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# PRE-HYPERTENSION AND HYPERTENSION IN A PRIVATE TERTIARY CARE CENTRE IN KANCHEEPURAM DISTRICT OF TAMIL NADU, INDIA AND THEIR ASSOCIATION WITH RISK FACTORS OF CARDIOVASCULAR DISEASES

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## ABSTRACT

**Background:** The proportion of hypertension in India as reported by various literatures has been on an increasing trend for the last three decades. The present study was carried out to determine the proportion of hypertension, its associated risk factors as well as to increase the awareness on importance of life style modifications among people visiting a rural hospital.

**Methodology:** Adults of age 18 years above, residing in and around Paiyanoor and visiting Vinayaka Mission Chennai hospital, Paiyanoor, Kancheepuram District, Tamilnadu for a period of two month was invited to be enrolled for the study. Hypertension was diagnosed as per the seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure. Biochemical estimation of serum triglycerides, cholesterol, HDL, LDL and VLDL was carried out. Statistical differences were obtained by one-way analysis of variance (ANOVA) for continuous variables and chi-square test for categorical variables. P values < 0.05 were considered to be statistically significant.

**Results:** The study subjects were grouped into normotensive, pre-hypertensive and hypertensive. 67.64% of the study subjects are hypertensive ( $p < 0.01$ ) with a mean blood pressure of  $145.13 \pm 12.52 / 93.61 \pm 9.68$  mmHg, SBP & DBP respectively. Significant differences of LDL and cholesterol levels are noted among the pre-hypertensive and hypertensive subjects when compared with the normotensive subjects.

**Conclusion:** A higher proportion of pre-hypertension and hypertension and significant differences in terms of age, occupational activity, cholesterol and LDL was observed among the study subjects. The present study supports the increasing trend in the rural communities of India which are under epidemiological transition.

**Key words:** Hypertension, Pre-hypertension, Cardiovascular risk factors, Rural

## INTRODUCTION

Hypertension is an important public health problem in developing countries especially in adults,

aged 40-55 years<sup>1,2</sup>. Considering the fact that a very narrow dividing line exist between normotension and hypertension and is still a debating

topic among the physicians, BP levels of systolic  $\geq 140$  mm Hg and/or diastolic  $\geq 90$  mm Hg is accepted as an indicator for the diagnosis of hypertension. At and above this level, an increased mortality risk and association with other diseases have been reported through prospective cohort and case-control studies from most of the developed and developing countries<sup>3,4,5,6</sup>. Increased life expectancy, urbanisation, development and affluence show a strong correlation with increased hypertension proportion in urban and rural populations of India. These modifying factors operate with other risk factors of hypertension in different combinations in different parts of the world. Majority of the predictive risk factors for hypertension in Indian population includes age (>50 years), male gender, socioeconomic group, body weight especially truncal obesity, increased insulin levels, abnormal lipid profile, metabolic syndrome and lifestyle conditions such as alcohol and cigarette consumption<sup>6</sup>. Such socio-demographic and lifestyle changes need to be focused to bring down the hypertension epidemic that is currently sweeping India and other parts of South Asia. The nature of genetic involvement in the development of hypertension also requires more studies.

Though several reports on the proportion of hypertension have been extensively carried out in the urban populations, from rural south India very few studies have reported the proportion and risk factors of hypertension. The present study has been undertaken to study the proportion of hypertension, its associated risk factors as well as to increase the awareness on importance of life style modifications among rural dwellers of Kancheepuram district, Tamil Nadu, south India.

## METHODOLOGY

Adults of age 18 years above, residing in and around Paiyanoor and visiting Vinayaka Mission Chennai hospital, Paiyanoor, Kancheepuram District, Tamilnadu for a period of two month was invited to be enrolled for the study. Those adults who were non cooperative or refuse to provide the necessary information was excluded. Those individuals who were not in regular checkups were excluded from the study. Children, disabled, acutely ill subjects and pregnant women were also excluded from the study. Informed consent and ethical approval was obtained prior to sample collection. A structured, pretested and predesigned questionnaire was

used to assess study subjects' self-reported behavioral and lifestyle factors. The questionnaire was supplemented with patient information sheet. For physical examination, standardized calibrated mercury column type sphygmomanometer and stethoscope, was used.

As there is a report of increasing proportion of hypertension, a study was decided to carry out initially as a pilot study to assess the hypertension situation in a tertiary health centre of Kancheepuram district, Tamil Nadu and then extend the work for a longer duration with proper funding. Hence a two month observation period (January to February 2013) was decided and patients visiting that duration time were invited to enroll in the study. Of the 46 hypertension patients 39 (84.78%) are aware of their increased BP values and were visiting the hospital for a regular checkup. No other major ailments with respect to kidney or heart were reported from the study subjects. However a study was not done for the correlation with cardiovascular risk factors among the study subjects. Hence the present study was done for obtaining a correlation of high BP values with cardiovascular risk factors among the study subjects. Being a hospital based sample study, only those who were visiting the hospital were considered for the study.

Hypertension was diagnosed as per the seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure<sup>7</sup>. Measurement of BP was performed after a 5 min period of rest using a mercury sphygmomanometer and two BP readings was taken from both arms at 30 s intervals. In case if the two readings differed by over 10 mm of Hg, a third reading was obtained, and the three measurements were averaged. The Korotkoff sounds phase I (the pressure at which the sounds were first heard) were taken as the Systolic Pressure (SBP) and the phase IV sounds (the pressure at which the sounds were first muffled and then disappeared) were taken as the Diastolic Pressure (DBP).

Biochemical assessment was performed for the subjects who gave written consent for the laboratory evaluation during interviews. Blood samples were drawn from the study subjects for the estimation of serum triglycerides, cholesterol, HDL, LDL and VLDL. The above mentioned parameters were analyzed as per the kit protocols (Bio-Diagnostics). Data entry and statistical analysis were performed using Microsoft Excel and SPSS version 15.0 software. Statistical differences

between groups were performed by one-way analysis of variance (ANOVA) for continuous variables and the chi-square test for categorical variables. The baseline characteristics of subjects were expressed as means  $\pm$  standard deviations for continuous variables. Independent variables tested were age, gender, variations in serum lipid markers. P values  $< 0.05$  were considered to be statistically significant.

## RESULTS

The study was conducted at Vinayaka Missions Chennai Hospital, Paiyanoor, Kancheepuram, Tamil Nadu for a period of 2 months (January to February 2013). A total of 68 subjects enrolled for the study. 36 (52.94%) are females and 32 (47.05%) are males ( $p = 0.628$ ). The mean age  $\pm$  S.D for males is  $51.43 \pm 18.10$  yrs and for females  $53.19 \pm 13.73$  yrs ( $p = 0.651$ ). The subjects were divided into three groups: Normotensive, Pre-hypertensive & Hypertensive. 10 (14.70%) are pre-hypertensive and 46 (67.64%) are hypertensive ( $p < 0.01$ ). The proportion of pre-hypertension is higher in females (60%) than males (40%). The proportion of hypertension is also higher in females (52.17%) than males (47.82%) ( $p = 0.881$ ). The mean age  $\pm$  S.D for normotensive is  $39.00 \pm 17.97$  yrs, for pre-hypertensive,  $56.00 \pm 14.97$  yrs and hypertensive  $55.07 \pm 13.84$  yrs ( $p < 0.004^{**}$ ).

**Table 1: Systolic (SBP) and Diastolic (DBP) blood pressure among groups**

Groups	Mean SBP $\pm$ SD*	Mean DBP $\pm$ SD*
Normotensive	114.75 <sup>a</sup> $\pm$ 6.57	74.92 <sup>a</sup> $\pm$ 6.68
Pre-hypertensive	129.50 <sup>b</sup> $\pm$ 1.08	77.30 <sup>b</sup> $\pm$ 5.12
Hypertensive	145.13 <sup>c</sup> $\pm$ 12.52	93.61 <sup>b</sup> $\pm$ 9.68
F value	41.062	30.526
P value	<b>&lt;0.001**</b>	<b>&lt;0.001**</b>

Note: \*Values in mmHg; \*\* denotes significance @ 1%. Different alphabets between group denotes significance at 5% level using Duncan Multiple Range Test (DMRT)

The study sample was categorized into different age groups. There are 4 groups: 20 - 35yrs, 36 - 50yrs, 51 - 75yrs and above 75yrs. The maximum number of participants are in the age group of 51 - 75yrs (30) followed by the age group of 36 - 50 yrs (21) ( $p < 0.001^{**}$ ). The proportion of gender among different age groups was not significant ( $p = 0.668$ ). Pre-hypertension is highest in the age group of 51 - 75yrs (5). Hypertension is also

highest in the age group of 51 - 75yrs (22) followed by the age group of 36 - 50yrs (17). The proportion rate of pre-hypertension and hypertension shows an upward trend as age advances. The proportion of hypertension increases with age till the age group of 51 - 75yrs and then dipped at the age group of above 75yrs. All the differences are statistically significant ( $p < 0.01$ ), which indicates that in the present study, age has a greater association with hypertension.

The mean systolic and diastolic blood pressure of normotensive group is  $114.75 \pm 6.57 / 74.92 \pm 6.68$  mmHg respectively (Table I). The mean systolic and diastolic blood pressure for pre-hypertensive is  $129.50 \pm 1.08 / 77.30 \pm 5.12$  mmHg respectively. Hypertensive group has a mean blood pressure of  $145.13 \pm 12.52 / 93.61 \pm 9.68$  mmHg respectively. There is significant difference between the groups with respect to mean SBP and DBP ( $p < 0.001^{**}$ ). The normality for mean systolic blood pressure is significantly different with respect to pre-hypertensive and hypertensive groups at 5%. The difference is also significant between pre-hypertensive and hypertensive groups. The mean diastolic blood pressure showed a significant difference between normotensive and hypertensive but not between pre-hypertensive and hypertensive. Among the male hypertensive subjects, there are two cases of isolated systolic hypertension, one in the age group of 36 - 50yrs and a second case in the age group of  $\geq 75$  yrs. Among the female hypertensive subjects, there are three cases of isolated systolic hypertension, one in the age group of 36 - 50yrs and two in the age group of 51 - 75yrs. There are two cases of isolated diastolic hypertension among the male hypertensive's one in the age group of 36 - 50yrs and 51 - 75yrs. Among the female hypertensive subjects, there are four cases of isolated diastolic hypertension, two each in the age groups of 36- 50yrs and of 51 - 75yrs.

The mean systolic blood pressure (SBP) is found to steadily increase with age, lowest being in age group of 20 - 35yrs ( $120.40 \pm 14.24$ ) and highest in age group of above 75yrs ( $142.43 \pm 13.59 / 85.71 \pm 12.72$ ) (Table II). The mean diastolic blood pressure (DBP) is highest in the age group of 36 - 50yrs ( $90.67 \pm 10.68$ ) when compared to 51 - 75yrs and above 75yrs age groups. Since P value for the distribution of mean systolic as well as diastolic blood pressures among different age groups is less than 0.01, increasing age is significantly associated with difference in the SBP and DBP among the study samples. The normality is sig-

nificantly different at 5% with respect to the age group of 20 – 35yrs but not significant between 36 – 50yrs, 51 – 75yrs and above 75yrs. For mean diastolic blood pressure, there is a significant difference at 5% between 20 – 35yrs, 36 – 50yrs

and 51 – 75yrs but not between 20 – 35yrs and above 75yrs. The difference for other variables among different age groups were not significant ( $p>0.05$ ).

**Table 2: Systolic (SBP) and Diastolic (DBP) blood pressure among different age groups**

Variable	Age Groups in years				F Value	P Value
	20-35	36-50	51-75	Above 75		
SBP (mmHg)	120.40 <sup>a</sup> ± 14.24	137.90 <sup>b</sup> ± 11.48	141.70 <sup>b</sup> ± 16.48	142.43 <sup>b</sup> ± 13.59	5.755	<b>0.002**</b>
DBP (mmHg)	77.70 <sup>a</sup> ± 11.04	90.67 <sup>b</sup> ± 10.68	89.90 <sup>b</sup> ± 11.58	85.71 <sup>a,b</sup> ± 12.72	3.508	<b>0.020*</b>

Note: \*\* denotes significance @ 1%. Different alphabets between group denotes significance at 5% level using Duncan Multiple Range Test (DMRT)

**Table 3: Distribution of lipid markers among the groups**

Variables (mean values)	Group			F Value	P Value
	Normotensive	Pre Hypertensive	Hypertensive		
Cholesterol (mg/dL)	129.25 <sup>a</sup> ± 35.84	153.00 <sup>b</sup> ± 27.46	156.89 <sup>b</sup> ± 20.40	5.987	<b>0.004**</b>
TG (mg/dL)	123.83 ± 43.91	163.60 ± 66.31	142.70 ± 65.09	1.116	0.334
HDL (mg/dL)	37.92 ± 6.47	38.30 ± 2.98	38.07 ± 3.71	0.023	0.978
LDL (mg/dL)	66.58 <sup>a</sup> ± 33.47	81.90 <sup>ab</sup> ± 25.29	90.10 <sup>b</sup> ± 23.22	4.110	<b>0.021*</b>
VLDL (mg/dL)	24.75 ± 8.78	32.80 ± 13.35	28.71 ± 13.11	1.132	0.329

Note: \*\* denotes significance @ 1%. \* denotes significance @ 5%. Different alphabets (<sup>a, b</sup>) between group denotes Significance at 5% level using Duncan Multiple Range Test (DMRT). TG: triglycerides, HDL: high density lipoproteins, LDL: low density lipoproteins, VLDL: very low density lipoproteins.

Differences of LDL and cholesterol levels are noted among the pre-hypertensive and hypertensive groups when compared with the normotensive group (Table III). These differences are highly significant for cholesterol at 1% and for LDL at 5%. For the variable cholesterol, the normality is significantly different with respect to pre-hypertensive and hypertensive groups at 5% but not significant between pre-hypertensive and hypertensive groups. For LDL, there is a significant difference at 5% between normotensive and hypertensive but not between normotensive and pre-hypertensive.

## DISCUSSION

The epidemiology of hypertension, in terms of both, its importance as a risk factor for cardiovascular and other diseases and of its own etiology, continues to be a major field of investigation with an enormous peer-reviewed literature every year. Elevated blood pressure is the most important cardiovascular risk factor<sup>6</sup>, contributing to one half of the coronary heart diseases and approximately two third of the cerebrovascular diseases because, it exerts excessive pressure on the interior wall of arteries,

thereby damaging internal endothelial lining of the blood vessels.

The proportion of hypertension among adults in developed countries is 25%. Similar proportion has also been observed in developing countries ranging from 10% to 20%<sup>6,8,9</sup>. Indian studies have shown a high proportion of hypertension almost similar to those in the USA. The proportion of hypertension in India is reported as ranging from 10 to 30.9%<sup>10</sup>. The average proportion of hypertension in India is 25% in urban and 10% in rural inhabitants. Previously a lower proportion of hypertension was reported from rural Indian populations. However there has been a steady increase of proportion over time in rural population studies as well<sup>9,11</sup>. This made us to undertake the current study to determine the hypertension proportion in a south Indian rural scenario. Using the JNC VII criteria<sup>7</sup>, we found hypertension to be of 67.6% proportion among the study sample. Pre-hypertension was found to be prevalent at 14.7%. A high proportion value obtained from our study indicates alarming increase in the proportion of hypertension in the rural population. Gilberts et al<sup>12</sup> carried out a study in rural Tamil Nadu in the age group of 20 years and above and found a proportion of 12.5%. Shanthirani et al<sup>13</sup> reported a 47% propor-

tion of pre-hypertension among urban residents in Chennai who were >18 year. In a survey on industrial population, Prabhakaran *et al*<sup>14</sup> reported pre-hypertension in 44% of their study subjects. Subburam *et al*<sup>15</sup> reported the proportion of hypertension in rural areas of Tamil Nadu in the age group of 45 – 60 years as 33%. The proportion rate of hypertension was 25.2% in a rural household community study from Kancheepuram district of Tamil Nadu<sup>16</sup>. From other parts of India, similar proportion rate has been reported using the JNC VII Criteria. Gupta *et al*<sup>17</sup> reported a proportion of 24% in males and 17% in females in the age group of 20 years and above from rural Rajasthan. The proportion of hypertension was 4.5% in the age group of 16 – 70 years in rural Haryana<sup>10</sup>. From eastern India, Hazarika *et al*<sup>18</sup> reported a proportion of 33.3% in the age group of 30 years and above among the native population of Assam. Among the age group of 30 years, Kokiwar *et al*<sup>19</sup> found a proportion of 19.04% in the rural population of Central India. Overall there is a significant increase in hypertension proportion in rural areas.

In the present study, we observed female gender (52.17%) more susceptible to hypertension than the male gender (47.82%). The proportion of pre-hypertension was also more in females (60%) when compared to males (40%). Significant results in terms of proportion among females were reported by Malhotra *et al*<sup>10</sup>, Hazarika *et al*<sup>18</sup>, Bharathi *et al*<sup>20</sup> and Kokiwar *et al*<sup>19</sup>. The proportion rate was higher among females (27.4%) when compared to males (22.6%)<sup>16</sup>. Bharathi *et al*<sup>20</sup> reported pre-hypertension to be more prevalent among females than males. This indicates a changing trend among females and increased stress may be credited for this change.

The mean age of hypertensive patients was found to be 55.07±13.84 and for pre-hypertensive subjects, 56.00±14.97. Kokiwar *et al*<sup>19</sup> reported the mean age of hypertensive to be 53.11±12.46. Radhika *et al*<sup>1</sup> reported the mean age to be 44.9±12.9. Mean age of hypertensive patients, as reported by the CURES study<sup>21</sup> was 44.9±12.9 for males. We found the mean age of male subjects to be 51.44 ± 18.100 and 53.19±18.100 for females. Our findings are in accordance with the above studies. However, the correlation of hypertension with gender was not significant in the present study, which is in contrast with other studies. There is an increasing trend of hypertension as age advances<sup>22,23,16,24</sup>. Similar results were observed in our study. The proportion of hypertension increased with age till the age group of

51 – 75yrs and then dipped at the age group of above 75yrs. The rise of BP with age is said to be an ageing process resulting in atherosclerotic changes<sup>24</sup>.

In the present study, the systolic and diastolic pressures were found to have high significance of class variance and the mean systolic and diastolic pressures for pre-hypertensive and hypertensive groups was 129.50±1.08, 77.30±5.12 and 145.13±12.52 and 93.61±9.68. We also observed isolated systolic and diastolic hypertension in the present study. Community based analysis from central India<sup>19</sup> showed an overall proportion of isolated systolic hypertension as 4.3% (2.3% males and 5.6% females) while proportion of isolated diastolic hypertension was low (0.9% males and 1.04% females). In the CURES study<sup>21</sup> the overall proportion of isolated systolic hypertension as 6.6% among the study subjects while the overall proportion of isolated diastolic hypertension was 4.2%. The significance of a higher proportion of systolic blood pressure has to be addressed as systolic blood pressure is more closely related to hypertension and increased cardiovascular risk<sup>25</sup>. A 10mmHg rise in systolic hypertension was observed to have more correlation with a 10% increase in all fatal and non-fatal cardiovascular complications<sup>26</sup>.

Hypercholesterolemia and hypertension are major risk factors for atherosclerosis and their combination is associated with a greater increase in the incidence of cardiac events<sup>27</sup>. Thus, it becomes increasingly important to understand the pathogenic mechanisms of their interaction. In the present study we observed a significant difference among normotensive and hypertensive samples with respect to cholesterol and LDL levels, both high diagnostic indicators for cardiovascular diseases. Our study is in agreement with other reports that high serum cholesterol and high blood pressure coexist and leads to the mortality associated with cardiovascular diseases.

## CONCLUSION

Overall, our study documented high proportion of both pre-hypertension and hypertension. The important variables analyzed such as age, gender, systolic and diastolic blood pressures, cholesterol and LDL levels were significantly different among study subjects. Hypertensive subjects had high cholesterol and LDL levels when compared to pre-hypertensive and normotensive subjects.

The high proportion of hypertension and pre-hypertension in the present study supports the increasing trend among rural subjects of India which are under the epidemiological transition. Pre-hypertension is also more prevalent and closely associated with high cholesterol and lipid levels and has to address for primary prevention.

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