

Significant High Lipid Profile in Pre-Hypertensive Subjects as Compare to Stage 1 and Stage 2 of Hypertensive Subjects

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ABSTRACT

Objective: To analyze the differences in lipid profile in various categories of hypertension in our local population.

Study Design: Cross Sectional Study

Place and Duration of study: This study was conducted at Amin Hayat Memorial Trust for diabetes and Hypertension, Lahore and Punjab Institute of Cardiology (PIC), Lahore from Dec. 2005 to May 2007.

Materials and Methods: A total of 510 subjects of either sex were screened during a cross-sectional study. Biochemical assessment includes the determination of TC (Total Cholesterol), LDL-C (Low Density Lipoprotein Cholesterol), HDL-C (High Density Lipoprotein Cholesterol), and TG (Triglycerides), which were measured by using commercially available kits using Hitachi 902 photometer. vLDL and LDL-C/HDL-C ratio was calculated by using formula.

Results: Abnormal lipid profile was observed in 59% of the study population. Around 75% of prehypertensive subjects had abnormal lipid profile as compare to stage 1 and stage 2 of hypertension. Beside prevalence significant high levels of TC, LDL-L, and LDL-C/HDL-C were also observed in prehypertensive group. Females had significantly high levels of TC, HDL-C and LDL-C/HDL-C compared to males.

Conclusion: A high prevalence of dyslipidemia was observed in all stages of hypertension; however, prehypertensive group had significant high levels of lipid profile and smoking and family history also predispose to high blood pressure.

Key Words: prehypertension, Stage 1 and stage 2 of hypertension, lipid profile.

INTRODUCTION

Hypertension and hypercholesterolemia each predispose to coronary heart disease, but the two acting in concert alter risk substantially because their combined effects are considered to be multiplicative rather than additive. Hypertensive subjects frequently have higher cholesterol levels than do normotensive subjects¹. A growing body of evidence has indicated that hypercholesterolaemia promotes impairment in several mechanisms implicated in blood pressure control such as nitric oxide bioavailability, renin-angiotensin activity, the sympathetic nervous system, sodium and fluid homeostasis².

In hypertensive patients, cardiovascular and renal diseases are related to a cluster of risk factors, among which dyslipidemia appears as the most important^{3,4}. People with hypertension are more likely to have lipid abnormality and obesity than those with normal blood pressure⁵.

The presence of linear relationship between cholesterol levels and blood pressure, independent of confounding variable such as age and BMI, has been reported by many different epidemiological survey carried out in different populations^{6,7}. Hypertension and dyslipidemia are often observed concomitantly. Nearly half of all hypertensive patients develop an abnormal lipid profile with elevated serum triglycerides (TG), total cholesterol

(TC) and LDL-C levels, high-density lipoprotein cholesterol HDL-C and its related ratios (TC/HDL-C, LDL-C/HDL) being normal or elevated, therefore indicating the variability of cardiovascular and high level risk in hypertensive patients⁸.

Boderline hypertensive subjects frequently have higher cholesterol levels than do normotensive subjects⁹. A positive relation between serum cholesterol level and blood pressure has been reported in many epidemiological studies, but the results have often been inconsistent across population sub group^{10, 11}. Different plasma lipids vary significantly in various populations groups due to difference in geographical, cultural¹², economical and social conditions¹³. Dietary habits and genetic makeup, age and gender differences also affect serum lipids considerably^{14, 15, 16}.

The present study was planned to analyse the differences in lipid profile in various categories of hypertension in our local population.

MATERIALS AND METHODS

Clinical facility of Amin Hayat Memorial trust for diabetes and hypertension, Lahore and Punjab Institute of Cardiology (PIC), Lahore were used for the study. A total of 510 subjects of either sex were screened during a cross-sectional study performed from December 2005 to May 2007. Written informed consent was obtained from all subjects prior to their participation. On the

study day, the subjects attended the hospital in a fasting state. Their demographic data, medical history, family history of hypertension, duration of the disease and habits were recorded through questionnaire. Our screening approach was specifically aimed at identifying the prehypertensive and hypertensive subjects with recent onset of the disease. Participants who reported smoking at least 3 cigarettes per day during the previous year were classified as current smokers. Plasma lipids levels were designated abnormal if total cholesterol was ≥ 200 mg/dl, LDL cholesterol ≥ 130 mg/dl, TGs ≥ 150 mg/dl and HDL cholesterol < 40 mg/dl¹⁷. Seventy % (357) of the subjects included in the study were untreated, newly diagnosed while 30% (153) were not taking antihypertensive drugs regularly. Diabetic subjects and those on the lipid lowering drugs or with hepatic, thyroid, infectious or chronic heart problem were excluded from the study.

The screened subjects were categorized into the groups using the criteria of JNC VII¹⁸ in (i) prehypertensive (preHTN) if systolic blood pressure (SBP) was 120-139 mmHg and diastolic blood pressure (DBP) was 80-89 mmHg (ii) stage 1 of hypertension if SBP was 140-159 mmHg and DBP was 90-99 mmHg (iii) Stage 2 of hypertension if SBP was ≥ 160 mmHg and DBP was ≥ 100 mmHg.

Biochemical assessment included the quantification of lipid profile (total cholesterol, low density lipoproteins cholesterol (LDL-C), high density lipoproteins cholesterol (HDL-C) and triglycerides) in the serum of subjects. Very low density lipoproteins (vLDL) and LDL-C to HDL-C ratio were calculated by using formulae.

Statistical analysis: The data was analysed with the help of SPSS software (version 13). Data was shown as mean $\pm$ SEM. Simple T-test was applied to find out the difference between the genders. One way Analysis of Variance (ANOVA) was used to find the difference among the hypertensive groups. The correlation analysis was done using Pearson's correlation.

RESULTS

A total of 510 subjects include 206 (40.4%) males and 304 (59.6%) females. The outcome based on hypertensive criterion was that prehypertensive subjects were 139, stage 1 includes 193 subjects and 178 subjects were included in stage 2 of hypertension.

Table No.1: Distribution of the study population in various categories of lipid and other risk factors

Variables	Overall	Male	Female
n	510 (%)	206 (%)	304 (%)
Age (years) Distribution			
<40	114 (22.4)	23 (11.2)	91 (29.9)
40-59	288 (56.5)	129 (62.6)	159 (52.3)
> 60	108 (21.3)	54 (26.2)	54 (17.8)

TC (mg/dl)			
<200	227 (44.5)	105 (50.9)	122 (40.1)
≥ 200	283 (55.5)	101 (49.0)	182 (59.9)
LDL-C (mg/dl)			
<130	247 (48.4)	106 (51.5)	141 (46.4)
≥ 130	263 (51.6)	100 (48.5)	163 (53.6)
HDL-C (mg/dl)			
<40	332 (65.0)	154 (74.8)	178 (58.6)
≥ 40	178 (34.9)	52 (25.2)	126 (41.5)
TG (mg/dl)			
<150	201 (39.4)	86 (41.8)	115 (37.8)
≥ 150	309 (60.6)	120 (58.3)	189 (62.2)
vLDL (mg/dl)			
<40	309 (60.6)	127 (60.7)	182 (59.9)
≥ 40	201 (39.4)	79 (38.3)	122 (40.1)
LDL-C/HDL-C ratio			
<3.3	220 (43.1)	84 (40.7)	136 (44.7)
≥ 3.3	290 (56.9)	122 (59.2)	168 (55.3)
Habits			
Smokers	131 (25.7)	123 (59.7)	8 (2.6)
Family history of HTN	302 (59.2)	115 (55)	187 (61.5)

Table No.2: Demographic and biochemical assessment of the study population.

Parameters	All	Male	Female	T-Value
n	510	206	304	
Age (years)	49.47 $\pm$ 0.49	52.13 $\pm$ 0.77	47.68 $\pm$ 0.61	0.000**
Range	(25-87)	(25-85)	(25-87)	
SBP (mmHg)	152.47 $\pm$ 0.87	150.51 $\pm$ 1.26	153.80 $\pm$ 1.09	0.046*
Range	(124 -230)	(125 - 230)	(124 – 230)	
DBP (mmHg)	94.29 $\pm$ 0.39	93.54 $\pm$ 0.54	94.81 $\pm$ 0.51	0.103 ^{NS}
Range	(80 -130)	(80-120)	(80 – 130)	
TC (mg/dl)	205.19 $\pm$ 1.76	200.72 $\pm$ 2.85	208.22 $\pm$ 2.23	0.044*
Range	(103 – 313)	(103-289)	(110 – 313)	
LDL-C (mg/dl)	131.60 $\pm$ 1.62	130.50 $\pm$ 2.73	132.19 $\pm$ 1.98	0.677 ^{NS}
Range	(49-266)	(46-266)	(52 – 236)	
HDL-C (mg/dl)	37.25 $\pm$ 0.41	35.08 $\pm$ 0.418	38.72 $\pm$ 0.62	0.000**
Range	(20-65)	(20-52)	(20 – 65)	
TG (mg/dl)	196.82 $\pm$ 4.325	194.87 $\pm$ 6.92	198.13 $\pm$ 5.54	0.686 ^{NS}
Range	(56-550)	(56-550)	(60 – 524)	
vLDL (mg/dl)	36.32 $\pm$ 0.68	35.87 $\pm$ 1.08	36.62 $\pm$ 0.87	0.564 ^{NS}
Range	(11.2-79.0)	(11.2-79.0)	(12.0 – 77.6)	
LDL-C/HDL-C Ratio	3.662 $\pm$ 0.05	3.856 $\pm$ 0.100	3.530 $\pm$ 0.060	0.003**
Range	(0.565-9.25)	(1.24-9.25)	(0.565 – 8.65)	

Table 3. Distribution of hypertensive subjects in various categories of lipid and other risk factors.

Variables	Prehypertensive	Stage 1	Stage 2
n	139(%)	193(%)	178(%)
Age (years) Distributions			
< 40 (%)	29 (20.9)	21 (10.9)	33 (18.5)
40-59	103 (74.1)	129 (66.8)	87 (48.9)
> 60	07 (5.0)	43 (22.3)	58 (32.6)
TC (mg/dl)			
< 200	31 (22.3)	110 (56.9)	87 (48.9)
≥ 200	108 (77.7)	83 (43.0)	91 (51.1)
LDL-C (mg/dl)			
< 130	29 (20.9)	124 (64.2)	94 (52.8)
≥ 130	110 (79.1)	69 (35.7)	84 (47.1)
HDL-C (mg/dl)			
< 40	94 (76.6)	122 (63.2)	116 (65.16)
≥ 40	45 (32.4)	71 (36.8)	62 (34.8)
TG (mg/dl)			
< 150	52 (37.4)	74 (38.3)	75 (42.1)
≥ 150	87 (62.6)	119 (61.7)	103 (57.9)
vLDL (mg/dl)			
< 40	84 (60.4)	109 (56.5)	116 (65.2)
≥ 40	55 (39.6)	84 (43.5)	62 (34.8)
LDL-C/HDL-C ratio			
<3.3	28 (20.1)	112 (58)	80 (44.9)
≥3.3	111 (79.9)	81 (41.9)	98 (55.1)

The distribution pattern of the population in various categories of lipids is given in Table-1. Using the cut off values for dyslipidemia, high blood cholesterol prevailed in 55.5% (n - 283) subjects. Out of which 48.5% were males and 53.62% were females. While high LDL-C and TG levels were present in 51.6% (n - 263) and 60.6% (n - 309) subjects respectively. It was more prevalent in females. Low HDL-C levels were observed in 65.09% (n - 332) subjects and it was more prevalent in males as compared to females, (74.80% vs 58.60%). In the study population 59.20% (n- 302) subjects had the positive family history of hypertension or diabetes, 30% (n -153) were physically active and 25.70% (n - 131) were smokers. It has been observed that subjects enrolled in study had high prevalence of abnormal lipid levels, which is major risk factor for developing hypertension.

The demographic and biochemical data of the participants included in the study is presented in Table 2. To further elaborate the study and analyze the effect of hypertension on the lipid profile the studied population was categorized into three groups on the basis of systolic and diastolic blood pressure (i)

prehypertension (preHTN) (n -139), stage 1 (n -193) and stage 2 (n -178). The distribution pattern of the population in various categories of lipids in three stages of hypertension is presented in Table 3. Using the cut off values for dyslipidemia, it is observed that 77.7% of preHTN have abnormal TC as compare to 43% in stage 1 and 51.1% in stage 2. High LDL-C and TG is present in 79.1% and 62.6% respectively and low HDL-C is prevalent in 76.6% of preHTN subjects. High LDL-C/HDL-C ratio is present in 79.9% of preHTN subjects as compare to 41.9 % in stage 1 and 55.1% in stage 2.

The mean values for age, SBP, DBP and lipid profile in different categories of hypertension is presented in Table 4. The analysis of variance revealed a significant difference among, age, SBP, DBP, TC, LDL-C and LDL-C/HDL-C ratio. Prehypertensive subjects were younger in age as compare to stage 1 and stage 2.

Highest level of TC levels were observed in Prehypertension stage (225.38 ±3.58 mg/dl), it decreased 13.76% in stage 1 (194.35±2.499mg/dl) and 10.7 % in stage 2 (201.19±2.81mg/dl). Statistically significant difference was observed among the mean values of prehypertension, stage 1 and stage 2. LDL-C levels are highest in Prehypertension stage which decreased 24% in stage 1 and 18.8% in stage 2. LDL/HDL ratio decreased by 26.4% in stage 1 and 19.8% in stage 2 as compared to preHTN. No statistically significant differences in HDL-C, TG and vLDL were observed among the groups.

DISCUSSION

Hypertension is one of the leading causes of cardiovascular morbidity and mortality. It is becoming an epidemic in developed as well as in developing countries. In recent years, with increasing economic and demographic development, there has been a shift in developing countries from infectious communicable diseases, towards chronic, non communicable, life style related disease. The increase in chronic diseases in developing countries has been brought about by the increasing prevalence of risk factors, such as high caloric consumption, decreased physical activity, obesity, increased alcohol consumption, and less use of fiber diet.

It has been estimated that HTN causes 4.5% of the current global disease pattern, affecting approximately a billion individual worldwide¹⁸. Furthermore, the worldwide figures for adults with HTN are predicted to rise by 60% by year 2025¹⁹. In Pakistan, HTN affects one out of every three persons over 45 year of age²⁰.

Subjects in prehypertension stage demonstrated prevalence of high blood cholesterol. It was observed in our study that preHTN subjects have significantly higher levels of TC, LDL-C, TG, vLDL and LDL-C/HDL-C ratio as compare to the stage 1 and stage 2 of hypertension.

Table No.4: Analysis of variance (ANOVA) in demographic and biochemical characteristics among hypertensive subjects

Parameters	PreHTN	Stage I	Stage II	P value
n	139	193	178	
Age (years)	44.81± 0.71	51.32±0.75	51.12±0.940	0.000**
Range	(25-75)	(26-87)	(25-80)	
SBP (mmHg)	132.94±0.39	147.79±0.40	172.89±1.03	0.000**
Range	(124-139)	(140-158)	(160-230)	
DBP (mmHg)	85.79±0.2	92.41±0.22	102.31±0.605	0.000**
Range	(80-89)	(90-99)	(90-103)	
TC (mg/dl)	225.38±3.58	194.35±2.5	201.19±2.81	0.000**
Range	(103-313)	(125-298)	(110-296)	
LDL-C (mg/dl)	155.82±3.35	118.48±1.86	126.64±2.62	0.000**
Range	(63-266)	(65-199)	(46-217)	
HDL-C (mg/dl)	37.04±1.09	37.46±0.45	36.85±0.51	0.918 ^{NS}
Range	(21-65)	(20-54)	(20-55)	
TG (mg/dl)	201.52±8.31	196.06±6.45	193.96±7.92	0.785 ^{NS}
Range	(56-534)	(60-496)	(60-550)	
vLDL (mg/dl)	36.933±1.25	37.332±1.12	34.701-1.16	0.221 ^{NS}
Range	(11.2-74.6)	(12.79)	(12.0-78.4)	
LDL-C/HDL-C Ratio	4.404-0.12	3.245±0.07	3.535±0.088	0.000**
Range	(1.0-8.65)	(1.70-7.35)	(0.56-9.25)	

** Significance at P<0.01 ^{NS} = Non significant

Several studies have reported the disparities of serum lipids with gender and age^{21, 22}. We also found that the prevalence of dyslipidemia was higher in women than men. The total cholesterol levels were observed significantly higher in females as compared to males. This result is in accordance with the study²³, they reported of non significant results statistically. This may be due to the reason that their study also includes non-hypertensive subjects. No significant difference was observed in LDL-C and TG levels of male and females. Significant difference was observed between the HDL-C levels in both genders being higher in females as compared to males. There is a general agreement that blood pressure rises with advancing age, but the magnitude of this rise is uncertain because hypertension is a common disease and its incidences increases with rising age. Blood pressure is well known to increase with age²⁴. and age has been thought to be an independent cause of the increase²⁵. In our study, significant positive association was found between SBP and DBP with age in preHTN and stage 2 groups but a weak association was observed in stage 1. It has indicated that the SBP and DBP rise with age in preHTN and stage 2 hypertensive subjects.

A significant high mean value of lipid profile is observed in preHTN group in our study population. But no significant difference was observed among the study groups i.e Normal BP, PreHTN and hypertensive in omani adults²⁶.

Significant association between serum cholesterol and SBP has been reported²⁷. But in our study no significant association was observed between total cholesterol and

SBP but significant association was found between BP rise and cholesterol level²⁸

CONCLUSION

A high prevalence of dyslipidemia was observed in all stages of hypertension; however, prehypertensive group had significant high levels of lipid profile and smoking and family history also predispose to high blood pressure.

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