

Association of Serum Total Cholesterol with Type 2 Diabetes Mellitus in Bangladeshi Male Adults: A Cross-Sectional Analytical Study

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Abstract

Introduction: Type 2 Diabetes Mellitus is a chronic metabolic disorder characterized by persistent hyperglycaemia and is often associated with abnormalities in lipid metabolism. Serum total cholesterol is one of the commonly measured lipid parameters and may provide useful information about cardiovascular risk in diabetic patients.

Objective: To evaluate and compare serum total cholesterol levels in Bangladeshi male adults aged above 40 years with Type 2 Diabetes Mellitus and healthy age-matched controls, and to determine the association between elevated cholesterol and diabetic status.

Methods: This cross-sectional analytical study was conducted among 200 Bangladeshi male participants aged above 40 years. Among them, 100 diagnosed Type 2 Diabetes Mellitus patients were included as the study group, and 100 healthy age-matched male individuals were included as the control group. Fasting blood samples were collected after overnight fasting, and serum total cholesterol was measured as the principal biochemical parameter. Data were expressed as mean $\pm$ standard deviation, and comparison between groups was performed by unpaired Student's *t* test.

Result: The mean serum total cholesterol level was higher in the study group than in the control group, with values of 174.91 ± 45.5 mg/dL and 145.08 ± 31.83 mg/dL, respectively. The mean difference was 29.83 mg/dL, with a *t* value of 5.37 and $p < 0.001$. This indicates a statistically highly significant elevation of serum total cholesterol among patients with Type 2 Diabetes Mellitus. The diabetic group also showed approximately 20.56% higher serum total cholesterol than controls.

Conclusion: The findings suggest that elevated serum total cholesterol is an important biochemical abnormality among Bangladeshi male patients with Type 2 Diabetes Mellitus aged above 40 years. However, as this was a cross-sectional study, the result should be interpreted as an association rather than proof of causation or disease progression.

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Introduction

Type 2 Diabetes Mellitus is a major chronic metabolic disease and an important public health problem worldwide. It is mainly characterized by persistent hyperglycaemia due to insulin resistance, impaired insulin secretion, or both. The burden of diabetes is increasing in low- and middle-income countries, including Bangladesh, where changes in diet, lifestyle, physical activity, urbanization, and population ageing have contributed to the rising number of affected adults.¹

Although Type 2 Diabetes Mellitus is commonly diagnosed and monitored through blood glucose and HbA1c, it should not be considered solely a disease of glucose imbalance. It is also strongly related to abnormalities in lipid metabolism. These abnormalities may increase the risk of vascular complications and long-term cardiovascular disease.²

Serum total cholesterol is a simple and commonly available biochemical marker. It reflects the total circulating cholesterol burden in blood. In patients with Type 2 Diabetes Mellitus, impaired insulin action may affect lipid synthesis, lipid transport, and lipid clearance. As a result, cholesterol levels may increase and contribute to a broader pattern of metabolic risk.^{3,4}

The relationship between diabetes and cardiovascular disease is clinically important. Diabetic patients are more vulnerable to vascular damage because of hyperglycaemia, oxidative stress, endothelial dysfunction, inflammation, and lipid abnormalities. In this context, increased serum total cholesterol may further increase the risk of atherosclerosis and cardiovascular complications.⁵

In Bangladesh, many diabetic patients are more familiar with fasting blood glucose and HbA1c than with lipid parameters. However,

glucose control alone does not fully represent cardiovascular risk. Lipid assessment, including serum total cholesterol, can provide additional clinical information for patient evaluation and follow-up.⁶

The present study was conducted to evaluate serum total cholesterol among Bangladeshi male patients with Type 2 Diabetes Mellitus aged above 40 years and to compare the findings with healthy male controls of the same age group.⁷

Methods

Study Design and Setting

This cross-sectional analytical study was conducted at Mymensingh Medical College, Bangladesh, from July 2019 to June 2020. The study included adult male participants aged above 40 years.

Study Population

A total of 200 male subjects were included in the study. They were divided into two groups: Group I: 100 male patients diagnosed with Type 2 Diabetes Mellitus, aged above 40 years.

Group II: 100 healthy male individuals of the same age group without diabetes.

Inclusion Criteria

The inclusion criteria were male participants aged above 40 years, diagnosed Type 2 Diabetes Mellitus patients for Group I, healthy non-diabetic male participants for Group II, willingness to provide fasting blood samples, and availability of required clinical and biochemical information.

Exclusion Criteria

The exclusion criteria were Type 1 Diabetes Mellitus, known cardiovascular disease, renal failure, use of drugs affecting lipid metabolism, medication likely to alter cholesterol status, and incomplete clinical or laboratory information.

Data Collection

Fasting blood samples were collected from all participants after overnight fasting. Serum total cholesterol was measured as the principal biochemical parameter. Other physical and biochemical parameters were recorded as part of the complete clinical assessment, but this manuscript focused specifically on serum total cholesterol.

Statistical Analysis

Data were expressed as mean $\pm$ standard deviation. The unpaired Student's *t* test was used to compare mean serum total cholesterol between Group I and Group II. A *p* value less than 0.05 was considered statistically significant, while a *p* value less than 0.01 was considered statistically highly significant. No direct Pearson correlation between serum total cholesterol and fasting serum glucose or HbA1c was available; therefore, such correlation was not claimed.

Results

A total of 200 male subjects participated in this study. Among them, 100 male patients with Type 2 Diabetes Mellitus aged above 40 years were included in Group I, and 100 healthy male individuals of the same age group were included in Group II.

The full study included estimation of physical parameters, fasting serum glucose, fasting serum lipid profile, and glycated haemoglobin. However, according to the objective of this article, the Results section is focused on serum total cholesterol.

Primary Cholesterol Finding

The mean serum total cholesterol level of Group I was 174.91 ± 45.5 mg/dL, while the mean serum total cholesterol level of Group II was 145.08 ± 31.83 mg/dL. The absolute mean difference between the two groups was 29.83 mg/dL.

Statistical analysis by unpaired Student's *t* test showed a *t* value of 5.37 and *p* < 0.001. This confirms that serum total cholesterol was significantly higher in male patients with Type 2 Diabetes Mellitus than in healthy controls.

Table I: Statistical Analysis of Serum Total Cholesterol Between Study and Control Groups

Parameter	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	Mean Difference	<i>t</i> Value	<i>p</i> Value	Interpretation
Serum total cholesterol mg/dL	174.91 $\pm$ 45.5	145.08 $\pm$ 31.83	29.83	5.37	<0.001	Highly significant elevation in T2DM

Group I: Male patients with Type 2 Diabetes Mellitus, age > 40 years
Group II: Healthy male adults of same age group

Magnitude of Cholesterol Elevation

The diabetic group showed approximately 20.56% higher serum total cholesterol compared with controls:

$$\frac{174.91 - 145.08}{145.08} \times 100 = 20.56\%$$

This indicates that the increase was not only statistically significant but also clinically meaningful. The standard deviation was also wider in the diabetic group, 45.5 mg/dL, than in the control group, 31.83 mg/dL. This suggests greater variation of cholesterol values among diabetic patients.

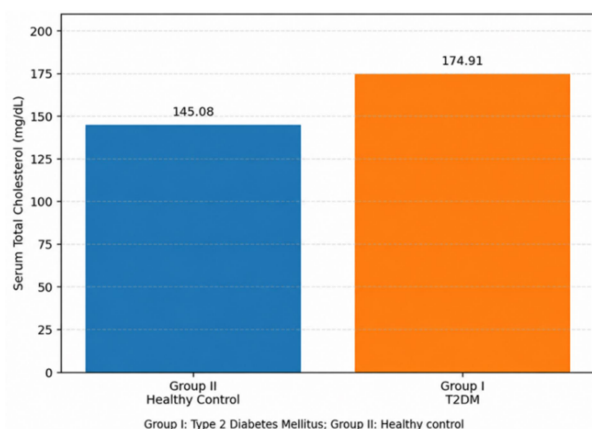


Figure 1. Mean Serum Total Cholesterol in Study and Control Groups

Figure 1 illustrates the mean serum total cholesterol values in the two groups. The study group showed a mean value of 174.91 mg/dL, whereas the control group showed 145.08 mg/dL.

Interpretation

The figure demonstrates the central finding of the study: serum total cholesterol was higher among male patients with Type 2 Diabetes Mellitus than among healthy controls. The visual difference is consistent with the highly significant statistical result, $p < 0.001$.

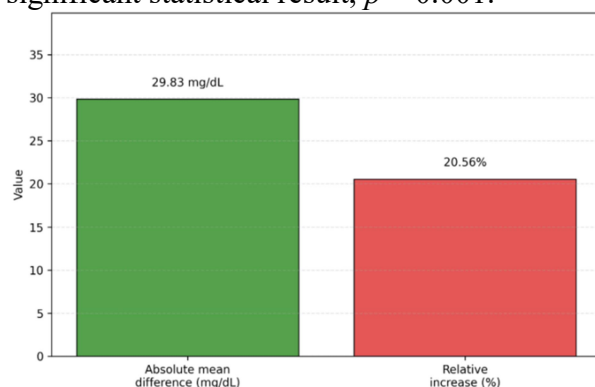


Figure 2. Absolute and Relative Increase in Serum Total Cholesterol

Figure 2 presents the cholesterol elevation as two effect measures: the absolute mean difference of 29.83 mg/dL and the relative increase of 20.56% in the diabetic group.

Interpretation

The figure shows that the increase in total cholesterol was not a small numerical difference but a measurable elevation in cholesterol burden among patients with Type 2 Diabetes Mellitus.

Discussion

The present study evaluated serum total cholesterol in Bangladeshi male patients with Type 2 Diabetes Mellitus aged above 40 years. The principal finding was that serum total cholesterol was significantly higher in diabetic patients than in healthy controls. Group I had a mean serum total cholesterol level of 174.91 ± 45.5 mg/dL, compared with 145.08 ± 31.83 mg/dL in Group II. The difference was statistically highly significant, with a mean difference of 29.83 mg/dL, $t = 5.37$, and $p < 0.001$. This finding supports the view that Type 2 Diabetes Mellitus is associated with higher circulating cholesterol burden in this study population.⁸

This result is biologically reasonable. Type 2 Diabetes Mellitus is closely linked with insulin resistance, and insulin resistance can disturb lipid metabolism. It may increase hepatic lipoprotein production, reduce normal lipid clearance, and contribute to an atherogenic lipid pattern. Although diabetic dyslipidaemia is often described by high triglyceride, low HDL-C, and abnormal LDL particles, total cholesterol may also be increased depending on the metabolic condition of the patient.⁹

The absolute difference of 29.83 mg/dL and relative increase of 20.56% suggest that the finding has practical clinical importance. In diabetic patients, even a moderate rise in cholesterol may become more important because it usually occurs together with other risk factors such as hyperglycaemia, hypertension, obesity, inflammation, and endothelial dysfunction. Therefore, serum

total cholesterol should not be ignored during diabetic assessment.¹⁰

The wider standard deviation in the diabetic group is also important. It shows that cholesterol values were more variable among diabetic patients than among healthy controls. Some diabetic patients may have near-normal cholesterol, while others may have much higher levels. This supports patient-specific lipid assessment rather than assuming that all patients with Type 2 Diabetes Mellitus have the same lipid risk.¹¹

The clinical importance of raised serum total cholesterol is mainly related to vascular risk. Excess cholesterol can contribute to atherosclerotic plaque formation, arterial narrowing, and reduced blood flow. In diabetic patients, vascular injury may progress faster because of chronic hyperglycaemia and metabolic stress. For this reason, cholesterol monitoring has value in the long-term care of diabetic patients.¹²

This finding is particularly relevant in Bangladesh. Many patients with diabetes focus mainly on blood glucose values, while lipid testing may not always be done regularly. As a result, dyslipidaemia may remain unnoticed until complications appear. Local studies have reported a high burden of dyslipidaemia among Bangladeshi patients with Type 2 Diabetes Mellitus, supporting the need for regular lipid screening in this population.¹³

However, the interpretation of this study must remain cautious. The design was cross-sectional, so it can show an association between Type 2 Diabetes Mellitus and higher serum total cholesterol, but it cannot prove that cholesterol caused diabetes progression. To establish progression, patients would need to be followed over time to see whether baseline cholesterol predicts worsening

glycaemic control, cardiovascular events, or diabetic complications.¹⁴

Another limitation is that the available results did not include a direct Pearson correlation between serum total cholesterol and fasting serum glucose or HbA1c. Therefore, this manuscript does not claim that serum total cholesterol directly correlates with glycaemic markers. This is important because unsupported correlation claims would overstate the findings.

Despite these limitations, the study has practical value. Serum total cholesterol is simple, available, and easy to interpret. Its significant elevation in diabetic patients supports routine monitoring and early cardiovascular risk assessment. Lifestyle modification, weight control, physical activity, smoking cessation, and lipid-lowering treatment may be considered when clinically indicated.¹⁵

Overall, this study reinforces the importance of serum total cholesterol assessment in Bangladeshi male patients with Type 2 Diabetes Mellitus. The finding does not prove causation, but it clearly shows that diabetic patients in this sample had a higher cholesterol burden than healthy controls.

Conclusion

Serum total cholesterol was significantly higher in male patients with Type 2 Diabetes Mellitus than in healthy male controls. The study group had a mean serum total cholesterol level of 174.91 ± 45.5 mg/dL, while the control group had 145.08 ± 31.83 mg/dL. The mean difference was 29.83 mg/dL, with $t = 5.37$ and $p < 0.001$.

The diabetic group showed approximately 20.56% higher serum total cholesterol than controls. This finding suggests that elevated serum total cholesterol is an important biochemical abnormality among Bangladeshi

male patients with Type 2 Diabetes Mellitus aged above 40 years.

Since this was a cross-sectional study, the result should be interpreted as an association rather than proof of causation or disease progression. Future longitudinal studies are needed to determine whether elevated serum total cholesterol predicts worsening glycaemic status, cardiovascular events, or diabetic complications. Routine monitoring of serum total cholesterol should be included in diabetic care to identify patients at increased metabolic and cardiovascular risk.

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