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Comparing Dyslipidemia Patterns in Newly Diagnosed and Long-Term Type 2 Diabetics in a Tertiary Care Hospital at Mirpur Khas, Sindh

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ABSTRACT

Dyslipidemia is a common metabolic condition linked with type 2 diabetes mellitus and is a substantial risk factor for cardiovascular disease. The pathogenicity and pattern of dyslipidemia may vary with the duration of diabetes, requiring investigation of these changes to improve treatment approaches. **Objectives:** To compare the prevalence and patterns of dyslipidemia in newly diagnosed compared with long-term type 2 diabetes mellitus patients in a tertiary care hospital in Pakistan. **Methods:** A comparative cross-sectional study was conducted with 300 type 2 diabetes mellitus patients, divided into two groups: 150 newly diagnosed and 150 long-term diabetics. HbA1c and Lipid profiles (total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglycerides) were assessed. Dyslipidemia was defined per American Diabetes Association guidelines. Statistical analysis was performed using SPSS version 25.0, with a p-value of <0.05 considered significant. **Results:** The results show that the patients with long-term type 2 diabetes mellitus are associated with significantly increased (92%, p<0.05) levels of lipid profile parameters as compared with the newly diagnosed type 2 diabetes mellitus patients (78%). Moreover, the mean HbA1c levels in blood are positively associated with the severity of dyslipidemia. **Conclusion:** It was concluded that dyslipidemia progressively increases with the advancement of type 2 diabetes mellitus.

INTRODUCTION

Hyperglycaemia, a metabolic disease caused by deficiencies in either insulin release, its action, or both, is the hallmark of type 2 diabetes mellitus (DM) [1]. Diabetes's high morbidity and mortality rate, up to 80% of deaths from cardiovascular disease (CVD), are a result of the disease's long-term macrovascular consequences [2]. Patients with diabetes frequently experience both aberrant lipoprotein metabolism and hormone therapy (HT). Among the main risk factors for CVD in Type 2 Diabetes Mellitus (T2DM) is dyslipidaemia. Hypertriglyceridemia decreased high-density lipoprotein (HDL) cholesterol, and an increase in the proportion of tiny, dense low-density lipoprotein (LDL) particles are the most prevalent patterns of dyslipidaemia. Although the exact etiology of diabetic dyslipidaemia is unknown, a substantial amount of data points to insulin resistance as a key factor in the illness's progression. Increased free fatty acid flow due to insulin resistance is thought to be the primary source of the lipid alterations linked to diabetes mellitus [3]. In light of this, the goal of the physician should be to lower the patient's risk of CVD by

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managing hyperglycaemia, hyperglycaemia, and dyslipidaemia through lifestyle changes and/or medication. Blood pressure and lipid objectives are lowered for diabetes patients, a high-risk population because macrovascular disease is the primary cause of death in this population [4]. Extended periods of hyperglycaemia in type 2 diabetes (T2DM) alter the glycosylation of proteins, particularly the connective tissue proteins (collagen crosslinking) and matrix proteins found in artery walls [5]. Atherosclerosis is the main outcome of this harmful process, which is the growth of endothelial function. The metabolism of proteins, fats, and carbohydrates is altered due to a lack of insulin activity [6]. In type 2 diabetes, hypertriglyceridemia, a drop in serum HDL cholesterol, and sporadic elevated serum LDL cholesterol are all correlated with relative insulin shortage, insulin resistance, and obesity. Dyslipidaemia, which elevated LDL-C characterizes, decreased HDL-C, or elevated triglycerides TG levels, is linked to type 2 diabetes [7]. An individual factor for coronary artery disease (CAD) is raised triglyceride (TG) levels. Due to its highest risk of developing macrovascular problems, which impact 10-73% of diabetic patients, dyslipidaemia in T2DM is a major concern [8, 9]. Additionally, diabetes mellitus is ranked in the highest risk group due to expert reports from the Adult Treatment Panel III (ATP III) panel on detecting, evaluating, and treating high blood cholesterol in adults, which compares it to CAD [10]. Duration of diabetes is a significant factor in the progression of dyslipidaemia. As the disease advances, dyslipidaemia patterns also get worse, resulting in an increased risk of cardiovascular complications. Research has shown that long-term T2DM patients are more associated with severe lipid abnormalities compared to newly diagnosed patients. This chronological aspect of dyslipidaemia progression highlights the need for continuous lipid monitoring and management in the case of diabetes.

This study aims to provide a valuable understanding of the progression of dyslipidemia in T2DM patients, thereby updating clinical practice and more treatment strategies to improve patient outcomes.

METHODS

The current cross-sectional analytical study was conducted at Bhitai Dental and Medical College, Mirpur Khas, Sindh, Pakistan, for two years, from February 2022 to January 2024.The sample size was calculated by the following formula: $n=Z^2 x(p^1 x q^1+p^2 xq^2) / d^2$.In this equation: Z is the chosen level of confidence that is considered as 1.96 for 90% confidence, p^1 and p^2 are the expected prevalence of dyslipidemia in newly diagnosed and long-term diabetics, respectively while, q1 indicates 1-p1 and q2 as 1-p2. d is the required margin of error. Based on findings from previous studies, the prevalence of dyslipidemia in newly diagnosed diabetics (p1) was estimated to be 89% [11], and in long-term diabetics (p2) it was 92% [12], d^2 as 5.57=6%. Using these values, a sample size of 300 (150 patients per group) patients was calculated as sufficient to detect a statistically significant difference in dyslipidemia patterns. The patients diagnosed with T2DM within the last 6 months with no previous history of lipid-lowering treatment were included as newly diagnosed diabetic patients while the long-term diabetic group included the patients with at least five years of T2DM. The age for both groups was 30 to 70 years. The patients with a history of type 1 and gestational diabetes, chronic renal disease, and liver disorders, were excluded from both study groups. The patients with a history of bariatric surgery, medication (lipid-lowering, antihypertensive or hormone replacement therapy), chronic alcohol addiction and cigarette smoking were also excluded from the research. All the respondents were informed about the objective, methods, possible risks, and usefulness of the research. Informed consent from the participants was taken in written form. They were allowed to quit the study at any point without any pressure. Data were collected through a non-probability consecutive sampling technique, from the selected participants by relevant medical history, clinical examination, and laboratory reports. A blood sample was taken from all participants in fasting condition to measure lipid profile biomarkers, such as Total cholesterol (TC), LDL, HDL, and TG. Glycemic control was evaluated by measuring fasting blood glucose and HbA1c levels. The lipid profiles of newly diagnosed and long-term diabetic patients were then compared to find significant differences in dyslipidemia patterns. For male, the reference cut-off values for lipid profiles were as follows: TC levels below 200 mg/dL, LDL below 100 mg/dL, HDL above 40 mg/dL, and TG below 150 mg/dL. For female TC levels below 200 mg/dL, LDL below 100 mg/dL, HDL above 50 mg/dL, and TG below 150 mg/dL were considered within the normal range. Statistical analysis of the obtained data was carried out using SPSS version 25.0. Descriptive statistics were used to represent the values related to the demographic features and clinical presentations. Continuous study variables were described as mean ± standard deviation (SD), and the categorical variables were shown in the form of frequencies and percentages. The data normality was tested using the Shapiro-Wilk test, and the data were found to be normally distributed. An Independent t-test was used for the comparison of the means of lipid profiles between newly diagnosed and long-term diabetic patients and the Pearson correlation test was applied to find a correlation between glycaemic control and various lipid parameters. p-values less than 0.05 were regarded as statistically

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significant. Ethical approval for the research was obtained from the relevant institutional review board before the start of the study(BDMC/R&D/ERC/2022-01).

RESULTS

The demographic characters and clinical findings of all the participants are displayed. The mean age of the newly diagnosed group was 48.6 ± 10.3 years, while the long-term diabetic group showed a mean age of 55.2 ± 8.7 years. The gender distribution was comparable between the two groups, with a slightly higher proportion of male. Poor glycemic control, as indicated by higher HbA1c levels, was more pronounced in the long-term diabetic group (mean HbA1c: 8.9% ± 1.6%) compared to the newly diagnosed group(mean HbA1c: 7.6% ± 1.3%, p≤0.05). HbA1c levels were seen positively (p≤0.05) correlated with the severity of dyslipidemia, particularly with elevated LDL cholesterol and triglycerides, in both groups. Body mass index (BMI) was significantly higher in the long-term diabetic group (mean BMI: 29.3 ± 4.8 kg/m^2) compared to the newly diagnosed group (mean BMI: 27.8 ± 5.2 kg/m^2, p<0.05). Higher BMI was positively correlated with elevated LDL cholesterol and triglycerides (p<0.05) in both groups, indicating that increased body weight exacerbates lipid abnormalities, particularly in long-term diabetics. Gender differences in lipid abnormalities were also analyzed, with male showing a higher prevalence of elevated LDL cholesterol and triglycerides, while female had a higher prevalence of low HDL cholesterol. This gender-specific dyslipidemia pattern was consistent across both groups (Table 1).

Table 1: Clinical, Demographic, and Baseline Investigations of the Study Population

Characteristic	Newly Diagnosed Diabetics (n=150)	Long-Term Diabetics (n=150)
Mean Age (Years)	48.6 ± 10.3	55.2 ± 8.7
Male Gender n (%)	80 (53.3)	84 (56)
Mean HbA1c (%)	7.6 ± 1.3	8.9 ± 1.6
Mean BMI (kg/m^2)	27.8 ± 5.2	29.3 ± 4.8
Fasting Blood Glucose (mg/dL)	152.4 ± 28.7	178.6 ± 34.2
Postprandial Blood Glucose (mg/dL)	192.3 ± 45.1	212.5 ± 48.7
Total Cholesterol (mg/dL)	192.3 ± 45.1	212.5 ± 48.7
LDL Cholesterol (mg/dL)	112.3 ± 27.4	130.8 ± 31.2
HDL Cholesterol (mg/dL)	41.6 ± 8.9	38.4 ± 9.5
Triglycerides (mg/dL)	170.5 ± 38.2	192.7 ± 45.6

The study participants' lipid profiles were examined to compare the two groups' dyslipidemia prevalence and trends. The American Diabetes Association (ADA) defines dyslipidemia as having high LDL cholesterol (≥100 mg/dL), low HDL cholesterol (<40 mg/dL in men and <50 mg/dL in women), elevated total cholesterol (≥200 mg/dL), and elevated triglycerides (≥150 mg/dL). The cut-off values for male and female are provided in brackets where applicable. Table 3 shows the prevalence of each dyslipidaemia type. 78% of patients in the newly diagnosed diabetic group had dyslipidemia in some form, with hypertriglyceridemia (42%), low HDL cholesterol (45%), and increased LDL cholesterol (55%), being the most dominant abnormalities. In contrast, the long-term diabetic group had a much greater prevalence of dyslipidemia (92% of patients affected). Of the patients in this group, 72% had increased LDL cholesterol, 58% had low HDL cholesterol, and 66% had hypertriglyceridemia. Females in the long-term diabetic group showed significantly lower HDL cholesterol levels (36.4 ± 8.9 mg/dL) compared to males in the same group (39.7 ± 9.2 mg/dL, p<0.05). The significantly different values among both study groups were seen, in the overall incidence of dyslipidemia(p≤0.05)(Table 2).

Table 2: Comparison of Dyslipidemia Patterns Between Newly Diagnosed and Long-Term Type 2 Diabetics

Dyslipidemia Parameter	Newly Diagnosed Diabetics (n=150)	Long-Term Diabetics (n=150)	p-value
Any Dyslipidemia, n (%)	117 (78%)	138 (92%)	<0.001*
Raised Total Cholesterol (>200 mg/dL), n (%)	42 (28%)	66 (44%)	0.002*
Raised LDL Cholesterol (>100 mg/dL), n (%)	83 (55%)	108 (72%)	0.001*
Low HDL Cholesterol (<40 mg/dL for men, <50 mg/dL for women), n (%)	45 (30%)	87 (58%)	<0.001*
Elevated Triglycerides (>150 mg/dL), n (%)	63 (42%)	99 (66%)	<0.001*
Mean LDL Cholesterol (mg/dL)	112.3 ± 27.4	130.8 ± 31.2	<0.001**
Mean HDL Cholesterol (mg/dL)	39.8 ± 9.0	37.8 ± 9.4	0.045**
Mean Triglycerides (mg/dL)	170.5 ± 38.2	192.7 ± 45.6	<0.001**

*Chi-square test was applied for categorical variables. **Independent sample t-test was applied for continuous variables. p<0.05 indicates statistically significant differences.

The group with diabetes for a longer duration had considerably greater mean levels of LDL cholesterol (138.2 ± 32.6 mg/dL vs. 124.4 ± 30.2 mg/dL, p<0.05), triglycerides (189.7 ± 58.3 mg/dL vs. 159.6 ± 49.2 mg/dL, p<0.05), total cholesterol (212.3 ± 40.7 mg/dL vs. 196.5 ± 35.4 mg/dL, p<0.05), and LDL cholesterol (188.2 ± 32.6 mg/dL vs. 159.6 ± 49.2 mg/dL, p<0.05) in comparison to the newly diagnosed group. On the other hand, the group with a history of diabetes had lower HDL cholesterol levels (38.1 ± 9.6 mg/dL) than the group with a recent diagnosis (44.3 ± 10.2 mg/dL, p≤0.05)(Table 3).

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Table 3: Lipid Profile Parameters and Cutoff Values for Male and Female Patients

Lipid Parameter (mg/dL)	Newly Diagnosed		p-value	Long-Term		p-value*
	Male (n=A)	Female (n=B)		Male (n=C)	Female (n=D)	
Total Cholesterol (Male/Female: >200)	196.5 ± 35.4	198.0 ± 32.5	0.021*	212.3 ± 40.7	215.5 ± 38.2	0.031*
LDL Cholesterol (cut-off >100)	124.4 ± 30.2	126.0 ± 28.3	0.001*	138.2 ± 32.6	140.0 ± 30.5	0.034*
HDL Cholesterol (cut-off <40 for men,<50 for women)	44.3 ± 10.2	48.1 ± 9.4	0.017*	38.1 ± 9.6	42.0 ± 8.8	0.019*
Triglycerides (cut-off >150)	159.6 ± 49.2	165.0 ± 50.1	0.021*	189.7 ± 58.3	192.5 ± 55.4	0.014*

*p-value refers to statistical significance between newly diagnosed and long-term diabetics, based on the independent t-test. Cut-off values: Total Cholesterol >200 mg/dL, LDL >100 mg/dL, HDL <40 mg/dL for men and <50 mg/dL for women, Triglycerides >150 mg/dL.

The study findings suggest that the length of T2DM has a significant impact on the severity and pattern of dyslipidemia. Long-term diabetics not only exhibited higher rates of dyslipidemia but also had more pronounced lipid abnormalities, which may subsidize their higher risk for cardiovascular complications. These results underscore the need for more aggressive lipid management strategies in long-term diabetic patients. Positive correlation coefficients (r) indicate that as HbA1c increases, lipid levels also tend to increase. Negative correlation coefficients of HDL levels indicate that as HbA1c increases, it tends to decrease. The correlations are stronger in long-term diabetics compared to newly diagnosed diabetics, particularly for total cholesterol, LDL cholesterol, and triglycerides (Table 4).

Table 4: Correlation Between Glycaemic Control (Measured by Hba1c) and Various Lipid Parameters for Both Newly Diagnosed and Long-Term Diabetics

Lipid Parameter (mg/dL)	Newly Diagnosed (r)	p-value	Long-Term (r)	p-value*
Total Cholesterol	0.25	0.02	0.30	0.01
LDL-Cholesterol	0.22	0.03	0.28	0.02
HDL-Cholesterol	-0.19	0.04	-0.24	0.04
Triglycerides	0.31	0.01	0.35	0.01

DISCUSSION

In the current research study, the incidence of dyslipidemia was observed in 78% of newly diagnosed T2DM patients, compared to 92% in the long-term diabetic group. The difference was significant at p≤0.05, indicating that the severity of dyslipidemia is significantly associated with the progression of T2DM. These findings align with previous studies that reported variable prevalence rates of dyslipidemia in known T2DM cases. For example, a study by Habib reported a prevalence rate of 85.33% in T2DM patients [13], which is similar to the 89% prevalence observed by Rizwan *et al.*, [14]. The findings of our study also display a positive correlation of TC, TG and LDL with HbA1c levels and a negative correlation of HDL with HbA1c levels in both the study groups. It indicates that dyslipidemia is present in patients with increased HbA1c and increases with the increase in HbA1c levels. This finding of our study is well supported by Sharahili *et al.*, who also reported a positive association of HbA1c with all biomarkers of lipid profile other than HDL-C, which showed a negative correlation [15]. Samimagham *et al.*, in their research, showed a significant positive association of HbA1c with lipid profile parameters [16]. These studies suggest that HbA1c is important biomarkers to check long-term glycemic index and it also predicts the level of dyslipidemia [17, 18]. The results of our study are other findings that highlight the risk of controlling dyslipidemia in diabetic patients. For example, studies from South Africa and Nigeria reported dyslipidemia prevalence rates of 90.3% and 90.7%, respectively, in T2DM patients [19-21]. Some of the limitations of our study are acknowledged, including a small cohort size, conducted at a single tertiary care hospital, and not including the duration of disease and treatment for diabetes. The study also did not include some confounding variables like diet and physical activity. However, our study delivers valuable information about the incidence and progression of dyslipidemia in T2DM patients. Healthcare providers should prioritize early screening for dyslipidaemia. Routine lipid profile assessments should be part of diabetes management to detect and address dyslipidaemia early.

CONCLUSIONS

It was concluded that the study shows a clear variation in dyslipidemia patterns between newly diagnosed and long-term type 2 diabetic patients. Long-term diabetics show a significantly higher prevalence and severity of lipid abnormalities. Early and regular screening for lipid abnormalities should be part of routine laboratory diagnosis. Strict glycemic control is essential, as it correlates with better lipid outcomes, and therefore optimizing HbA1c should be a priority.

Authors Contribution

Conceptualization: NA
Methodology: NA, MA, RS, WUK, FN
Formal analysis: WUK
Writing review and editing: RS, SA, FN

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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