

# Comparative Analysis of Biochemical Abnormalities in Diabetic Patients with or without Cardiovascular Complications

AKRAM YOUSIF<sup>1</sup>, SALMAN ABBAS<sup>2</sup>, AMANULLAH BHUTTO<sup>3</sup>, MUHAMMAD ZUBAIR<sup>4</sup>, MUMTAZ ALI LAKHO<sup>5</sup>, MUHAMMAD RAHMAN KHALID<sup>6</sup>

<sup>1</sup>Post Graduate Trainee Adult Cardiology, National Institute of Cardiovascular Diseases Karachi, Pakistan

<sup>2</sup>Post Fellow Advanced Cardiac Imaging, National Institute of Cardiovascular Diseases Karachi, Pakistan

<sup>3</sup>Assistant Professor Pathology, Ghulam Mohammad Mahar Medical college Sukkur, Pakistan

<sup>4</sup>Post Fellow Advanced Cardiac Imaging, National Institute of Cardiovascular Diseases Karachi, Pakistan

<sup>5</sup>Associate Professor Medicine, Liaquat University of Medical & Health Sciences Jamshoro, Pakistan

<sup>6</sup>Senior Registrar Cardiology, Liaquat University of Medical & Health Sciences, Jamshoro, Pakistan

Corresponding author: Akram Yousif, Email: Akramchanna@gmail.com

## ABSTRACT

**Aim:** To assess the lipid profile and blood glucose concentration association between diabetic patients with and without cardiac disease.

**Study design:** Case-control study

**Place and Duration:** National Institute of Cardiovascular Diseases Karachi from January 2021 to June 2021

**Methodology:** The study included a total of 180 participants categorized into comparative groups. Diabetic patients were categorized into cardiac and non-cardiac patients. Demographic data were collected using a questionnaire, and clinical data were recorded with the physical examination. Blood was collected from all patients for further glucose and lipid profile testing. Data were evaluated using SPSS version 21.

**Results:** The average age was  $49.53 \pm 11.24$  and  $54.38 \pm 11.87$  years for non-cardiac and cardiac patients. Whereas BMI of  $28.16 \pm 5.89$  and  $27.64 \pm 4.18$  was observed in diabetic patients with non-cardiac and cardiac diseases. A total of 73 (81.2%) were smokers with cardiac diseases, and 58 (64.4%) were smokers without cardiac disease. A total of 80% of cardiac and 57.7% of non-cardiac patients had a family history of diabetes. Significant high levels of Cholesterol, LDL-C, and Glucose were observed. However, significantly lower levels of HDL-C were observed between patients with and without cardiac disease.

**Conclusion:** The results of the current study indicate that patients with diabetes having cardiovascular disease have a significant association with biochemical parameters. Those with diabetes are more likely to acquire hyperlipidemia.

**Keywords:** Biochemical parameter, cardiovascular disease, Diabetes Mellitus, Cholesterol, Dyslipidemia

## INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by elevated blood glucose with disruptive effects on the digestion of carbohydrates, proteins, and fats that are either caused by a lack of insulin release or a decreased ability of tissues to respond to insulin.(1) Type 2 diabetes mellitus (DM) is a significant risk factor for the development of cardiovascular disease, cerebrovascular disease, and peripheral vascular disease, according to epidemiological studies. (2)Atherosclerosis is exacerbated by changes in the lipid and lipoprotein profile in type 2 diabetes.(3) Since there have been many changes in people's lifestyles in Pakistan, less physical activity and weight gain have contributed as a risk factor for developing diabetes.(4)Others risk factors associated with Type 2 Diabetes (T2D) are increased BMI (Body Mass Index), age, obesity, familial history, etc. Over 80% of people with type 2 diabetes are overweight.(5) In Pakistan, prevalence will increase to 14.5 million by 2025 from 5.3 million between 2000 and 2025.(6) Diabetes is more persistent in Pakistani women than in men. (7)

Cardiovascular disease (CVD) is the leading cause of mortality in every country around the globe. (8) According to estimates, approximately 17 million deaths worldwide are reported from CVD. The main risk factor for cardiovascular disease in Pakistan is notably higher, with 29%smoking,18% experiencing hypertension, and 13% having substantially elevated cholesterol levels. (9)Before biochemical hyperglycemia manifests in type 2 diabetes, an increased cardiovascular risk typically predominates for a protracted time. During this time, hypertension, Dyslipidemia, and obesity are frequently prevalent and are typically referred to as metabolic syndrome. These risk factors might lead to the early development of Coronary Heart Disease (CHD). They could indicate an increased rate of diabetes in the time after a cardiovascular illness has been treated.(10)

It has been demonstrated that an early intervention to normalize coursing lipids can reduce cardiovascular complications and death. Most type II diabetes individuals have smaller/denser LDL-C segments, which likely contributes to the blood's overall atherogenicity. The American Diabetes Association (ADA) has

suggested glycated hemoglobin (HbA1c) as a diagnostic test for those with diabetes mellitus.(11)This study evaluates the typical blood glucose levels during the last few months. It may be used to identify prediabetes in offspring, specifically for type II diabetes mellitus, since it is an outstanding indication of the onset of diabetes and associated risks. The therapeutic deviation Diabetic patients frequently have Dyslipidemia. The broad term "hyperlipidemia" refers to persistently high levels of triglycerides and Cholesterol in the blood after a fast. But Dyslipidemia is defined as the combination of genetic, organic, or pathophysiological factors that can come together to alter the blood lipids and lipoprotein concentrations unpredictably. Regular associations exist between type 2 diabetes and obesity, lipid abnormalities, hypertension, and cardiovascular disease. (12)The many risk factors for the progression of type 2 DM include obesity, ethnicity, a sedentary lifestyle, sex, familial heritage, hypertension, and smoking. In Pakistan, cardiovascular disease (CVD) and diabetes are the two biggest health concerns.(13)

Compared to those without diabetes, type 2 diabetic patients usually have an atherogenic lipid profile, or low HDL and high TG, dramatically increasing their risk of cardiovascular disease (CVD).(14) Recently, it was shown that people with type 2 diabetes who also have apolipoprotein had a higher risk of cardiovascular disease. The metabolic variability in lipid digestion causes increased Cholesterol and LDL. Similarly, compared to diabetic patients without CVD, type 2 diabetes patients with CVD had significantly higher levels of hypercholesterolemia and hyperlipidemia.(15) The current study sought to evaluate diabetes individuals' potential risk for cardiovascular illnesses and associated complications.

The study aims to identify the biochemical relationships between a group of diabetic patients with cardiovascular and non-cardiovascular patients in the Pakistani population. To provide the way for the advancement of explicit treatments for patients with CVD and allow future attitudes to be established for its control, maintaining a strategic distance from the challenges in risk patients. To learn how common Dyslipidemia is in people with diabetes. Although obesity and inactivity are known to be linked to diabetes-

related morbidity and mortality, there is a lack of national data that shows the independent relationships between each risk factor and the frequency of cardiovascular comorbidities and associated diabetes in Pakistani society.

## METHODOLOGY

The study included a total of 180 participants selected randomly. They are further classified into two categories of diabetes with cardiac and non-cardiac diseases following a thorough clinical examination and a diagnosis. The research also considered 60 healthy people and 60 people without diabetes who had cardiovascular illnesses. All the patients chosen were physically examined. Thorough medical history was collected to learn about illnesses (particularly hypertension, myocardial infarction, coronary heart disease, stroke, endocrine disorders, and peripheral vascular disease). Patients with a clinically diagnosed type II DM with/without CVD are included in the criteria. HbA1C readings of more than 6% or a fasting blood glucose level of 126.0 mg/dL were used to determine the prevalence of diabetes. Patients with a history of previous coronary artery bypass grafting and those with acute renal and liver disorders were excluded from the study.

Permission was taken from the ethical review committee of the institute. The patients completed a dichotomous questionnaire based on age, diet, smoking, family history of diabetes, and the length of their diabetes. The clinical data was confirmed by reading the patients' hospital records. Body mass index (BMI) was expressed as kilograms (kg)/height in meters squared. About 10 ml of blood samples were taken and centrifuged for 10 minutes at 4,000 rpm. The Serum was subsequently used for the analysis of Fasting Blood Glucose (FBG), Lipid Profile Panel: HDL-cholesterol (HDL-C), Triacylglycerol (TAG), Total cholesterol (TC), Risk proportion (TC/HDL-C) by using, and Indirect LDL-cholesterol and Non-HDL. Hypercholesterolemia is defined as TC > 200 mg/dl, high LDL-C 100 mg/dl, hyper triglyceridemia 150 mg/dl, and low HDL-C 40 mg/dl.

Data were evaluated using SPSS version 21. The means of several parameters were compared using the autonomous samples t-test. All other parameters were supplied in mg/dl, and the estimated HbA1c level was presented as the amount of total hemoglobin. Results are presented as a mean and standard deviation; when  $p > 0.05$ , they are not deemed significant.

## RESULTS

Patients were categorized as diabetic with or without cardiac diseases. Both the groups were compared for the biochemical and other parameters for analysis. The average age of diabetic patients without cardiac disease was  $49.53 \pm 11.24$  years compared to that of cardiac patients,  $54.38 \pm 11.87$  years. However, the BMI of  $28.16 \pm 5.89$  and  $27.64 \pm 4.18$  was observed in diabetic patients with non-cardiac and cardiac diseases. The average duration of 5 to 10 years of diabetes was noted in 35.5% of non-cardiac patients and 60% of cardiac patients.

In comparison, the average duration of more than ten years of diabetes was noted in 64.5% of non-cardiac patients and 40% of cardiac patients. A family history of diabetes was observed in 80% of cardiac patients and 57.7% of non-cardiac patients. Smoking habits have been observed in both cases. Out of 90 cases in both groups, 73 (81.2%) were smokers with cardiac diseases, and 58 (64.4%) were smokers without cardiac disease, as shown in **Table 1**.

The biochemical parameters of both cases with and without cardiac disease in diabetic Mellitus patients were compared. High levels of Cholesterol ( $***p < 0.001$ ), LDL-C ( $**p < 0.01$ ), and Glucose ( $*p < 0.05$ ) were observed. However, significantly lower levels of HDL-C ( $***P < 0.001$ ) with slightly significant triglycerides ( $*p < 0.05$ ) were observed between patients with and without cardiac disease, as shown in **Table 2**.

At the same time, a significant association of lipid profile was observed with cardiac patients compared to the control group, as shown in **Table 3**.

Table-1: Description of demographic and clinical characteristics of the study population

Characteristics	Diabetic Patients		p-value
	Non-Cardiac Disease (90 cases)	Cardiac Disease (90 cases)	
Age	49.53± 11.24	54.38 ± 11.87	** P<0.01
BMI (kg/m <sup>2</sup> )	28.16 ±5.89	27.64 ± 4.18	* P<0.05
Diabetes Duration			* P<0.01
5-10 years	32 (35.5%)	54 (60%)	
> 10 years	58 (64.5%)	36 (40%)	
Family History			* P<0.05
Yes	52 (57.7%)	72 (80%)	
No	38 (42.3%)	18 (20%)	
Smoking			* P<0.05
Yes	58 (64.4%)	73 (81.2%)	
No	32 (35.4%)	17 (18.8%)	

Table-2: Comparison of lipid profile and serum glucose in cardiac and non-cardiac patients having diabetes.

Parameters	Diabetic Patients		p-value
	Non Cardiac diseases	With Cardiac diseases	
Glucose	190.25 ± 78.38	215.54± 28.67	* P<0.05
Cholesterol	238.76± 58.93	196.76±26.98	***P<0.001
Triglycerides	167.74± 52.18	181.53± 32.84	* P<0.05
HDL-C	44.28± 10.86	31.98± 7.80	***P<0.001
LDL-C	149.76± 43.08	132.47± 41.81	* P<0.01

Table-3: Comparison of lipid profile and serum glucose in control and cardiac patients without diabetes.

Parameters	Control	Cardiac disease	p-value
Glucose	95.65 ± 21.32	124.53 ± 30.65	* P<0.01
Cholesterol	205.68 ± 40.86	165.86 ± 31.22	*** P<0.001
Triglycerides	153.35 ± 54.36	184.53± 41.26	*** P<0.001
HDL-C	56.76 ± 32.14	31.24 ± 5.32	*** P<0.001
LDL-C	115.73 ± 41.53	102.08 ± 23.08	* P<0.05

## DISCUSSION

In light of clinical and metabolic parameters, the current study sought to evaluate the possible risk of cardiovascular illnesses and associated complications in diabetes individuals. One hundred eighty participants were chosen for the study; 90 were diabetics with cardiac disorder and 90 without cardiovascular disease. The difference between the two groups was less significant ( $p < 0.05$ ) in terms of BMI (kg/m<sup>2</sup>), smoking, and family history, and a low significance ( $p < 0.01$ ) difference was observed with age and length of diabetes. Similar results were observed in the previous study. (13) With the increased age of every ten years, there are 88% chances of diabetes development.

The risk of developing diabetes increases with the increase in BMI and age. (16) A recent study showed that smoking among T2DM (Diabetes Mellitus type 2) patients were one of the top five risk factors for mortality and acute myocardial infarction. (17) According to a study conducted in China on 7763 male T2DM patients, smoking cigarettes was linked to higher fasting plasma glucose levels and HbA1c, especially in those who received treatment and had the most pack-years and duration of smoking. (18) In the Pakistani population, smoking significantly contribute to the risk factor for developing diabetes and cardiovascular diseases. (19)

Obesity and high BMI values have long been associated with the development of diabetes and cardiac diseases. (20) In the present study, the average BMI of  $28.16 \pm 5.89$  with diabetes and  $27.64 \pm 4.18$  with diabetes along with cardiac disease is relatively high, showing a positive association between obesity and the development of these diseases. Patients with T2DM had a 12%

higher risk of heart failure, a 53% higher risk of MI (myocardial infarction), and a 10% higher risk of CAD. T2DM is a significant risk factor for CVD and its aftereffects. (21)

It is crucial to understand the duration of diabetes for the development of comorbidities such as cardiomyopathy. We observed the duration of developing the cardiac disease with diabetes was less, suggesting a higher risk of developing this comorbidity. The present study observed no significant difference in fasting glucose in patients with diabetes and diabetes with cardiac diseases. In comparison, the observed cases of CVD and control have a low significant difference in fasting glucose levels. A previous study observed that in the various categories of fasting glucose levels in both comorbidity groups, patients with fasting glucose levels between 110 and 124 mg/dL had the lowest risk for all-cause mortality. (22)

In Association with diabetes-related cardiovascular problems, lipid metabolism is a crucial factor. (23) No significant changes have been observed in the present study suggesting that risk factors contribute to disease outcomes may be considered. In the control group, a normal lipid profile was observed, and a significant correlation between lipid profile and cardiac disease was observed in our study. Numerous studies have shown that decreasing low-density lipoprotein cholesterol (LDL-C) with statins in people with type 2 diabetes helped lower the risk of CVD. Lipid profile has long been recognized as one of this population's most significant risk factors for CVD. (24, 25)

In a cross-sectional analysis of 223,612 T2DM patients in China, researchers found that while lower triglycerides were linked to a shorter risk of CVD, they were linked to a longer risk. (26) Along with medicine, several unique fractions of various risk factors also exist, depending on the Association between coverage and size alteration. The long-term research would help to strengthen the national healthcare system of a fragile and low-income country by minimizing the cost efficacy and lowering the rising burden of illness through early diagnosis.

## CONCLUSION

The present study found that the lipid profile (Cholesterol, triglycerides, HDL, and LDL) and fasting blood glucose has a less significant association in diabetic patients with and without cardiac diseases and high significance among cardiac disease cases and control groups. However, in a third-world country like Pakistan, it is an inexpensive diagnostic marker in evaluating essential parameters to predict the risk factor of cardiovascular disease complications in people with diabetes with type 2 diabetes

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**Permission:** The ethical review committee approved the study of the institute.

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