

ORIGINAL ARTICLE

Prevalence and Associated Risk Factors of Diabetic Retinopathy in Patients with Diabetes Mellitus at A Tertiary Care Hospital of North Bengal, Bangladesh

DOI: 10.5281/zenodo.18013971

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Received: 03 Dec 2025

Accepted: 08 Dec 2025

Published: 17 Dec 2025

Published by:

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ABSTRACT

Background: Diabetic retinopathy (DR) is a common microvascular complication of diabetes mellitus (DM) and a leading cause of visual impairment. Identifying its prevalence and associated risk factors is essential for timely intervention. **Objectives:** To determine the prevalence of diabetic retinopathy and identify associated risk factors among patients with diabetes mellitus attending a tertiary care hospital of North Bengal (Rangpur Division), Bangladesh. **Methods & Materials:** A hospital-based cross-sectional study was conducted among 362 adult patients with type 1 or type 2 diabetes from January 2024 to June 2025. Data were collected using structured interviews, medical records, clinical measurements, and ophthalmic examinations. Diabetic retinopathy was graded using ICDR/ETDRS scales. Multivariable logistic regression was performed to identify independent risk factors for DR. **Results:** The mean age of participants was 52.3 ± 11.6 years; 54% were male and 46% female. Type 2 diabetes predominated (89%). The mean duration of diabetes was 8.7 ± 6.2 years, and mean HbA1c was $8.1 \pm 1.9\%$. The prevalence of DR was 32.6%, with mild non-proliferative DR being most common (16.3%). Multivariable analysis identified duration of diabetes ≥ 10 years (AOR = 3.4, 95% CI: 2.0–5.7), HbA1c $\geq 7\%$ (AOR = 2.8, 95% CI: 1.7–4.6), hypertension (AOR = 1.9, 95% CI: 1.1–3.3), and smoking (AOR = 1.6, 95% CI: 1.0–2.7) as independent risk factors for DR. Age, gender, BMI, and dyslipidemia were not significantly associated. **Conclusions:** Approximately one-third of diabetic patients had DR. Longer diabetes duration, poor glycemic control, hypertension, and smoking were key modifiable risk factors. Regular retinal screening, optimal glycemic and blood pressure management, and lifestyle interventions, particularly smoking cessation, are recommended to prevent DR progression and preserve vision.

Keywords: Diabetic retinopathy, Diabetes mellitus, Prevalence, Risk factors, Glycemic control, Hypertension, Smoking, Bangladesh

(The Insight 2025; 8(3): 569-572)

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INTRODUCTION

Diabetic retinopathy (DR) is a chronic microvascular complication of diabetes mellitus (DM) characterized by progressive damage to the retinal blood vessels, leading to visual impairment and potentially blindness if left untreated. [1,2] DR develops due to prolonged hyperglycemia, which causes endothelial dysfunction, pericyte loss, capillary basement membrane thickening, and increased vascular permeability. These changes result in retinal ischemia, microaneurysms, hemorrhages, exudates, and, in advanced stages, neovascularization. [1]

Globally, the prevalence of DR among individuals with diabetes is estimated at 22.27%, with approximately 103 million adults affected in 2020. This number is projected to rise to 160.5 million by 2045. [3] A comprehensive review a study reported that the prevalence of DR among individuals with diabetes ranged from 10% in India to 43% in Indonesia. [4] This variability underscores the impact of regional healthcare

disparities and the importance of tailored interventions. In China, the prevalence of DR among diabetic patients has been reported between 24.7% and 43.1%, indicating a substantial burden of the disease. [5] Similarly, a study in Bangladesh found that the overall prevalence of retinopathy in the study population was 5.4% and among people with diabetes, prevalence was much higher, at 21.6%. [6] Another study from a tertiary care hospital reported a prevalence of 29.4% among type 2 diabetic patients. [7] These discrepancies highlight the need for region-specific data to better understand the epidemiology of DR.

Persistent hyperglycemia triggers metabolic dysregulation through advanced glycation end products, polyol pathway activation, and oxidative stress, leading to pericyte loss, endothelial damage, and disruption of the blood-retinal barrier. [8] These vascular changes cause capillary non-perfusion, ischemia, and microaneurysm formation, while

ischemia-induced VEGF release drives neovascularization in proliferative DR. [9] Studies have shown that longer diabetes duration, poor glycemic control, hypertension, and dyslipidemia are major risk factors for diabetic retinopathy. [10,11]

Previous studies in Bangladesh have identified diabetes duration, poor glycemic control, hypertension, obesity, dyslipidemia, nephropathy, and smoking as major risk factors for diabetic retinopathy. [12-14] Barriers such as poor awareness and limited access to screening further exacerbate the risk. [15] However, most existing research has been community- or camp-based, with limited evidence from tertiary care hospitals where more severe and complex cases are concentrated. This highlights the need for updated hospital-based studies to determine the prevalence and associated risk factors of diabetic retinopathy in Bangladeshi patients with diabetes

METHODS & MATERIALS

This hospital-based cross-sectional retrospective study was conducted at Prime Medical College, Rangpur, and Rangpur Medical College, Rangpur, Bangladesh, from January 2024 to June 2025. Adult patients (≥ 18 years) with a confirmed diagnosis of type 1 or type 2 diabetes mellitus who had attended the outpatient and inpatient endocrinology/medicine and ophthalmology departments during the study period were included. Patients with incomplete records, media opacities, prior retinal surgery, critical illness, or pregnancy were excluded. Using a reported prevalence of diabetic retinopathy of 31% [12] and allowing for a 10% non-response or incomplete record rate, the final sample size was 362, selected consecutively from available records.

Data were extracted from hospital records and patient charts using a structured data extraction form. Information collected

included socio-demographic characteristics, medical history, comorbidities, lifestyle factors (when documented), and diabetes-related care. Clinical data such as height, weight, body mass index (BMI), blood pressure, blood glucose, and HbA1c (when available) were retrieved from patient files.

Ophthalmic records were reviewed for documentation of visual acuity, anterior segment findings, pupillary dilation, and fundus examination results (direct/indirect ophthalmoscopy, slit-lamp biomicroscopy, and fundus photography where available). Diabetic retinopathy was graded according to the International Clinical Diabetic Retinopathy (ICDR) classification and, when available, the Early Treatment Diabetic Retinopathy Study (ETDRS) scale. Diabetic macular edema was assessed based on documented clinical findings or optical coherence tomography (OCT) reports. A subset of fundus images (10–15%) was re-graded by a second ophthalmologist to assess inter-grader reliability. Confidentiality of patient data was strictly maintained. Data were coded, entered, and analyzed using SPSS version 26. Statistical significance was set at $p < 0.05$.

RESULTS

Socio-demographic and Clinical Characteristics

A total of 362 patients with diabetes mellitus were included in the study. The mean age of participants was 52.3 ± 11.6 years, with 54% being male and 46% female. The majority had type 2 diabetes (89%), while 11% had type 1 diabetes. The mean duration of diabetes was 8.7 ± 6.2 years, and the mean HbA1c was $8.1 \pm 1.9\%$. Hypertension was present in 42% of participants, and 28% had dyslipidemia. Lifestyle factors showed that 35% were current smokers, and 60% reported regular physical activity [Table I].

Table – I: Baseline Characteristics of Study Participants (n = 362)

Characteristics	n (%) or Mean $\pm$ SD
Age (years)	52.3 $\pm$ 11.6
Sex	
- Male	196 (54%)
- Female	166 (46%)
Type of diabetes	
- Type 1	40 (11%)
- Type 2	322 (89%)
Duration of diabetes (years)	8.7 $\pm$ 6.2
HbA1c (%)	8.1 $\pm$ 1.9
Comorbidities	
- Hypertension	152 (42%)
- Dyslipidemia	101 (28%)
Lifestyle factors	
- Current smokers	127 (35%)
- Regular physical activity	217 (60%)

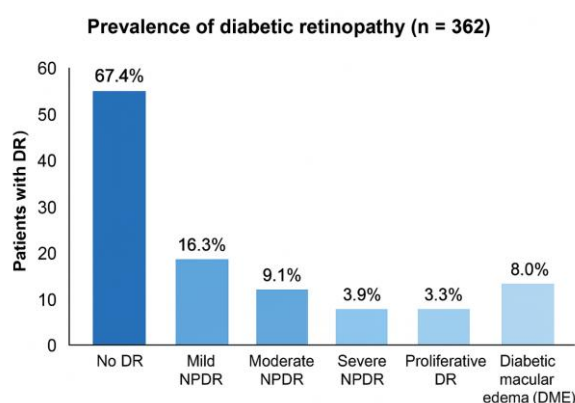


Figure – 1: Prevalence of Diabetic Retinopathy by severity

Prevalence and severity of Diabetic Retinopathy

Figure 1 illustrate the prevalence of diabetic retinopathy among the study participants. Among the 362 participants with diabetes, 67.4% (n = 244) had no signs of diabetic retinopathy (DR), whereas 32.6% (n = 118) exhibited some form of DR. Mild non-proliferative DR (NPDR) was the most common, affecting

16.3% (n = 59), followed by moderate NPDR in 9.1% (n = 33), severe NPDR in 3.9% (n = 14), and proliferative DR (PDR), the most advanced stage, in 3.3% (n = 12). Furthermore, diabetic macular edema (DME), a vision-threatening complication, was observed in 8.0% (n = 29) of participants (Table II).

Table – II: Prevalence and severity of diabetic retinopathy (n = 362)

DR Category	n	%
No DR	244	67.4
Any DR	118	32.6
- Mild NPDR	59	16.3
- Moderate NPDR	33	9.1
- Severe NPDR	14	3.9
- Proliferative DR	12	3.3
Diabetic macular edema (DME)	29	8.0

Risk Factors Associated with Diabetic Retinopathy

Multivariable logistic regression showed that the following factors were independently associated with DR: Duration of diabetes ≥ 10 years (AOR = 3.4; 95% CI: 2.0–5.7; $p < 0.001$); Poor glycemic control (HbA1c $\geq 7\%$) (AOR = 2.8; 95% CI: 1.7–

4.6; $p < 0.001$); Presence of hypertension (AOR = 1.9; 95% CI: 1.1–3.3; $p = 0.02$); Smoking (AOR = 1.6; 95% CI: 1.0–2.7; $p = 0.05$); Other variables such as age, gender, BMI, and dyslipidemia were not significantly associated with DR in the adjusted model (Table III).

Table – III: Multivariable logistic regression of factors associated with diabetic retinopathy (n = 362)

Variable	AOR	95% CI	p-value
Age ≥ 50 years	1.2	0.7–2.0	0.45
Duration of DM ≥ 10 years	3.4	2.0–5.7	<0.001
HbA1c $\geq 7\%$	2.8	1.7–4.6	<0.001
Hypertension	1.9	1.1–3.3	0.02
Smoking	1.6	1.0–2.7	0.05
Dyslipidemia	1.3	0.8–2.2	0.25

DISCUSSION

In our study, the mean age of participants was 52.3 ± 11.6 years, with a slightly higher proportion of males (54%). The majority had type 2 diabetes (89%), which aligns with the general epidemiology reported by Fong et al., where type 2 diabetes predominates among adults with diabetic retinopathy. [16] These demographic characteristics reflect the typical profile of patients at risk for retinopathy in clinical and population-based settings.

The prevalence of DR in our cohort (32.6%) is somewhat higher than that reported in a recent hospital-based study of type 2 diabetic patients in Rangpur division which found a prevalence of 18.8%. [17] That study also observed strong associations with longer duration of diabetes and poor metabolic control—consistent with our findings. [17] Another tertiary hospital based study involving 200 type 2 diabetics reported a DR prevalence of 35.5%, with non-proliferative and proliferative forms being 19.0% and 16.5% respectively; risk factors included increased age (≥ 50 years), uncontrolled diabetes, hypertension, smoking, and high LDL cholesterol. [18] This aligns closely with our risk factor profile, though our PDR prevalence is lower and our cohort has somewhat lower smoking and dyslipidemia rates.

In younger type 1 diabetics in Bangladesh (BIRDEM), DR prevalence was only 6.6%, almost entirely mild non-proliferative disease. Higher HbA1c and longer diabetes duration were the main associated risk factors. [19] This underscores the influence of type of diabetes, disease duration, and glycemic control.

In the present study, duration of diabetes ≥ 10 years was independently associated with diabetic retinopathy (AOR =

3.4), which is in line with the findings of Niazi et al., who also identified longer duration of diabetes as a significant determinant of retinopathy among their study population in Pakistan. [20] In our sample, the mean diabetes duration was 8.7 years and mean HbA1c 8.1%, indicating a high-risk profile. This aligns with Yang et al., who showed that longer diabetes duration and poor glycemic control significantly increase complication risk, reinforcing their role as key determinants of diabetic retinopathy. This consistency reinforces the well-established understanding that prolonged exposure to hyperglycemia accelerates retinal microvascular damage, thereby increasing the risk of retinopathy. [21]

In our study, hypertension was significantly associated with diabetic retinopathy (AOR = 1.9), consistent with Liu et al., who found blood pressure control to be a key determinant of retinopathy risk. [22] Smoking also showed a significant association (AOR = 1.6), in line with the meta-analysis by Cai et al., which confirmed smoking as a contributor to retinopathy across diabetes types. [23] In contrast, dyslipidemia was not significantly associated in our sample (AOR = 1.3), though mechanistic evidence supports its role in retinal vascular damage. [24]

CONCLUSION

In this study of 362 diabetic patients, 32.6% had diabetic retinopathy, with mild non-proliferative DR being the most common form. Longer duration of diabetes (≥ 10 years), poor glycemic control (HbA1c $\geq 7\%$), hypertension, and smoking were identified as independent risk factors, emphasizing the need for early detection and management of these modifiable factors. To reduce the burden of diabetic retinopathy, it is recommended that patients undergo regular retinal screening,

maintain optimal glycemic and blood pressure control, and adopt healthy lifestyle practices, including smoking cessation. Health authorities and clinicians should prioritize these interventions, particularly for high-risk patients, to prevent the progression of DR and preserve vision.

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