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ORIGINAL ARTICLE

High Prevalence of Dyslipidemia in Type 2 Diabetics: Strong Association with Obesity, Poor Glycemic Control, and Smoking

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ABSTRACT

In the current research article, the researcher examined and studied the prevalence of and risk factors of dyslipidemia among patients with T2DM at a tertiary care hospital in Lahore, Pakistan, its correlation with obesity, poor glycemic control, and smoking. Dyslipidemia is a widespread and fatal metabolism disorder in T2DM that greatly increases the risk of cardiovascular disease. Even though diabetes is a significant problem in Pakistan, little is known about the extent and distribution of dyslipidemia and its preventable risk factors.

A cross-sectional analysis was done on 250 T2DM patients between January and August 2023. Patients taking lipid-lowering medications or who had secondary dyslipidemia were excluded. Lipid profiles, glycated hemoglobin (HbA1c), and BMI, as well as smoking status were checked. Dyslipidemia was determined according to the ADA.

The prevalence of dyslipidemia was 96.4%. An increase in the triglyceride content was the most frequently reported disruption (82.8%), followed by LDL-C (76.8%) and low HDL-C (72.4%). Mixed dyslipidemia pattern occurred in 71.6 percent of the subjects. Dyslipidemia was strongly linked with obesity ($p < 0.001$) where 98.2 percent of individuals with obesity had it. Equally poor glycemic control (HbA1c flanking 7%) was pronouncedly associated with dyslipidemia (98.4%, $p < 0.001$) and 100 pct of the current smokers suffered dyslipidemia in the test. Obesity, uncontrolled HbA1c and smoking were independent predictors confirmed by logistic regression.

This research points to a very high rate of dyslipidemia in Pakistani patients with T2DM and advises the introduction of early screening measures and combined obesity treatment, glycemic measures, and smoking cessation interventions to decrease the risk of cardiovascular diseases.

Keywords: Dyslipidemia, Type 2 Diabetes, Obesity, Glycemic Control, Smoking

INTRODUCTION

T2DM is a metabolic disorder and insulin resistance is a plus relative deficiency known as diabetes mellitus type 2; it has the highest growing rate worldwide[1,2]. As cited in the International Diabetes Federation (IDF), there were an estimated 537 million adults living with diabetes in the world in the year 2021, with an increase in projection to 643 million adults living with diabetes by the year 2030[3]. Commonly abbreviated to diabetic dyslipidemia, dyslipidemia in such patients normally features reduced levels of high-density lipoprotein cholesterol (HDL-C), high levels of low-density lipoprotein cholesterol (LDL-C), and high triglyceride (TG) concentrations[4,5]. This atherogenic lipid profile greatly adds the risk of macrovascular problems, especially coronary artery diseases and stroke.

The South Asia, in particular countries such as Pakistan has a very disturbing situation regarding burden of T2DM. Pakistan is number three in the world in the prevalence of diabetes with more than 33 million adults having it[6,7]. Nevertheless, there is low awareness, screening, and management of related metabolic disorders that include dyslipidemia. Dyslipidemia is underrecognized and undertreated, a factor leading to a high cardiovascular complication burdens in diabetic population[8,9]. The loss of cardiometabolic homeostasis in T2DM has been identified as leading to one of the most severe risks of developing dyslipidemia that has been linked to a higher cardiovascular morbidity and mortality[4]. In addition, the presence of reversible risk factors, such as obesity, poor glycemic regulation and smoking, compounds the lipid abnormalities and increases the intensity and speed of atherosclerosis development[10]. It is important to learn how these factors interact to develop effective preventative and treatment strategies.

It is a well-documented risk factor of insulin resistance, and T2DM, with obesity being especially prevalent with central adiposity[11]. It is also inherently associated with dyslipidemia based on the following mechanisms; free fatty acid flux elevation, overproduction of very-low-density lipoprotein (VLDL) in the liver, and also by defective clearance of triglyceride-rich lipoproteins. In South Asian communities, the slightest elevations of body mass index (BMI) lead to severe metabolic disorder caused by visceral fats deposition[12,13]. The dyslipidemia induced by obesity is usually characterized by an increase in TG and LDL-C and a decrease in HDL-C, which concentrates cardiovascular risk in diabetic patients[14].

Another main factor that leads to dyslipidemia in T2DM is poor glycemic control [15]. Lipid metabolism An atherogenic lipid profile results in the changes in lipid metabolism caused by chronic hyperglycemia including increased hepatic lipogenesis and hepatic insulin resistance, a decrease in lipoprotein lipase activity and hepatic steatosis. Increased HbA1c includes not only having poor glycemic control but is also strongly associated with an increased TG and LDL-C concentration and a decreased HDL-C concentration[16]. Thus, strict glycemic control is crucial in the prevention of microvascular complications, as well as the treatment of dyslipidemia and cardiovascular risk in diabetics[17,18].

Another known cardiovascular risk factor is smoking, which combines with the metabolic disarray of diabetic patients[10]. Oxidative stress, endothelial dysfunction, and systemic inflammation are effects of tobacco smoke and lead to a negative reaction to lipid metabolism. Severe smokers with diabetes commonly have a more atherogenic lipid profile with higher TG and lower HDL-C compared to non-smokers[19]. Even in spite of the risks known, prevalence of smoking is still too high in most low- and middle-income countries, such as Pakistan, contributing to an increase in dyslipidemia burden in diabetics.

A few studies both local and international have tried to measure the prevalence and risk factors of dyslipidemia in diabetics. Nonetheless, there is limited and scattered data in Pakistan. The majority of research either cannot provide analysis in detail or cannot evaluate the impact of obesity, glycemic control, and smoking on combined impact on lipid profiles of diabetics. Considering the rising rates of diabetes and cardiovascular

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diseases in the country, it is urgent to address these relationships by establishing locally relevant studies with the help of this paper.
This study seeks to fill this gap by assessing prevalence and trend of dyslipidemia in T2DM patients in a Lahore-based tertiary care hospital in Pakistan. What is more important is that it explores the relationship of dyslipidemia with obesity, unfavorable glycemic control, and smoking status the three key, modifiable risk factors responsible in causing the cardiovascular burden of this population. The study aims to deliver practical recommendations that will, hopefully, be used in clinical practice and policy by a) identifying risk subgroups and clarifying the interconnectedness of these variables, and b) presenting on data-driven actionable recommendations that can inform clinical practice and policies. Effective identification and treatment of dyslipidemia may greatly diminish chances of poor cardiovascular prognosis in diabetics, particularly those who are obese, poorly controlled and smokers.
Conclusively, this paper aims at addressing the knowledge gap in epidemiology of dyslipidemia among Pakistani diabetics by determining its prevalence rates and associations. The results can be crucial to screening, preventative cardiology, and developing specific intervention actions to enhance the metabolic wellbeing of T2DM individuals.

METHODOLOGY

The study was a cross-sectional study at the General Hospital, Lahore, conducted to determine the prevalence and patterns of dyslipidemia in diabetics with Type 2 diabetes mellitus (T2DM) and to determine its relationship with obesity, poor glycemic control, and smoking between January 2023 and August 2023. The inclusion criteria were a proven diagnosis of T2DM patients without restriction by age and gender. All participants had written informed consent.

Additional exclusion criteria included individuals taking lipid-lowering drugs and those with secondary dyslipidemia that was not related to diabetes, i.e., hypothyroidism, nephrotic syndrome, chronic liver disease, or familial hyperlipidemia.

Blood tests Fasting 812 hours Lipid profile Total cholesterol (TC), Triglycerides (TG), Low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) A glycemic index was assessed through glycated hemoglobin (HbA1c) levels, and body mass index (BMI) was computed on measured height and weight. The self-report yielded a number of non-smokers and smokers.

The analysis of data was conducted through the SPSS 25. The normally distributed quantitative variables were reported as mean plus or minus standard deviation (SD), whereas nonnormal sampled data were reported as median with interquartile range (IQR). Categorical variables were presented as frequencies and percents. Dyslipidemia was classified according to American Diabetes Association (ADA) definitions and was deemed to be present when one or more of the following conditions were found: TC > 200 mg/dL; TG > 150 mg/dL; LDL-C > 100 mg/dL; HDL-C < 40 mg/dL (men) / < 50 mg/dL (women). The Chi-square test was used to analyze the relationship between dyslipidemia and independent variables (BMI, HbA1c, and smoking) and the p - value < 0.05 was taken as statistically significant.

RESULTS

A total of 250 patients diagnosed with Type 2 diabetes mellitus were included in the study. The mean age of the participants was 55.4 ± 9.1 years, with a slight female predominance (52.4%). The majority of patients (66.8%) were obese, based on BMI ≥30 kg/m², while 18.4% were overweight, and 14.8% had normal BMI.

Out of 250 patients, 241 (96.4%) were found to have some form of dyslipidemia. The most prevalent lipid abnormality was elevated triglycerides, seen in 82.8% of the patients, followed by elevated LDL-C (76.8%), low HDL-C (72.4%), and elevated total cholesterol (60.8%). A mixed pattern of dyslipidemia (≥2 lipid abnormalities) was observed in 71.6% of the patients.

Table 1: Prevalence of Different Dyslipidemia Traits among Type 2 Diabetic Patients (n = 250)

Lipid Abnormality	Frequency (n)	Percentage (%)
Elevated Total Cholesterol (>200 mg/dL)	152	60.8%
Elevated Triglycerides (>150 mg/dL)	207	82.8%
Elevated LDL-C (>100 mg/dL)	192	76.8%
Low HDL-C (<40 mg/dL in males, <50 mg/dL in females)	181	72.4%
Any Dyslipidemia	241	96.4%
Mixed Dyslipidemia (≥2 abnormalities)	179	71.6%

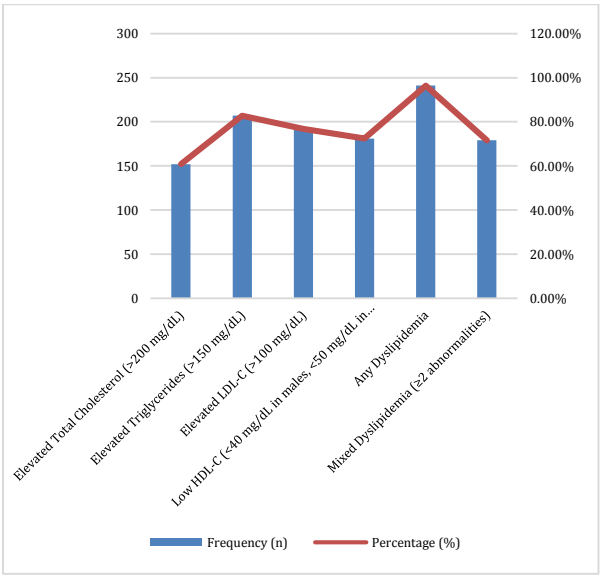

Figure 1: Prevalence of Different Dyslipidemia Traits among Type 2 Diabetic Patients

Obesity and dyslipidemia had significant correlation with each other (p < 0.001). There were 98.2 percent of obese individuals with dyslipidemia, whereas among normal BMI there were 92.7 percent. Triglycerides and LDL-C were, in apposite, more frequent in obese patients. The median BMI of the dyslipidemic patients was 31.2 +/- 5.6 kg/m 2.

Table 2: Association Between BMI Category and Dyslipidemia

BMI Category	n	Dyslipidemia (%)	p-value
Normal (<25)	37	34 (91.9%)	
Overweight (25–29.9)	46	44 (95.7%)	<0.001
Obese (≥30)	167	164 (98.2%)	

Association of Dyslipidemia with Glycemic Control: Why Glycemic control, which is hbA1c = 7 percent or higher, was observed in 74.4 percent (186/250) of the patients. Amongst them, the number with dyslipidemia constituted 98.4%, a meaningful relationship (p < 0.001). Conversely, the rate of dyslipidemia among patients with HbA1c <7% was 90.6%. The elevated HbA1c values were associated with the increased triglycerides and LDL-C levels.

Among 250 participants 68 (27.2%) were current smokers. Dyslipidemia was found more in smokers, with 100 percent prevalence, which was higher than non-smokers with 94.5 percent prevalence. Smoking was markedly correlated with high triglycerides (p < 0.001), and even with low HDL-C (p = 0.02). This implies that smoking is a potent potentiating agent of dyslipidemia among diabetics.

Logistic regression was used to ascertain the independent predictors of dyslipidemia. Obesity (OR 3.14, 95% CI: 1.3573.32), uncontrolled HbA1c (OR 4.25, 95 percent CI: 1.62711.18), and

smoking (OR 2.87, 95 percent CI: 1.09752) were independent, significant predictors of dyslipidemia after our model adjusted for age and gender.

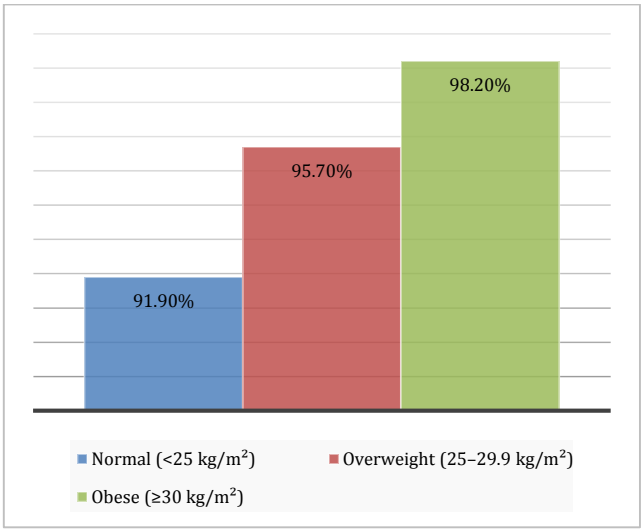

Figure 2: Association Between BMI Category and Dyslipidemia

Table 3: Association Between HbA1c Levels and Dyslipidemia

HbA1c Category	n	Dyslipidemia (%)	p-value
<7% (Controlled)	64	58 (90.6%)	
≥7% (Uncontrolled)	186	183 (98.4%)	<0.001

The research report indicates that the proportion of the dyslipidemia among patients with type 2 diabetes mellitus is alarmingly high (96.4%). The dyslipidemic pattern was characterized by elevated triglycerides among LDL-C and had a significant percentage with multiple dyslipidemias. There was a powerfully statistically significant correlation between dyslipidemia and the presence of obesity, inadequate glycemic control, and smoking. These results highlight the necessity of orderly lipid screening and life circumstance interventions along with early drug treatment to lessen cardiovascular risks of the susceptible population.

DISCUSSION

Through this research we found out that the prevalence of Dyslipidemia in Type 2 diabetes mellitus (T2DM) patients is dangerously high (96.4%) with the predominant lipid abnormality being high triglycerides, high LDL-C and low HDL-C. The results of this study can be viewed as non-contradictory to the evidence on dyslipidemia as a prominent metabolic derangement of diabetic patients, which, in many instances, presents a key factor that elevates the risk of cardiovascular diseases (CVD) in people with diabetes.

The prevalence in our study serves to emphasize the established notion that dyslipidemia is mostly under-diagnosed and under-treated particularly in low- and middle-income countries, such as Pakistan, where the prevalence rates of diabetes are already amongst the highest globally. The patterns of the dyslipidemia that were observed, especially the abundance of hypertriglyceridemia and low HDL-C, point to the so-called atherogenic diabetic dyslipidemia, defined by the excess of triglycerides, small dense LDL and low levels of HDL-C. This trend has been revealed to be more common among the South Asian populations owing to genetic, dietary, and lifestyle aspects.

The relation of dyslipidemia and obesity was also found to be strong in our study. Most patients (more than 85%) were either overweight or obese, and between them dyslipidemia rates were much higher. Obesity especially central adiposity causes insulin resistance; coupled with melioration of lipid abnormalities. High BMI was strongly related to high triglyceride levels and LDL-C. This relationship has been in line with other past researchers such as Ramesh et al., and Singh et al., which evidenced similar associations between elevated BMI and dyslipidemia among the diabetics. These results demonstrate that lifestyle interventions (food and physical exercise) in weight control play a key role in corroborating lipid-related cardiovascular risk.

Ineffective glycemic control, given high HbA1c concentrations, also demonstrated a close relationship, which was significant, with dyslipidemia in our study population. The distribution of lipid abnormalities was significantly different with both hypertriglyceridemia and high LDL-C more common in patients with HbA1c of 7 or more. This facilitates the notion that hyperglycemia has a direct effect on lipid metabolism by encouraging hepatic overproduction of very-low-density lipoprotein (VLDL) as well as inhibiting lipoprotein lipase action thereby raising circulating triglyceride concentration. The metabolic imbalances that arise are not only indicators of poor glycemic controls, but are also atherogenic, predisposing individuals to long-term vascular complications. International studies that have given similar results include Haffner et al and UKPDS Group that showed substantial occurrence of cardiovascular risk in diabetics wth present dyslipidemia and poor glycemic control.

Another important factor that predicts dyslipidemia among our study population was smoking. Every person who smoked in the sample had some sign of dyslipidemia, with high triglycerides and low HDL-C taking the center of the stage. The toxic effect of nicotine and other constituents of tobacco smoke on the lipid metabolism include increase in sympathetic activity, disruption of the lipoprotein levels, and enhanced oxidation. These alterations facilitate endothelial dysfunction and atheroma development hence further increasing the risk of developing coronary artery disease in diabetic smokers. Our findings are consistent with those of a research conducted by Younis et al., which indicated that the T2DM smokers were more at risk of dyslipidemia and coronary events compared to non-smokers.

This research shows that integrated management strategies in patients with diabetes are urgently needed that are not confined to simply glycemic control but also to modifiable cardiovascular risk factors, which may include dyslipidemia, obesity, and smoking. Combining fasting lipid profile examination at an early stage and follow-up of HbA1c and BMI levels can facilitate early interventions. Therapeutic lifestyle changes are the fundamental management in patients with proven dyslipidemia with pharamcologic therapy, especially statins, accompanies; this is based on ADA and AACE guidelines.

In spite of its strengths though, this study also has a few limitations. It is a single-center, cross-sectional study that restricts causal conclusions and generality. They also failed to evaluate dietary patterns, physical exercise, and adherence to medications, which would further have an effect on lipid parameters. However, the high sample size and uniform associations with the key risk factors give a rich perspective on metabolism issues of diabetic patients of Pakistan.

To sum up, the prevalence of dyslipidemia is very high in T2DM-affected individuals and it is closely linked with obesity, lack of glycemic control and smoking. Such results recommend the use of comprehensive cardiovascular risk assessment and early intervention of diabetic individuals. One of the ways to curb cardiovascular morbidity and mortality in this high-risk population is by treating these modifiable risk factors via lifestyle modification, smoking cessation, and proper lipid lowering therapy.

CONCLUSION

The article discloses that dyslipidemia in Type 2diabetes mellitus among patients at a tertiary care premiere facility in Lahore and has a critically high prevalence of 96.4 per cent. Strong independent predictors of dyslipidemia were obesity, poor glycemic control, and smoking, and each played a major role in atherogenic

lipid profile. This conclusion indicates the necessity of more thorough management of all aspects of diabetic care with an emphasis on weight loss, glycemic control and smoking. To manage diabetes, regular screening of lipids and patient education should become part of the routine in Pakistan. These identified modifiable risks factors can play a significant role in reducing the adverse cardiovascular event and overall outcomes of diabetics and relieve the general public burden of diseases and deaths due to diabetic causes.

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