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TO STUDY THE INFLUENCE OF VARIOUS CLINICAL, DEMOGRAPHIC, SOCIAL AND SOCIOECONOMIC PARAMETERS ON LIPID PROFILE ABNORMALITIES IN HYPERTENSIVE PATIENTS

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ABSTRACT: Hypertension is the leading cause of morbidity and mortality in both developing and developed countries.¹ The association of hypertension & dyslipidemia is common. Dyslipidemia, causes endothelial damage and the loss of physiological vasomotor activity that may become manifested as increased blood pressure.^{2,3,4,5} We conducted study of 240 patients to evaluate the influence of various clinical, demographic, social and socioeconomic parameters on lipid profile abnormalities in hypertensive patients. Our study shows that hypertension obesity smoking sedentary life style male gender is significantly associated with dyslipidemia.

KEYWORDS: Dyslipidemia, hypertension, pre-diabetic.

INTRODUCTION: Approximately 1 billion people worldwide are affected by, hypertension.⁶ Even though the association of high blood pressure and major cardio-vascular events like stroke and cardiac failure were recognized by ancient physicians like Hippocrates and Galen, the real breakthrough came in the early twentieth century after the introduction of non-invasive BP monitoring with sphygmomanometer by Riva Roci⁷ and Korotk off. The risk factors that have been associated with hypertension are increased salt intake, Diabetes mellitus, Cigarette smoking, elevated serum lipids, sedentary lifestyle, diet rich in saturated fats, genetic factors and stress.⁸

Though the association of hypertension & dyslipidemia is common and been proved by various studies beyond doubt, the reason for this co-occurrence has not been probed out yet. Three possible mechanisms are proposed for this but none have been proven.

Dyslipidemia can increase the incidence of Hypertension.

1. Hypertension can increase the incidence of Dyslipidemia.
2. There may be a common factor which cause increased incidence of both.

This study is conducted to assess the abnormalities in plasma lipid profile of hypertensive patients and to determine the factors influencing it

MATERIALS AND METHODS: Patients who are diagnosed as hypertensive in medical OP department and ward of Kurnool Medical College, Govt. General Hospital were taken. Study population included patients belonging to surrounding places of Kurnool district. Study period is from January 2012 to May 2013.

The Study design is Cross sectional study with cases and controls.

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THE STUDY GROUP INCLUDED:

- Newly detected hypertensive patients of age group between 31-75 yrs.
- Control group is non-hypertensive patients of same age group who attended medical OPD for minor illnesses.

FOLLOWING GROUP WERE EXCLUDED FROM THE STUDY:

- Patients who are already known hypertensive and on drugs.
- Patients with secondary hypertension.
- Newly diagnosed hypertensive patients with one or more complications like CVA, IHD, nephropathy and retinopathy at presentation.
- Hypertensive patients who are alcoholic.
- Hypertensive diabetic patients.

The participants were explained about the study and informed consent was obtained. Then they were interviewed and analyzed for exclusion criteria. Cases which meet both the inclusion criteria and did not have any of the exclusion criteria were selected to participate in the study. 214 such cases 120 controls were included in the study. Detailed history regarding patient's education, occupation, family income, daily physical activities, smoking, alcohol intake and family history of hypertension were asked. The socio economic status of the patient was determined using "Modified (2012) Kuppaswamy scale". Participants with daily physical activity of ≤ 2 MET (Metabolic Equivalent of Task) were considered as sedentary. Those who smoke ≥ 5 cigarettes / day were considered as smokers.

Waist circumference was measured in a horizontal plane at the level of the narrowest part between the costal margin and the iliac crest. Hip circumference was measured at the largest protrusion of the buttock with thin clothes without compressing the skin. Body mass index (BMI) was calculated using the formula

$$\text{BMI} = \text{Weight in kg} / (\text{Height in meter})^2$$

The waist hip ratio was also calculated. Participants with BMI ≥ 25 kg/m², waist circumference ≥ 88 cm in females and ≥ 102 cm in males and WHR ≥ 0.85 in females and ≥ 0.90 in males were considered obese. Blood pressure was measured in the right arm of patient in sitting posture. It was measured after 30 min of rest and arm supported at heart level. They were also abstained from smoking and ingestion of caffeine within the previous 6 hrs. Two such readings were taken at least 24 hrs apart and the average of the two was taken.

5 ml of venous blood sample after an over-night 12 hrs fasting was collected for investigation. A 2 hrs postprandial sample was also collected. The TC, TG and HDL c were determined using enzymatic calorimetric method. The LDL-c and VLDL-c were estimated using Friedewald formula.

$$\text{LDL-c} = \text{TC} - (\text{HDL} + \text{VLDL})$$

RESULTS AND ANALYSIS:

- 214 patients with newly diagnosed hypertension from medical OP and Ward were included in the study group.
- 120 non-hypertensive persons of same age group were included in the study as control.

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To study the prevalence of dyslipidemia in the hypertensive patients were compared with the normotensive group.

SUMMARY OF STATISTICS FOR CONTINUOUS VARIABLES:

SI. NO.	ITEMS	MEAN	MEDIAN	RANGE
1	AGE	55.9159	58	30-75
2	HEIGHT	157.907	158	138-174
3	WEIGHT	67.4579	65	50-97
4	BMI	27.2507	26.6727	19.8-40.4
5	WAIST-CIRCUM	94.7664	95	78-116
6	WHR	0.9154	0.9189	0.76-1.07
7	SBP	162.710	160	130-200
8	DBP	93.2897	90	10-140
9	FBS	95.7196	96	72-123
10	PPBS	126.121	126	93-190
11	TC	196.804	191	150-283
12	TG	197.312	180	58-495
13	LDL	119.153	117	64-190
14	HDL	37.935	38	24-53
15	VLDL	40.0617	36.8	12-99

LIPID		'N'	MEAN	SE	'P'
TC	CASES	214	197	2.67	<0.0001 SIGNIFICANT
	CONTROL	120	166	2.77	
TG	CASES	214	197	7.03	<0.0001 SIGNIFICANT
	CONTROL	120	120	5.40	
LDL	CASES	214	119	2.45	<0.0001 SIGNIFICANT
	CONTROL	120	98.4	2.74	
HDL	CASES	214	37.9	0.63	<0.0001 SIGNIFICANT
	CONTROL	120	42.3	0.98	

Table 1: Mean lipid values: cases vs controls

INTERPRETATION: The total cholesterol, triglycerides, LDL-c are significantly higher in hypertensive patients (cases) when compared with non-hypertensive patients (control) In our study, dyslipidemia is defined as TC \geq 200 mg/dl, TG \geq 150 mg/dl, LDL \geq 130 mg/dl and HDL $<$ 40 mg/dl.

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LIPID	'N'		MEAN	SE	'P'
TC	YRS(31-45)	50	189	4.08	0.049
	YRS(61-75)	94	203	4.38	SIGNIFICANT
TG	YRS(31-45)	50	182	12.88	0.12
	YRS(46-60)	70	217	16.73	INSIGNIFICANT
LDL	YRS(46-60)	70	111	4.77	0.0072
	YRS(60-75)	94	127	3.44	SIGNIFICANT
HDL	YRS(31-45)	50	38.4	1.23	0.6
	YRS(60-75)	94	37.6	0.97	INSIGNIFICANT

Table 2: Mean lipid values in different age-groups

INTERPRETATION: Three age groups were formed among the hypertensive patients. Group-I: 31-45yrs, group-2: 46-60yrs and group-3: 61-75yrs. The total cholesterol is significantly high among hypertensive patients of group-3 when compared with group-I.

LIPID	'N'		MEAN	SE	'P'
TC	MALE	116	198	3.62	0.50
	FEMALE	98	195	3.96	INSIGNIFICANT
TG	MALE	116	201	8.29	0.52
	FEMALE	98	192	11.88	INSIGNIFICANT
LDL	MALE	116	121	3.11	0.31
	FEMALE	98	116	3.89	INSIGNIFICANT
HDL	MALE	116	36.4	0.78	0.0084
	FEMALE	98	39.7	0.96	SIGNIFICANT

Table 3: Mean lipid values: males vs females

INTERPRETATION: Hypertensive females have significantly higher HDL levels when compared with hypertensive males.

LIPID	'N'		MEAN	SE	'P'
TC	SMOKER	44	215	6.49	0.00014
	NON-SMOKER	72	188	3.32	SIGNIFICANT
TG	SMOKER	44	233	16.98	0.0019
	NON-SMOKER	72	182	6.77	SIGNIFICANT
LDL	SMOKER	44	129	6.89	0.7327
	NON-SMOKER	72	117	2.55	INSIGNIFICANT
HDL	SMOKER	44	39.3	1.33	0.00304
	NON-SMOKER	72	34.7	0.85	SIGNIFICANT

Table 4: Mean lipid values: smokers vs Non-smokers

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INTERPRETATION: Hypertensive smokers have significantly higher TC, TG and HDL values when compared with hypertensive non-smoker males

LIPID	'N'		MEAN	SE	'P'
TC	OBESE	148	205	3.12	<0.0001 SIGNIFICANT
	NON OBESE	66	177	3.09	
TG	OBESE	148	209	9.42	0.011 SIGNIFICANT
	NON OBESE	66	171	6.72	
LDL	OBESE	148	124	3.24	0.0035 SIGNIFICANT
	NON OBESE	66	109	2.40	
HDL	OBESE	148	39.6	0.68	<0.0001 SIGNIFICANT
	NON OBESE	66	34.1	1.08	

Table 5: Mean lipid values: body mass index (BMI)

INTERPRETATION: Hypertensive patients with BMI ≥ 25 kg/m² are considered obese and < 25 kg/m² as non-obese. Obese patients showed significantly higher values of all lipid parameters. Hypertensive patients with BMI ≥ 25 kg/m² have significantly higher percentage of TC, LDL and HDL in dyslipidemic range when compared with hypertensive patients with BMI < 25 kg/m².

LIPID	'N'		MEAN	SE	'P'
TC	OBESE	96	208	3.95	0.00015 SIGNIFICANT
	NON OBESE	118	188	3.20	
TG	OBESE	96	215	12.48	0.024 SIGNIFICANT
	NON OBESE	118	183	7.30	
LDL	OBESE	96	126	4.34	0.019 SIGNIFICANT
	NON OBESE	118	114	2.55	
HDL	OBESE	96	39.2	0.75	0.06218 IN-SIGNIFICANT
	NON OBESE	118	36.9	0.94	

Table 6: Mean lipid values: waist – circumference

INTERPRETATION: Hypertensive patients with waist circumference ≥ 102 cm for males and ≥ 88 cm for females were considered obese. Obese patients have significantly high TC, TG and LDL values when compared with non-obese patients. Hypertensive patients who are obese with respect to waist circumference have significantly higher percentage of patients with their TC and LDL in dyslipidemic range.

LIPID	'N'		MEAN	SE	'P'
TC	OBESE	160	198	2.97	0.28 INSIGNIFICANT
	NON-OBESE	54	192	5.85	
TG	OBESE	160	204	8.93	0.119 INSIGNIFICANT
	NON-OBESE	54	178	7.95	

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LDL	OBESE	160	119	2.78	0.90
	NON-OBESE	54	120	5.27	INSIGNIFICANT
HDL	OBESE	160	38.3	0.70	0.29
	NON-OBESE	54	36.8	1.36	INSIGNIFICANT

Table 7: Mean lipid values: waist-hip ratio (whr)

INTERPRETATION: Obesity when defined as waist hip ratio ≥ 0.85 in females and ≥ 0.90 in males did not show any significant alterations in mean lipid values when compared with non-obese hypertensive patients. Hypertensive patients with waist-hip ratio in obese range did not show any significant high percentage of dyslipidemia.

LIPID	'N'		MEAN	SE	'P'
TC	SEDENTARY	116	208	3.83	<0.0001
	NON-SEDENT	98	183	2.59	SIGNIFICANT
TG	SEDENTARY	116	212	11.75	0.022
	NON-SEDENT	98	180	5.74	SIGNIFICANT
LDL	SEDENTARY	116	125	4.07	0.00924
	NON-SEDENT	98	112	1.98	SIGNIFICANT
HDL	SEDENTARY	116	35.3	0.79	<0.0001
	NON-SEDENT	98	40.1	0.87	SIGNIFICANT

Table 8: Mean lipid values: sedentary vs non-sedentary

INTERPRETATION: Hypertensive sedentary patients have significantly higher values of TC, TG and LDL lipids when compared with hypertensive non-sedentary patients.

LIPID	'N'		MEAN	SE	'P'
TC	SES 2&3	104	206	3.79	0.00052
	SES 4&5	110	188	3.36	SIGNIFICANT
TG	SES 2&3	104	206	11.85	0.22
	SES 4&5	110	189	7.79	INSIGNIFICANT
LDL	SES 2&3	104	125	4.00	0.0186
	SES 4&5	110	114	2.74	SIGNIFICANT
HDL	SES 2&3	104	36.4	0.86	0.0132
	SES 4&5	110	39.5	0.86	SIGNIFICANT

Mean Lipid Values: Socioeconomic Status (SES)

INTERPRETATION: Hypertensive patients of SES 2&3 have significantly high mean TC, LDL and low HDL values when compared with hypertensive patients of SES 4 & 5.

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LIPID	'N'		MEAN	SE	'P'
TC	STAGE 1	64	191	4.02	0.19
	STAGE 2	150	199	3.37	INSIGNIFICANT
TG	STAGE 1	64	195	15.73	0.86
	STAGE 2	150	198	7.54	INSIGNIFICANT
LDL	STAGE 1	64	114	4.22	0.153
	STAGE 2	150	121	2.98	INSIGNIFICANT
HDL	STAGE 1	64	37.8	1.13	0.899
	STAGE 2	150	38.0	0.76	INSIGNIFICANT

Table 9: Mean lipid values: stages of hypertension

INTERPRETATION: There is no significant difference in mean lipid values between patients of stage-1 and stage-2 hypertension.

LIPID	'N'		MEAN	SE	'P'
TC	PRE-DIAB	70	206	4.61	0.0144
	NON-DIAB	144	192	3.15	SIGNIFICANT
TG	PRE-DIAB	70	208	14.56	0.31408
	NON-DIAB	144	192	7.70	INSIGNIFICANT
LDL	PRE-DIAB	70	125	4.83	0.074
	NON-DIAB	144	116	2.74	INSIGNIFICANT
HDL	PRE-DIAB	70	38.8	1.15	0.3543
	NON-DIAB	144	37.5	0.76	INSIGNIFICANT

Table 10: Mean lipid values pre-diabetic vs nondiabetic

INTERPRETATION: Hypertensive pre-diabetic patients have significantly high mean total cholesterol when compared with hypertensive non-diabetic patients.

DISCUSSION: PREVALENCE OF DYSLIPIDEMIA: On analysis of the lipid profile of 214 hypertensive patients and 120 normotensive persons the mean TC values in cases and controls are 197 mg/dl and 166 mg/dl respectively. The mean TG values are 197 mg/dl and 120 mg/dl, the mean LDL c values are 119 mg/dl and 98.4 mg/dl. All these differences are statistically significant with a 'p' value of <0.0001 when analyzed with unpaired T test. The mean HDL (37.9 mg/dl) in hypertensive is significantly lower (p <0.0001) than normotensive (42.3 mg/dl).

About 43.92% of hypertensive has high TC (i.e. ≥ 200 mg/dl) when compared with the normotensives (i.e. 5%). High TG (≥ 150 mg/dl) is found in 84.11 % of the hypertensive population, whereas it is seen only in 20% of normotensives. The high LDL in the groups is 28.03% and 5%. The low HDL (<40 mg/dl) is seen in 53.27 % of hypertensive and 30% of normotensive. All these values are statistically significant when analyzed using Chi-square test.

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The higher level of serum TC, TG and LDL-cholesterol in the study population may be due to genetic factors and lack of physical exercise, dietary factors, severe stress, increased age, gender, alcohol and tobacco consumption.

INFLUENCE OF AGE: The hypertensive patients included in our study were divided into three age groups (31-45yrs, 46-60yrs, and 61-75yrs) and the mean lipid values of the group were compared. The TC were significantly higher in hypertensive of the group-3 when compared with the group-I (mean TC 203 mg/dl vs. 189 mg/dl, $p=0.049$). The TG, LDL and HDL did not show any significant differences. On analyzing the percentage of dyslipidemia in each group, the group-3 had significantly higher percentage of patients with TC in dyslipidemic range (53.19% vs. 20%, $p=0.0151$) when compared with group I.

INFLUENCE OF SEX: In our study hypertensive males have significantly lower mean HDL levels when compared with hypertensive females (HDL 36.4 mg/dl vs. 39.7 mg/dl, $p=0.0084$). About 63.79% of males were in the dyslipidemic HDL range, when compared with females (40.08%), the value is significant ($p=0.0084$).

This favourable profile in females was probably due to the influence of oestrogen hormone.

INFLUENCE OF SMOKING: The mean TC, TG, LDL and HDL values in our study were higher in hypertensive smokers when compared with hypertensive non-smoker males. (Mean values: TC-215 mg/dl vs. 188 mg/dl, TG-233 mg/dl vs. 182 mg/dl, LDL-129 mg/dl vs. 117 mg/dl and HDL-39.3 mg/dl vs. 34.7 mg/dl). Among these except LDL all values were statistically significant.

The percentage of dyslipidemia is higher among the smoker population with respect to all lipid parameters, but only the TC was significant.

The proposed mechanisms by which smoking alters the lipid profile are⁹ Nicotine stimulates the release of adrenaline, leading to increased serum concentration of FFA. FFA is a stimulant of hepatic secretion of VLDL and hence TG. HDL-c varies inversely with VLDL-c in serum. FFA also stimulates hepatic synthesis and secretion of cholesterol. Smoking induces cytochrome p-450 system that degrades anti HT drugs¹⁰

INFLUENCE OF OBESITY: Body Mass Index (BMI): In our study obese patients when defined with BMI of ≥ 25 kg/m² showed significantly high values of TC, TG, LDL and HDL (p values 61 TC- <0.0001 , TG- 0.011, LDL- 0.0035 and HDL- <0.0001). The percentage of dyslipidemia is also significantly higher among obese patients with respect to TC, LDL and HDL and insignificantly high with respect to TG.

WAIST CIRCUMFERENCE: Patients with obesity when defined as waist circumference of ≥ 88 cm in females and ≥ 102 cm in males showed significantly high values of TC ($p=0.00015$), TG ($p=0.024$), LDL($p=0.019$) and high but insignificant ($p=0.063$) value of HDL. The percentage of dyslipidemia was significantly high with respect to TC and LDL and insignificantly high with respect to TG and insignificantly low with respect to HDL.

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WAIST HIP RATIO (WHR): Patients with obesity when defined by WHR ≥ 0.85 in females and ≥ 0.9 in males showed high TC, TG and LDL values and low HDL values, but none of them were significant. The percentage of dyslipidemia prevalence also showed similar trend.

INFLUENCE OF PHYSICAL ACTIVITY: In our study hypertensive patients who were sedentary had significantly high TC, TG and LDL and significantly low HDL values. Study by Ignez Salas Martius and Teixeira Coelho in Brazil also showed similar pattern of lipid abnormalities.

INFLUENCE OF SOCIO-ECONOMIC STATUS: The mean TC, TG and LDL are high and mean HDL values are low among SES class 2&3 hypertensive patients when compared with hypertensive patients of SES class 4&5 (p values TC- 0.00052, TG- 0.22, LDL- 0.0186 and HDL- 0.0132), all these values are significant except for TG. The high prevalence of dyslipidemia in high socio-economic group is probably due to their sedentary life style and increased intake of fatty foods.

INFLUENCE OF STAGES OF HYPERTENSION: Comparison of lipid profile of stage - I hypertensive patients with stage - II hypertensive patients did not show any significant difference in mean values and percentage prevalence. A study conducted by S. Sharif, A. Cheema and M. Khan¹¹ at Lahore showed significantly high values of TC and LDL among stage-II hypertensive but no significant difference in mean values of HDL and TG.

INFLUENCE OF PRE-DIABETIC STATE: The lipid profile of hypertensive patients with their blood sugar values in pre – diabetic range showed high mean values of TC, TG, LDL and HDL when compared with the values of hypertensive patients with normal blood sugar. Among these only TC was significantly high.

CONCLUSIONS:

1. In this study significant percentage of hypertensive patients were in dyslipidemic state when compared with normotensive persons.
2. In the present study significant percentage of hypertensive patients were in dyslipidemic state when compared with normotensive persons.
3. Elderly hypertensives have significantly higher percentage of individuals with total cholesterol in dyslipidemic range (53.19%) when compared with young and middle aged hypertensives in the present study.
4. Hypertensive smokers have significantly higher percentage of individuals with total cholesterol in dyslipidemic range (69.5%) when compared with hypertensive Non-smokers (34.2%).
5. Obesity when calculated using body Mass index and waist Circumference correlates positively with abnormal lipid profile in hypertensives, whereas the Waist Hip Ratio does not show any correlation in the present study.
6. Hypertensives in high socio economic status have high prevalence of dyslipidemia in the present study consistent with their lifestyles.

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7. The stages of hypertension did not alter the lipid profile in hypertensives in the present study.
8. In the present study hypertensive patients in Pre-diabetic state has significant association with dyslipidemia.

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