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A Study To Assess Level of Visual Acuity(VA) among patients with Type-II Diabetes Mellitus in selected villages under Rural Heath and Training Centre, Vayalanallur

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Abstract

Background: *Diabetes Mellitus (DM) is a global health concern affecting approximately 463 million individuals, with visual impairment being one of its most debilitating complications. In India, 77 million people live with diabetes, and rural populations often lack access to timely screening and eye care services.*

Objective: *To assess the level of visual acuity among patients with Type II Diabetes Mellitus residing in rural areas served by the Rural Health and Training Centre, Vayalanallur.*

Methodology: *A descriptive cross-sectional study was conducted among 350 diabetic patients aged over 20 years. Participants were selected using purposive sampling. Data were collected using structured interviews and clinical assessments, including BMI, waist circumference, and visual acuity testing via the WHO Eyes App—a validated mobile-based vision screening tool.*

Results: *Among the 350 participants, 42% exhibited moderate visual impairment, 39.7% had mild impairment, and 18.3% had severe impairment. Statistically significant associations were observed between visual impairment and factors such as BMI, co-morbid conditions, waist circumference ($p < 0.01$), and family history of blindness ($p < 0.05$).*

Conclusion: *The study highlights a high prevalence of visual impairment among diabetic patients in rural settings. Integrating routine vision screening into primary diabetic care using digital tools like the WHO Eyes App could aid in early detection and prevention of vision loss.*

Keywords: *Type II Diabetes Mellitus, Visual Acuity, Visual Impairment, WHO Eyes App, Rural Health, Primary Care, Vision Screening*

INTRODUCTION

Diabetes Mellitus (DM) is a growing global health concern that has reached epidemic proportions in recent decades. According to the International Diabetes Federation (IDF, 2020), approximately 463 million people worldwide are currently living with diabetes, and this number is projected to rise significantly in the coming years. The South Asian region is one of the most affected areas, with an estimated 88 million individuals diagnosed with diabetes. Notably, India accounts for a staggering 77 million of these cases, highlighting the urgent need for targeted public health interventions and screening strategies within the country.

Among the numerous complications associated with diabetes, visual impairment stands out as one of the most debilitating. The World Health Organization (WHO, 2017) reports that globally, an estimated 285 million people suffer from some form of visual impairment. Of this, 39 million are blind, while 246 million experience moderate to severe visual impairment. These visual challenges severely impact individuals' daily functioning, independence, and overall quality of life. Furthermore, visual impairment

contributes to a significant disability burden, accounting for approximately 27.7 million disabilityadjusted life years (DALYs) worldwide.

The prevalence of visual impairment varies by country and region. For instance, in the United States, about 8% of the population is affected by visual impairment, while in China, it affects approximately 4.5% of the population. In India, an estimated 4.95 million people are visually impaired. Specifically in Tamil Nadu, a southern state of India, around 3.44% of the population is reported to have some degree of visual impairment. These statistics underscore the urgent need for systematic screening, early diagnosis, and timely management of visual complications—particularly among individuals with chronic conditions such as diabetes. Addressing this burden through community-based interventions and the use of digital tools can help reduce preventable vision loss and improve health outcomes.

METHODOLOGY

A descriptive cross-sectional study design was employed to assess the level of visual acuity among patients with Type II Diabetes Mellitus (T2DM). The study was conducted in the field practice areas of the Rural Health and Training Centre (RHTC), Vayalanallur, affiliated with Sri Ramachandra University. The target population included individuals aged 20 years and above with a confirmed diagnosis of Type II DM, attending the outpatient diabetes clinic regularly and willing to participate. Participants with a known history of diabetic retinopathy or those with cognitive impairments were excluded from the study. A total of 350 participants were recruited using purposive sampling. Socio-demographic and healthrelated data were collected using a structured interview schedule. The parameters recorded included age, type of family, history of eye surgery, occupation, reading habits, duration of mobile phone and television usage per day, family history of blindness, monthly family income, and presence of any co-morbid conditions.

Assessment of Visual Acuity:

Visual acuity was assessed using the WHO Eyes App, a free, population-facing mobile application developed for vision screening. The app is available for both Android and iOS platforms and supports multiple UN languages, including English, Arabic, and Chinese. In this study, the English version of the app on Android devices was used.

The WHO Eyes App is designed to assess both near and distance visual acuity. It uses an "E" chart approach, displaying the letter "E" in different orientations and sizes. Participants are asked to identify the direction in which the open end of the letter is facing. With each correct response, the letter size decreases, simulating a traditional Snellen chart test. For accurate testing, the app requires the subject to be positioned at specific distances: 2 meters for distance vision and 40 centimeters for near vision. While the iOS version uses built-in distance calibration, the Android version requires manual positioning by the examiner.

Visual acuity results are presented as a score (0–100%) and a visual fraction. Vision impairment was classified as follows:

- **Mild**: Visual acuity worse than 6/12 up to 6/18
- **Moderate**: Worse than 6/18 up to 6/60
- **Severe**: Worse than 6/60 up to 3/60
- **Blindness**: Worse than 3/60
- Near vision impairment was defined as a visual acuity worse than N6 or M0.8 at 40 cm.

Data collection procedure

Phase I: Participants attending the Non-Communicable Disease (NCD) clinic at the Rural Health and Training Centre (RHTC), Vayalanallur, were approached. The study protocol was explained to all eligible individuals, and informed consent was obtained. Following this, participants were screened for visual acuity using the WHO Eyes App, which assesses both near and distance vision.

Phase II: Participants who demonstrated any degree of visual impairment during Phase I were referred to the Ophthalmology Clinic at the same center for further clinical evaluation and management. **Data analysis and interpretation**

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population (N = 350). Frequency and percentage distributions were calculated for all categorical variables. The association between visual impairment and various demographic and clinical parameters was analyzed using Chi-square tests, with statistical significance set at $p < 0.05$.

Table 1:Demographic and Clinical Characteristics of Study Participants (N = 350)

S.No	Demographic Variables	No.	%
1.	Age		
	20-40	77	22
	Above 40	273	78
2.	Type Of Family		
	Nuclear Family	212	60.6
	Joint Family	138	39.4
3.	History Of Eye Surgery		
	Yes	122	34.9
	No	228	65.1
4.	Type Of Occupation		
	Professional	70	20
	Non professional	168	48
	Unemployment	112	32
5.	Reading Habits		
	Yes	209	59.7
	No	141	40.3
6.	Duration Of Watching Tv Per Day		
	Two Hours	229	65.4
	More Than Two Hours	121	34.6
7.	Duration Of Mobile Usage Per Day		
	Two Hours	90	41
	More Than Two Hours	130	59
8.	Family History Of Blindness		
	Yes	94	43

	No	126	57
9.	Family Monthly Income (Rs.)		
	239	24	6.9
	7101	99	28.3
	11836	127	36.3
	17755	74	21.1
	23673	24	6.9
	6.47347	2	6
10.	Any Other Co-Morbid Conditions		
	Yes	300	85.7
	No	50	14.3
11.	BMI		
	Underweight Under 18.5	22	6.3
	Normal 18.5-24.9	187	53.4
	Overweight 25.0-29.9	126	36
	Obese Above 30	15	4.3
12.	Waist Circumference (In Cms)		
	1.Below Normal	35	10
	2.Normal Weight	183	52.3
	3.Overweight	128	36.6
	4.Obesity	4	1.1
13.	Short Vision		
	Mild	139	39.7
	Moderate	147	42
	Severe	64	18.3
14.	Distance Vision		
	Mild	220	62.9
	Moderate	99	28.3

	Severe	31	8.9

Frequency and percentage distribution of level of Short Visual Impairment among patients with TypeII Diabetes Mellitus (N=350)

level of Visual Impairment	N	%
Mild	139	39.7
Moderate	147	42
Severe	64	18.3

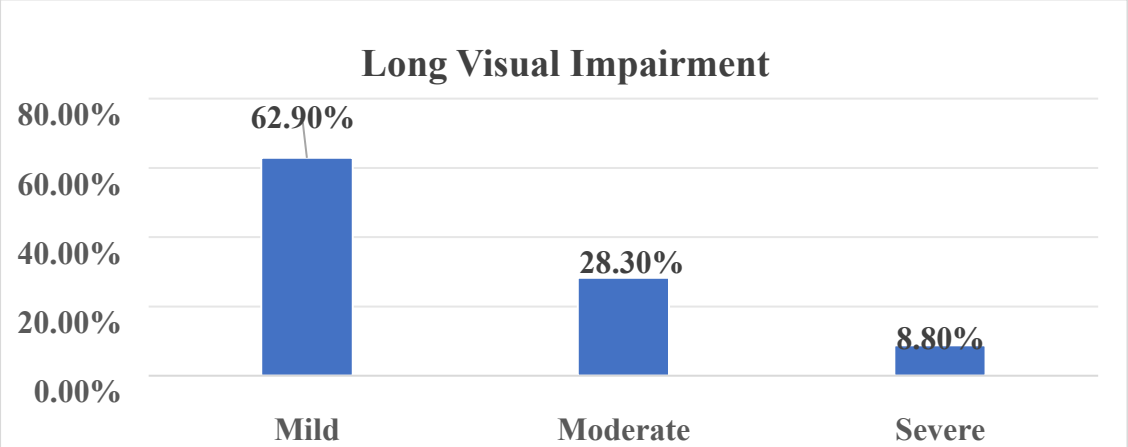

Figure 1:Distribution of distance visual impairment among patients with Type-II Diabetes Mellitus (N = 350). The majority (62.9%) exhibited mild impairment, while 28.3% had moderate and 8.8% had severe impairment. Table 2:Association Between Short and Distance Vision Impairment Among Patients with Type-II Diabetes Mellitus (N = 350)

S.No.	Level of Visual Impairment	Short Vision Vs Distance Vision			Chi Square \ P Value
1.	Mild	89	87	44	
2.	Moderate	36	47	16	
3.	Severe	14	13	4	x^2=4.144 p=.657

DISCUSSION

The present study assessed visual acuity among adults with Type-II Diabetes Mellitus (T2DM) in a rural setting, with a total sample size of 350 participants. The majority of the participants (78%) were aged above 40 years, indicating that middle-aged and older adults form the core of the diabetic population in this study. In terms of family structure, 60.6% of the participants belonged to nuclear families, while 39.4% were from joint families.

A significant proportion of the study group (34.9%) had a prior history of eye surgery, while the remaining 65.1% had no such history. Occupationally, 20% were professionals, 48% non-professionals, and 32% were unemployed. Reading habits were present in 59.7% of the participants. Regarding screen usage, 65.4% of participants reported watching television for less than two hours daily, while 34.6% watched for more than two hours. Similarly, 59% used mobile phones for more than two hours per day, suggesting increased exposure to digital devices, which could contribute to eye strain and early visual symptoms. The

study findings revealed that 42% of participants had moderate short vision impairment, 39.7% had mild impairment, and 18.3% had severe impairment. These results are comparable to those reported by Mondal et al. (2006), who studied the association between increased anaerobic glycolysis and visual acuity in T2DM patients without retinopathy. Their findings showed mean ages of 49.9 ± 3.38 years in the control group and 50.1 ± 3.3 years in the study group, consistent with the age profile of our study population.

The current findings are also supported by a systematic review conducted by Gretchen (2012), which estimated that 32.4 million people globally were blind in 2010 and 191 million had moderate to severe visual impairment (MSVI), with women representing a majority in both categories. The age-standardized prevalence of blindness among adults over 50 years was notably high in regions such as Western SubSaharan Africa (6.0%), Eastern Sub-Saharan Africa (5.7%), and South Asia (4.4%), aligning with the burden observed in our cohort.

Regarding distance visual acuity, 62.9% of participants had mild impairment, 28.3% had moderate impairment, and 8.8% had severe impairment. These results are consistent with the Beijing Eye Study by Liang et al. (2006), which reported that 1.0% of participants had low vision and 0.4% were blind. In that study, low vision and blindness were significantly associated with older age, refractive error, and lower educational status, but not with gender or urban/rural residency. Our findings reinforce the influence of age and systemic health parameters on visual outcomes.

Statistical analysis in the present study identified significant associations between visual impairment and factors such as family history of blindness, co-morbid conditions, BMI ($p < 0.05$), and waist circumference ($p < 0.01$). These results are in agreement with the findings of Varma et al. (2006), who assessed the impact of unilateral and bilateral visual impairment on health-related quality of life (HRQoL) in Latinos aged 40 years and older. Their study emphasized that non-correctable visual impairment had an adverse impact comparable to that of other major chronic conditions, such as stroke.

Additionally, our findings are supported by a study conducted by Lee et al. (2022), which investigated the role of alcohol consumption in the progression of diabetic retinopathy and visual acuity deterioration in patients with T2DM. Their results indicated a statistically significant association between alcohol intake and visual deterioration (adjusted OR 1.83; 95% CI: 1.34–2.48), reinforcing the multifactorial nature of vision loss in diabetic populations.

Interestingly, our study did not find a statistically significant association between short vision impairment and distance vision impairment. This contrasts with findings from LeAnn et al. (2002), who developed the Impact of Vision Impairment (IVI) profile and reported moderate correlations between IVI scores and both near and distance vision ($r = 0.21–0.31$). Their study concluded that vision impairment more strongly correlates with restrictions in participation than with general health or comorbidities. Overall, the present study contributes to the growing body of evidence on the burden and determinants of visual impairment among individuals with T2DM, particularly in rural communities. It emphasizes the need for early, community-based screening and targeted interventions that address modifiable risk factors such as obesity and co-existing health conditions.

CONCLUSION

The findings of this study indicate that a significant proportion of individuals with Type-II Diabetes Mellitus residing in rural areas are not undergoing regular screening for diabetes-related complications, particularly visual impairment. The high prevalence of undiagnosed visual impairment observed highlights a critical gap in early detection and preventive care. Community health nurses and frontline healthcare workers play a pivotal role in bridging this gap. The integration of accessible, technology-based screening tools—such as the WHO Eyes App—into routine community health services can facilitate early identification of vision-related complications and prompt referral for appropriate management. Strengthening such grassroots-level interventions is essential for reducing the burden of preventable vision loss and improving the overall quality of diabetic care in rural settings.

REFERENCE

[1] Andrade, L. C., Souza, G. S., Lacerda, E. M., Nazima, M. T., Rodrigues, A. R., Otero, L. M., Pena, F. P., Silveira, L. C., and Côrtes, M. I., 2014, "Influence of Retinopathy on the Achromatic and Chromatic Vision of Patients With Type 2 Diabetes," *BMC Ophthalmol.*, **14**, pp. 104. https://doi.org/10.1186/1471-2415-14-104

[2] Clarke, P. M., Simon, J., Cull, C. A., and Holman, R. R., 2006, "Assessing the Impact of Visual Acuity on Quality of Life in Individuals With Type 2 Diabetes Using the Short Form-36," *Diabetes Care*, **29**(7), pp. 1506–1511. https://doi.org/10.2337/dc05-2150

[3] Cleemen, C., Müller, N., Lehmann, T., Voigt, U. A., Meller, D., Kloos, C., Wolf, G., Müller, U. A., and Voigt, M., 2022, "Prevalence of Impairment of Visual Acuity and Severity of Retinopathy in Patients With Diabetes Mellitus," *Exp. Clin. Endocrinol. Diabetes*, **130**(10), pp. 652–659. https://doi.org/10.1055/a-1752-0024

[4] Cusick, M., SanGiovanni, J. P., Chew, E. Y., Csaky, K. G., Hall-Shimel, K., Reed, G. F., Caruso, R. C., and Ferris, F. L. III, 2005, "Central Visual Function and the NEI-VFQ-25 Near and Distance Activities Subscale Scores in People With Type 1 and

2 Diabetes," *Am. J. Ophthalmol.*, **139**(6), pp. 1042–1050. https://doi.org/10.1016/j.ajo.2005.01.008

[5] Das, T., Behera, U. C., Bhattacharjee, H., Gilbert, C., Murthy, G. V. S., Rajalakshmi, R., Pant, H. B., Shukla, R., and SPEED

Study Group, 2020, "Spectrum of Eye Disorders in Diabetes (SPEED) in India: Eye Care Facility Based Study. Report # 1. Eye Disorders in People With Type 2 Diabetes Mellitus," *Indian J. Ophthalmol.*, **68**(Suppl 1), pp. S16–S20. https://doi.org/10.4103/ijo.IJO_33_19

[6] Dhamdhere, K. P., Schneck, M. E., Bearse, M. A., Jr, Lam, W., Barez, S., and Adams, A. J., 2014, "Assessment of Macular Function Using the SKILL Card in Adults With Type 2 Diabetes Mellitus," *Invest. Ophthalmol. Vis. Sci.*, **55**(6), pp. 3368– 3374. https://doi.org/10.1167/iovs.13-13368

[7] Drinkwater, J. J., Davis, T. M. E., and Davis, W. A., 2020, "Incidence and Predictors of Vision Loss Complicating Type 2

Diabetes: The Fremantle Diabetes Study Phase II," *J. Diabetes Complicat.*, **34**(6), pp. 107560. https://doi.org/10.1016/j.jdiacomp.2020.107560

[8] Eski Yucel, O., Birinci, H., and Sullu, Y., 2019, "Outcome and Predictors for 2-Year Visual Acuity in Eyes With Diabetic

Macular Edema Treated With Ranibizumab," *J. Ocul. Pharmacol. Ther.*, **35**(4), pp. 229–234. https://doi.org/10.1089/jop.2018.0082

[9] Huang, Q., and Li, J., 2021, "Research Progress of lncRNAs in Diabetic Retinopathy," *Eur. J. Ophthalmol.*, **31**(4), pp. 1606–

1617. https://doi.org/10.1177/1120672120970401

[10] Kalra, S., and Singh, R. R., 2018, "Visual Acuity Assessment in Diabetes," *J. Pak. Med. Assoc.*, **68**(9), pp. 1407–1409.

[11] Kristinsson, J. K., Stefánsson, E., Jónasson, F., Gíslason, I., and Björnsson, S., 1994, "Screening for Eye Disease in Type 2 Diabetes Mellitus," *Acta Ophthalmol.*, **72**(3), pp. 341–346. https://doi.org/10.1111/j.1755-3768.1994.tb02770.x

[12] Kumar, K., Baliga, G., Babu, N., Rajan, R. P., Kumar, G., Mishra, C., Chitra, R., and Ramasamy, K., 2021, "Clinical Features and Surgical Outcomes of Complications of Proliferative Diabetic Retinopathy in Young Adults With Type 1 Diabetes Mellitus Versus Type 2 Diabetes Mellitus - A Comparative Observational Study," *Indian J. Ophthalmol.*, **69**(11), pp. 3289–3295. https://doi.org/10.4103/ijo.IJO_1293_21

[13] Liao, K. M., Wu, W. C., Jang, Y., Su, F. Y., and Tsai, L. T., 2021, "Impacts of Monocular, Binocular, and Functional Visual Acuity on Vision-Related Quality of Life in Patients With Type 2 Diabetes," *Sci. Rep.*, **11**(1), pp. 298. https://doi.org/10.1038/s41598-020-79483-9