

Original Research Article

## Association of Serum Lipids with High Blood Pressure among Diabetic Patients

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### ABSTRACT

**Background:** *Dyslipidemia and hypertension in diabetic patients increase the risk of microvascular as well as macrovascular complications. The risk is usually increased and even multiplied when both dyslipidemia and hypertension coexist.* Aim of the study: *This study aimed to evaluate the association of serum lipids with high blood pressure among diabetic patients.* Methods: *This prospective observational cohort study was conducted in National Center for Control of Rheumatic Fever & Heart Diseases, Dhaka, Bangladesh, from March 2021 to July 2022. Total 247 diabetic patients from different age groups of either gender were enrolled in this study. Patients taking lipid lowering agents were excluded. Demographic and clinical information as well as data regarding lipid profile and blood pressure of the participants was recorded.* Results: *Total cholesterol, triglycerides and LDL-C were significantly correlated with systolic as well as diastolic blood pressure and were raised among hypertensive patients as compared to non-hypertensive ( $P<0.001$ ). The highest correlations were found between non-HDL-C with systolic and diastolic blood pressures ( $r=0.420$  and  $r=0.421$ , respectively with  $p<0.001$ ). However, HDL-C was inversely correlated with systolic and diastolic blood pressure and was raised among non-hypertensive patients. Regression models and mathematical linear equations were developed to estimate increasing blood pressure by given serum lipid levels. All regression models were significant ( $p<0.0001$ ).* Conclusion: *High lipid levels contribute to development of increase systolic as well as diastolic blood pressures. Besides blood pressure checking, proper assessment of total-cholesterol, triglycerides and HDL-C, non-HDL-C levels should be considered as mandatory procedure in management of all diabetic patients.*

**Keywords:** Serum lipid, Blood pressure, Diabetes, Hypertension.

### INTRODUCTION

Hypertension and dyslipidemia are important modifiable risk factors for diabetes and coronary artery disease (CAD) which are responsible for about 87% disability in low and middle-income countries. [1,2] Among diabetic patients, dyslipidemia and high blood pressure increase the risk both macro vascular and microvascular complications. [3] Hypertension is a very common comorbid condition in diabetes, affecting 20%-60% of patients with diabetes depending on age, obesity and ethnicity also. [4] Studies have demonstrated that elevated systolic blood pressure confers significantly higher risk of all

causes and coronary heart disease mortality than elevated diastolic blood pressure or combined systolic/diastolic hypertension, especially in diabetic patients. [5] Prevalence of hypertension is higher in diabetic patients than in nondiabetic individuals. [6] Recently the close association of blood cholesterol and low-density lipoprotein-cholesterol (LDL-C) with essential hypertension has been reported. [6,7] Hypertension has many risk factors that include diabetes and dyslipidemia, and due to its multifactorial consequences, it has become a major public health issue around the world. [8-10] One fifth of Bangladeshi adults suffer from hypertension. [11] Recent data on dyslipidemia in Bangladeshi population are scarce and epidemiological studies have shown an increased prevalence of lipid disorders among population in both urban and rural area. [12,13] Association between dyslipidemia and hypertension is of much clinical and public health importance and such data can be used for future non-communicable diseases prevention programs in Bangladesh. The objective of this study was to evaluate the association of serum lipids with high blood pressure among diabetic patients in a specialized center in Dhaka, Bangladesh.

## METHODOLOGY

This prospective observational cohort study was conducted in National Center for Control of Rheumatic Fever & Heart Diseases (NCCRF&HD), Dhaka, Bangladesh from March 2021 to July 2022. A total 247 diabetic patients were enrolled in this study as the study subjects. As per the inclusion criteria of this study, only diabetic patients from the different age groups of either gender were included. Patients taking lipid lowering agents for more than one week were excluded. All demographic data along with clinical information as well as data regarding lipid profile and blood pressure of the participants was recorded. Data were processed, analyzed and disseminated by using Microsoft Excel and SPSS version 23.0 program as per necessity. In statistical analysis, p value <0.05 was considered as the indicator of significance.

## ETHICAL APPROVAL

The protocol of this study was approved by Ethical Review Committee of NCCRF&HD and informed written consent was taken from the patients or legal guardians. It was obtained after explaining the purpose and nature of the study. Anonymity of the patients and confidentiality of information was maintained strictly.

## RESULTS

In this study, total 247 diabetic patients were enrolled. Among total participants, 56% (n=139) were male and 44% (n=108) were female and male-female ratio was 1.3:1. Majority of the patients (83%) had type-2 diabetes. Hypertensive cases contribute 39% of total population and 61% were free from hypertension. Among the respondents 58% were with abnormal lipid status.

All types of serum lipid values were found higher among hypertensive patients (p-value<0.001) than that in non-hypertensive patients. In assessing the correlation between serum lipids and blood pressure (systolic and diastolic) we found significant positive correlation. HDL-C was found to be negatively significant with systolic and diastolic blood pressures. Regression models and linear equations for the serum lipids with systolic and diastolic blood pressures were analyzed. The linear mathematical equations were constructed where systolic or diastolic blood pressure were calculated by the given lipid levels. All the models were found to be significant (p<0.0001).

**Table 1:** Demographic and other characteristics of diabetic patients (N=247).

Parameters	Frequenc y	%
Gender distribution		
Male	139	56%
Female	108	44%
Type of diabetes		
Type-1	42	17%
Type-2	205	83%
Status of hypertension		

Hypertensive	96	39%
Non-hypertensive	151	61%
Lipid status		
Abnormal lipids	143	58%
Normal lipids	104	42%

**Table 2:** Variables with descriptive statistics (Mean  $\pm$ SD).

Variables	Mean $\pm$ SD
Age (year)	49.84 $\pm$ 13.44
Diabetes duration (year)	13.37 $\pm$ 4.58
Triglycerides (mg/dl)	155.46 $\pm$ 84.26
Total cholesterol (mg/dl)	187.73 $\pm$ 52.91
LDL-C (mg/dl)	117.73 $\pm$ 47.77
HDL-C (mg/dl)	43.17 $\pm$ 16.37
Non-HDL-C (mg/dl)	149.37 $\pm$ 47.59
Systolic blood pressure (mm Hg)	127.37 $\pm$ 15.47
Diastolic blood pressure (mm Hg)	78.57 $\pm$ 8.76

**Table 3:** Serum lipids levels with hypertension state (Mean  $\pm$  SD; 95% CI) (N=247).

Serum lipids	Hypertension status with serum lipids(mg/dl)				p-value
	Present		Absent		
	Mean $\pm$ SD	95% CI	Mean $\pm$ SD	95% CI	
Total cholesterol	195 $\pm$ 47	191 to 196	184 $\pm$ 57	181 to 190	<0.001
Triglycerides	163 $\pm$ 95	157 to 170	151 $\pm$ 88	147 to 160	<0.001
LDL-C	124 $\pm$ 56	118 to 126	114 $\pm$ 45	94 to 104	<0.001
HDL-C	41 $\pm$ 14	42 to 38	42 $\pm$ 24	41 to 45	<0.001
Non-HDL-C	152 $\pm$ 50	147 to 154	146 $\pm$ 46	141 to 148	<0.001

**Table 4:** Correlation between serum lipids and systolic blood pressure. (N=247)

Variable tested for correlation	Pearson's correlation coefficient	p-value
Systolic BP and triglycerides	0.389	< 0.0001
Systolic BP and total cholesterol	0.387	< 0.001
Systolic BP and LDL-C	0.361	<0.01
Systolic BP and HDL-C	0.359	<0.01
Systolic BP and Non-HDL-C	0.420	<0.0001

**Table 5:** Correlation between lipids and diastolic blood pressure. (N=247)

Variable tested for correlation	Pearson's Correlation Coefficient	p-value
Diastolic BP and triglycerides	0.398	<0.0001
Diastolic BP and T cholesterol	0.384	<0.001
Diastolic BP and LDL-C	0.348	<0.01
Diastolic BP and HDL-C	0.365	<0.01
Diastolic BP and Non-HDL-C	0.421	<0.0001

**Table 6:** Regression models for systolic blood pressure and serum lipids (N=247).

Variables	F-value	T-value	p-value
Serum Triglyceride and systolic BP	13.29	163.04	<0.0001
Serum cholesterol and systolic BP	11.72	75.14	<0.0001
Serum LDL-C and systolic BP	4.88	111.67	<0.0001
Serum HDL-C and systolic BP	5.41	124.0	<0.0001
Serum Non-HDL-C and systolic BP	19.71	90.27	<0.0001

**Table 7:** Regression models for diastolic blood pressure and serum lipids. (N=247)

Variables	F-value	T-value	p-value
Serum triglyceride and diastolic BP	26.76	181.5	<0.0001
Serum cholesterol and diastolic BP	11.2	84.3	<0.0001
Serum LDL-C and diastolic BP	3.5	126.6	<0.0001
Serum HDL-C and diastolic BP	7.4	141.3	<0.0001
Serum Non-HDL-C and diastolic BP	19.6	101.1	<0.0001

## DISCUSSION

This study aimed to evaluate the association of serum lipids with high blood pressure among diabetic patients. Management of dyslipidemia is an important part in managing diabetes patients. As per the recent recommendations, target of LDL-C is to be less than 100 mg/dl in patients with diabetes, followed by non-HDL-C cholesterol of <130 mg/dl as a secondary target if triglyceride level remains elevated (>200 mg/dl). [14] This report indicates the importance of non-HDL-C as a potential marker of dyslipidemia. [15] Our study has demonstrated the percentage of diabetic dyslipidemia and hypertension to be 61% and 42% respectively, which is alarming. [14] Studies have found significant positive correlation of serum lipids with levels of systolic and diastolic blood pressure. [16] No study has found correlation between non-HDL-C and hypertension. [14] In our study, between lipids and blood pressure, the highest correlations were found between non-HDL-C with systolic as well as diastolic blood pressures ( $r=0.420$  and  $r=0.421$ , respectively,  $P<0.001$  for both); after non-HDL, the correlations for triglycerides were also significant with SBP and DBP. HDL-C was inversely related with systolic as well as diastolic blood pressures. Our data has demonstrated that correlations for non-HDL-C with blood pressures were the most significant, and that lipid is contributing most for the elevated blood pressures. In many research trials, it has been demonstrated that dyslipidemia is associated with the development of nephropathy as well as early detection of dyslipidemia with nephropathy is recommended in primary care clinics. [17] Qiao et al had reported that blood cholesterol and LDL-C are associated with blood pressure level in individual. [18] Cross-sectional survey among Chinese patients showed that co-existence of high blood pressure and abnormal glucose metabolism. [19] It is recommended to follow the best available guidelines for management of diabetes and its complications. [20] In our study, the most significant elevations of blood pressure were attributed due to raised non-HDL-C and then the triglycerides. All the findings of this current study may be helpful in further similar studies.

## LIMITATION OF THE STUDY

This was a single-center study with small sample size therefore, findings of this study might not reflect the exact scenario of the whole country.

## CONCLUSION & RECOMMENDATION

As per the findings of our study, we may conclude that, high lipid levels contribute to the development of increased systolic as well as diastolic blood pressure. Besides blood pressure checking, proper assessment of all types of serum Lipids levels should be considered as a mandatory procedure in management of diabetic patients.

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