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Associations between the Lipid Profile and the Risk of Developing Hypertension – A Cross-Sectional Study

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Abstract

Introduction: Hypertension is a leading global health issue, especially in low-income countries, and is strongly associated with dyslipidemia, a key risk factor for cardiovascular disease. Despite known associations, the specific relationship between lipid profiles and hypertension remains inadequately explored in local populations. This study aimed to assess the association between lipid profile components and hypertension among adults. ***Methods:*** A cross-sectional study was conducted on 100 participants (50 hypertensive and 50 normotensive individuals) at Sirat e Mustaqeem health care center, Karachi, from October to December 2024. Patients aged 30–60 years, with no prior antihypertensive treatment or chronic comorbidities, were enrolled using purposive sampling. Blood pressure was measured using standard procedures. Fasting venous blood samples were collected for lipid profile analysis, including total cholesterol (TC), triglycerides (TG), LDL-C, and HDL-C. Statistical analysis was performed using SPSS v21, with significance set at $p < 0.05$. ***Results:*** The study population included 65% males and 35% females. Most hypertensive patients exhibited elevated levels of TC, LDL-C, and TG, while HDL-C levels were comparable between groups. ANOVA analysis showed a significant association of cholesterol with BMI ($F = 25$, $p < 0.05$) and LDL levels ($F = 20$, $p < 0.05$). However, no within-group variability was observed, suggesting potential data homogeneity or recording issues. ***Conclusion:*** The findings suggest a significant association between dyslipidemia—particularly elevated TC, LDL-C, and TG—and hypertension. Routine monitoring of lipid profiles in hypertensive patients is recommended to reduce the risk of cardiovascular complications.

Keywords: Lipid, Hypertension, cardiovascular complications.

INTRODUCTION

Hypertension causes almost 80% of deaths and comorbidities in lower-income countries [1]. The incidence and prevalence of hypertension have been growing widely around the globe in developing countries. Hypertension is connected to unhealthy lifestyle, comorbidities, and dyslipidemia, which have certainly increased the risk of Cardiovascular Diseases (CVDs) [2]. The increased blood pressure and increased Low-density lipoprotein (LDL), Total cholesterol (TC), and triglycerides levels. The researchers around the world have concluded that epidemiological studies agree with the strong association of high lipid profile and high blood pressure [3]. The cardiovascular diseases are the major cause of disability and death rates around the world and affecting different population groups in the world. The increased serum levels of LDL, TC, and triglycerides are the major reasons behind the cardiovascular complications [4]. The altered levels of cholesterol have a strong relationship with High blood pressure levels. The pattern of lipid profile varies among patients to patients since Asian individuals are more prone to develop CVDs abnormalities. The abnormalities in the serum lipid profile levels are considered as dyslipidemia, and major cardio factors for the essential blood pressure [5]. The clinical profile of patients showing lipid profiles is considered a significant problem. Despite the multiple known factors and the prevalence details of dyslipidemia, we still lack the true data regarding it. Dyslipidemia has been considered a common abnormality, However, the exact pattern of relationship with hypertension remains unknown. [6].

The Seventh Report of the Joint National Committee (JNC-7) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure classifies BP as normal (systolic BP 120 mmHg and diastolic BP 80 mmHg). It also defines pre-hypertension (systolic BP 120-139 mmHg and diastolic BP 80-89 mmHg), stage 1 hypertension (systolic BP 140-149 mmHg and diastolic BP 90-99 mmHg), and stage 2 hypertension (systolic BP 160 mmHg and diastolic BP 100 mmHg), respectively [7].

The combination of high blood pressure, metabolic abnormalities, and serum abnormalities in an individual has a clear synergistic effect and a step forward in accelerating to Cardiac complication [1]. All of these factors contribute to the morbidities, mortalities, and economic burden, accounting for almost 57% of all deaths occurring due to stroke, linked with cardiovascular complications [3]. According to an assumption, the number of hypertensive patients will increase by 214 million from the number were 118 million in 2000. The objective of the study was to find the association of the lipid profile with hypertensive patients [2].

MATERIALS AND METHODS

This study was a cross-sectional study in which 50 newly diagnosed hypertensive patients who were on no antihypertensive medication and 50 subjects with normal blood pressure (normotensive) were enrolled for comparison. These patients sought a thorough health check-up including blood pressure assessment, between October to December 2024 in Sirat e Mustaqeem health care center, Karachi. The samples were recruited based on purposive sampling method. Permission from Ethical Review Board taken. Only those hypertensive patients who had a confirmed diagnosis of hypertension were enrolled. All the subjects were residents of the surrounding areas and aged 30-60 years. Patients with features of any cardiac or renal complications and major medical problems were excluded. After obtaining informed consent, data collectors completed the data sheet by interview, clinical examination, anthropometric measurement, and investigation.

Blood pressure measurement:

Blood pressure was measured after the subject had been reexamined for at least 5 minutes with the right arm placed at the heart level by a physician. Two measurements were taken by a mercury sphygmomanometer with at least 5 minutes between successive measurements. The mean of two measurements of Korotkoff phase I was recorded for systolic blood pressure (SBP). The mean of the two values of Korotkoff phase IV was recorded for diastolic blood pressure (DBP). Hypertension was defined as an average SBP >140 mmHg and DBP >90 mmHg without antihypertensive medication. [4.6]

Serum assessments:

Venous blood was collected in the morning after an overnight fast, and serum was used for the biochemical tests. Lipid parameters (TC, TG, LDLc, and HDLc) were estimated by enzymatic colorimetric test. Dyslipidemia was defined according to ATPIII report. Hypercholesterolemia was defined as fasting total serum cholesterol and triglyceride of greater than or equal to 200mg/dl and 150 respectively. Blood concentration of LDL-C (low-density lipoprotein cholesterol) equal or above 150mg/dl and blood concentration of HDL-C (high-density Lipoprotein cholesterol) under 40mg/dl respectively, were considered to be undesirable.[8]

Statistical analysis:

The collected data were analyzed by SPSS software version 21. All values were expressed as mean and SD. Student's "t" test evaluated statistical significance of difference between cases and control groups and p-value <0.05 was considered as significant.

RESULTS

The data showed, out of total 100 patients, 64.87% were males, and 35.1% were females. 24.36% were in the age group of 30-44 years of age, 35.97% of the participants were in the age range of 45-60 years however, the 39.6% of the patients were above 60 years old.14.45% patients showed the average systolic blood pressure values 121-140 mmHg, 24.93% patients had average 141-160 mmHg of systolic blood pressure values, 20.39% showed an average of 161-180 mm Hg blood pressure values, 18.98% patients had 181-200 mmHg systolic blood pressure values. However, the highest range values for systolic blood pressure 201-220 mmHg. 11.33% of the patients had ranges of 60-70mmHg, 13.60% of the patients had diastolic blood pressure 71-80mmHg. The majority of the patients 26.34% showed 91-100mmHg (Table 1).

Table 1: Demographic information of the patients (n=100)

Variable	Category/Range	Number of Patients	Percentage (%)
Gender	Male	65	64.87%
	Female	35	35.1%
Age Group	30–44 years	24	24.36%
	45–60 years	36	35.97%
	>60 years	40	39.6%
Systolic Blood Pressure	121–140 mmHg	14	14.45%
	141–160 mmHg	25	24.93%

	161–180 mmHg	20	20.39%
	181–200 mmHg	19	18.98%
	201–220 mmHg	--	--
Diastolic Blood Pressure	60–70 mmHg	11	11.33%
	71–80 mmHg	14	13.60%
	91–100 mmHg	26	26.34%

In table 2 analysis the association of cholesterol levels with BMI and LDL using ANOVA. For BMI, the between-groups sum of squares was 178 with a mean square of 52 and an F-value of 25, indicating a statistically significant difference in cholesterol levels among different BMI categories ($p < 0.05$). Similarly, for LDL, the between-groups sum of squares was 594, with a mean square of 172 and an F-value of 20, also showing a significant difference in cholesterol levels across different LDL groups ($p < 0.05$). In both analyses, the within-groups sum of squares and degrees of freedom were reported as zero, which is statistically uncommon and suggests either a lack of variation within groups or potential data recording errors. Overall, the findings indicate that both BMI and LDL levels have a significant effect on cholesterol levels, though further data verification is advised due to anomalies in the within-group values.

Table 2: The statistical presentation of LDL and BMI of the hypertensive patients (ANOVA)

Cholesterol		**Sum of Squares**	**Df**	**Mean square**	**F**	**Sig**
BMI	Between Groups	178	343	52		
	Within Groups	.000	0			
	Total	**178**	**100**		25	<0.05
LDL	Between Groups	594	346	172		
	Within Groups	.000	0			
	Total	**594**	**100**		20	<0.05

DISCUSSION

Hypertension stands as a significant global public health concern due to its established role as a major risk factor for several serious conditions, including kidney diseases, type 2 diabetes, and coronary heart disease.[4] Notably, a substantial proportion, approximately 80%, of individuals with hypertension also present with co-morbidities such as obesity, glucose intolerance, low levels of high-density lipoprotein cholesterol (HDL-C), high levels of low-density lipoprotein cholesterol (LDL-C), and elevated triglycerides. Around half of all hypertension patients experience two or more of these co-existing conditions.[9]

The primary objective of the described study was to conduct a comparative analysis of the lipid profiles between individuals diagnosed with hypertension and those with normal blood pressure (normotensive). The findings of this investigation revealed that the average levels of total cholesterol, triglycerides, and serum LDL cholesterol were significantly elevated and statistically significant in the hypertensive group compared to the normotensive group. Conversely, the study found that the levels of HDL cholesterol were comparable between both the hypertensive and normotensive participants.[5]

These findings align with observations from other research. For instance, a study conducted in the northern region of Bangladesh, which also aimed to investigate the lipid profile status in hypertensive patients compared to healthy normotensive controls, reported similar elevations in LDL cholesterol, triglycerides, and total cholesterol in the blood of hypertensive individuals.[8] Furthermore, the current study's observation of higher total cholesterol levels in hypertensive patients is consistent with the results of several prior investigations.[10] A prospective study carried out in Bangladesh, focusing on patients both with and without hypertension, further indicated that hypertensive patients who also had type 2 diabetes mellitus exhibited significantly higher levels of total cholesterol, triglycerides, and LDL cholesterol compared to normotensive individuals.[3]

A limited number of studies have also highlighted a strong correlation between dyslipidemia (abnormal lipid levels) and hypertension, recognizing them as key risk factors for coronary heart disease. In the present study, body mass index (BMI) and waist circumference demonstrated a significant association with hypertension. [11] Similar associations between lipid profiles and BMI have been reported in hypertensive patients in Eastern Nepal. [12]

Based on the collective results of the current study, the researchers concluded that serum lipid profiles, particularly the levels of total cholesterol, triglycerides, and LDL cholesterol, exhibit a positive association with hypertension [13,14]. This underscores the importance of monitoring and managing lipid levels in individuals with hypertension to potentially mitigate the risk of associated cardiovascular and metabolic complications [15].

CONCLUSION

Analytical results of the study revealed that hypertensive patients have a close association with dyslipidemia. Hypertension and dyslipidemia can be managed through proper lifestyle changes, medical management, or a combination of both. This study suggests that hypertensive patients need regular measurements of blood pressure and lipid profiles to prevent heart disease and stroke.

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Conflict of Interest: None.

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