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RELATION OF DIABETIC RETINOPATHY WITH LIPID PROFILE OF PATIENTS WITH TYPE II DIABETES MELLITUS

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Abstract: Background: **Objectives:**The aim of the study is to establish the prevalence of diabetic retinopathy in type II diabetes mellitus patients, and to compare the lipid profile of patients with and without diabetic retinopathy.**Methodology:**This is a cross-sectional research that was carried out in the Department of Medicine, Shaikh Zayed Hospital, Lahore. N=175 patients with type II diabetes mellitus aged between 30-70 years were included. Clinical and demographic data were obtained. An ophthalmologist carried out fundscopy to detect diabetic retinopathy. Blood samples were measured as lipid profile, such as total cholesterol, triglycerides, low and high-density lipoprotein. The SPSS version 25.0 was used to analyze the data. The p-value of 0.05 or less was considered significant.**Results**:Of 175 patients, 153 (87.4) patients had diabetic retinopathy. Patients with retinopathy were elderly and had patients with longer duration of diabetes. Mean triglycerides and low-density lipoprotein were found to be significantly elevated in the retinopathy group whereas the high-density lipoprotein was found to be significantly reduced. Patients with retinopathy had higher total cholesterol although the difference was not significant. In multivariate analysis, longer diabetes duration, high triglycerides and low high density lipoprotein were found to be independent predictors of diabetic retinopathy.**Conclusion:**The occurrence of diabetic retinopathy was very common among patients with type II diabetes mellitus. High triglycerides and low high-density lipoprotein, which is dyslipidemia, was significantly associated with diabetic retinopathy.

Keywords: diabetic retinopathy; dyslipidemia; high-density lipoprotein; triglycerides; type II diabetes mellitus

INTRODUCTION

Diabetes is a major public health problem. The global burden of diabetes has increased steadily, and type 2 diabetes accounts for most cases worldwide. The Global Burden of Disease 2021 analysis also showed that diabetes prevalence will keep rising in the coming years.[1] Diabetic retinopathy is one of the most important microvascular complications of diabetes. A 2022 systematic review from the Eastern Mediterranean Region found that the pooled

prevalence of diabetic retinopathy was 31%.[2] A 2023 study from the United States estimated that 9.60 million people, or 26.43% of those with diabetes, had diabetic retinopathy in 2021.[3]

Recent studies have shown that lipid abnormalities may play a role in diabetic retinopathy, but the results are not fully consistent. In a 2022 retrospective study from Saudi Arabia, higher triglyceride levels and higher systolic blood pressure were significantly associated with diabetic retinopathy, while other lipid parameters showed less clear associations.[4] In 2023, a systematic review and meta-analysis reported that higher baseline triglyceride and cholesterol levels were significantly associated with the occurrence of diabetic retinopathy in patients with type 2 diabetes mellitus.[5] However, a 2024 large United States national database study reported a more complex and partly conflicting relationship between lipid abnormalities and diabetic retinopathy, suggesting that the association may differ by stage or outcome of disease.[6] Another 2024 study showed that greater severity of retinal hard exudates in diabetic retinopathy was significantly associated with higher total cholesterol, triglycerides, LDL, and VLDL levels.[7]

These findings show that diabetic retinopathy remains common and that dyslipidemia may be an important modifiable factor. Still, the available evidence is not uniform. Some studies show a clear link, while others show mixed results. Also, most recent data come from other countries and populations. This makes local research necessary. The present study is important because it will determine the frequency of diabetic retinopathy in patients with type II diabetes mellitus and compare the lipid profile in patients with and without retinopathy. Such data can help identify high-risk patients early and may support better screening and prevention strategies in our setting.

METHODOLOGY

The study was a cross-sectional study carried out in the Department of Medicine, Shaikh Zayed Hospital, Lahore. The research period was six months following the approvals of the synopsis between 01 July 2025 and 01 January 2026. Nevertheless, the research was done within 03 months (01 October 2025). This study was ethically approved by the Shaikh Zayed Medical Complex, Lahore (Ref). No. 02-TERC/NHRC-SZH/INT-SC/48). The study included 175 patients. Non-probability consecutive sampling was employed where a 95% confidence, 5% margin of error and an expected incidence of diabetic retinopathy of 87.2% in type II diabetes mellitus were used to calculate the sample size.8

Patients of either gender, aged 30 to 70 years, were enrolled. Type II diabetes mellitus was confirmed according to standard diagnostic criteria, including HbA1c ≥6.5%. For this study, only patients with documented disease duration of more than one year were enrolled. Patients with non-diabetic retinopathy were excluded. Patients with liver disease, defined as alanine aminotransferase or aspartate aminotransferase more than 40 IU or hepatitis B or C, were also excluded. Patients with renal dysfunction, defined as serum creatinine more than 2.0 mg/dl, and those with cardiac, respiratory, or gastrointestinal disorders were excluded on medical record review. Patients who had already received laser treatment or intravitreal anti-vascular endothelial growth factor injections were also excluded.

After informed written consent, eligible patients were recruited from the outpatient department. Demographic and clinical information was recorded on a structured proforma. This included age, gender, height, weight, body mass index, duration of diabetes, treatment for diabetes, smoking history, alcoholism, occupation, duration of screen use per day, and family history of retinopathy. Height was measured in meters by standee meter. Weight was measured in kilograms by weighing machine. Body mass index was calculated in kg/m². Smoking was defined as more than 5 pack-years. Alcoholism was defined as alcohol intake of more than 20 ml/day.

All patients underwent fundoscopic examination by an ophthalmologist for assessment of diabetic retinopathy. Diabetic retinopathy was labeled when characteristic retinal changes suggestive of diabetic retinopathy were identified on ophthalmoscopic examination. After fundoscopy, the patients were divided into two groups: diabetic retinopathy present and diabetic retinopathy absent. Blood samples were then collected and sent to the hospital laboratory for lipid profile testing. Lipid profile was measured in mg/dl and included total cholesterol, triglycerides, low-density lipoprotein, and high-density lipoprotein. The data were analyzed and inputted into SPSS version 25.0. The Shapiro-Wilk test was used to test normalcy of the continuous variables. Quantitative variables were described in terms of mean and standard deviation. Frequency and percentage were used to provide qualitative variables. The comparison of baseline characteristics between diabetic retinopathy patients and non-retinopathy patients was performed. There were comparisons of categorical variables using chi-square test or Fisher's exact test where necessary. Independent samples t-test were used to determine the mean lipid profile values in both groups. In the case of multivariate analysis, to find independent variables that are related to retinopathy, binary logistic regression was used in which diabetic retinopathy was the dependent variable. Adjusted odds ratios and 95% confidence intervals were reported. A p-value of 0.05 or below was used as statistically significant.

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RESULTS

There were a total of 175 participants, including 90 (51.4%) males and 85 (48.6%) females. Of these, 153 (87.4%) had diabetic retinopathy, while 22 (12.6%) did not. As shown in Table 1, patients with diabetic retinopathy were older on average than those without retinopathy (46.4 ± 7.0 vs 42.9 ± 7.1 years, p=0.034) and had a markedly longer duration of diabetes (13.7 ± 3.9 vs 6.6 ± 2.9 years, p<0.001). A family history of retinopathy was also more common in the retinopathy group (25.5% vs 0.0%, p=0.005). In contrast, gender distribution, BMI, smoking status, treatment pattern, and daily screen time did not differ significantly between the two groups.

Table 1. Baseline clinical characteristics of participants by diabetic retinopathy status

Variable	Overall (n=175)	DR present (n=153)	DR absent (n=22)	p-value
Age (years)	46.0 ± 7.1	46.4 ± 7.0	42.9 ± 7.1	0.034
Male sex	90 (51.4%)	77 (50.3%)	13 (59.1%)	0.589
Female sex	85 (48.6%)	76 (49.7%)	9 (40.9%)	
BMI (kg/m²)	27.8 ± 4.3	28.0 ± 4.3	27.1 ± 4.6	0.397
Duration of diabetes (years)	12.8 ± 4.5	13.7 ± 3.9	6.6 ± 2.9	<0.001
Smoking, yes	62 (35.4%)	55 (35.9%)	7 (31.8%)	0.888
Family history of retinopathy, yes	39 (22.3%)	39 (25.5%)	0 (0.0%)	0.005
Treatment: Oral drugs	68 (38.9%)	62 (40.5%)	6 (27.3%)	0.491
Treatment: Insulin	47 (26.9%)	40 (26.1%)	7 (31.8%)	
Treatment: Both	60 (34.3%)	51 (33.3%)	9 (40.9%)	
Screen time (hours/day)	4.3 ± 1.9	4.2 ± 1.9	4.8 ± 2.2	0.270

As shown in Table 2, patients with diabetic retinopathy had a more deranged lipid profile than those without retinopathy. Mean triglyceride levels were significantly higher in the retinopathy group (180.12 ± 67.92 vs 115.87 ± 47.67 mg/dl, p<0.001), and mean LDL levels were also significantly higher (88.00 ± 32.07 vs 73.31 ± 15.53 mg/dl, p=0.001). In contrast, mean HDL levels were significantly lower among patients with diabetic retinopathy (35.45 ± 8.90 vs 49.21 ± 7.27 mg/dl, p<0.001). Although mean total cholesterol was higher in patients with retinopathy, the difference was not statistically significant (171.25 ± 34.38 vs 163.40 ± 28.18 mg/dl, p=0.244).

Table 2. Comparison of lipid profile between patients with and without diabetic retinopathy

Lipid parameter	DR present (n=153)	DR absent (n=22)	Mean difference	p-value
Total cholesterol (mg/dl)	171.25 ± 34.38	163.40 ± 28.18	7.85	0.244
Triglycerides (mg/dl)	180.12 ± 67.92	115.87 ± 47.67	64.25	<0.001
LDL (mg/dl)	88.00 ± 32.07	73.31 ± 15.53	14.69	0.001
HDL (mg/dl)	35.45 ± 8.90	49.21 ± 7.27	-13.77	<0.001

As shown in Table 3, after multivariable adjustment, longer duration of diabetes and higher triglyceride levels were independently associated with greater odds of diabetic retinopathy. In contrast, higher HDL levels were independently associated with lower odds of diabetic retinopathy. Age showed a borderline association after adjustment but did not reach statistical significance.

Table 3. Multivariable analysis for factors associated with diabetic retinopathy

Variable	Adjusted OR	95% CI	p-value
Age (per 1-year increase)	1.18	1.00–1.40	0.054
Duration of diabetes (per 1-year increase)	2.11	1.38–3.22	0.001
Triglycerides (per 10 mg/dl increase)	1.29	1.09–1.54	0.004
HDL (per 10 mg/dl increase)	0.20	0.07–0.55	0.002

DISCUSSION

The main finding of the present study was that diabetic retinopathy was very common in patients with type II diabetes mellitus. Patients with diabetic retinopathy had a longer duration of diabetes. They also had a more abnormal lipid profile. Triglycerides and LDL were higher. HDL was lower. Total cholesterol was higher, but the difference was not significant. In multivariable analysis, longer duration of diabetes, higher triglycerides, and lower HDL remained independently associated with diabetic retinopathy.

These findings are biologically plausible. Long-standing diabetes causes chronic hyperglycemia,

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endothelial injury, oxidative stress, and breakdown of the retinal blood-retinal barrier. Dyslipidemia can worsen this process. High triglycerides and LDL may promote lipid leakage and hard exudate formation. Low HDL may reduce the protective anti-inflammatory and anti-oxidative effects in the retinal microcirculation. This may explain why triglycerides and HDL showed stronger associations in the present study.

At the local level, Aftab et al. from Punjab also reported that serum lipids were more deranged in type 2 diabetic patients with retinopathy than in those without retinopathy. Their findings support the present results, especially the adverse role of triglycerides and LDL.[9] At the national level, Gitay et al. from Pakistan found that serum triglycerides increased with the onset and progression of diabetic retinopathy, while worsening glycemic control also contributed to disease severity. This is in line with our finding that triglycerides were strongly linked with retinopathy.[10] At the regional level, Ramalingam et al. from India showed that diabetic patients with clinically significant macular oedema had more abnormal serum lipids, and total cholesterol and triglycerides were the main lipid fractions linked with macular oedema. This agrees with the general concept that abnormal lipids worsen retinal disease, although our study showed a stronger signal for triglycerides, LDL, and HDL than for total cholesterol.[11]

Another regional study by Liu et al. in China found that increased lipid levels were associated with a higher risk of diabetic retinopathy, especially in some subgroups with better glycemic control and younger age. This supports the view that dyslipidemia can have an independent role beyond hyperglycemia alone.[12] In contrast, Romero-Aroca et al. in a large international cohort with 10 years of follow-up reported that the effect of lipids on diabetic retinopathy was weaker than the effect of duration of diabetes and glycemic control. This partly differs from our results, but it also explains why duration of diabetes remained a strong independent factor in our model.[13] A 2022 systematic review by Soedarman et al. showed that traditional cholesterol measures were not fully consistent across studies, while apolipoproteins may be stronger markers of diabetic retinopathy presence and severity. This may explain why total cholesterol was not significant in our study, while triglycerides and HDL showed clearer associations.[14]

A 2022 literature review by Bryl et al. concluded that hyperlipidemia contributes more clearly to retinal hard exudates and diabetic macular oedema than to all stages of diabetic retinopathy equally. This helps explain why some lipid fractions show stronger associations than others in cross-sectional studies.[15] Julve et al. also reported in 2022 that advanced lipoprotein profiling and glycated proteins improved prediction of diabetic retinopathy beyond routine clinical variables. This suggests that the true lipid-retina relationship may be more complex than routine total cholesterol, LDL, HDL, and triglycerides alone.[16] Lei et al. in 2023 found that total cholesterol, HDL, and LDL were significantly associated with subfoveal choroidal thickness in Chinese patients with proliferative diabetic retinopathy, while triglycerides were not significant in that specific model. This differs from our study, likely because their work focused on proliferative disease and choroidal structure rather than simple presence or absence of retinopathy.[17]

Shen et al. used serum lipidomic and metabolomic profiling and showed that abnormal lipid pathways are closely linked with hard exudates in diabetic retinopathy. This provides mechanistic support for our finding that dyslipidemia is linked with retinal disease in type 2 diabetes.[18] A Mendelian randomization study by Li et al. suggested that genetically determined lipid traits may have a causal relationship with diabetic retinopathy risk. This strengthens the plausibility that the lipid-retina association is not only due to confounding.[19] Another drug-target Mendelian randomization study by Chen et al. suggested that lipid-regulating pathways may influence diabetic retinopathy risk and may become useful therapeutic targets.[20] Jenkins et al. reviewed the systemic and retinal effects of lipid-lowering therapy and discussed how lipids may contribute to retinal deposits, vascular leakage, and progression of diabetic retinopathy. Their work supports the clinical relevance of monitoring lipids in such patients.[21]

The recent position paper by Banach et al. emphasized that diabetic dyslipidemia is an important modifiable factor in retinopathy prevention and supported more active management of lipid abnormalities in diabetes. This fits well with the implications of our study.[22] The LENS trial by Preiss et al. further showed that fenofibrate reduced progression of diabetic retinopathy. This means that the association between lipids and retinopathy is not only observational, but may also have therapeutic importance.[23] Overall, the present study adds local evidence that abnormal triglycerides, LDL, and HDL are linked with diabetic retinopathy, while duration of diabetes remains a key clinical driver.

Limitations

This study has some limitations. First, it was a single-center cross-sectional study. So, cause and effect cannot be confirmed. Second, the number of patients without diabetic retinopathy was much smaller than the number with retinopathy. This may have affected statistical balance. Third, only routine lipid parameters were studied. Apolipoproteins, non-HDL cholesterol, and advanced lipid markers were not

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measured. Fourth, other important factors such as HbA1c, blood pressure, renal albumin loss, and use of lipid-lowering drugs were not fully analyzed in the final model. Finally, retinopathy severity and macular oedema were not explored in detail in the final analysis.

Future directions

Future studies should use a multicenter design and a larger sample. They should include a better balance between retinopathy and non-retinopathy groups. Prospective follow-up studies are needed to see whether abnormal lipids predict new retinopathy or progression over time. Future work should also include HbA1c, blood pressure, albuminuria, and medication use in the model. More detailed lipid markers such as apolipoproteins, non-HDL cholesterol, triglyceride-to-HDL ratio, and lipid indices should also be studied. It would also be useful to assess lipid profile in relation to retinopathy grade, hard exudates, and diabetic macular oedema. Interventional studies on lipid-lowering therapy may further clarify whether better lipid control can reduce retinal damage in our population.

CONCLUSION

Diabetic retinopathy was highly frequent in patients with type II diabetes mellitus. Dyslipidemia, particularly high triglycerides and low high-density lipoprotein, showed a significant association with diabetic retinopathy.

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CONFLICT OF INTEREST

There is no such interest where authors might conflict as per authors.

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