

## Severity of diabetic retinopathy and its relationship with duration of diabetes and hypertension

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**Objective:** This study aims to evaluate the risk factors affecting diabetic retinopathy and its severity in type 2 diabetic patients about the duration of diabetes and hypertension.

**Methods:** A retrospective chart analysis was done of patient data collected from the patients visiting our tertiary institute (Karnataka Institute of Endocrinology and Research) from November 1st, 2022 to October 31st, 2023. In these diabetic patients, the prevalence of diabetic retinopathy and its severity concerning the duration of diabetes and hypertension was evaluated. Diabetic retinopathy and diabetic macular edema (DME) were classified based on the International Clinical Disease Severity Scale for Diabetic Retinopathy (DR).

**Result:** 5363 was the total number of diabetic patients included in this study. The prevalence of Diabetic retinopathy(DR) was 13.95% with diabetes for less than 5 years, 37% with diabetes for 5 to 10 years and 58.74% for more than 10 years. In diabetic patients with associated hypertension, the prevalence of diabetic retinopathy (DR) was 36 % as compared to 28.4% without associated hypertension. In multivariate analysis for factors associated with diabetic retinopathy, the odds ratio (OR) was 3.61% (95% CI, 3.08 – 4.23, P – Value < 0.001) in patients with diabetes between 5 – 10 years and in patients with diabetes above 10 years the odds ratio (OR) was 8.69 (95% CI, 7.36 – 10.26, P – Value < 0.001) as compared to patients with diabetes < 5 years. The odds ratio (OR) for developing DR was 1.19 (95% CI, 1.03 – 1.37, P – Value 0.015) in patients with diabetes and hypertension as compared to diabetic patients without hypertension.

**Conclusion:** The prevalence of diabetic retinopathy is higher in diabetic patients with longer duration of diabetes and diabetic patients with associated hypertension. It is important to evaluate all diabetic patients for diabetic retinopathy and maintain good glycemic and hypertensive control. Managing comorbidities along with diabetes reduces the prevalence and complications of diabetic retinopathy.

**Keywords:** diabetic retinopathy, Hypertension, Diabetes, duration

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## Introduction

Diabetes mellitus is a metabolic condition characterised by an elevation of blood sugars caused due to inadequate insulin secretion insulin resistance or both. The overall prevalence of diabetes in India is estimated to be 11.4% and hypertension 35.5 % according to a study done in India in 2023. It is a huge health burden for India, with almost 100 million of the Indian population affected by diabetes [1]. The National Health and Nutrition Examination Survey (1988 - 1994) conducted in the United States showed 71% of adults with diabetes to have hypertension [2]. Two-thirds of type 2 diabetes patients have high blood pressure at the time diabetes is first diagnosed [3]. The concomitant presence of diabetes and hypertension increases the risk of diabetic retinopathy and nephropathy.

Diabetic retinopathy is a common microvascular complication seen in diabetic patients caused due to chronic hyperglycemia. It is considered to be a major risk factor for vision loss and vision impairment in diabetic patients. Vision impairment at a young age leads to decreased quality of life and increased financial burden for the patient and society. It is important to identify diabetic patients who are at risk of developing severe diabetic retinopathy. The relative risk of developing diabetic retinopathy increases by 1.7 if the patient has diabetes and hypertension [2, 3]. Every 10 mm Hg increase in systolic blood pressure leads to 1.23 times increased risk of diabetic retinopathy and 1.19 times increased risk of developing vision-threatening retinopathy [4]. Duration of diabetes is also a well-known risk factor for the development and progression of diabetic retinopathy [5]. The purpose of the study was to assess the risk factors of diabetic retinopathy about the duration of diabetes and hypertension in diabetic patients visiting our institute in Bangalore, Karnataka.

## Methods

**Study design:** Retrospective chart analysis of patient data collected from the database of patients visiting our institute (Karnataka Institute of Endocrinology and Research) from November 1st, 2022 to October 31st, 2023. A total of 5,363 patients attending the vitreoretina department were included in the study. The study design and methodology are described in detail elsewhere [7].

For the assessment of duration of diabetes as a risk factor, the patients were divided into 3 groups:

Group 1: Duration of diabetes < 5 years; Group 2: Duration of diabetes 5-10 years; 3) Duration of diabetes >10 years

For the assessment of hypertension as the risk factor, patients were divided into 2 groups:

Group 1: Patients with diabetes and no hypertension; Group 2: Patients with diabetes and hypertension.

Data was collected by utilizing a semi-structured questionnaire and a detailed dilated examination was done by an ophthalmologist (vitreoretina specialist).

All of them underwent a detailed ophthalmological evaluation which included best corrected visual acuity (BCVA), intraocular pressure (IOP), dilated fundus evaluation and slit lamp biomicroscopy at the vitreoretina department of Karnataka Institute of Endocrinology and Research. They were graded based on the International Clinical Disease Severity Scale for Diabetic Retinopathy into no diabetic retinopathy (DR), mild non-proliferative diabetic retinopathy (NPDR), moderate nonproliferative diabetic retinopathy and proliferative diabetic retinopathy (PDR). All the patients received treatment and were advised to follow up according to the International Council of Ophthalmology guidelines. The presence of diabetes and hypertension was based on a diagnosis made by the physician and noted in the patient's medical record.

**Inclusion criteria:** All type 2 diabetic patients above 30 years visiting our institute for diabetes management during the study period were included in the study.

**Exclusion criteria:** Diabetic patients below 30 years and type 1 patients were excluded from the study.

## Results

**Characteristics of the study population:** A total of 5363 patients visiting our tertiary institute were included in the study with a mean age of 53.89 years and most of the patients were male 3228 (60%). With regards to the duration of diabetes, 373(13.95%) patients had diabetic retinopathy with diabetes < 5 years, 512 (37.07%) patients had diabetic retinopathy with diabetes 5 -10 years and 769 (58.74%) patients had diabetic retinopathy with diabetes >10 years.

The mean duration of diabetes was 8.41 years. 1576 Patients of the total participants had hypertension as a co-morbidity.

**Table 1: Comparison of Severity of diabetic retinopathy in the study group**

	Number of Cases	Prevalence	95 % C. I
NO NPDR	3709		
Mild NPDR	812	15.14%	14.19 – 16.13
Moderate NPDR	438	8.17%	7.45 – 8.93
Severe NPDR	152	2.83%	2.41 – 3.31
PDR	252	4.69%	4.14 – 5.29
Total	5363		

Out of the 5363 patients, 3709(69 %) patients had no diabetic retinopathy. 1654 patients had diabetic retinopathy. The prevalence of diabetic retinopathy was 30.8 %.

812 (15.14%) patients had mild NPDR, 438 (8.17%) patients had moderate NPDR, 152 (2.83%) patients had severe NPDR and 252(4.69%) patients had PDR.

**Table 2: Comparison of prevalence of Diabetic retinopathy with duration of diabetes**

	DR	NO DR	Total	P-Value
< 5 Years	373 (13.95%)	2300 (86%)	2673	<0.001
5yrs – 10 years	512 (37.07%)	869 (62.92%)	1381	
>10 Years	769 (58.74%)	540 (41.25%)	1309	
Total	1654	3709	5363	

373 (13.95%) Patients have diabetic retinopathy with diabetes for less than 5 years compared to 769 (58.74%) patients with diabetes for more than 10 years. The longer the duration of diabetes, the larger the number of patients with diabetic retinopathy. 512 (37%) patients with diabetes between 5 to 10 years had diabetic retinopathy. The odds ratio (OR) for developing diabetic retinopathy is 3.61 in patients with diabetes less than 5 years and 8.69 in patients with diabetes more than 10 years as compared to diabetes under 5 years.

**Table 3: Comparison of Severity of Diabetic Retinopathy with Duration of diabetes**

	NO DR	Mild	Moderate	Severe	PDR	Total	P-Value
<5 Years	2300 (86%)	223 (8%)	102 (4%)	26 (1%)	22 (1%)	2673	<0.001
5-10 Year	869 (63%)	272 (20%)	132 (10%)	40 (3%)	68 (4%)	1381	
>10 Years	540 (41%)	317 (24%)	204 (16%)	86 (7%)	162 (12%)	1309	
Total	3709	812	438	152	252	5363	

769 (58.74%) Patients with diabetes above 10 years have diabetic retinopathy. Among them 317 (24%) patients have Mild DR, 204 (16%) patients have moderate DR, 86 (7%) patients have severe DR and 162(12%) patients have PDR.

512 (37.07%) patients have DR with diabetes between 5 to 10 years. Among them 272 (20%) patients have mild DR, 132 (10%) patients have moderate DR, 40 (3%) patients have severe DR and 68 (4%) patients have PDR.

373 (13.95%) patients with a duration of less than 5 years have diabetic retinopathy. Among them 223 (8%) patients have mild DR, 102 (4%) patients have moderate DR, 26 (1%) patients have severe DR and 22 (1%) patients have PDR.

Among the 1654 (30.84%) patients who have diabetic retinopathy there is an increasing number of patients seen in all the stages of DR with an increase in the duration of diabetes. In the mild NPDR group, there is an increase from 8% in less than 5 years duration to 24% in more than 10 years duration. In the moderate NPDR group, there is an increase from 4% in less than 5 years duration to 16% in more than 10 years duration. In the severe NPDR group, it increases from 1% in less than 5 years duration to 7% in more than 10 years duration and the PDR group it increases from 1% in less than 5 years duration to 12% in more than 10 years duration. The highest number of patients with PDR is seen in the group with a duration of diabetes above 10 years.

Duration of diabetes is a risk factor for the development of diabetic retinopathy and the severity of diabetic retinopathy also increases with a longer duration of diabetes.

**Table 4: Comparison of prevalence of diabetic retinopathy in patients with and without Hypertension**

	DR	NO DR	Total	P-Value
HT	581 (36.86%)	995 (63.13%)	1576	<0.001
No HT	1073 (28.33%)	2714 (71.66%)	3787	
Total	1654	3709	5363	

Out of the total of 5363 patients, 1576 diabetic patients had hypertension as a co-morbidity. In this group, 581 (36.86%) patients had diabetic retinopathy. In 3787 diabetic patients without hypertension, 1073 (28.33%) patients had diabetic retinopathy.

The odds ratio for developing diabetic retinopathy was 1.19 in patients with diabetes and hypertension as compared to patients with diabetes alone.

**Table 5: Comparison of severity of diabetic retinopathy in patients with diabetes and hypertension**

	Number of Cases	Percentage
NO NPDR	995	63%
Mild NPDR	265	17%
Moderate NPDR	147	9%
Severe NPDR	62	4%
PDR	107	7%
Total	1576	

In 581 diabetic patients with hypertension diagnosed with diabetic retinopathy, 265 patients (17%) were diagnosed with Mild NPDR, 147 (9%) patients were diagnosed with moderate NPDR, 62 (4%) patients were diagnosed with severe NPDR and 107(7%) patients were diagnosed with PDR.

The prevalence of mild NPDR, moderate NPDR, severe NPDR and PDR is higher in patients with diabetes and hypertension as compared to diabetes alone. Not only is hypertension a risk factor in DR, but it affects the severity of diabetic retinopathy also.

**Table 6: Multivariate analysis for factors associated with Diabetic retinopathy**

	Univariate analysis			Multivariate analysis		
	OR	95% C. I	P-Value	OR	95% C. I	P-Value
Duration of diabetes						
<5 Years	1					
5-10 Years	3.63	3.11 - 4.24	<0.001	3.61	3.08 - 4.23	<0.001
>10 Years	8.78	7.52 - 10.25	<0.001	8.69	7.36 - 10.26	<0.001
Hypertension						
Yes	1.48	1.30 - 1.67	<0.001	1.19	1.03 - 1.37	0.015
No	1					

The odds ratio of developing diabetic retinopathy was higher with a longer duration of diabetes. The odds ratio was 8.69 in patients with more than 10 years of diabetes as compared to less than 5 years of diabetes. The odds ratio was 3.61 in patients with diabetes between 5 to 10 years as compared to less than 5 years of diabetes.

The odds ratio for developing diabetic retinopathy was 1.19 in patients with diabetes and hypertension as compared to patients with diabetes alone.

## Discussion

Diabetic retinopathy is a very common complication of long-term diabetes and can progress to vision-threatening diabetic retinopathy. Chronic uncontrolled diabetes with associated uncontrolled hypertension worsens diabetic retinopathy.

Duration of diabetes is a significant factor in the development and progression of retinopathy as shown in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR). The prevalence of DR was 28.8% in Type 2 DM of <5 years duration and 77.8% in type 2 DM of more than 15 years [17]. In the Wisconsin study (WESDR) of type 1 diabetes patients the prevalence of DR was 3 % at 3 years, 25% at 5 years, 60 % at 10 and 80% at 15 years. The presence of PDR was 0% in the first 5 years of diabetes and increased to 27.9% during 13-14 years of diabetes [9].

In comparison, our study shows a DR prevalence of 14% in patients with diabetes < 5 years and 59% in patients with diabetes >10 years. In our study, the presence of PDR was 1% in duration <5 years which increased to 12% in diabetes >10 years. In the Chennai Urban Rural Epidemiology eye study (CURES) done in south India, 41.8% had DR after 15 years of diabetes as compared to our study where 46% had DR after 10 years of diabetes [20]. In another study, the prevalence of retinopathy concerning diabetes duration was 1.1% at diagnosis, 6.6% for 0-5 years, 12% for 5-10 years, 24% for 10-15 years, 39.9% for 15- 20 years, 52.7% for 20-25 years, 58.7% for 25-30 years and 63% for ≥30 years [16].

According to a study done in Kuwait, the risk for diabetic retinopathy increased from 8.6% in patients with diabetes <5 years to 45.0% in patients with diabetes for 5-10 years and 76.4% in patients with diabetes longer than 10 years [12]. In our study, 13.95% had DR with <5 years of diabetes, 37.07% had DR with diabetes for 5-10 years and 58.74 % had DR with >10 years of diabetes. The severity of DR also proportionally increased with the duration of diabetes in our study, as seen in many studies also [5], [12], [16], [17], [18].

In this study, the odds ratio (OR) for developing diabetic retinopathy in patients with a duration of more than 10 years is 8.69 as compared to 3.61 in patients with diabetes under 5 years.

This study showed that there is a higher prevalence of diabetic retinopathy and severity of diabetic retinopathy with a longer duration of diabetes.

Uncontrolled hypertension is a contributing factor in the progression of vision-threatening diabetic retinopathy (VTDR). According to the United Kingdom Prospective Diabetes Study (UKPDS), there was a 35% reduction in the progression of DR and a 47% reduction in the risk of visual loss with tight control of hypertension. An 11% reduction in photocoagulation/vitreous haemorrhage was seen with a 10 mm decrease in systolic blood pressure. There was a 2.8 times likelihood of developing DR with a systolic BP of >140 as compared to systolic BP<125 [22]. Diastolic blood pressure was a significant predictor of the progression of diabetic retinopathy to proliferative diabetic retinopathy in younger onset (type1) diabetes mellitus, according to the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) and the severity of retinopathy was found to be related to higher systolic BP (17,18). According to a few other studies, control of systemic hypertension has been shown to reduce the onset of DR and slow down the progression of DR [4], [5], [12], [17], [19], [20], [21].

In the present study, the DR prevalence was 36.86 % in patients with diabetes and hypertension and 28.3% in diabetic patients without hypertension. The odds ratio for developing diabetic retinopathy is 1.19 in diabetic patients with hypertension compared to those without hypertension.

There was a 7.7 % increase in the prevalence of DR in patients with diabetes and hypertension compared to diabetic patients without hypertension. A nationwide Chinese study also showed similar results with an 8.1 % increased risk for DR and a 38.1% increased risk for PDR in diabetic patients with hypertension [25]. This suggests that efforts should be made to identify and treat hypertension and diabetes patients.

## Conclusion

The prevalence of diabetic retinopathy is higher in diabetic patients with longer duration of diabetes and diabetic patients with associated hypertension. Regular screening for diabetic retinopathy, maintaining good glycemic control, regular monitoring and strict control of hypertension in all diabetic patients is extremely important.

Managing comorbidities along with diabetes reduces the prevalence and complications of diabetic retinopathy preventing the progression of diabetic retinopathy to vision-threatening diabetic retinopathy.

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