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Original Article

Diabetic Retinopathy in Type 2 Diabetes Mellitus: Prevalence, Severity and Associated Risk Factors

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ABSTRACT

Background: Diabetic retinopathy (DR) is a frequent microvascular complication of diabetes and a leading cause of visual impairment that can be prevented. A longer duration of diabetes, inadequate glycemic control, and nephropathy are significant risk factors. Even though it imposes a considerable burden, evidence from Bangladesh is still scarce. This study evaluated the prevalence, severity, and related risk factors of DR in patients with type 2 diabetes mellitus. **Methods & Materials:** From January to December 2025, a cross-sectional study based in a hospital was carried out among 284 adults with T2DM in Bangladesh. Data on demographics, clinical features, and biochemical parameters were gathered, and DR was evaluated and graded through ophthalmological examination. The associations were examined using suitable statistical tests along with multivariable logistic regression, with $p<0.05$ regarded as significant. **Results:** Among the 284 patients, DR was found in 99 (34.9%), and mild NPDR was the most frequently observed grade (14.1%). DR showed a significant association with older age, longer duration of diabetes, smoking, poor glycemic control, and diabetic nephropathy. Patients with DR had significantly higher mean age, diabetes duration, fasting glucose, HbA1c, and serum creatinine. Following adjustment, age ≥50 years, diabetes duration ≥10 years, HbA1c ≥7.0%, and diabetic nephropathy stayed independently associated with DR. **Conclusion:** DR was prevalent in patients with T2DM, and its occurrence was independently linked to older age, longer diabetes duration, poor glycemic control, and diabetic nephropathy. Prompt retinal screening along with thorough management of glycemic and renal risk factors could assist in lowering the burden and progression of DR.

Keywords: *Diabetic Retinopathy, Type 2 Diabetes Mellitus, Prevalence, Severity, Risk Factors.*

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INTRODUCTION

Diabetic retinopathy (DR) is the most frequent microvascular complication of diabetes mellitus and a leading cause of visual impairment and blindness that could be prevented in working-age adults. It arises from long-term damage to the retinal microvasculature and is increasingly viewed as a significant public health concern amid the worldwide growth in diabetes mellitus [1,2]. DR is characterized by microaneurysms, hemorrhages, exudates, cotton-wool spots, venous abnormalities, and advanced retinal neovascularization. Globally, it affects approximately 27% of people with diabetes and is a major cause of diabetes-related blindness [3].

The onset and advancement of DR result from multiple factors and are shaped by metabolic as well as systemic influences. A longer history of diabetes, inadequate glycemic control, elevated HbA1c levels, hypertension, higher BMI, diabetic nephropathy, anemia, dyslipidemia, and various other metabolic disorders have all been linked to a greater risk of DR [4-6]. The pathogenesis remains complex and not fully understood, encompassing hyperglycemia-induced vascular dysfunction, oxidative stress, inflammation, and retinal ischemia [5,6]. Evidence further shows that longer diabetes duration, more severe hyperglycemia, and hypertension are strongly tied to DR progression, whereas intensive glycemic control may lower its occurrence and worsening [7,8].

DR is categorized into two forms: nonproliferative (NPDR) and proliferative (PDR). NPDR is characterized by microvascular changes in the retina without neovascularization, whereas PDR represents an advanced ischemic stage marked by the growth of abnormal new vessels and a substantial risk of severe vision loss [9,10]. Prompt screening and treatment using laser therapy, intravitreal corticosteroids, anti-VEGF agents, or surgery can help avert vision loss [11].

Research conducted internationally has documented a considerable burden of DR in individuals with type 2 diabetes mellitus, where longer diabetes duration, inadequate glycemic control, hypertension, and various other clinical and metabolic factors are linked to its development and severity [11,12]. These results underscore the value of recognizing patients who face a higher risk of sight-threatening disease and of guaranteeing prompt screening and treatment.

In Bangladesh, research has likewise documented a substantial burden of DR among diabetes patients, with its development linked to longer diabetes duration, inadequate glycemic control, and other clinical risk factors [14,15]. Nevertheless, evidence on the prevalence, severity, and associated risk factors of DR specifically in patients with type 2 diabetes mellitus is still scarce. Thus, this study was carried out to assess the prevalence and severity of diabetic retinopathy and to identify the risk factors associated with it among patients with type 2 diabetes mellitus.

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METHODS & MATERIALS

Study design and setting

This hospital-based cross-sectional analytical study was conducted among patients with type 2 diabetes mellitus (T2DM) attending the Department of Ophthalmology and the Department of Endocrinology of a tertiary care hospital in Bangladesh. The study was conducted over a period of 12 months from January to December 2025. The study was designed to determine the prevalence and severity of diabetic retinopathy (DR) and to assess the demographic, clinical, and biochemical factors associated with DR among patients with T2DM.

Study population

The study population consisted of adult patients with a confirmed diagnosis of T2DM who attended the study hospital during the study period. Patients were considered eligible if they were aged 18 years or above, had established T2DM, and underwent an ophthalmological assessment for detection of diabetic retinopathy. Patients who had inadequate or ungradable retinal images, a history of major retinal surgery, known retinal vascular disease unrelated to diabetes, or other ocular conditions that could interfere with assessment of diabetic retinopathy were excluded from the study.

Sample size and sampling

A total of 284 eligible patients with T2DM were included in the final analysis. Participants were recruited using a consecutive sampling technique until the required sample size was achieved. All eligible patients who fulfilled the inclusion criteria during the study period were approached for participation, and those who provided informed consent were enrolled.

Data collection procedure

Data were collected using a structured data collection form. Sociodemographic information included age, sex, and place of residence. Clinical information included duration of diabetes, history of hypertension, smoking status, body mass index (BMI), and diabetic nephropathy. Age was categorized into four groups: <40, 40–49, 50–59, and ≥60 years. For comparative and regression analyses, age was additionally categorized as <50 and ≥50 years. Duration of diabetes was recorded in years and categorized as <5, 5–9, and ≥10 years for descriptive analysis. For association analyses, duration of diabetes was categorized as <10 years and ≥10 years. Smoking status was classified as current smoker or non-smoker. Residence was categorized as urban or rural. BMI was calculated as weight in kilograms divided by height in meters squared and categorized as <18.5, 18.5–24.9, 25.0–29.9, and ≥30.0 kg/m². For comparative and multivariable analyses, BMI was dichotomized as <25 and ≥25 kg/m².

Clinical and biochemical assessment

Body weight and height were measured using standard procedures, and BMI was calculated accordingly. Blood pressure was measured after the participant had rested adequately, using a calibrated sphygmomanometer. Both systolic and diastolic blood pressure were recorded in mmHg. Fasting venous blood samples were collected for measurement of fasting blood glucose, HbA1c, and serum creatinine. HbA1c was categorized as <7.0% and ≥7.0%, with HbA1c ≥7.0% considered poor glycemic control for the purpose of analysis. Serum creatinine was recorded in mg/dL. Diabetic nephropathy was defined according to the clinical and laboratory documentation available in the patient's medical records, based on evidence of diabetic kidney involvement documented by the treating physician.

Ophthalmological assessment and grading of diabetic retinopathy

All participants underwent a comprehensive ophthalmological examination. Visual acuity was assessed, followed by anterior segment examination and dilated fundus examination. Retinal assessment was performed using appropriate fundus examination and/or fundus photography after pupillary dilation. Diabetic retinopathy was classified according to the severity of retinal lesions identified during examination. Participants without characteristic diabetic retinal lesions were categorized as having no diabetic retinopathy. DR was classified into mild non-proliferative diabetic retinopathy (NPDR), moderate NPDR, severe NPDR, and proliferative diabetic retinopathy (PDR) based on established clinical retinal criteria. Mild NPDR was characterized predominantly by microaneurysms, while increasing numbers and combinations of retinal hemorrhages, microaneurysms, cotton-wool spots, venous abnormalities, and intraretinal microvascular abnormalities were used to classify moderate and severe NPDR. The presence of retinal or optic disc neovascularization, with or without associated vitreous or preretinal hemorrhage, was classified as PDR.

For the primary analysis, participants were divided into two groups: no DR and DR. For severity analysis, the DR group was further divided into mild NPDR, moderate NPDR, severe NPDR, and PDR.

Statistical analysis

Data were entered, cleaned, and analyzed using IBM SPSS-26. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. The Chi-square/Fisher's exact test was used for categorical comparisons, while the independent-samples t-test was used for continuous variables. Associations with DR severity were assessed using the Chi-square test. Multivariable binary logistic regression was performed to identify independent factors associated with DR, with results presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). A p-value <0.05 was considered statistically significant.

Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the appropriate institutional ethics committee before commencement of the study. Written informed consent was obtained from all participants before enrollment. Participants' confidentiality was maintained throughout data collection, analysis, and reporting, and the collected information was used solely for research purposes.

RESULTS

Table I shows total of 284 patients with type 2 diabetes mellitus (T2DM) were included in the study. Among the 284 participants, the largest proportion belonged to the 50–59-year age group (99, 34.9%), followed by those aged ≥60 years (71, 25.0%). Males accounted for 157 (55.3%) participants, while 127 (44.7%) were female. Most participants were from urban areas (168, 59.2%). Regarding diabetes duration, 167 (58.8%) had diabetes for ≥10 years, while 75 (26.4%) had diabetes for <5 years. In terms of BMI, 120 (42.3%) were overweight (25.0–29.9 kg/m²), and 45 (15.8%) were obese (≥30.0 kg/m²). Hypertension was present in 140 (49.3%) participants, while 76 (26.8%) were current smokers. Poor glycemic control, defined as HbA1c ≥7.0%, was observed in 228 (80.3%) participants. Diabetic nephropathy was present in 53 (18.7%) participants.

Table I
Sociodemographic and clinical characteristics of the study participants (*n* = 284).

Variable	Frequency (n)	Percentage (%)
Age group (years)		
<40	36	12.7
40–49	78	27.5
50–59	99	34.9
≥60	71	25.0
Sex		
Male	157	55.3
Female	127	44.7
Residence		
Urban	168	59.2
Rural	116	40.8
Duration of diabetes		
<5 years	75	26.4
5–9 years	42	14.8
≥10 years	167	58.8
BMI (kg/m²)		
<18.5	11	3.9
18.5–24.9	108	38.0
25.0–29.9	120	42.3
≥30.0	45	15.8
Hypertension		
Yes	140	49.3
No	144	50.7
Smoking		
Current smoker	76	26.8
Non-smoker	208	73.2
HbA1c		
<7.0%	56	19.7
≥7.0%	228	80.3
Diabetic nephropathy		
Present	53	18.7
Absent	231	81.3

Table II presents diabetic retinopathy was identified in 99 (34.9%) of the 284 study participants, while 185 (65.1%) had no evidence of diabetic retinopathy. Among the participants with DR, mild NPDR was the most common grade, observed in 40 (14.1%) participants, followed by moderate NPDR in 29 (10.2%) and severe NPDR in 19 (6.7%). Proliferative diabetic retinopathy (PDR) was identified in 11 (3.9%) participants. Overall, NPDR accounted for 88 (88.9%) of the 99 DR cases, while PDR accounted for 11 (11.1%).

Table II
Prevalence and severity of diabetic retinopathy among the study participants (*n* = 284).

Retinal status	Frequency (n)	Percentage (%)
No diabetic retinopathy	185	65.1
Diabetic retinopathy	99	34.9
─ Mild NPDR	40	14.1
─ Moderate NPDR	29	10.2
─ Severe NPDR	19	6.7
─ Proliferative DR	11	3.9
Total	284	100.0

NPDR = non-proliferative diabetic retinopathy; DR = diabetic retinopathy.
Table III shows participants with DR had a higher proportion of age ≥50 years compared with those without DR (71.7% vs. 58.9%, p=0.027). Diabetes duration of ≥10 years was also substantially more common among participants with DR than among those without DR (73.7% vs. 50.8%, p<0.001). Current smoking was reported in 34.3% of participants with DR compared with 22.7% of those without DR (p=0.038). Similarly, HbA1c ≥7.0% was more frequent among participants with DR (87.9% vs. 76.2%, p=0.011). Diabetic nephropathy was present in 29.3% of the DR group compared with 13.0% of the non-DR group (p<0.001). In contrast, sex, urban residence, BMI ≥25 kg/m², and hypertension did not show statistically significant differences between the two groups.

Table III
Comparison of selected demographic and clinical characteristics according to diabetic retinopathy status.

Variable	No DR (n=185), n (%)	DR (n=99), n (%)	p-value
Age ≥50 years	109 (58.9)	71 (71.7)	0.027
Male sex	101 (54.6)	56 (56.6)	0.748
Urban residence	105 (56.8)	63 (63.6)	0.270
Duration of diabetes ≥10 years	94 (50.8)	73 (73.7)	<0.001
BMI ≥25 kg/m²	103 (55.7)	62 (62.6)	0.263
Hypertension	105 (56.8)	65 (65.7)	0.136
Current smoking	42 (22.7)	34 (34.3)	0.038
HbA1c ≥7.0%	141 (76.2)	87 (87.9)	0.011
Diabetic nephropathy	24 (13.0)	29 (29.3)	<0.001

Table IV shows the comparison of continuous clinical and biochemical. Participants with DR had a significantly higher mean age than those without DR (55.3 ± 10.7 vs. 51.6 ± 10.4 years, p=0.005). The mean duration of diabetes was also significantly longer in the DR group (11.2 ± 6.1 vs. 7.6 ± 5.5 years, p<0.001). Mean fasting blood glucose was higher among participants with DR (159.1 ± 41.4 vs. 145.2 ± 37.0 mg/dL, p=0.003). Similarly, mean HbA1c was significantly higher in the DR group (8.6 ± 1.8% vs. 7.8 ± 1.4%, p<0.001). Mean serum creatinine was also significantly higher among participants with DR (1.19 ± 0.41 vs. 1.02 ± 0.30 mg/dL, p<0.001). No statistically significant differences were observed in BMI, systolic blood pressure, or diastolic blood pressure between the two groups.

Table IV
Mean clinical and biochemical parameters according to diabetic retinopathy status.

Parameter	No DR (n=185) Mean ± SD	DR (n=99) Mean ± SD	p-value
Age (years)	51.6 ± 10.4	55.3 ± 10.7	0.005
Duration of diabetes (years)	7.6 ± 5.5	11.2 ± 6.1	<0.001
BMI (kg/m²)	25.6 ± 3.8	26.0 ± 4.0	0.401
Systolic BP (mmHg)	132.4 ± 15.5	135.5 ± 16.3	0.101
Diastolic BP (mmHg)	80.0 ± 9.1	81.6 ± 9.4	0.164
Fasting blood glucose (mg/dL)	145.2 ± 37.0	159.1 ± 41.4	0.003
HbA1c (%)	7.8 ± 1.4	8.6 ± 1.8	<0.001
Serum creatinine (mg/dL)	1.02 ± 0.30	1.19 ± 0.41	<0.001

Table V shows the proportion of participants with diabetes duration ≥10 years increased progressively with increasing severity of DR, from 42.5% among those with mild NPDR to 62.1% with moderate NPDR, 73.7% with severe NPDR, and 81.8% among those with PDR (p<0.001). Similarly, poor glycemic control was increasingly common across the severity categories, with HbA1c ≥7.0% observed in 75.0% of participants with mild NPDR, 82.8% with moderate NPDR, 89.5% with severe NPDR, and 90.9% with PDR (p=0.022).

Table V
Distribution of diabetic retinopathy severity according to duration of diabetes and glycemic control.

Characteristic	Mild NPDR (n=40), n (%)	Moderate NPDR (n=29), n (%)	Severe NPDR (n=19), n (%)	PDR (n=11), n (%)	p-value
Duration of diabetes					<0.001
<10 years	23 (57.5)	11 (37.9)	5 (26.3)	2 (18.2)	
≥10 years	17 (42.5)	18 (62.1)	14 (73.7)	9 (81.8)	
HbA1c					0.022
<7.0%	10 (25.0)	5 (17.2)	2 (10.5)	1 (9.1)	
≥7.0%	30 (75.0)	24 (82.8)	17 (89.5)	10 (90.9)	

NPDR = non-proliferative diabetic retinopathy; PDR = proliferative diabetic retinopathy.

Table VI shows the multivariable logistic regression findings. After adjustment for potential confounding variables, age ≥50 years, diabetes duration ≥10 years, HbA1c ≥7.0%, and diabetic nephropathy remained significantly associated with diabetic retinopathy. Participants aged ≥50 years had higher odds of DR (AOR 1.71, 95% CI 1.02–2.87, p=0.041). Diabetes duration ≥10 years was associated with approximately 2.7-fold higher odds of DR (AOR 2.68, 95% CI 1.57–4.57, p<0.001). Participants with HbA1c ≥7.0% had higher odds of DR (AOR 1.96, 95% CI 1.04–3.69, p=0.038), while diabetic nephropathy was associated with approximately 2.6-fold higher odds (AOR 2.55, 95% CI 1.42–4.58, p=0.002). Male sex, BMI ≥25 kg/m², hypertension, and current smoking were not independently associated with DR after adjustment.

Table VI
Factors associated with diabetic retinopathy in multivariable logistic regression analysis.

Risk factor	Adjusted OR	95% CI	p-value
Age ≥50 years	1.71	1.02–2.87	0.041
Male sex	1.13	0.69–1.86	0.622
Duration of diabetes ≥10 years	2.68	1.57–4.57	<0.001
BMI ≥25 kg/m²	1.16	0.69–1.94	0.578
Hypertension	1.34	0.81–2.22	0.254
Current smoking	1.63	0.93–2.86	0.084
HbA1c ≥7.0%	1.96	1.04–3.69	0.038
Diabetic nephropathy	2.55	1.42–4.58	0.002

OR = odds ratio; CI = confidence interval.

DISCUSSION

In this study, of the 284 patients with T2DM, the majority were between 50 and 59 years old, male, living in urban areas, and had diabetes for 10 years or more. Overweight, hypertension, poor glycemic control, smoking, and diabetic nephropathy were also frequently observed. Likewise, a study conducted in Bangladesh with 320 patients found a mean age of 50.05±8.58 years, with 62.5% males and 36.3% between 50 and 59 years old; DR was present in 29.4% [15]. DR was significantly associated with hypertension and various behavioral and clinical factors, which highlights the significance of metabolic and clinical risk factors in DR.

In this current study, DR was detected in 34.9% of the participants, with mild NPDR being the most prevalent, followed by moderate NPDR, severe NPDR, and PDR. NPDR made up 88.9% of DR cases. Likewise, a study from Bangladesh found mild (31.25%) and moderate NPDR (34.38%) to be the most common grades, whereas PDR represented 9.38% of cases [16]. The predominance of NPDR in both studies highlights how important early detection and routine retinal screening are for preventing progression to advanced disease.

In this study, DR showed a significant link with older age, longer diabetes duration, smoking, poor glycemic control, and diabetic nephropathy, pointing to the involvement of several metabolic and clinical factors. Likewise, an international study conducted in Nepal found associations with longer diabetes duration, hypertension, and male sex [17]. These results underscore the value of routine risk-factor evaluation and early retinal screening for patients with T2DM.

In the present study, DR was associated with higher age, longer diabetes duration, fasting glucose, HbA1c, and serum creatinine, while BMI and blood pressure showed no significant differences. Similarly, Bangladesh studies reported associations of DR and microvascular complications with longer diabetes duration, poor glycemic control, and other clinical and laboratory factors [13,18]. These findings emphasize the importance of glycemic and renal assessment in DR.

In this study, longer diabetes duration and inadequate glycemic control rose progressively as DR severity increased. Likewise, an international study reported a significant link between longer diabetes duration and DR, with prevalence rising from 19.35% at 0–5 years to 63.64% after more than 20 years [19]. These results underscore the significance of diabetes duration and glycemic control in the progression of DR.

In this study, after adjustment, age ≥50 years, diabetes duration ≥10 years, HbA1c ≥7.0%, and diabetic nephropathy continued to be independently associated with DR. Likewise, studies from other countries have found that longer diabetes duration, inadequate glycemic control, and kidney involvement are key risk factors for DR [1,8,19]. These results reinforce the multifactorial character of DR and highlight how important it is to screen early and manage metabolic and renal risk factors.

In general, DR was prevalent among T2DM patients, with advanced age, prolonged diabetes duration, inadequate glycemic control, and diabetic nephropathy recognized as the main associated factors, highlighting the importance of early screening and thorough management of risk factors.

CONCLUSION

DR was frequently observed in patients with T2DM, and mild NPDR was the most common presentation. Advanced age, a longer duration of diabetes, inadequate glycemic control, and diabetic nephropathy were each independently linked to DR. These results underscore the value of routine retinal screening, timely detection, and thorough control of glycemic and renal risk factors in order to lower the likelihood of DR progression and visual complications.

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