493.24±29. 51	415.71±17. 54	369.82±51 .67	426.26±7. 40	400 mg
Female	325.73±17. 14	437.83±10. 28	310.65±62 .54	357.40±9. 11	
t-value	**4.778****	**1.165**	**4.423****	**5.929****	
Magnesium (mg)					
Male	319.06±11. 81	339.14±11. 32	298.16±8. 81	318.79±2. 43	350 mg$^{\#}$
Female	360.00±15. 67	311.63±9.0 9	302.64±13 .77	324.76±4. 02	
t-value	**2.118****	**1.890***	**0.283**	**1.318**	

Na : K (mg)					
Male	2.10±0.31	1.76±0.14	1.64±0.15	1.83±0.03	1:1
Female	2.06±0.37	2.77±0.14	2.12±0.19	2.32±0.05	
t-value	**0.083**	**4.740****	**1.924***	**8.617****	

Values are Mean ± standard error # FNB (1980)
* Significant at P<0.05 ** Significant at P<0.01

Dietary sodium restriction is one of the foundations of antihypertensive diets [18]. It was reported that reductions in dietary sodium were associated with decreases in SBP, with the greatest decreases associated with the lowest sodium intakes. Compared to a high sodium control diet, a low-sodium (≤65 mmol/day) DASH diet was associated with a decrease in SBP of 11.5 mmHg in patients with hypertension, and a decrease in SBP of 7.1 mmHg in patients without hypertension. Higher serum total calcium levels are positively associated with hypertension in a representative sample of U.S. adults [17].Among the randomized controlled trials reviewed, the sodium-to-potassium ratio appears to be more strongly associated with blood pressure outcomes than either sodium or potassium alone in hypertensive adult populations [13].

Modest reduction in salt intake for four or more weeks causes significant and, from a population viewpoint, important falls in blood pressure in both hypertensive and normotensive individuals, irrespective of sex and ethnic group [8].The current recommendations to reduce salt intake from 9-12 to 5-6 g/day will have a major effect on blood pressure, but a further reduction to 3 g/day will have a greater effect and should become the long term target for population salt intake.

Moreover, the mean intake of minerals i.e. Na, P and Na: K ratio was found to be higher, whereas, lower for Mg and Fe by the hypertensive subjects when compared with the RDA. In a study, higher intake of Ca and Na above RDA by the hypertensive subjects was reported, however, the average intake of K, Mg and Fe was found to be lower than the RDA and were advised to increase the intake of foods rich in these nutrients because such deficiencies have been reported to aggravate the Hypertension condition[23].

3.5 Correlation of various risk factors with blood pressure

Correlation studies (Table 6) showed a positive correlation of systolic as well as diastolic BP with the energy intake, total fat intake, sodium intake, whereas, a negative correlation was found of systolic BP as well as diastolic BP with potassium intake by all the hypertensive subjects. A wide range of variation was observed with respect to systolic and diastolic blood pressure and among male and female subjects for rest of the factors studied. A negative correlation was found of SBP and DBP with the intake of protein, Ca and Na: K ratio of the male subjects, however, the correlation was found to be positive with all the parameters of female subjects. Moreover, a positive correlation was found between SBP and Mg intake of male and female subjects, whereas, the correlation was found to be negative with DBP of all the subjects. Energy intake (2652.8±83.4 Kcal) to be higher than energy expenditure (2305.0±106 Kcal) by the hypertensive subjects and also reported decrease in BP as a result of decreased energy intake and body weight

Table 6: Correlations of nutrient intake with the Systolic and Diastolic blood pressure

Parameters	**Male**		**Female**	
	Systolic BP	**Diastolic BP**	**Systolic BP**	**Diastolic BP**
Age	0.460**	0.997**	-0.862**	0.490*
Nutrients				
Energy intake	0.613**	0.968**	0.634**	0.785**
Total fat	0.830**	0.840**	0.832**	0.570**
Protein	-0.124	-0.960**	0.999**	0.028
Sodium	0.491**	0.605**	0.868**	0.513**
Potassium	-0.994**	-0.493**	-0.468**	-0.870**
Calcium	-0.669**	-0.947**	0.633**	0.786**
Magnesium	0.435**-	-0.654**	0.578**	-0.804**
Na : K	0.754**	-0.901**	0.480**	0.886**

* Significant at P<0.05 ** Significant at P<0.01

during intervention period. This might be the main cause of body weight above standards and require increased physical activity [23]. Salt has been reported to be one of the important contributory factors of Hypertension. Decreased intake of dietary sodium has been demonstrated to have a hypotonic effect, both alone and as an adjunctive measure to pharmacologic therapy [6,22,1].

4. CONCLUSIONS

Epidemicity of Hypertension, the 'Silent Killer' calls for the need of making essential BP measurements by the doctors in hospitals of the outdoor patients too.Self BP measurement by hypertensive subjects should be encouraged. Public health approaches, such as reducing calories, saturated fat, salt in processed foods and sodium reduction in the food supply should be encouraged to achieve downward shift in population's BP towards normal BP range. Thus potentially reducing morbidity, mortality and the lifetime risk of an individual's becoming hypertensive.

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