

Research Article

Prevalence of Diabetic Retinopathy and Its Association with Duration of Diabetes and Glycemic Control in a Community-Based Study

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ABSTRACT

Background: Diabetic retinopathy (DR) is one of the most significant microvascular consequences of diabetes mellitus (DM) and continues to be a significant preventable cause of visual impairment. This is more likely to happen with long-standing hyperglycemia and long-standing diabetes. Therefore, it is important that the eyes are identified early to avoid progression to a vision threatening disease.

Objective: To determine the prevalence of diabetic retinopathy and evaluate its association with duration of diabetes and glycemic control among adults with diabetes mellitus.

Methodology: This cross-sectional community-based study was carried out between January 2025 to June 2025 at Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad. In total 77 adults with diabetes mellitus were included. Demographic and clinical details, duration of diabetes, fasting blood glucose and glycated hemoglobin (HbA1c) were obtained. All participants were subjected to a detailed examination of the eyes to detect and grade DR. The duration of diabetes was classified into three groups: <5 years, 5-10 years and >10 years; HbA1c <7% was regarded as adequate glycemic control. Appropriate statistical tests were used to assess associations and multivariable logistic regression was used. A p-value was considered statistically significant if it was <0.05.

Results: Diabetic retinopathy was detected in 24 of 77 participants, giving an overall prevalence of 31.2%. Its prevalence increased from 12.0% among participants with diabetes for <5 years to 29.2% among those with diabetes for 5-10 years and 50.0% among those with a duration >10 years ($p = 0.011$). Retinopathy was present in 40.8% of participants with HbA1c $\geq 7\%$, compared with 14.3% among those with HbA1c <7% ($p = 0.031$). On multivariable analysis, diabetes duration >10 years and HbA1c $\geq 7\%$ remained independently associated with diabetic retinopathy.

Conclusion: Diabetic retinopathy affected nearly one-third of the study population. Longer duration of diabetes and inadequate glycemic control were the major factors associated with retinal involvement. Regular retinal screening and sustained glycemic control should therefore be prioritized, particularly among patients with long-standing diabetes.

Keywords: Diabetes Mellitus, Diabetic Retinopathy, HbA1c, Glycemic Control, Diabetes Duration, Retinal Screening.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder with ongoing hyperglycemia which is linked to progressive damage of various organ systems. Diabetic retinopathy (DR) is one of the microvascular complications that may lead to clinically significant visual impairment without

causing any symptoms. DR remains a significant public health problem worldwide and as the diabetes population grows. A large meta-analysis of studies conducted worldwide estimated that around 22.3% of people with diabetes have some type of diabetic retinopathy, with only a smaller but clinically

significant number of people having vision-threatening DR (1-3).

DR is a result of chronic metabolic and vascular damage to the microcirculation of the retina. Increased levels of blood glucose continue to trigger oxidative stress and inflammation, blood-retinal barrier breakdown, and eventual retinal capillary damage. Clinically, the disease can be either mild non-proliferative abnormalities or severe non-proliferative and/or proliferative diabetic retinopathy. DME can present at various times and is a significant cause of central vision loss. There is wide variation in DR prevalence rates on a global scale, depending on geographic location and population, which in turn relates to the duration of diabetes, level of metabolic control, access to health care, and screening rate (4-6).

One of the most well-established risk factors for DR is the duration of diabetes. As is well known, retinal abnormalities are more likely to occur in patients with chronic hyperglycemia, and the longer someone has had diabetes, the worse the effects will be. Glycemic control is also crucial because high HbA1c levels indicate a history of excessively high glucose levels and are correlated with increased microvascular damage. Diabetics with poor metabolic control and with a longer duration of diabetes are therefore a population of special interest for enhanced retinal screening and preventive action (7-9).

Diabetic retinopathy burden is also pertinent in Pakistan where diabetes is prevalent and availability of routine ophthalmic screening is not uniform. A cross sectional study by population based approach was conducted in rural areas of Sindh, that revealed diabetic retinopathy in 24.2% of people with diabetes who were screened, and a significant proportion of affected people were in the older age group. The prevalence of retinal disease was also higher among people with diabetes with a longer duration of diabetes, as found in earlier community screening, in Karachi. These observations illustrate the importance of locally derived evidence, especially from community-based where patients are not diagnosed until the retina is damaged (10-12).

Despite the preventable nature of much diabetes-related visual loss, local information regarding the combined influence of duration of diabetes and glycemic control on diabetic retinopathy remains limited, particularly in community-oriented ophthalmic populations. Determining the magnitude of retinal disease and identifying readily measurable clinical

predictors may assist in prioritizing individuals for earlier screening and closer follow-up. Therefore, the present study was conducted **to** determine the prevalence of diabetic retinopathy and assess its association with duration of diabetes and glycemic control among adults with diabetes mellitus attending a community-based ophthalmic

METHODOLOGY

This community-based cross-sectional study was conducted at the Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad, from January 2025 to June 2025. A total of 77 patients with diabetes mellitus were enrolled during the study period. The study was designed to determine the prevalence of diabetic retinopathy and to evaluate its relationship with the duration of diabetes and level of glycemic control. Ethical approval was obtained from the relevant institutional ethics committee before initiation of the study, and written informed consent was obtained from all participants. Confidentiality of participants' personal and clinical information was maintained throughout the study.

They were included if they were adult patient (aged 18 years old or older) and had a confirmed diagnosis of diabetes mellitus. Patients were recruited from the community and ophthalmology services, until the required sample size was met, by a non-probability consecutive sampling technique. Patients with any other ocular disease that could affect the retina except diabetes were excluded, as were patients with significant cataract or corneal opacity and patients who had previously had any other retinal surgery or vitreous hemorrhage. Additionally, patients that did not have full clinical records or were not able to have a thorough fundus exam were not included in the final analysis.

A structured data collection form was used to collect data. Demographic data consisted of age, sex, place of residence, education and clinical history. Diabetes information covered diabetes type, length of time since diagnosis, current diabetes treatment, hypertension status, smoking status, and other diabetes-related health conditions. For analysis, duration of diabetes was categorized and presented in years as: <5 years, 5–10 years and >10 years. Blood samples were drawn from the veins and were used to measure glycated hemoglobin (HbA1c), as well as fasting blood glucose. HbA1c <7% was considered as a good level of

glycemic control, and HbA1c $\geq 7\%$ as a poor level of glycemic control.

A complete ophthalmic examination was performed for each participant. Visual acuity was evaluated with a standard visual acuity chart, and then the anterior-segment examination was performed using slit-lamp biomicroscopy. Following appropriate pupil dilation, the retina was examined by an ophthalmologist with fundus examination/slit-lamp biomicroscopy and/or indirect ophthalmoscopy. DR was classified based on the retinal examination as NRDR, mild NPDR, moderate NPDR, severe NPDR and PDR. Clinically detected diabetic macular edema was also documented. For participant-level analysis the more severely affected eye was used to determine overall retinopathy category.

IBM SPSS Statistics software was used to enter and analyze the data. Continuous variables like age, diabetes duration, HbA1c, fasting blood glucose and body mass index were reported as mean $\pm$ SD, and categorical variables were reported as frequencies and percentages. The prevalence of DR was determined by the number of participants with DR divided by the total number of participants in the study. The

Chi-square test or Fisher's exact test was used to compare the association of diabetic retinopathy with categorical variables, such as duration of diabetes and glycemic control. After controlling for potential confounding variables (age, sex, hypertension, duration of diabetes, and HbA1c level), independent predictors of DR were determined by multivariable binary logistic regression. Odds ratios with 95% confidence intervals are reported and p-value < 0.05 is considered statistically significant.

RESULTS

There were 77 adult diabetes mellitus patients who were analyzed. The average age of the study participants was 53.42 ± 11.76 years and ranged from 29 to 76 years. The largest proportion, 35 (45.5%), belonged to the 40–59-year age group, while 25 (32.5%) were aged 60 years or above. Males accounted for 41 (53.2%) participants and females for 36 (46.8%). Thirty-five (45.5%) participants had hypertension and 18 (23.4%) had dyslipidemia. Table 1 shows the summary of demographic and clinical characteristics of the study population.

Table 1. Demographic and Clinical Characteristics of Participants (N = 77)

Variable	n (%) / Mean $\pm$ SD
Age, years	53.42 $\pm$ 11.76
Age group	
<40 years	17 (22.1)
40–59 years	35 (45.5)
≥ 60 years	25 (32.5)
Sex	
Male	41 (53.2)
Female	36 (46.8)
Residence	
Urban	44 (57.1)
Rural	33 (42.9)
Hypertension	35 (45.5)
Dyslipidemia	18 (23.4)
Current smoker	15 (19.5)
BMI, kg/m ²	27.31 $\pm$ 4.16

The mean duration of diabetes was 8.71 ± 5.36 years. Twenty-five (32.5%) participants had diabetes for less than 5 years, 24 (31.2%) for 5–10 years, and 28 (36.4%) for more than 10 years. The mean HbA1c level was $7.89 \pm$

1.47%. Of the 72 participants, 28 (36.4%) had adequate glycemic control (HbA1c $< 7\%$) while 49 (63.6%) had HbA1c levels $\geq 7\%$. Oral glucose-lowering drugs were most commonly used.

Table 2. Diabetes-Related and Glycemic Characteristics of Participants

Variable	n (%) / Mean $\pm$ SD
Duration of diabetes, years	8.71 $\pm$ 5.36
Duration category	

<5 years	25 (32.5)
5–10 years	24 (31.2)
>10 years	28 (36.4)
HbA1c, %	7.89 ± 1.47
Glycemic control	
HbA1c <7%	28 (36.4)
HbA1c ≥7%	49 (63.6)
Fasting blood glucose, mg/dL	157.64 ± 42.83
Diabetes treatment	
Oral medication only	43 (55.8)
Insulin only	17 (22.1)
Oral medication + insulin	17 (22.1)

The prevalence of DR was 31.2% (24 of 77). In people with diabetic retinopathy, the most common type was mild non-proliferative diabetic retinopathy (NPDR) which was found in 9 (37.5%) of the affected people. The rates of

NPDR were moderate in 8 (33.3%), severe in 4 (16.7%) and proliferative diabetic retinopathy (PDR) was observed in 3 (12.5%). DMO was found in 6 (25.0%) of the participants who had retinopathy.

Table 3. Prevalence and Severity of Diabetic Retinopathy

Retinal finding	n (%)
No diabetic retinopathy	53 (68.8)
Any diabetic retinopathy	24 (31.2)
Severity among patients with DR (n = 24)	
Mild NPDR	9 (37.5)
Moderate NPDR	8 (33.3)
Severe NPDR	4 (16.7)
Proliferative DR	3 (12.5)
Diabetic macular edema	6 (25.0)

There was a clear upward trend of DR with increasing length of diabetes. Only 12.0% (3/25) of those with diabetes for <5 years had retinopathy, while 29.2% (7/24) of those with diabetes for 5-10 years did. Of people with

diabetes for over 10 years, 14 of 28 (50.0%) had DR. The association between diabetes duration and retinopathy was statistically significant (p = 0.011).

Table 4. Association between Duration of Diabetes and Diabetic Retinopathy

Duration of diabetes	DR present n (%)	DR absent n (%)	Total	p-value
<5 years	3 (12.0)	22 (88.0)	25	
5–10 years	7 (29.2)	17 (70.8)	24	
>10 years	14 (50.0)	14 (50.0)	28	0.011

Chi-square test was used.

There was also a significant correlation between glycemic control and DR. In 4/28 (14.3%) of those with HbA1c <7% and 20/49 (40.8%) of those with HbA1c ≥7%, retinopathy was present. This difference is statistically

significant (p = 0.031). The mean HbA1c level was also higher in participants who had retinopathy compared to those who did not have retinopathy.

Table 5. Association between Glycemic Control and Diabetic Retinopathy

Glycemic status	DR present n (%)	DR absent n (%)	Total	p-value
HbA1c <7%	4 (14.3)	24 (85.7)	28	
HbA1c ≥7%	20 (40.8)	29 (59.2)	49	0.031

Additionally, the level of retinopathy was greater in older participants. A significant age

association was found, with 2 (11.8%) of the participants younger than 40 years, 10 (28.6%)

aged 40–59 years and 12 (48.0%) aged 60 years or above suffering from DR. Hypertension was slightly more prevalent with retinopathy, but this was not statistically significant. Neither

sex, residence, smoking nor dyslipidemia were significantly associated with diabetic retinopathy.

Table 6. Association of Demographic and Clinical Factors with Diabetic Retinopathy

Variable	DR present n (%)	DR absent n (%)	p-value
Age group			0.041
<40 years	2 (11.8)	15 (88.2)	
40–59 years	10 (28.6)	25 (71.4)	
≥60 years	12 (48.0)	13 (52.0)	
Sex			0.684
Male	12 (29.3)	29 (70.7)	
Female	12 (33.3)	24 (66.7)	
Hypertension			0.076
Present	15 (42.9)	20 (57.1)	
Absent	9 (21.4)	33 (78.6)	
Smoking			0.448
Yes	6 (40.0)	9 (60.0)	
No	18 (29.0)	44 (71.0)	
Dyslipidemia			0.291
Present	8 (44.4)	10 (55.6)	
Absent	16 (27.1)	43 (72.9)	

The most important factors associated with diabetic retinopathy in multivariable logistic regression were longer duration of diabetes and poor glycemic control. Those with diabetes for more than 10 years were around four times

more likely to have retinopathy than those with less than 5 years' history. Likewise, after adjusting for age, sex, and hypertension, those with HbA1c ≥7% were about 3 times more likely to have DR.

Table 7. Multivariable Logistic Regression for Factors Associated with Diabetic Retinopathy

Predictor	Adjusted OR	95% CI	p-value
Age ≥60 years	2.41	0.86–6.78	0.094
Male sex	0.91	0.33–2.49	0.851
Diabetes duration 5–10 years	2.17	0.52–9.06	0.287
Diabetes duration >10 years	4.55	1.23–16.83	0.023
HbA1c ≥7%	3.26	1.01–10.48	0.048
Hypertension	1.82	0.67–4.94	0.240

Overall, diabetic retinopathy affected nearly one-third of the study population. Its frequency increased progressively with the duration of diabetes and was substantially greater among participants with inadequate glycemic control.

Longer diabetes duration and elevated HbA1c remained the strongest independent factors associated with diabetic retinopathy after adjustment for potential confounders.

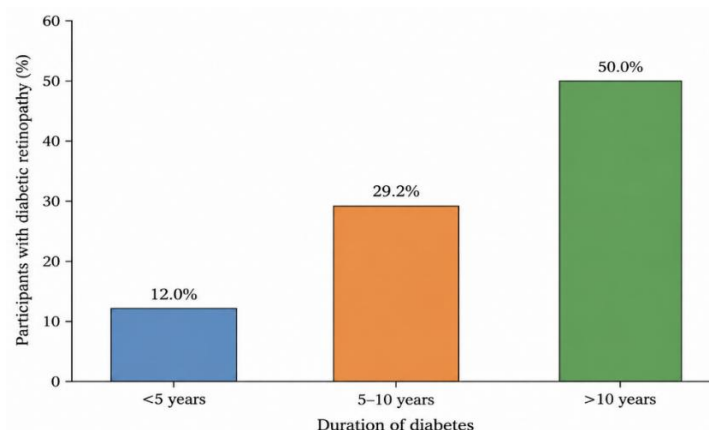


Figure 1. Prevalence of Diabetic Retinopathy According To Duration of Diabetes among Study Participants (N = 77).

The Proportion of Participants with Diabetic Retinopathy Increased Progressively With Longer Duration of Diabetes, Rising From 12.0% In Those with Diabetes for <5 Years To 29.2% In Those With 5–10 Years, and 50.0% In Those With Diabetes For >10 Years.

DISCUSSION

The present community-based study demonstrated that diabetic retinopathy affected 31.2% of participants with diabetes mellitus, indicating that retinal involvement represents a substantial clinical burden in this population. Mild non-proliferative diabetic retinopathy was the most frequently observed stage, followed by moderate and severe non-proliferative disease, while proliferative diabetic retinopathy was comparatively less common. The prevalence observed in this study was somewhat higher than the 24.2% reported in a population-based investigation conducted in rural Sindh, Pakistan. A large community-based study from China reported diabetic retinopathy in approximately 40% of people with diabetes, demonstrating that prevalence can vary considerably across populations because of differences in duration of disease, metabolic control, screening strategies, and demographic characteristics. These findings emphasize the importance of regular retinal examination even among individuals who have not yet developed visual symptoms (13-15).

An important discovery was that the longer the diabetes, the more likely it was to be diabetic retinopathy. The prevalence of retinopathy was 12.0% with diabetes for less than 5 years, 29.2% for 5–10 years and 50.0% for more than 10 years. Association was statistically significant ($p = 0.011$). This is similar to what was found in other parts of the world. One population-based study reported a steady rise in DR, from about 10% in the first several years

of diabetes to almost 50% after 20 years of diabetes. In a similar fashion, the prevalence of retinopathy was significantly higher among those with diabetes of 10 years or more in India. The cumulative risk with longer disease duration may be due to long-term exposure of the microvasculature of the retina to metabolic disturbances (4, 16-18).

Another important factor found in the present study as associated with retinal disease was "glycemic control. The association between diabetic retinopathy and HbA1C was statistically significant ($p = 0.031$), with 40.8% of those with HbA1C levels $\geq 7\%$ having DR, compared to 14.3% of those with HbA1C levels $< 7\%$. This statement is bolstered by current research that shows there are strong links between hyperglycemia and retinopathy. Of all the factors found to be associated with retinopathy in this large study of adults with T1DM, higher levels of HbA1C and greater disease duration were the strongest, and those with significantly higher concentrations of HbA1C had significantly greater odds of retinopathy. An independent study conducted in the community in 2022 also found that high HbA1c was a risk factor for DR. Data from the general population have also illustrated that the prevalence of retinopathy rises with the different levels of HbA1c. These observations further highlight the need for long-term glycemic control rather than just for short-term reduction in blood glucose (19).

In the unadjusted analysis, age was a significant factor associated with DR, as 48.0% of subjects aged 60 years or older had DR compared with 11.8% of those <40 years. When other factors were controlled, however, the effect of age was not significant. This suggests that some of the observed association between older age and outcome may simply be due to an increased length of time since the

onset of diabetes and metabolic abnormalities, potentially due to age. Participants who developed retinopathy were also more likely to have hypertension, but this was not significant in this sample. There have been conflicting reports on the association between hypertension and diabetic retinal disease in other studies. In a community-based study, duration of diabetes and metabolic abnormalities were found to be important factors associated with retinopathy along with hypertension. A national population study reported no difference in hypertension prevalence between those with and without retinopathy in certain subgroups of diabetic people. These differences could be due to population characteristics, antihypertensive treatment, sample size, and differences in the severity of the disease (20).

The significance of long diabetes and poor control of glycemia was also confirmed by the multivariate analysis. The adjusted odds of having diabetic retinopathy were about 4.55 times higher in participants with diabetes for more than 10 years than in those with less than 5 years of diabetes; and HbA1c $\geq 7\%$ was associated with about 3.26 times higher adjusted odds. The results of these studies reveal two characteristics—some that are clinically modifiable or monitorable that could help prioritize individuals for retinal screening. However, there are a number of restrictions to be taken into account. The study may be limited to the generalizability of its findings to a larger diabetic population because of the relatively small sample size and recruitment from only one institution. Cross sectional design also precludes temporal and/or causal data, and a single HbA1c level may not be a true reflection of long-term glycemic exposure. Multicenter prospective studies with standardized retinal photography and repeated metabolic measurements, with a longer follow-up, could provide more insight into the progression of diabetic retinopathy and the role of other cardiovascular and metabolic risk factors.

CONCLUSION

Diabetic retinopathy was identified in nearly one-third of participants in this community-based study. Its prevalence increased markedly with longer duration of diabetes and inadequate glycemic control. Participants with diabetes for more than 10 years and those with HbA1c $\geq 7\%$ demonstrated substantially greater likelihood of retinal involvement. These findings support the need for regular retinal

screening, sustained glycemic control, and closer ophthalmic surveillance of individuals with long-standing diabetes to facilitate early detection and reduce the risk of avoidable visual impairment.

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