

The Impact of Type 2 Diabetes Mellitus Duration on Diminishing Visual Acuity in Pakistan

Type 2 Diabetes
Duration on
Diminishing
Visual Acuity

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ABSTRACT

Objective: This study aims to provide a comprehensive picture of diabetic retinopathy in Pakistan by evaluating how diabetes affects blindness and visual impairment in people with the disease.

Study Design: Hospital-based cross-sectional study.

Place and Duration of Study: This study was conducted at the Mehboob Charity Vision International Eye and General Hospital, Mansehra, KPK, Pakistan from May 2023 to December-2023.

Methods: It uses standardized eye charts to assess visual acuity and clinical data and uses statistical software for both quantitative and qualitative analysis.

Results: The study found a significant prevalence of T2DM in 273 (90.75%) respondents compared to only 27 (9.20%) respondents with T1DM. Visual acuity results depict varying degrees of impairment, with 35 respondents (11.65%) having 6/60 or less, 95 (31.28%) respondents in the 6/38 to 6/19 range, and 155 respondents (51.53%) in the 6/15 to 6/6 range. Other ocular complications include posterior subcapsular cataracts (14.72%), lenticular changes (19.01%), and 6.34% with Proliferative Diabetic Retinopathy (PDR). Fundus examination results indicate 163 (53.96%) respondents presented with normal findings, 29 (9.52%) respondents with mild Non-Proliferative Diabetic Retinopathy (NDPR), and 19 (6.34%) respondents with moderate NDPR. Refractive errors occur bilaterally in 255 (84.12%) respondents, and a cup-disc abnormal ratio is noted in 14 (4.76%) respondents. Glaucoma is present in 5 (1.58%) of cases.

Conclusion: This study highlights the significant impact of Type 2 Diabetes Mellitus (T2DM) on visual acuity in Pakistan, highlighting the complexity of diabetic retinopathy, its varying degrees of impairment and associated factors emphasizing the need for targeted interventions to alleviate this burden.

Key Words: Type 2 Diabetes Mellitus (T2DM), Diabetic Retinopathy, Visual Acuity, Vision Impairment, Pakistan, Blindness.

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INTRODUCTION

The definition of vision impairment and blindness used by the International Classification of Diseases 11 (ICD 11) has been approved by the WHO¹. As to this criterion, an individual is considered visually impaired if the VA in their better eye is worse than 3/60.

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Visual acuity gauges how sharply one can see by measuring the visual system's ability to resolve space. Typically, a Snellen's chart is used to assess visual acuity at a distance of 20 feet or 6 meters. A visual acuity of 6/6 or 20/20 is considered normal².

Nearly half of the 2.2 billion individuals who suffer from near- or far-sightedness globally may have been avoided or treated untreated³. High-income nations are more likely to suffer glaucoma and age-related macular degeneration, whereas low- and middle-income nations have greater rates of untreated cataracts⁴.

A complication of diabetes mellitus that has the potential to cause blindness is diabetic retinopathy⁵. Diabetic maculopathy and the consequences of proliferative diabetic retinopathy (PDR), including vitreous hemorrhage, tractional retinal detachment, and neovascular glaucoma, are the causes of visual loss⁶. Additionally, diabetes mellitus damages the retinal neurovascular system, resulting in inflammation and neurodegeneration^{7,8}.

Together with diabetic retinopathy, maculopathy, ischemic optic neuropathy, iridocyclitis, and rubeosis iridis, glaucoma is the other visual consequence of

diabetes that can cause blindness. With an estimated 3.54% global incidence, glaucoma is the most prevalent cause of permanent blindness⁹. Low vitamin D levels and diabetes/metabolic syndrome are risk factors for cataracts, which are the most common cause of curable blindness worldwide (51%). Diabetes patients frequently have altered visual acuity, but they also have more noticeable age-related lens alterations, which may have an impact on the development of myopia^{10,11}.

This study investigates the connection between visual impairments and Type 2 Diabetes Mellitus (T2DM), emphasizing the necessity for long-term research on how Pakistani people's visual acuity declines over time with T2DM^{12,13}.

METHODS

This is a hospital-based cross-sectional study that investigates a sample of 302 diabetic patients suffering from type 2 DM who attended Mehboob Charity Vision International Eye and General Hospital, Mansehra, Pakistan between May-December-2023.

Source of population: The source population of this study was all diabetic patients from Mehboob Charity Vision International Eye and General Hospital, Mansehra, Pakistan.

Study population: The study involves individuals aged 40 and above diagnosed with T2DM for a minimum of five years from Mehboob Charity Vision International Eye and General Hospital, Mansehra, Pakistan.

Sampling procedure: This study's sample selection technique was a simple random sampling procedure that guaranteed each participant an equal chance of being selected to take part in the research project.

Operational definition: Diabetic Retinopathy: Diabetic retinopathy is when blood vessels in the retina swell, leak or close off completely. Abnormal new blood vessels can also grow on the surface of the retina¹³.

Classification of Diabetic Retinopathy: PDR (proliferative diabetic retinopathy) is subdivided into:

“**Mild NPDR:** micro-aneurysms only Moderate NPDR: more extensive than microaneurysms but not as severe as NPDR

Severe NPDR: consisting of any of the following absence of PDR sign;

- i. More than 20 intraretinal hemorrhages in each of four quadrants.
- ii. Definite venous beading in two or more quadrants. Prominent IRMA in one or more quadrants.

Visual Impairment: When an eye ailment impairs the visual system and its functioning, vision impairment results¹⁴.

- Mild – presenting visual acuity worse than 6/12.
- Moderate – presenting visual acuity worse than 6/18.

- Severe – presenting visual acuity worse than 6/60.
- Blindness – presenting visual acuity worse than 3/60.”

Data collection and quality control procedure: After examining relevant research, a systematic questionnaire was developed to account for every potential variable that may potentially address the study's objective. One Optometrist and two ophthalmologists with experience in treating DM and DR carried out our clinical examination¹⁵. 302 patients who met the inclusion criteria agreed to take part in the study within this time frame. Because the remaining 2447 did not meet the outcome measure, they were not included in the research.

Statistical analysis: Microsoft Excel was used to enter the data, and SPSS Software version 20.0 was used to clean and transport the data for analysis¹⁶.

Ethical consideration: The ethical committee and Board of Research of Lincoln University College, Malaysia authorized the study. Every patient enrolled in the research gave their informed consent.

RESULTS

The results of eye examination study conducted between May and December 2023 revealed significant insights into the diabetic population undergoing assessments.

Among the 2749 patients who reported to the Outpatient Department (OPD) for eye examinations, 302 were diabetic and they were selected for inclusion in the study. The participants' sociodemographic and health-related characteristics are summarized in Table No. 1. 273 (90.75%) participants had Type 2 Diabetes Mellitus (T2DM) while only 23 (9.20%) accounted for Type 1 Diabetes Mellitus (T1DM). Among the diabetics, 220 (73.01%) exhibited uncontrolled glycemic levels, while the remaining 43 (14.2%) had normal glycemic levels which emphasizes challenges in diabetes management within the studied cohort. The analysis revealed that the study included 133 (44.1%) males and 168 females (55.8%). Of the total respondents, 209 (69.32%) were from rural areas, 57 (19%) from urban areas, and 35 (11.65%) did not specify their residence¹⁷.

A significant portion of the health profile is attributed to family history, with 97 (31.90%) respondents reporting no history at all, 71 (23.92%) respondents reporting a paternal history, 108 (35.58%) respondents reporting a maternal history, and 25 (8.58%) respondents reporting a history in conjunction with both parents as shown in Table No. 1. 183 (60.73%) participants are overweight while 32 (10.42%) are obese which depicts that significant number of participants have abnormal BMI which is a potential risk factor for diabetes. There is variation in lifestyle choices: 33 (11.04%) participants rely on automobile

miles, 19 (6.13%) participants use motorcycles, 235 (77.91%) incorporate walking routines and 122 (40.49%) exercise regularly. In terms of following diet programs, the majority 221 (73.61%) participants take oral pills, 41 (13.49%) participants use insulin, and one of the respondents reported using homeopathic, herbal, or Ayurvedic methods. Twenty-four percent of the respondents report having had diabetes for one to five years, which is an extensive duration and suggests that many of them were only recently diagnosed¹⁸.

Table No. 1: The research participants' sociodemographic and health-related characteristics.

Variables	Categories	%
Age (Years)	1-20	0.61%
	21-40	4.90%
	41-60	47.23%
	61 and Above	46.01%
Sex	Male	44.1%
	Female	55.8%
Place of Residence	Rural	69.32%
	Urban	19.01%
	Nil	11.65%
Type of Diabetes	Type 2	90.75%
	Type 1	9.20%
Family History	No Family History	31.90%
	Father	23.92%
	Mother	35.58%
	Both	8.58%
BMI	Normal	28.83%
	Overweight	60.73%
	Obesity	10.42%
Lifestyle	Car Mileage	11.04%
	Motorbike	6.13%
	Walk Routine	77.91%
	Exercise	40.49%
Following Diet Plan	Oral Tab	73.61%
	Insulin	13.49%
	Homeo	0.00%
	Herbal	0.00%
	Ayurvedic	0.00%
Duration of Diabetes	1-5	21.47%
	6-10	24.53%
	11-15	15.95%
	16-20	9.00%
	21-25	6.13%
	25 and above	1.22%

The analysis of the severity of ocular complaints in study respondents which have the potential to affect their daily routine is summarized in *Table 2* which provides insight into how eye-related problems affect their day-to-day activities. A sizeable fraction, 170 (56.44%) respondents, claim that their ocular symptoms are troublesome enough to interfere with their employment¹⁹.

Table No.2: Severity of Ocular Complaints & Occupation-Related Data

Variables	Categories	Frequency %
Severity Level	Severe Enough to Take Rest	21.47%

	Normal	8.58%
	Mild Discomfort	12.28%
	Disturb Work	56.44%
Occupation Type	Housewife	41.71%
	Driver	1.84%
	Teacher	2.45%
	Jobless	7.97%
	Other	7.97%
Spectacles Usage	Yes	25.76%
	No	45.39%
Daily Screen Time	1-2 Hours	46.62%
	3-5 Hours	1.84%
	6-8 Hours	0.00%
	Nil	12.88%

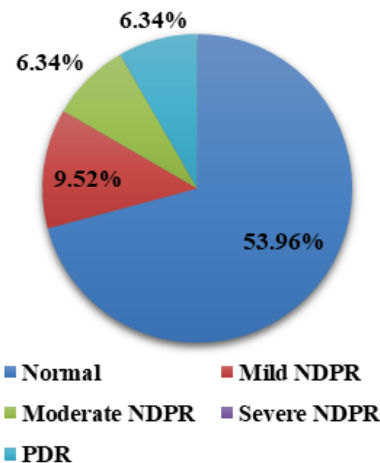


Figure No. 1: Fundus examination in diabetics

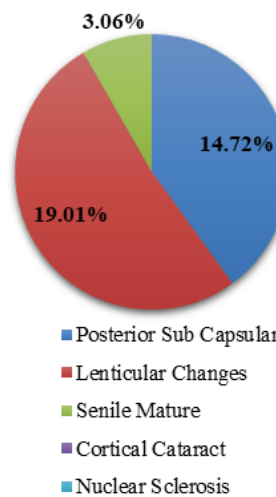


Figure No. 2: Cataracts Complications in Diabetics

Data on Visual Impairment and related diabetic retinopathy complications have been summarized in *Table No. 3*. These findings highlight the distribution of visual acuity, ranging from lower to normal or near-normal acuity with highest percentage falling in 6/15 to 6/6 range, with 155 (51.53%) reporting this level in the right eye (R), and 147 (47.85%) respondents in the left eye (L).

The fundus examination also revealed important results which showed that around 160 (53%) respondents of the respondent's fundus examination depicted normal results.

Table 4 discusses the effects of the length of diabetes on visual acuity and related problems. A decline in the prevalence of normal retina in 102 (34%) respondents in the first 10 years to 6 (2%) respondents in 21-20 years of duration of diabetes is proof of how diabetes has negative impacts on vision.

Table No. 3: Visual Impairment and Diabetic Retinopathy Complications

Variables	Categories	Frequency %
Visual Acuity	6/60 or Less	R=11.65% L=14.11%
	6/38 To 6/19	R=31.28% L=28.22%
	6/15 To 6/6	R=51.53% L=47.85%
Cataracts	Posterior Sub Capsular	14.72%
	Lenticular Changes	19.01%
	Senile Mature	3.06%
	Cortical Cataract	0.00%
	Nuclear Sclerosis	0.00%
Fundus	Normal	53.96%
	Mild NDPR	9.52%
	Moderate NDPR	6.34%
	Severe NDPR	0%
	PDR	6.34%
Management of Diabetic Retinopathy	Intra Vitral Avastin A	12.88%
	PRP Laser	0.00%
	Oral Medicines	33.12%
	Topical Drops	33.12%

suggests a serious eye issue. The disability drops to 0% in Years 11–20 and 21–30 as diabetes advances, indicating possible adaptability or survival. This emphasizes the severity of vision deterioration associated with diabetes and the significance of early visual health monitoring. Two percent of people with diabetes in the first one to ten years of the disease report having a visual acuity level of "Hand Movement" (HM), which means they can see hand movement but not discern details or forms¹⁸.

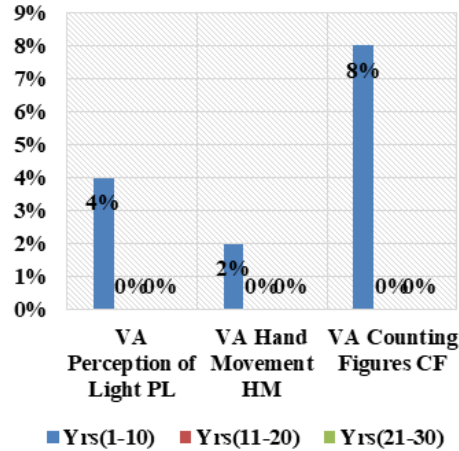


Figure No. 3: Impact of duration of diabetes on VA-PL, VA-HM, VA-CF

Table No.4: Impact of Duration of Diabetes and associated complications on Visual Acuity

Duration (Years)	Yrs (1-10)	Yrs (11-20)	Yrs (21-30)
VA Perception of Light PL	4%	0%	0%
VA Hand Movement HM	2%	0%	0%
VA Counting Figures CF	8%	0%	0%
VA 6/60	2%	0%	0%
VA 6/48	12%	4%	0%
VA 6/38	4%	2%	0%
VA 6/30	4%	0%	0%
VA 6/24	6%	2%	0%
VA 6/19	24%	6%	2%
VA 6/15	12%	4%	0%
VA 6/12	4%	2%	0%
VA 6/9.5	8%	6%	0%
VA 6/7.5	14%	0%	0%
Normal Retina	34%	22%	2%
Diabetic Retina	4%	2%	0%
Controlled HTN	58%	12%	2%
Uncontrolled HTN	12%	7%	0%
Controlled Glycemic Level	20%	12%	0%
Uncontrolled Glycemic Level	50%	12%	2%

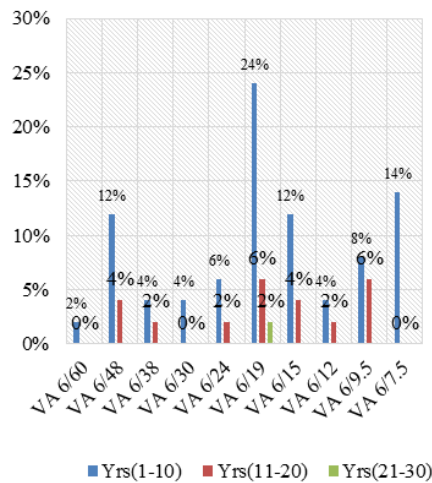


Figure No. 3: Frequency of visual impairment in diabetics in different durations

Four percent of subjects had severe vision impairment in the first one to ten years of diabetes; they are able to sense light but not discriminate objects or forms. This

In a similar vein in the first one to ten years, 24 (8%) respondents report having a visual acuity level of "Counting Figures" (CF), which indicates that they have limited clarity but can count or recognize basic shapes or figures¹⁸.

6 (2%) participants in the first 1–10 years of diabetes have a visual acuity of 6/60, which is considered to be visually impaired as summarized in Table 4. However, there are larger percentages of vision impairment 6/48 (12%), 6/38 (4%), and 6/30 (4%).

This illustrates the variety of effects that diabetes may have in its early stages on eyesight. The percentages for 6/48 (4%), 6/38 (2%), and 6/24 (2%), which show that some degree of visual impairment still exists, show that the prevalence of severe visual impairment declines as diabetes advances into Years 11–20¹⁸.

The percentage of managed hypertension falls as reported in 36 (12%) respondents as the duration of diabetes rises, but uncontrolled hypertension reported in 21 (7%) respondents. In a similar vein, 36 (12%) respondents have glycemic levels under control, while the remaining 36 (12%) respondents do not. This emphasizes the necessity of early treatments, ongoing monitoring, and individualized treatment plans¹⁹.

DISCUSSION

In our study, the majority of the participants were male, with 133 (44.1%) being males and 169 (55.8%) females. Numerous studies have documented a persistent rise in the prevalence of diabetes and prediabetes in Pakistan. It is strongly advised to conduct a national diabetes care survey on risk factors and preventative strategies. The majority of the population was from rural areas. It contradicts the studies that report more diabetic patients from urban areas¹⁹.

As studies have revealed that having a parent, mother, or both with T2DM raises the estimated probability of being diagnosed with the disorder by around 2-4 times. A significant portion of the health profile was attributed to family history, with 96 (31.90%) respondents reporting no history at all, 72 (23.92%) respondents reporting a paternal history, 108 (35.58%) respondents reporting a maternal history, and 26 (8.58%) respondents reporting a history in conjunction with both parents in our study.

The impact of diabetes on the eyes is known to more than half of Pakistani patients, but less is known about diabetic retinopathy and its implications.

Our study has also revealed the negative impact of diabetes duration on visual acuity and related problems. The findings highlight the necessity for ongoing care as it demonstrates that early diabetes patients frequently have uncontrolled blood pressure and glucose levels, with regulated blood pressure and glucose levels declining as the illness advances. Similarly, our study found a relationship between diabetic retinopathy and glaucoma as well as significant visual impairment²⁰.

Sample selection bias can provide an overrepresentation of people who are seeking medical treatment or have

significant vision impairments, and retrospective design can cause information bias. Underrepresentation of those who have been badly impacted by survivorship bias and publication bias might lead to the publishing of studies that have statistically significant results²⁰.

CONCLUSION

The study emphasizes the need for focused interventions to lessen the burden of T2DM and its influence on visual acuity in Pakistan. Additionally, it draws attention to the complexity of diabetic retinopathy, the range of damage it can cause, ocular consequences like cataracts, and related issues like refractive problems. The study also highlights the significance of a family history of diabetes and advocates for better education and preventative actions. It also demands all-encompassing healthcare plans that consider the various professional backgrounds of those with diabetes.

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List of Abbreviations:

T2DM - Type 2 Diabetes Mellitus
 T1DM - Type 1 Diabetes Mellitus
 VA - Visual Acuity
 DR - Diabetic Retinopathy
 PDR - Proliferative Diabetic Retinopathy
 NPDR - Non-Proliferative Diabetic Retinopathy
 BMI - Body Mass Index
 OPD - Outpatient Department
 HTN - Hypertension
 DM - Diabetes Mellitus
 CI - Confidence Interval
 ICD 11 - International Classification of Diseases 11
 WHO - World Health Organization
 PL - Perception of Light
 HM - Hand Movement
 CF - Counting Figures

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Agreement to accountable for all aspects of work:	All the above authors

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