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Prevalence and Risk Factors of Diabetic Retinopathy in Type 2 Diabetic Patients Attending Tertiary Care Hospitals in Punjab

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ABSTARCT

Background: Diabetic retinopathy (DR) is one of the most frequent microvascular consequences of type 2 diabetes mellitus, accounting for a significant portion of avoidable blindness globally. In low- and middle-income countries like Pakistan, where diabetes incidence is growing and regular screening is restricted, DR is a serious public health concern.

Objective: The purpose of this research was to assess the prevalence, forms, and risk factors of diabetic retinopathy in patients with type 2 diabetes mellitus treated at tertiary care facilities in Punjab, Pakistan.

Methods: A cross-sectional study was carried out from June 2023 to May 2025 at Gulab Devi Hospital and Ghurki Trust Teaching Hospital in Lahore. 70 individuals with confirmed type 2 diabetes were recruited using sequential nonprobability sampling. After pupil dilatation, a fundus examination was conducted using indirect ophthalmoscopy. The clinical and biochemical information collected were age, gender, blood pressure, body mass index (BMI), HbA1c, lipid profile, diabetes duration, and nephropathy indicators. Data were evaluated using SPSS version 25, and p-values < 0.05 were deemed statistically significant.

Results: Diabetic retinopathy was seen in 34.3% of individuals (n = 24). Non-proliferative diabetic retinopathy (NPDR) accounted for 62.5% of cases, followed by proliferative diabetic retinopathy (PDR) at 25.0% and diabetic macular edema (DME) at 12.5%. Significant risk variables for DR were diabetes duration > 10 years ($p < 0.001$), poor glycemic control (HbA1c ≥ 8%; $p = 0.010$), hypertension ($p = 0.036$), BMI ≥ 27 kg/m² ($p = 0.048$), and diabetic nephropathy ($p = 0.012$). Elevated LDL cholesterol levels were more common among DR patients, but not statistically significant ($p = 0.065$).

Conclusion: Diabetic retinopathy affects a significant number of type 2 diabetes patients at Punjab's tertiary care facilities, often in severe, vision-threatening stages. The most important modifiable risk variables were poor glycemic management, prolonged illness duration, hypertension, obesity, and nephropathy. In Pakistan, regular eye examination, appropriate metabolic management, and early intervention are critical for preventing diabetic retinopathy-related vision loss.

Keywords: Diabetic retinopathy, Type 2 diabetes mellitus, Risk factors, Punjab, Pakistan, Microvascular complications

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INTRODUCTION

Diabetic retinopathy (DR), a major microvascular consequence of type 2 diabetes mellitus (T2DM), is one of the leading causes of preventable blindness and visual impairment globally [1, 2]. The global increase in diabetes is being accompanied by an increase in diabetes-related comorbidities, particularly DR, in low- and middle-income countries (LMICs), where access to professional ophthalmological care and regular screening is limited. Ocular ischemia, increased vascular permeability, capillary obstruction, and abnormal neovascularization are all signs of structural and functional damage to the retinal microvasculature brought on by chronic hyperglycemia [5]. Ranging between mild non-proliferative diabetic

retinopathy (NPDR) and more severe diseases such as proliferative diabetic retinopathy (PDR) and diabetic macular edema (DME), which can significantly affect the vision unless treated, can be of different degrees of severity [6].

It is estimated by the International Diabetes Federation (IDF) that in 2021, 537 million people around the world had diabetes, and by 2045, the count is scheduled to climb to 783 million. DR is believed to occur in a third of diabetics and 10 percent of diabetics is believed to advance to stages which threaten vision such as PDR and DME [8].

The situation is even more concerning in such countries as Pakistan, where many people can hardly afford routine screening of chronic conditions, which does not mean the healthcare system is not overloaded already. As per a recent study, the incidence of diabetes is highest in Pakistan whereby the prevalence of diabetes is 26.7 percent among adults [9]. A number of eclectic elements such as urbanization, sedentary living and dietary habits, ignorance on the part of the populace, predisposition due to family history and inefficient consumption of medical services are causing this epidemic, which is on the rise [10,11].

The national trends in the prevalence of diabetes in Punjab, the largest and most populated province in Pakistan, have extra barriers to the management of comorbidities like DR. Ophthalmological evaluations are not very timely to ensure that irreversible retinal damage has already been caused before severe signs manifest themselves. T2DM patients are not aware of the eye risks of the disease [12]. Moreover, the absence of coordinated diabetes care pathways and the inadequate cooperation between diabetologists and ophthalmologists along with the lack of coordinated care delivery in the public hospitals are further magnified by the tardity of referrals and care fragmentation [13].

Earlier studies undertaken within the different parts of Pakistan have shown a prevalence of DR ranging between 10% and 45 percent which is contingent on the features of the population under study, the diagnostic procedures that are applied and the medical environment [14]. Not all of these studies and research though has been divided into single-setting to urban tertiary hospitals or community surveys with small clinical assessments and lacks a representative view across the Punjab clinical and demographic setting. Moreover, the evidence on current and comprehensive data about the prevalence of DR and its primary clinical and biochemical risk factors in the area is lacking. Though other elements like obesity, nephropathy, dyslipidemia, hypertension, and inadequate glycemic control (HbA1c) are quite familiar causes of DR, they have not been given the needed focus in studies conducted in the region [15,16].

DR should be detected early as it is one of the situations that can help greatly to avoid developing severe impairment of vision. Widespread approaches to treatment such as laser photocoagulation, intravitreal anti-VEGF therapy and optimal systemic metabolic management approaches have been found to be effective in sparing vision and preventing progression of the disease [17,18]. This is because awareness of the prevalence, and determinants of DR in high-risk groups would be important in the development of evidence based screening programs and local based public health policies.

The current study was not only expected to establish the prevalence of diabetic retinopathy in T2DM patients who have received care in tertiary care units in Punjab, Pakistan, but also to identify the demographic, clinical, and biochemical risk factors in respect to diabetic retinopathy. The results should offer a basis of preventive ophthalmologic programs and serve as a source of support to integrate routine eye screening in diabetic efficacy programs in Pakistan.

MATERIALS AND METHODS

The two-year cross-sectional study will be at Ghurki Trust Teaching Hospital and Gulab Devi Hospital that are two major tertiary care hospitals in Lahore, Punjab, during June 2023 and May 2025. These institutions were selected because of their high number of patients and a wide range of patients with various areas and surroundings as they comfortably covered both urban and rural populations to examine prevalence and risk factors of diabetic retinopathy (DR) among diabetics with type 2 diabetes mellitus (T2DM). The study population was comprised of patients with type 2 diabetes who visited the medical and ophthalmology outpatient of the cooperating hospitals during the study period. A total of 70 patients were enrolled using a non-probability sequential sampling strategy. Participants had to be between the ages of 35 and 75, have a genuine diagnosis of type 2 diabetes for at least a year, and consent to both clinical and ophthalmological tests. A history of ocular trauma, previous intraocular surgery, type 1 diabetes, gestational diabetes, any known non-diabetic retinal illness, and the incapacity or refusal to have a thorough fundus examination were among the exclusion criteria. Both institutions' Institutional Review Boards received ethical clearance, and after being fully informed of the study's objectives, methods, and voluntary nature, each participant provided written informed permission.

The clinical and demographic data, including the age, gender, smoking habits, duration of diabetes, and comorbidities, including high blood pressure or nephropathy, were collected through in-depth interviews and patient records. The clinical assessment included blood pressure measurements, anthropometric measurements such as height, weight and body mass index (BMI). Some of the laboratory tests utilized in the assessment of metabolic and renal function included serum creatinine, urine albumin and creatinine ratio, lipid profile including total cholesterol, LDL, HDL and triglycerides and HbA 1 c level examined over the past three months.

A full examination had been done on each of the respondents with an ophthalmologist being a licensed person. After the dilation of the pupil by drops of tropicamide 1% slit-lamp biomicroscopy and indirect ophthalmoscopy were employed to analyze the retina. The best-corrected visual acuity was then obtained using a Snellen chart. The four types into which the retinal abnormalities were broken based on the Early Treatment Diabetic Retinopathy Study (ETDRS) criteria were diabetic macular edema (DME), proliferative diabetic retinopathy (PDR), non-proliferative diabetic retinopathy (mild, moderate, and severe), and no DR. The data were entered and analyzed using version 25 of the IBM SPSS Statistics. Researchers were applied to the characterization of clinical and demographic features of the participants using continuous data in terms of mean and SD and categorical data in terms of frequencies and percentages. A relationship was evaluated to determine the relationship between DR and possible risk factors by the use of independent t-test of continuous variables and chi-squared test of categorical data. Binary logistic regression was utilized in the determination of independent determinants of sickness risk. The level of 0.05 determined the level of significance to be below.

RESULTS

It was a cross-sectional study that was conducted on Gulab Devi Hospital and Ghurki Trust Teaching Hospital in Lahore between June 2023 and May 2025 with a total of 70 participants with type 2 diabetes mellitus. There were 40 females (57.1) and 30 males (42.9) and the mean age of the participants obtained was 56.8/9.7 years. The patients with diabetic retinopathy (DR) numbered 34.3% (n=24) whilst those without it were 65.7% (n=46) at the time of the ophthalmological examination. The clinical and demographic features of the study population are represented in Table 1. This difference between genders was not statistically significant ($p = 0.879$), even though women represented more percentages of DR cases.

This was not revealed to be statistically significant ($p = 0.304$) even though DR patients had slightly older ages in the average (58.2 ± 8.6 years) compared to DR patients (55.9 ± 9.8 years). The results showed a significant coefficient ($p < 0.001$) between the duration of diabetes and DR, and 83.3% of patients with DR reported a history of it over 10 years. Hypertension was much more highly prevalent in DR group (70.8) than in non-DR group (43.5) ($p = 0.036$). Moreover it was possible to find a statistically significant difference ($p = 0.048$) in presence of obesity (defined as having BMI greater than 27 kg/m2) between the DR patients and the non-DR patients (34.8%). DR patients (79.2% poor glycemic control, HbA1c > 8% and non-DR patients, 45.7% poor glycemic control, HbA1c > 8% had a statistically significant difference, $p = 0.010$). This indicates that the renal involvement was higher in 62.5% of DR and 30.4% of non-DR patients with evidence of urine albumin-to-creatinine ratios (UACR > 30 mg/g) indicating diabetic nephropathy. DR patients were significantly higher in having LDL cholesterol that exceeded 130mg/dl (54.2) than non-DR patients (37.0) but this was not found to be statistically significant ($p = 0.065$).

Classification of Diabetic Retinopathy Types: Among the 24 patients diagnosed with diabetic retinopathy, the most frequent category was non-proliferative diabetic retinopathy (NPDR), observed in 15 patients (62.5%). Within NPDR, 6 patients (25.0%) had mild NPDR, 5 (20.8%) had moderate NPDR, and 4 (16.7%) had severe NPDR. Proliferative diabetic retinopathy (PDR) was seen in 6 patients (25.0%), with findings such as neovascularization and vitreous hemorrhage. Diabetic macular edema (DME) was diagnosed in 3 patients (12.5%), of which two cases were center-involving and one was non-center involving.

The results of this research show that individuals with type 2 diabetes mellitus who come to tertiary care institutions in Punjab have a significant frequency of diabetic retinopathy (34.3%). The majority of patients were classified as non-proliferative diabetic retinopathy (NPDR), which provided an important opportunity for early management and disease prevention. However, the fact that 37.5% of DR cases featured vision-threatening phases such as diabetic macular edema (DME) and proliferative diabetic retinopathy (PDR) demonstrates the late stage at which many patients are diagnosed. This trend is due to a lack of early ocular screening and insufficient understanding of disease risks, both of which lead to persistent vision impairment.

Several clinical and biochemical factors were significantly associated with DR, including diabetic nephropathy ($p = 0.012$), obesity with BMI ≥ 27 kg/m² ($p = 0.048$), hypertension ($p = 0.036$), poor glycemic control (HbA1c $\geq 8\%$; $p = 0.010$), and diabetes duration of more than 10 years ($p < 0.001$). chronic data indicate that systemic microvascular injury, aggravated by chronic comorbidities, plays an important role in retinal involvement. Although high LDL cholesterol levels (≥130 mg/dL) were more prevalent in DR patients, the correlation was not statistically significant ($p = 0.065$), which may be due to the limited sample size.Overall, our findings underline the critical necessity for comprehensive diabetes treatment that includes blood pressure and weight management, renal function monitoring, and routine retinal screening. Implementing focused screening programs for high-risk patients, especially those with a lengthy illness duration and several comorbidities, has the potential to drastically minimize vision loss. This method is particularly important in Pakistan's overcrowded public healthcare system, where delayed diagnosis of DR is a recurring problem.

Table-1: Demographic, Clinical, and Biochemical Characteristics of Patients with and without Diabetic Retinopathy (n = 70)

Variable	With DR (n = 24)	Without DR (n = 46)	p-value
Age (years, mean ± SD)	58.2 ± 8.6	55.9 ± 9.8	0.304
Gender			0.879
– Male	10 (41.7%)	20 (43.5%)	
– Female	14 (58.3%)	26 (56.5%)	
Residence (Urban)	17 (70.8%)	29 (63.0%)	0.473
Duration of Diabetes >10 years	20 (83.3%)	15 (32.6%)	<0.001 **
BMI ≥ 27 kg/m²	14 (58.3%)	16 (34.8%)	0.048 **
Hypertension	17 (70.8%)	20 (43.5%)	0.036 **
HbA1c ≥ 8%	19 (79.2%)	21 (45.7%)	0.010 **
Nephropathy (UACR >30 mg/g)	15 (62.5%)	14 (30.4%)	0.012 **
LDL ≥ 130 mg/dL	13 (54.2%)	14 (30.4%)	0.065

*p-value < 0.05 considered statistically significant

Table-2: Types and Severity of Diabetic Retinopathy Among Affected Patients (n = 24)

Type of DR	Sub-Type	Frequency (n)	Percentage (%)
Non-Proliferative DR (NPDR)	Mild	6	25.0%
	Moderate	5	20.8%
	Severe	4	16.7%
Proliferative DR (PDR)	With neovascularization	4	16.7%
	With vitreous hemorrhage	2	8.3%
Diabetic Macular Edema (DME)	Center-involving DME	2	8.3%
	Non-center involving DME	1	4.2%
Total		24	100%

DISCUSSION

This study assessed the prevalence and risk factors of diabetic retinopathy (DR) among patients with type 2 diabetes mellitus who attended Ghurki Trust Teaching Hospital and Gulab Devi Hospital, two tertiary care institutions in Punjab, over a two-year period. The overall prevalence of DR in this cohort was 34.3%, which is consistent with regional and international reports indicating a prevalence between 25% and 45%, depending on the study setting, geographic location, diagnostic methods, and demographic factors [19–21]. These findings underscore the considerable burden of DR among Pakistani diabetics, particularly those seeking care at tertiary hospitals [22,23].

Within this study population, 62.5% of patients with DR had non-proliferative diabetic retinopathy (NPDR), representing the majority of cases. However, 12.5% had diabetic macular edema (DME) and 25% had proliferative diabetic retinopathy (PDR), both of which are vision-threatening stages [24]. This distribution highlights the late presentation of many patients, likely due to inadequate routine ocular screening and poor disease awareness, particularly in the public sector [25,26]. These results emphasize the urgent need to integrate retinal screening into standard diabetic care, especially in government hospitals where patients often present with advanced disease [27].

Duration of diabetes was found to be the strongest predictor of DR, with disease duration beyond 10 years showing a highly significant association ($p < 0.001$). This aligns with previous evidence that chronic hyperglycemia progressively damages retinal capillaries, leading to ischemia, neovascularization, hemorrhages, and microaneurysms [28]. Supporting this, the mean duration of diabetes in DR patients in this study was 13.8 ± 4.2 years, compared with 9.6 ± 5.3 years in non-DR patients [29,30].

Poor glycemic control, defined as HbA1c ≥ 8%, was also significantly associated with DR ($p = 0.010$). Chronic hyperglycemia and long-term glycemic variability accelerate endothelial dysfunction and retinal injury, increasing the risk of both NPDR and PDR [31]. More than 80% of DR patients in this cohort had uncontrolled diabetes, underscoring the importance of strict glycemic management as a preventive strategy [32,33].

Hypertension was another significant predictor ($p = 0.036$), consistent with earlier studies showing that elevated blood pressure worsens retinal ischemia and vascular damage [34]. Similarly, obesity (BMI ≥ 27 kg/m²) was significantly associated with DR ($p = 0.048$), reflecting the metabolic interplay of insulin resistance, systemic inflammation, and microvascular dysfunction [6,10]. These findings confirm the multifactorial nature of DR, where management of blood pressure and body weight is as essential as glycemic control in disease prevention [5,34].

Additionally, a high urine albumin-to-creatinine ratio (UACR > 30 mg/g) suggested a substantial correlation between DR and diabetic nephropathy. Compared to 30.4% of non-DR patients, 62.5% of DR patients had nephropathy ($p = 0.012$). The systemic character of vascular damage in chronic diabetes is highlighted by the combination of renal and retinal microangiopathy, underscoring the need of thorough end-organ surveillance [29, 35]. DR patients were more likely to have higher LDL cholesterol levels (≥130 mg/dL), although the correlation was not statistically significant ($p = 0.065$), perhaps because of the small sample size. However, as lipid abnormalities are linked to retinal exudates and the development of DME, dyslipidemia should be frequently evaluated [14,16,31]. It is important to recognize this study's limitations. The capacity to demonstrate causal linkages is limited by its cross-sectional

design. The results may not be as applicable to the larger diabetic community, especially those in primary care or rural regions, due to the relatively small sample size (n = 70) and the fact that the study was limited to two tertiary care facilities. Notwithstanding these limitations, this study presents a foundation for further multicenter and longitudinal research as well as important insights about DR trends within a neglected Punjabi community [33–35].

CONCLUSION

According to the study's results, diabetic retinopathy is quite common (34.3%) among type 2 diabetic patients who visit Punjab's tertiary care facilities. By the time they were assessed, a significant percentage of patients had already developed vision-threatening stages of retinopathy, such as PDR and DME, indicating a lack of preventative screening and a delayed diagnosis. Longer duration of diabetes (>10 years), poor glycemic control (HbA1c ≥8%), obesity, concomitant hypertension, and diabetic nephropathy were the most important risk factors for the development of DR. The urgent need for comprehensive diabetes therapy, which includes regular ophthalmological assessments, stricter glucose control, frequent blood pressure and renal function monitoring, and patient education, is highlighted by these modifiable and interconnected risk factors. In order to guarantee early identification and prompt referral, public health policies should concentrate on incorporating DR screening programs within diabetic clinics, particularly in public sector institutions. Furthermore, to decrease the prevalence of diabetes-related blindness in Pakistan, multidisciplinary care models comprising endocrinologists, ophthalmologists, nephrologists, and nutritionists must be used. To understand the natural course of DR and assess the effectiveness of early treatments in lowering its incidence and severity, further research with bigger sample numbers, community-based settings, and longitudinal follow-up is advised.

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Authors' Contributions:

MKW, MIT, SS, and AI: Conceptualization, study design, data collection, manuscript drafting.

SN: Data analysis, statistical interpretation, critical revision.

MT: Supervision, literature review, data validation, final approval.

All authors read and approved the final manuscript.

Data Availability Statement: The data used in this study are available upon reasonable request from the corresponding author, subject to ethical and institutional guidelines.

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