Original Article

Predictors of Visual Impairment in Individuals with Type 2 Diabetes Mellitus: Insights from a Population-based Study in Pakistan

Muhammad Junaid, Fawad Ahmed, Zia-ur-Rehman, Irfan Ali and Suriyakala Perumal Chanan

ABSTRACT

Objective: The purpose of the hospital-based study was to assess visual impairment in diabetes patients and the factors that may predict it.

Study Design: Cross-sectional descriptive study

Place and Duration of Study: This study was conducted at the Mehboob Charity Vision International Eye and General Hospital, Mansehra, Pakistan from May 2023 to March 2024 in affiliation with Lincoln University Malaysia,

Methods: A study in Pakistan aimed to identify predictors of visual impairment in individuals with type 2 diabetes mellitus (T2DM). The study involved 505 diabetic patients from Mehboob Charity Vision International Eye and General Hospital, Mansehra. Data on socio-demographic, behavioral, and clinical-related variables were collected through structured interviews and clinical examinations.

Results: The results showed that visual impairment was prevalent in more than 75% of respondents, with mild and moderate VI being the most common. Older age was a significant predictor, with the odds of having mild and moderate VI increasing with age. Additional variables were found to be predictive, including the length of diabetes, high blood pressure, and inadequate glycemic management. The study suggests more research with larger sample sizes and longitudinal designs and highlights the significance of early detection and therapy of visual impairment in T2DM patients. The present research of 500 diagnosed type 2 diabetes in Pakistan to examine the factors that contribute to visual impairment. More than three quarters of respondents had visual loss with mild to moderate losses being most prevalent. Diabetes duration of more than 10 years, poor glycemic control and hypertension showed strong correlation with visual impairment.

Conclusion: These findings suggest tremendous public health importance to call for timely diagnosis, appropriate treatment, and control to prevent DR.

Key Words: Visual impairment, Type 2 diabetes, Prevalence, Risk factors, Pakistan

INTRODUCTION

The World Health Organization (WHO) describes visual impairment as exhibiting distance visual acuity poorer than 6/18. The effects of diabetes constitute a serious threat to the health care systems of many developing nations [2].

Mehboob International Eye and General Hospital, Mansehra, KPK.

Correspondence: Muhammad Junaid, Executive Director, Mehboob Charity Vision International Eye and General Hospital, Mansehra, Pakistan, Affiliation: Lincoln University College, Malaysia.
Contact No: 0312-5203940
Email: junaid@lincoln.edu.my

With over 240 million cases worldwide, the DM epidemic has spread quickly. Ocular problems like diabetic retinopathy, diabetic papillopathy, cataracts, glaucoma, and disorders of the ocular surface can result from diabetes mellitus [3].

Diabetic retinopathy (DR) develops in phases, with non-proliferative retinopathy (NPDR) being the first stage and more severe proliferative diabetic retinopathy (PDR) following. Diabetes also increases the risk of cataracts and glaucoma, lessening the toll that diabetic eye illnesses have on patients and healthcare systems [4]. It is concerning since data from community surveys continuously indicates that half of DM patients do not receive a diagnosis, and many are uninformed that they run the risk of developing DR and other consequences. The most prevalent microvascular consequence of diabetes in the working population is diabetic retinopathy DR [5].

In 2015, hyperglycemia during pregnancy was linked to 16.2% of live births and it is anticipated that 10.4% of adults will have diabetes by 2040.

METHODS

Study setting and design: This is a hospital-based cross-sectional study that was conducted at Mehboob Charity Vision International Eye and General Hospital, Mansehra, Pakistan from May 2023 to March 2024 in affiliation with Lincoln University Malaysia, The study was conducted on a sample of 505 diabetic patients suffering from Diabetes Mellitus among 4674 patients. The purpose of the hospital-based study was to assess visual impairment in diabetes patients and the factors that may predict it[6,7].

Source of population: All people living with Diabetes Mellitus who visited Mehboob Charity Vision International Eye and General Hospital, Mansehra during data collection period were eligible for the study[8].

Study population: The study involves individuals diagnosed with T2DM for at least one year to guarantee that people with established diabetes were enrolled with long-term consequences like vision impairment could be assessed. Moreover, the research sample's heterogeneous makeup, which included people of various ages, genders, and ethnicities[9].

Sampling procedure: simple randomization sampling procedure was adopted, so that every participant had an equal chance of being chosen to participate in the study[10].

Operational definition: The study developed operational criteria for reduced uncertainty[11].

Visual Acuity: The capacity of the visual system to detect minute differences in the surroundings, is known as central visual acuity[12].

Visual Impairment: If the presenting VA in the better eye is worse than 3/60, the individual is considered visually impaired.

The World Health Organization divides visual impairment into the following categories[13].

  i.   "Normal: 20/10-20/25
 ii.   Near Normal visual impairment: 20/30-20/60
iii.   Moderate visual impairment: 20/70-20/160
 iv.   Severe visual impairment: 20/200-20/400, or 11-20 degrees on visual field
  v.   Profound visual impairment: 20/500-20/1000 visual acuity, or 6- 10 degrees on visual field
 vi.   Total visual impairment: No light perception (NLP)"

Blindness: The term "total blindness" refers to a person who is completely devoid of light perception; this is also known as "no light perception[14].

Low Vision: When a person's vision cannot be fully corrected with conventional techniques including glasses, contact lenses, medicine, surgery, magnifying devices, or assistive devices.

BMI: A person's weight in kilograms divided by their height in meters squared yields their body mass index, or BMI."

Obesity: Overweight is a disease that categorizes individuals into classes depending on the quantities of adipose tissues in the body with increased risks to health[15].

Glycemic Control: The ideal blood glucose levels for diabetes individuals is known as glucose control.

Data collection and quality control procedure: "pre-tested, structured-interviewer-administered a questionnaire containing Socio-demographic variables" (age, residence, employments and education status) behavioral variables (diet and exercise), clinical-related were used to collect data. 505 people fulfilled, consent taken as the requirements for inclusion[15].

Statistical analysis: Data was entered on SPSS Software version 25.0 and the same software was used to clean and analyze the data.

Ethical consideration: Every patient enrolled in the research gave their informed consent.

RESULTS

Socio-demographic characteristics: Five hundred and five type-2 diabetic patients participated in the study with a response rate of 95%. Sociodemographic characteristics are highlighted in Table 1.

"The median age of participants was 57 years. The minimum age recorded was 15 years while the maximum was 100 years." A higher number of respondents were in the age bracket of 51-70 years old (n=307, 60%) followed by 141 (27.9%) respondents in the age bracket of 31-50 years while 44 (10.2%) respondents were 70+ and only 4 (0.8%) respondent was under 30 years of age. The underrepresentation of younger people highlights the need for focused initiatives to reduce health inequities associated with diabetes in a range of age groups within the community[16].

Most of the respondents were from rural areas (n=401, 79.4%) as compared to 104 (20.6%) respondents whose residence was urban. The data on education status highlights the disparities among respondents for attainment of education as 377 (74.7%) of the participants were uneducated which can be explained by most respondents belonging to rural areas, followed by 93 (18.4%) individuals who had secondary education, 29 (5.7%) had primary and 06 (1.2%) had tertiary education.

Analysis depicted a higher percentage of females (n=265, 52.5%) as compared to males (n=240, 47.5%). The study reported a higher number i.e.,465 (92.1%) T2DM patients as compared to 40 (7.9%) T1DM patients. 365 (72.3%) were unemployed as compared to 140 (27.7%) participants who were employed.

Prevalence of Visual Impairment and Vision-related Characteristics: As shown in **Table 2,** data on the prevalence of visual impairment revealed VI was prevalent in approximately 376 (74.5%) of the respondents. Two major VI issues were mild and

moderate VI as 127 (25.1%) patients had moderate VI (< 6/18 to 6/60) followed by 197 (39.0%) patients who had mild VI (< 6/9.5 to 6/18). Blindness was reported in approximately 10% of the patients. Among them, 45(8.9%) had severe blindness (< 3/60) as compared to 7 (1.4%) who were moderately blind (< 6/60 to 3/60). Normal vision (6/9.5 OR MORE THAN 6/9.5) was prevalent in a small fraction of 129(25.5%) patients only.

Table No.1: Sociodemographic Characteristics

Socio-Demographic Characteristics:		
Categories	Frequency	Percent
AGE		
Less than 30 years	4	0.8%
31-50 years	141	27.9%
51 to 70 years	307	60.8%
More than 70 years	53	10.5%
RESIDENCE		
Rural	401	79.4%
Urban	104	20.6%
EDUCATION		
No	377	74.7%
Primary	29	5.7%
Secondary	93	18.4%
Tertiary	06	1.2%
SEX		
Male	240	47.5%
Female	265	52.5%
EMPLOYED		
No	365	72.3%
Yes	140	27.7%
DIABETES TYPE		
T1DM	40	7.9%
T2DM	465	92.1%

Table No.2: Visual Impairment

Prevalence Of Visual Impairment And Vision-Related Characteristics		
EXERCISE ROUTINE		
YES	258	51.1%
NO	247	48.9%
HTN		
Yes	370	73.3%
No	135	26.7%
TREATMENT		
Oral Med	469	92.9%
Insulin	26	5.1%
Both	10	2.0%
GLYCEMIC CONTROL		
Good	219	43.4%
Poor	286	56.6%
DURATION OF DIABETES		
Less than 10 years	366	72.5%

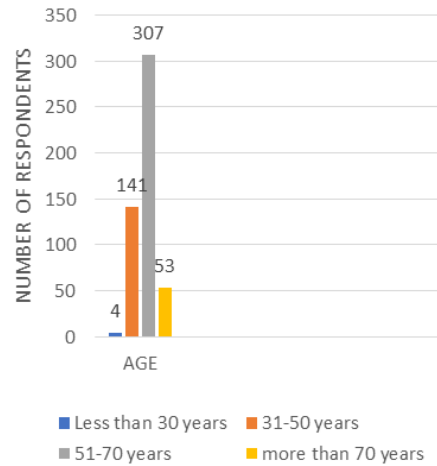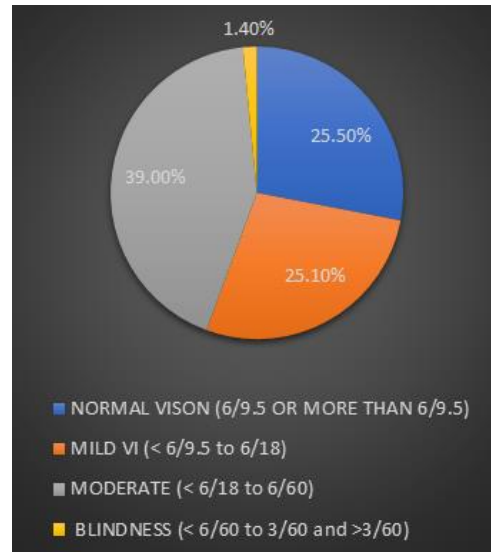| 11 to 15 years	88	17.4%
16 to 20 years	25	5.0
More than 21 years	26	5.1%
VISUAL IMPAIRMENT		
Normal Vison (6/9.5 or more than 6/9.5)	129	25.5%
MILD VI (< 6/9.5 to 6/18)	127	25.1%
MODERATE (< 6/18 to 6/60)	197	39.0%
Moderate Blindness (< 6/60 to 3/60)	7	1.4%
Severe Blindness (< 3/60)	45	8.9%

Figure No.1: Age Distribution

Figure No.2: Virtual Impairment

258 (51.1%) participants reported to be physically active while 247 (48.9%) participants were not. Hypertension was reported in 370(73.3%) participants as compared to 135(26.7%) participants who were not

having comorbid hypertension. Oral medication was the most used method for treatment as reported in 469(92.9%) patients followed by use of insulin in 26 (5%) respondents and use of both insulin and oral medications simultaneously in just 10(2.0%) respondents. 286(56.6%) patients had poor glycemic while 219(43.4%) patient's glycemic control was good. Most of the patients have been diabetic for less than 10 years (n=366, 72.5%) followed by 88(17.4%) patients who were diabetic for 11-15 years and 51(10.1%) patients were diabetic for 16 and more than years [17].

VI Predictors in T2DM patients: Multinomial logistic regression was performed to assess the impact of independent variables like glycemic control, HTN, age, sex, duration of diabetes, treatment options, education, employment status, residence, exercise routine and type of diabetes on visual impairment. of all the predictors, age group's effect on visual impairment was significant (χ^2 = 9.927, df = 4, p = .042) depicting the role of age in model's predictive power [18].

DISCUSSION

This cross-sectional study was conducted at Mehboob Charity Vision International Eye and General Hospital in Mansehra, Pakistan, involving 505 diabetic patients with Diabetes Mellitus. More than 90% of the respondents were type 2 diabetics which is consistent with other studies [19].

258 (51.1%) participants were physically active. These stats are different from already conducted studies which reported lower physical activity levels. Oral medication was the most used treatment method, followed by insulin and both kind of treatments which aligns with literature. 286 (56.6%) patients had poor glycemic while 219 (43.4%) patient's glycemic control was good. It aligns with the past studies. Most patients had been diabetic for less than 10 years, followed by those with 11-20 years and those over 21 years [20]. This cross-sectional study was focused on T2DM patient's assessment and the prediction of effects of independent variables on VI. Visual impairment (VI) was prevalent in 74.5% of respondents, with mild and moderate VI being the most common. Normal vision was prevalent in 25% of patients [21].

The same prediction has been reported by other studies as well which found that a significant proportion of diabetes individuals had visual impairment [22].

According to the study, treating and preventing vision impairment in diabetes patients necessitates a multidisciplinary strategy that includes patient education, prompt intervention, and early identification [23]. This research offers significant understanding into the factors that predict visual impairment in individuals with Type 2 Diabetes Mellitus (T2DM) [24]. The study highlights how crucial it is to treat diabetic eye disease early and completely.

CONCLUSION

In the light of Manuscript conclusion, it is clear that the percent prevalence of visual impairment in the T2DM individuals in Pakistan is much higher and 75% participants reported to have mild a moderate visual impairment. The most significant risk factors include the above-listed cardiovascular risk factors such as ageing, having diabetic for quite a long time without being able to manage the condition, hypertension, and poor glycemic control. These results underline the importance of screening, early diagnosis, control and prevention of diabetes induced visual loss. The study emphasizes the need for enhancing the uptake of health care, enhancing the awareness and adopting intervention measures to enhance glycemic control in the population especially the rural and other under privileged ones to reduce the burden of diabetes related vision loss.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Muhammad Junaid, Fawad Ahmed
Drafting or Revising Critically:	Zia-ur-Rehman, Irfan Ali, Suriyakala Perumal Chanan
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Adelson JD, et al. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study. The Lancet Global Health 2021;9(2)e144–e160,

2. Akalu Y, Belsti Y. Hypertension and Its Associated Factors Among Type 2 Diabetes Mellitus Patients at Debre Tabor General Hospital, Northwest Ethiopia. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy 2020;13:1621–1631.

3. Almutairi NM, Alahmadi S, Alharbi M, Gotah S, Alharbi M. The Association Between HbA1c and Other Biomarkers With the Prevalence and Severity of Diabetic Retinopathy. Cureus 2021, doi: https://doi.org/10.7759/cureus.12520

4. Aslam R, Suhail S, Sajid R, bin Younis B. Type 2 Diabetes Mellitus(T2DM) in Pakistan: Prevalence,

Trends and Management Strategies. Annals King Edward Med Univ2022;28(2):247–254.

5. Azeem S, Khan U, Liaquat A. The increasing rate of diabetes in Pakistan: A silent killer. Annals Med Surg 2022;79:103901.

6. Chen S, et al. Association of glycemic control with hypertension in patients with diabetes: a population-based longitudinal study. BMC Cardiovas Disorders 2023;23(1). doi: https://doi.org/10.1186/s12872-023-03478-3.

7. Dandona L, Dandona R. Revision of visual impairment definitions in the International Statistical Classification of Diseases. BMC Med 2006;4(1). doi: https://doi.org/10.1186/1741-7015-4-7

8. Farmaki P, Damaskos C, Garmpis N, Garmpi A, Savvanis S, Diamantis E. Complications of the Type 2 Diabetes Mellitus. Current Cardiol Reviews 2020;16(4):249–251.

9. Jin P, et al. A Five-Year Prospective Study of Diabetic Retinopathy Progression in Chinese Type 2 Diabetes Patients with 'Well-Controlled' Blood Glucose. PLOS One 2015;10(4):e0123449.

10. Kajiwara A, et al. Gender differences in the incidence and progression of diabetic retinopathy among Japanese patients with type 2 diabetes mellitus: A clinic-based retrospective longitudinal study. 2014;103(3):e7–e10.

11. Khan MA, Hashim MJ, King J, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of Type 2 Diabetes – Global Burden of Disease and Forecasted Trends. J Epidemiol Global Health 2020;10(1):107–111.

12. Lartey SY, Aikins AK. Visual impairment amongst adult diabetics attending a tertiary outpatient clinic. Ghana Med J 2017;52(2)84.

13. Leasher JL, et al. Global Estimates on the Number of People Blind or Visually Impaired by Diabetic Retinopathy: A Meta-analysis From 1990 to 2010. Diabetes Care 2016;39(9):1643–1649.

14. Mumtaz SN, Fahim MF, Arslan M, Shaikh SA, Kazi U, Memon MS. Prevalence of diabetic retinopathy in Pakistan: A systematic review. Pak J Med Sci 2018;34(2). doi: https://doi.org/10.12669/pjms.342.13819

15. Ong KL, et al. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet 2023;402:10397.

16. Li M, et al. Females with Type 2 Diabetes Mellitus Are Prone to Diabetic Retinopathy: A Twelve-Province Cross-Sectional Study in China. J Diabetes Res 2020;2020:1–9.

17. Shaikh S, et al. Prevalence of diabetic retinopathy and related factors in patients with type 2 diabetes mellitus in Hyderabad and adjoining areas. J Entomol Zool Studies 2017;5(6):1755–1759.

18. Sayeed KA, et al. Impact of Diabetes-related Self-management on Glycemic Control in Type II Diabetes Mellitus. Cureus 2020;12(4). doi: https://doi.org/10.7759/cureus.7845

19. Solomon SD, et al. Diabetic Retinopathy: A Position Statement by the American Diabetes Association. Diabetes Care 2017;40(3):412–418.

20. Tariq O, Rosten C, Huber J. Experiences of living with type 2 diabetes in Pakistan: the role of culture and family in physical activity. Int J Equity Health 2022;21(1). doi: https://doi.org/10.1186/s12939-022-01706-4

21. Tinajero MG, Malik VS. An Update on the Epidemiology of Type 2 Diabetes. Endocrinol Metabolism Clinics North Am 2021;50(3): 337–355.

22. Voigt M, et al. Prevalence and Progression Rate of Diabetic Retinopathy in Type 2 Diabetes Patients in Correlation with the Duration of Diabetes. Experimental and Clinical Endocrinology & Diabetes: Official J German Soc Endocrinol German Diabetes Assoc 2018;126(9):570–576.

23. Wilkinson CP, et al. Proposed international clinical diabetic retinopathy and diabetic macular edema disease severity scales. Ophthalmol 2003;110(9):1677–1682.

24. Wong T, et al. Guidelines on diabetic eye care the International Council of Ophthalmology recommendations for screening, follow-up, referral, and treatment based on resource settings. Ophthalmol 2018;125(10):1608–1622.