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Prevalence of Refractive Errors in Type 2 Diabetic Patients in Northern India
Running Title: Refractive Error and Diabetes

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Abstract: Purpose: To determine the prevalence of refractive errors among the type 2 diabetic population through a community-based study conducted in Lucknow.

Background of the study: Diabetes prevalence is on the increase rapidly the epidemic proportions during development as well as the world developed. Refractive error in the diabetic population is considered a leading cause of visual impairment.

Methods: ***A total of 437 patients (> 40 years old) with type 2 diabetes were examined via complete eye screening tests, including objective autorefraction. Spherical equivalent refractions of both eyes were reported. Data collected include age, gender, general medical information, and serum biochemistry.***

Results: ***The mean refraction was −0.84 ± 2.59 D. Prevalence rates were determined for astigmatism (63.8%), hyperopia (1.4%) & myopia (0.2%). 34.6% of the patients were emmetropic. Age is an essential factor for all refractive errors. Correlation showed that every increase of one year of age and one percent of HbA1c is associated with 0.05 D (P = 0.003) and 0.14D (P = 0.04) shift in hyperopia, respectively.***

Conclusions: ***This study provides epidemiological data on refractive errors in a North Indian diabetic population in Lucknow, India. The astigmatism prevalence is higher than the reported rates in the diabetic population compared to hyperopia and myopia. The second major finding was emmetropia.***

Keywords: Refractive errors, Type 2 diabetes, Prevalence, Community-based stud

1. INTRODUCTION

Since the 19th century, it has been recognized that changes in blood sugar concentration can influence vision in patients with diabetes.[1,2,3] Optometrists are trained to think about the likelihood of undiagnosed diabetes if a patient complains of a bilateral, unexpected, or rapid change of vision or prescription. If diabetes is suspected, eye care practitioners may reschedule prescribing spectacles until the refractive error has become stable, which generally occurs when the patient's diabetes becomes controllable. Chronic refractive changes reported in diabetic patients include a rise in myopia.[4,5,6,7,8,9] This prospective study examines 874 eyes of 437 diabetic patients. They underwent glycemic control for severe hyperglycemia in a shot to create an objective evaluation of refractive changes during treatment.

2. MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted at the rural center of Era Medical College and Hospital in Lucknow from January 2018 to December 2019. A total of 874 eyes of 437 patients was examined. All the patients with type 2 diabetes mellitus with clear optical media were included in the study. Eyes with corneal opacity, opaque media, pseudophakia, aphakia, history of prior surgery or patients with proliferative diabetic retinopathy or clinically significant macular edema were excluded. All the subjects underwent comprehensive eye examinations consisting of subjective, objective, anterior, and posterior eye examinations. Visual acuity was determined using Snellen's chart. Refractive error was defined according to spherical equivalent (SE) refraction, which was calculated as the spherical diopters plus one half the cylindrical diopters. Myopia was defined as SE refraction ≤ -0.25 D. Hyperopia was defined as SE refraction ≥ -0.25D. Emmetropia was defined as SE refraction between -0.25D and +0.25 D. The level of metabolic control was evaluated by measuring glycosylated haemoglobin (HBA1c), fasting blood sugar (FBS) and postprandial blood sugar (PPBS). The participants of this study were well-informed about the purpose of the study, and confidentiality was maintained. Data from both eyes were reported and analyzed using SPSS 23.

3. RESULTS

Among the 437 subjects, 47.1% were female, and 52.9% were male. Their mean age was 50.30 ±5.83 years. Among them, 72.5% were illiterate, 25.9% had a primary level of education, and 1.6% were higher education graduates.

Table 1: Monocular UCVA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6/6	300	34.3	34.3	34.3
	6/9	42	4.8	4.8	39.1
	6/18	262	30	30	69.1
	6/24	112	12.8	12.8	81.9
	6/36	56	6.4	6.4	83.3
	6/60	102	6.4	6.4	100.0
	Total	874	100.0	100.0	

As seen in Table 1, the monocular uncorrected visual acuity (UCVA) was better than or equal to 6/18 in 69.1

Table 2: Monocular BCVA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6/12.	60	6.9	6.9	6.9
	6/6.	608	69.6	69.6	76.4
	6/9.	206	23.6	23.6	100.0
	Total	874	100.0	100.0	

As presented in Table 2, the monocular best-corrected visual acuity was better than 6/12 in each eye.

Table 3: Refractive Error

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Astigmatism	558	63.8	63.8	63.8
	Hypermetropia	12	1.4	1.4	65.2
	Myopia	2	.2	.2	65.4
	Emmetropia	302	34.6	34.6	100
	Total	874	100.0	100.0	

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Figure 1: Refractive status of the eye

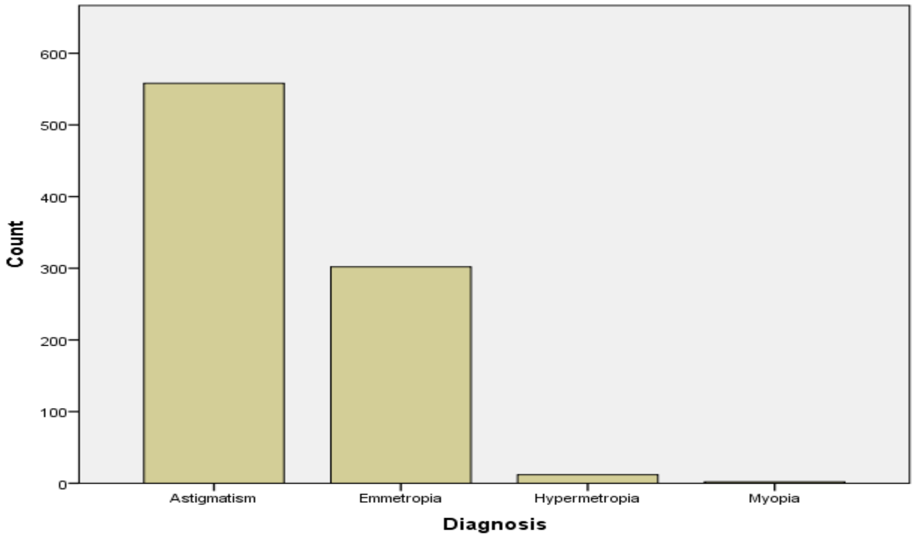

Table 3 and Figure 1 show that among 874 eyes, 558 (63.8%) had astigmatism, 302 (34.6%) were emmetropic, 12 (1.4%) were hypermetropic, and 2 (0.2%) were myopic.

Table 4: Spherical equivalent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-0.75	40	4.6	4.6	4.6
	-1.25	264	30.2	30.2	34.8
	-1.75	98	11.2	11.2	46.0
	-2.25	56	6.4	6.4	52.4
	-2.75	102	11.7	11.7	64.1
	+0.75	10	1.1	1.1	65.2
	+2.75	2	.2	.2	65.4
	0.00	302	34.6	34.6	100.0
	Total	874	100.0	100.0	

Table 4 shows that the spherical equivalent that was calculated for astigmatism eyes were -0.75 D to +2.75D.

Table 5: Duration of Diabetes

Year		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	91	20.8	20.8	20.8
	10	50	11.4	11.4	32.3
	2	60	13.7	13.7	46.0
	3	50	11.4	11.4	57.4
	4	78	17.8	17.8	75.3
	5	108	24.7	24.7	100.0
	Total	437	100.0	100.0	

As seen in Table 5, the maximum duration of having diabetes among 437 patients was ten years. 11.4% of the patients had diabetes for ten years. The minimum duration of having diabetes was one year, and 20.1% of patients fit this category. The mean duration was 3.92 ±2.628 years.

Table 6: Laboratory findings (n=437 patients)

		Frequency	Hba1c	Per cent
Valid	Good Controlled	127	5.6-7.8	29.1
	Fair Controlled	209	7.9-10.1	47.8
	Poor Controlled	101	>10.1	23.1
	Total	437		100.0

Figure 2: Distribution of refractive status with DR

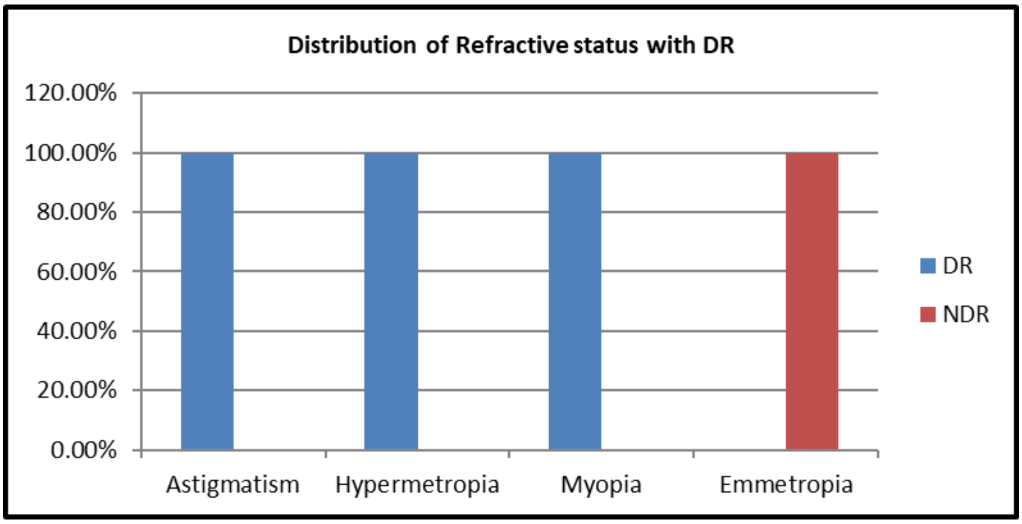

Table 6 and Figure 2 shows that the mean fasting blood sugar (FBS) was 145.01 ±66.13 mg/dl, postprandial blood sugar (PPBS) was 219 ±92 mg/dl, and HBA1C was 7.09 ±1.06%. 127 (29.1%) had reasonable glycemic control.

Table 7: Fundus examination findings (n=874)

Diabetes Retinopathy		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	NO	302	34.6	34.6	34.6
	Yes	572	65.4	65.4	100.0
	Total	874	100.0	100.0	

The majority, or 65.4% of the patients, had diabetes retinopathy, while 34.6% of them had normal fundus. None of the patients had proliferative diabetic retinopathy, as seen in Table 7. There was no statistical significance between myopia and hypermetropia with HBA1C p=0.461.
There was a statistically significant correlation between astigmatism and HBA1C p=0.00.

4. DISCUSSION

Refractive error in the diabetes population is considered one of the leading causes of visual impairment. A hospital-based cross-sectional study was conducted at the rural center of Era Medical College and Hospital in Lucknow, Uttar Pradesh, India, found that the prevalence of all types of refractive error in type 2 Diabetes was 65.4%. There is no similar study in our region to compare the present study.

Table 8: Comparison of the distribution of refractive errors between the present study and various published studies (Diabetes population)

Study	**n**	**Population**	**Myopia (%)**	**Hyperopia (%)**	**Astigmatism (%)**
Present study	874	Diabetic	0.2	1.4	63.8
Shristi et al[10]	170	Diabetic	25.2	45.0	29.8
Rani et al[11]	1080	Diabetic	21	39	47
Kinmen Study[12]	547	Diabetic	57	24	88
Mwale et al[13]	96	Diabetic	39.5	19	6.8

Studies done in different countries, summarized in Table 8, showed that hyperglycemia often goes unnoticed by diabetic patients and that there can be several undesirable symptoms related to acute hypoglycemia. A rapid decline in glucose concentration is related to sweating, trembling, anxiety, weakness, hunger, nausea, and vomiting. However, prolonged hypoglycemia can include more severe symptoms like visual disturbances, restlessness, irritability, inability to concentrate, confusion and personality changes, among others.[14] Thus, diabetic patients should take immediate action to correct his/her hypoglycemic state (usually with an intake of glucose), so that any associated refractive error shifts maybe therefore avoided. Consequently, the response of the crystalline lens to untreated hyperglycemia could also be of more immediate concern to the optometrist involved in carrying out eye examinations on diabetic patients. Thus, the refractive error change will be influenced by fluctuating glucose concentration. Therefore, it seems appropriate to enquire about glucose concentration when carrying out eye examinations on diabetic patients. If glucose concentration is uncharacteristically high or low at the time of refraction, then it is wise to repeat the refraction before prescribing, furthermore as advising patients about the possible implications for diabetic retinopathy and other complications related to the disease. In hyperglycemia, glucose can accumulate within the lens, causing a rise in curvature and a shift towards myopia.[15] However, hyperopic changes have also been shown to occur during hyperglycemia. This is often thought to result in a decrease in a ratio within the lens. If the geometric effect dominates (swelling of the lens altering lens curvature), the refraction will shift towards myopia. If the refractive effect dominates, the refraction will shift towards hypermetropia. The underlying mechanism governing the relationship between plasma glucose concentration and refractive error is not fully understood. There is no clear answer on whether the refractive changes seen are due simply to changes in the refractive index of the cornea, aqueous humour, or lens or whether the swelling of the lens occurs - causing changes to its curvature, position, or size. It is possible that both the ratio and surface curvature change, within which case either a myopic or hyperopic response may occur, counting on the individual's physiology. However, from a clinical point of view, fluctuating glucose concentration influences short-term changes in refraction, and these changes could also be large enough to measure. In most cases, people with diabetes appear to become more myopic as their glucose concentration increases. Where acute changes are reported within the literature, the latency of those changes appears to be short, being of the order of some minutes. This means that a hypo or hyperglycemic state could influence refractive findings during the eye examination. When taking a diabetic patient's history, it seems appropriate to enquire about the most recent glucose concentration, or maybe suggest taking a finger stick test before the eye examination. It should be borne in mind that (consistently) high glucose readings could induce transient myopia. During a hypoglycemic treatment, some diabetic patients suffer from blurred vision. It is well known that changes in plasma glucose cause the transient refractive error. Still, the biological basis of refractive changes within the eyes of diabetic patients has not yet been established, and therefore the underlying mechanism is still unknown.

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5. REFERENCES

[1] HuntjensB, O'Donnell C. Refractive error changes in diabetesMellitus. Optometry in Practice; (2006).P. 103-114.
[2] Da Costa, J .Medical Diagnosis. 7th Edition. Philadelphia, J.BLippincott(1890).
[3] Duke-Elder, S. "Changes in refraction in diabetes mellitus." Br JOphthalmol(1925). 9: 167-87.
[4] Fledelius, HC. "Is myopia getting more frequent? A cross-sectionalstudy of 1416 Danes aged 16 years+." Acta Ophthalmol (Copenh(1983)) 61(4): 545-59.
[5] Fledelius, HC. "Myopia and diabetes mellitus with special reference toadult-onset myopia." Acta Ophthalmol (Copenh);(1986)64(1): 33-8.
[6] Fledelius, HC "Refractive change in diabetes mellitus around onset orwhen poorly controlled. A clinical study." Acta Ophthalmol (Copenh) ;(1987). 65(1): 53-7.
[7] Fledelius, HC and Miyamoto, K. "Diabetic myopia - is it lens-induced? An oculometric study comprising ultrasound measurements." Acta Ophthalmol(Copenh);(1987).65(4): 469-73.
[8] Mantyjarvi, M .Myopia and diabetes. A review." Acta OphthalmolSuppl; (1988). 185: 82-5.
[9] Fledelius, HC "Is myopia getting more frequent? A cross-sectionalstudy of 1416 Danes aged 16 years+." Acta Ophthalmol (Copenh) ;(1983). 61(4): 545-59.
[10] Shristi Shrestha, Khem Raj Kaini. Refractive errors in type II diabetic patients Manipal Teaching Hospital, Pokhara, Nepal. DOI: https://doi.org/10.3126/jucms.v3i3.24243
[11] Rani PK1, Raman R, Rachapalli SR, Kulothungan V, Kumaramanickavel G, Sharma T. Prevalence of refractive errors and associated risk factors in subjects with type 2 diabetes mellitus SN-DREAMS, report 18. j.ophtha.2009.10.025. Epub 2010 Feb 16.
[12] Shih-Jen, Chen,Tao-Hsin, Tung,Jorn-Hon, Liu,An-Fei, Lee,Fenq-Lih, Lee,Wen-Ming Hsu & show all. Prevalence and Associated Factors of Refractive Errors Among Type 2 Diabetics in Kinmen, Taiwan Pages 2-9 | Received 02 Dec 2006, Accepted 20 Jul 2007, Published online: 08 Jul 2009.
[13] Mwale C1 Karimurio J, Njuguna M. Refractive errors in type 2 diabetic patients.East African Medical Journal, 01 Jun 2007, 84(6):259-26 DOI: 10.4314/eamj.v84i6.9534 PMID: 18254467
[14] National Diabetes Information Clearinghouse (2003). Hypoglycemia, Department of Health and Human Services. National Institute of Health.
[15] Mantyjarvi, M and Nousiainen, I "Refraction and accommodation in diabetic school children." Acta Ophthalmol (Copenh);(1988). 66(3): 267-71.