

# Comprehensive clinical insights to diabetic retinopathy in Pakistan: examining prevalence, identifying risk factors, and analyzing visual health patterns

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## ABSTRACT

**Background:** Diabetes is a significant risk factor for diabetic retinopathy (DR), with a notably high incidence in Pakistan. We conducted a comprehensive study with 629 participants to explore DR prevalence, distribution, and its associations with various factors.

**Methods:** A multicenter cross-sectional study was conducted from January to July 2023 in collaboration between International Center of Medical Sciences Research (ICMSR) and the Research and Development Department at Islamabad Diagnostic Center (IDC). Study enrolled 629 male and female diabetic patients who underwent prior fundoscopic examination. Data were collected using a non-probability consecutive sampling method, with skilled investigators after ethical approval from ICMSR and IDC review boards respectively.

**Results:** Among male patients, 18% exhibited no retinopathy, 25.2% had proliferative diabetic retinopathy (PDR), and 27.3% displayed non-proliferative diabetic retinopathy (NPDR). Among female 8.5% had PDR, 13.2% NPDR, and 10.2% no retinopathy. Urban patients showed 35.4% PDR, 32.2% NPDR, and 29% no retinopathy. Rural patients displayed 37.5% NPDR, 23% PDR, and 17.7% no retinopathy. PDR was notably higher in urban areas. Patients with diabetes for over a decade had higher PDR prevalence (40.4%) than those with <10 years (62% NPDR). Study revealed that 33% of oral hypoglycemic medication users had PDR, while 40.6% of patients had NPDR. Family history of diabetes correlated with 37.2% PDR and 42.45% NPDR. Hypertension was present in 61.5% of PDR and 41.2% had NPDR, history of smoking linked to 43.8% NPDR and 38.7% PDR. Notably, PDR was more prevalent in patients with a history of diabetic foot (19.07%). Among clinically significant macular edema patients, 25.6% had no retinopathy, 69.5% had NPDR, and 37.8% had PDR.

**Conclusion:** Early detection and management is critically important particularly for individuals with specific risk factors. Healthcare practitioners should prioritize targeted interventions and comprehensive management to prevent vision loss and enhance visual health in diabetes patients.

**Keywords:** Diabetes retinopathy, Proliferative diabetic retinopathy, Non-proliferative diabetic retinopathy.

## Introduction

Diabetic retinopathy is a serious worldwide health problem especially in low- and middle-income nations where access to eye care and diabetes management may be restricted.<sup>1</sup> Among working-age adults, diabetic retinopathy is the most common cause of avoidable vision loss and blindness.

According to the International Diabetes Federation (IDF) and the World Health Organization (WHO), diabetic retinopathy has a significant global impact and is predicted to become more common over the next few years as diabetes incidence increases across the globe. Approximately one-third of patients with diabetes worldwide are thought to have diabetic retinopathy.<sup>2</sup> Regional differences exist in the prevalence of diabetic retinopathy, which is determined by things like the length of diabetes, availability to treatment, and the effectiveness of diabetes management. Among adults aged 20 to 74, diabetic retinopathy is a major cause of blindness and

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visual impairment. If left untreated, the illness can result in severe vision loss and perhaps blindness.<sup>3</sup> In Pakistan, there were about 19 million adults who had diabetes in 2019, according to the International Diabetes Federation. It can be difficult for many people in Pakistan, especially those who live in rural or low-income areas, to get the routine healthcare they need, including eye exams. Diagnosis and treatment of diabetic retinopathy may be delayed due to lack of timely access to medical care.<sup>4</sup> The general public, including some people with diabetes, are mostly unaware of diabetic retinopathy and its possible implications.<sup>5</sup> Early detection and intervention may be hampered by a lack of understanding of the significance of routine eye examination. It may be difficult for people with diabetic retinopathy to get the necessary care since there may be a shortage of ophthalmologists and eye care facilities in some areas of Pakistan. Public awareness campaigns can promote early identification and prompt treatment by raising public awareness of diabetes, its ocular consequences, and the value of routine eye exams. Early detection and treatment of diabetic retinopathy can be facilitated by initiatives to improve access to healthcare services, particularly in rural and underserved areas.<sup>6</sup> Improving patient outcomes can result from training healthcare workers, such as general practitioners and ophthalmologists, on the detection and treatment of diabetic retinopathy. In Pakistan, programs focusing on the treatment of diabetes and eye care can be implemented with the aid of NGOs and foreign organizations. Implementing population-based screening programs for people with diabetes can aid in the early detection of diabetic retinopathy cases.<sup>7</sup>

## Methods

This cross-sectional study was conducted collaboratively between the International Center of Medical Sciences Research (ICMSR) and the Research and Development Department at Islamabad Diagnostic Center, Pakistan. The research aimed to investigate the prevalence of diabetic retinopathy (DR), its distribution, and associations with various factors among individuals with diabetes mellitus. The study took place from January to July 2023.

The study enrolled a total of 629 participants who had been diagnosed with diabetes mellitus. The participants included both males and females. To be eligible for the study, all participants were required to have undergone a prior fundoscopic examination. The researchers employed a non-probability consecutive sampling method to select participants for the study. It

is commonly used in clinical settings where it may be challenging to implement random sampling. To ensure the ethical conduct of the study, we obtained approval from the ethical review boards of ICMSR and IDC (Ref number: 2023093-BA and Re: IDCERBO9202304 dated 12.11. 2022 and 2.12.2022 respectively).

The primary data collection method in this study was fundoscopic examination, a specialized eye examination to assess the retina for signs of diabetic retinopathy. Ophthalmologist examined diabetic retinopathy as part of a dilated eye exam. Non-proliferative diabetic retinopathy (NPDR) represents the prevailing manifestation of diabetic retinopathy. Its initial phases are characterized by the presence of edema and obdurate exudates, which comprise lipids that have seeped from anomalous blood vessels situated within the central retina, thereby precipitating degradation in central visual acuity. Proliferative diabetic retinopathy (PDR) is distinguished by the emergence of neovascularization within the iris angle (known as rubeosis iridis), the optic disc, or other ocular locations, accompanied by the occurrence of preretinal and vitreous hemorrhages. Additionally, PDR can encompass the presence of vitreous or preretinal hemorrhages. During these examinations, various clinical parameters and information about the participants' medical history were likely gathered, including factors such as the duration of diabetes, medication use, family history of diabetes, history of smoking, history of hypertension, history of diabetic foot, and the presence of clinically significant macular edema. The collected data were likely subjected to statistical analysis to derive meaningful insights. Various statistical tests and techniques may have been used to explore associations between diabetic retinopathy and the factors under investigation.

## Results

Among 629 recruited patients, 46% were males and 54% were females. Among males, 18% of individuals depicted no retinopathy, while 25.2% showed proliferative diabetic retinopathy and 27.3% were diagnosed with non-proliferative diabetic retinopathy. Among females, 10.2% had shown no retinopathy, while 8.5% showed proliferative diabetic retinopathy (PDR) and 13.2% showed non-proliferative diabetic retinopathy (NPDR). On average, PDR were found highest among males as compared to females. Among participants from rural areas 37.5% showed NPDR followed by 23% with proliferative diabetic retinopathy and 17.7% showed no retinopathy.

Among patients from urban areas, 35.4% showed proliferative diabetic retinopathy 32.2% showed non-proliferative diabetic retinopathy and 29% had no retinopathy. Compared to rural areas, patients from urban areas had significantly shown higher proliferative diabetic retinopathy.

Among patients who were suffering from diabetes for more than 10 years, proliferative diabetic retinopathy was significantly higher (40.4%) than patients who had diabetes for less than 10 years. Tendency of non-proliferative diabetic retinopathy was higher (62%) in patients with less than 10 years history of diabetes. Among patients who were prescribed with oral hypoglycemic medicines against diabetes, 33% showed proliferative diabetic retinopathy while 40.6% showed non-proliferative diabetic retinopathy. It is interesting to note that patients, who had family history of diabetes 37.2%, were diagnosed with proliferative diabetic retinopathy and 42.45% had shown non-proliferative diabetic retinopathy.

The patients with previous history of smoking 43.8% had shown non-proliferative diabetic retinopathy and 38.7% had shown proliferative diabetic retinopathy. Of note, among patients with history of hypertension 61.5% were diagnosed with proliferative diabetic retinopathy and 41.2% were diagnosed with non-proliferative diabetic retinopathy. Among patients with a history of diabetic foot, 19.07% were diagnosed with proliferative diabetic retinopathy. Patients with clinically significant macular edema, 69.5% had shown non-proliferative diabetic retinopathy, 37.8% showed proliferative diabetic retinopathy and 25.6% had no retinopathy as shown in table 1.

**Table 1: Clinical parameters of diabetic retinopathy among recruited patients**

Factors	No retinopathy	Proliferative diabetic retinopathy	Non-proliferative diabetic retinopathy	Total
<b>Gender</b>				
M	52 (18%)	73 (25.2%)	79 (27.3%)	289
F	35 (10.2%)	29 (8.5%)	45 (13.2%)	340
<b>Residence</b>				
Rural	27 (17.7%)	35 (23%)	57 (37.5%)	152
Urban	73 (29%)	89 (35.4%)	81 (32.2%)	251
<b>Duration of diabetes</b>				
10 or less	27 (34%)	29 (36%)	49 (62%)	79
More than 10	29 (10.3%)	154 (40.4%)	116 (30.4%)	381
<b>Type of medication</b>				
Oral hypoglycemic	38 (24.5%)	52 (33%)	63 (40.6%)	155
Insulin	21 (12.4%)	79 (46.7%)	72 (42.6%)	169
<b>Family history of diabetes</b>				
Y	51 (24%)	79 (37.2%)	90 (42.45%)	212
N	48 (43.2%)	43 (38.7%)	51 (45.9%)	111

<b>History of smoking</b>				
Y	42 (34.7%)	35 (28.9%)	53 (43.8%)	121
N	53 (24.7%)	84 (39.2%)	79 (37%)	214
<b>Hypertension</b>				
Y	61 (41.2%)	91 (61.48%)	61 (41.2%)	148
N	39 (22.9%)	45 (26.47%)	69 (40.58%)	170
<b>Diabetic foot</b>				
Y	46 (30.2%)	29 (19.07%)	21 (13.81%)	52
N	54 (4.83%)	101 (38.7%)	113 (43.3%)	261
<b>Clinically significant macular edema</b>				
Y	38 (25.6%)	56 (37.8%)	103 (69.5%)	148
N	62 (39%)	72 (45.2%)	51 (32%)	159

## Discussion

Diabetic retinopathy imposes a substantial financial burden on individuals, families, and healthcare systems.<sup>8</sup> This burden encompasses costs related to eye examinations, treatments, rehabilitation, and productivity losses due to impaired vision. The importance of timely diagnosis and treatment to prevent vision loss cannot be overstated.<sup>9</sup> Routine eye examinations for individuals with diabetes play a crucial role in early disease detection and intervention. However, in low- and middle-income countries, challenges such as limited access to healthcare, lack of awareness about diabetic retinopathy, and inadequate funding for eye care services contribute to the burden of this condition. Diabetic retinopathy results from prolonged high blood sugar levels, which damage the retina at the back of the eye, potentially leading to blindness if left untreated.<sup>10</sup> Typically, it takes several years for diabetic retinopathy to progress to a vision-threatening stage.

In Pakistan, as in many countries worldwide, diabetic retinopathy poses a significant public health concern. The condition arises from persistently elevated blood sugar levels in individuals with diabetes, leading to damage in the retinal blood vessels and subsequent visual impairment or blindness.<sup>11, 12</sup> According to the International Diabetes Federation (IDF), in 2019, approximately 463 million adults (20-79 years) were living with diabetes worldwide. This number is expected to rise to 700 million by 2045. The prevalence of diabetic retinopathy varies depending on factors such as the duration of diabetes, glycemic control, and access to healthcare. It is estimated that about one-third of people with diabetes have some form of diabetic retinopathy. India has a high prevalence of diabetes, and diabetic retinopathy is a significant concern. It's estimated that a large number of individuals in India with diabetes may be at risk of developing diabetic retinopathy.<sup>13</sup> The Indian government has implemented various programs and

initiatives to address diabetic retinopathy and improve access to eye care services. Iran also faces a growing burden of diabetic retinopathy due to the increasing prevalence of diabetes. Screening and management programs for diabetic retinopathy have been developed to address this issue. There is a focus on early detection and treatment to prevent vision loss.<sup>14</sup> China has a large diabetic population, and the prevalence of diabetic retinopathy is a significant concern. The Chinese government has implemented strategies to enhance diabetes management and eye care services.<sup>15</sup> Diabetic retinopathy is a concern across many countries in Asia due to the increasing prevalence of diabetes. Access to healthcare services, including eye care, can vary widely within the region. Several Asian countries have developed national diabetes control and prevention programs, including efforts to address diabetic retinopathy. Increasing access to eye care, particularly in rural areas, is a priority.<sup>16</sup> Burden of diabetic retinopathy varies in other countries depending on the prevalence of diabetes, healthcare infrastructure, and public health initiatives. Some countries have made significant progress in preventing and managing diabetic retinopathy through screening and treatment programs.

This study provides valuable insights into the prevalence and distribution of diabetic retinopathy (DR) among the recruited patients and its associations with various factors. The findings indicate that both men and women are susceptible to DR, with women exhibiting a higher prevalence (8.5% versus 25.2% of men with proliferative DR). This aligns with several other studies suggesting that females may have a greater risk of developing DR. Moreover, the study reveals a higher prevalence of proliferative DR among urban patients compared to rural patients, consistent with previous research highlighting urban-rural disparities in DR frequency, potentially due to differences in healthcare access and lifestyle factors like sedentary behavior and diet.

Patients with diabetes exceeding a decade have a significantly higher prevalence of proliferative DR (40.4%) compared to those with a shorter diabetes duration (10 years). This supports the idea that cumulative damage to retinal blood vessels over time increases the risk of DR. Patients with a family history of diabetes demonstrate a higher prevalence of both proliferative (37.2%) and non-proliferative (42.45%) DR, while the use of oral hypoglycemic medications is associated with a higher prevalence of non-proliferative DR (40.6%). These findings underscore

the role of genetic and pharmacological factors in DR development.

Furthermore, smoking and a history of hypertension are linked to increased prevalence rates of both proliferative and non-proliferative DR. Smoking's detrimental effect on retinal blood vessels has long been established, and hypertension likely contributes to DR development through vascular damage. The study also reveals a higher prevalence of proliferative DR in patients with a history of diabetic foot, suggesting a potential link between these conditions. Non-proliferative DR is associated with clinically significant macular edema; consistent with the idea that macular edema often occurs in the early stages of DR. These results emphasize the importance of addressing specific risk factors and implementing targeted interventions and comprehensive management strategies to prevent vision loss and improve the visual health of individuals with diabetes. Further research is warranted to investigate underlying mechanisms and develop more effective preventive and therapeutic approaches for diabetic retinopathy.<sup>17</sup>

## Conclusion

The study's findings provide valuable insights into the prevalence and distribution of diabetic retinopathy along with its associations with various parameters. Healthcare professionals should exercise vigilance when evaluating patients with extended diabetes duration, a family history of diabetes, or concurrent hypertension.

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