

REFRACTIVE ERRORS IN TYPE II DIABETIC PATIENTS

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ABSTRACT

INTRODUCTION: The prevalence of diabetes is increasing rapidly. Refractive error in the diabetic population is considered a main cause of visual impairment. So this study was conducted to find out the pattern of refractive errors in patients with type II diabetes mellitus in Western Nepal.

MATERIAL AND METHODS: It was a hospital-based cross-sectional study. Three hundred forty eyes of one hundred seventy patients with type II diabetes underwent comprehensive eye examination including subjective and objective refraction and serum biochemistry.

RESULTS: The mean refraction was -0.132 ± 0.88 D. Emmetropia was seen in 49.7% of the patients, hypermetropia in 22.6%, myopia in 12.6%, and astigmatism in 15% of the patients. Older age groups had more hypermetropic refractive error ($p < 0.05$). Female gender was a risk factor for hypermetropia ($p = 0.042$). Good glycemic control was seen in 49.7%. There was statistically significant correlation between fasting blood sugar level and spherical equivalent refraction ($p < 0.05$, $r = -0.115$).

CONCLUSION: The present hospital-based study noted a refractive error in 50.3% among diabetic population in Pokhara with hypermetropia being the most common type (22.6%) than myopia (12.6%) and astigmatism (15%).

KEYWORDS: Refractive error; Type II diabetes

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INTRODUCTION

The prevalence of diabetes is increasing rapidly reaching epidemic proportions throughout both the developing and industrialized world. Although the prevalence of both type I and type II diabetes is increasing worldwide, the prevalence of type II diabetes is rising much more rapidly because of increasing obesity and reduced activity levels as countries become more industrialized. The total number of diabetic patients is projected to rise from 171 million in 2000 to 366 million in 2030.¹

The US Centers for disease control and prevention reported that among individuals aged ≥ 20 years with DM, 11% had visual impairment. In individuals with younger onset of diabetes, diabetic retinopathy was responsible for visual acuity of $<20/200$ in around 80% of the eyes, whereas in individuals with older onset diabetes, this was the case in one third.² Refractive error in the diabetic population is considered a main cause of visual impairment.³

The occurrence of transitory refractive changes in diabetic patients has been recognized since 1873. However, since that initial observation there have been conflicting reports of the nature of the changes and the reasons for them.⁴ Both myopic shifts^{5,6} and hyperopic shifts^{4,7} have been reported in patients with diabetes. Furthermore, no influence of diabetes on ocular refraction was observed in the Blue Mountain Study.^{8,9}

The lens is a major modifiable determinant of refraction. The lenticular thickness increases with age but the ocular refraction actually becomes more hyperopic.^{10,11} The paradoxical increase in convexity of the lens with no myopic shift in ocular refraction with age, has been called the 'lens paradox' which can be explained by decrease in the equivalent refractive index of the lens with age, which compensates for the more convex shape of the ageing lens.¹²

The main cause of the refractive changes in diabetes is a change in the thickness of the lens,¹³⁻¹⁵ shape or a change in its refractive index.¹⁶ Several reports have shown increased lens thickness in diabetic patients.¹⁵⁻²⁰ It could be suggested that if the change in shape of the lens is small, hyperopia will predominate during hyperglycemia due to a decrease in the refractive index of the lens. Alternatively, if the change in the shape of the lens is large in comparison to the decrease in refractive index of the lens, it will cause myopia. There may be no change if the variation in the shape of the lens is equal to the variation in the refractive index of the lens. So this study was done to determine the pattern of refractive errors in patients with type II diabetes mellitus.

MATERIAL AND METHODS

A hospital based cross-sectional study was conducted at Manipal Teaching Hospital from January 2011 to June 2012. Total 340 eyes of 170 patients were examined. All the patients with type II 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, clinically significant macular edema and diabetic macular edema were excluded. All the subjects underwent comprehensive eye examination consisting of subjective and objective refraction, anterior and posterior eye examination. Visual acuity was determined using Snellen chart. Then the visual acuity was converted to log MAR equivalent. Refractive error was defined according to spherical equivalent (SE) refraction which was calculated as the spherical diopters plus one half of the cylindrical diopters. Myopia was defined as SE refraction ≤ -0.25 D. Hyperopia was defined as SE refraction $\geq +0.25$ D. Emmetropia was defined as SE refraction between -0.25 D and $+0.25$ D. Grading of lens opacities was performed by using the Lens Opacities Classification System (LOCS III). Significant nuclear sclerosis was defined as nuclear opalescence of $\geq N2$. The level of metabolic control was evaluated by measuring glycosylated haemoglobin (HbA_{1c}), fasting blood sugar (FBS) and post-prandial blood sugar (PPBS). Subjects who had participated in 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.

RESULTS

Of the 170 subjects, 71 (41.8%) were women and 99 (58.2%) were men. The mean age of these subjects was 51.09 ± 10.55 years. The older age groups had more hypermetropic refractive errors ($P < 0.05$). The monocular uncorrected visual acuity (UCVA) was better than or equal to 6/18 in 281 (81.6%) eyes.

Table 1: Distribution of monocular visual acuity

Monocular UCVA	No.	Percentage (%)
6/6	164	48.2
6/9	43	12.7
6/12	40	11.8
6/18	34	10.0
6/24	28	8.2
6/36	19	5.6
6/60	12	3.5
Total	340	100

Out of 340 study eyes, 169 (49.7%) were emmetropic, 77 (22.6%) were hypermetropic, 43 (12.6%) were myopic and 51 (15%) had astigmatism. The mean refraction was -0.132 ± 0.88 D. Hypermetropia was more prevalent in females as compared to males. Gender was an independent risk factor for refractive error (*chi-square test; p = 0.042*)

Table 2: Distribution of spherical equivalent

Spherical Equivalent(SE)	No.	Percentage (%)
-4.00 to -2.00	8	2.4
-1.75 to 0.00	236	69.4
+0.5 to +2.00	96	28.2
Total	340	100

Table 3: Genderwise distribution of refractive errors

Refractive error	F	M
Astigmatism	13.4%	16.2%
Hypermetropia	30.3%	17.2%
Myopia	12.0%	13.1%
Emmetropia	44.4%	53.5%
Total	100	100

The mean duration of diabetes was 4.74 ± 5.10 years. The mean FBS was 145.01 ± 66.13 mg/dl, PPBS was 219 ± 92 mg/dl and HBA_{1c} was $7.09 \pm 1.06\%$. 169 (49.7%) had good glycemic control.

Table 4: Distribution of glycemic control

Glycemic control	Hba _{1c} (%)	No.	Percentage(%)
Good	5.6-7.0	169	49.7
Fair	7.1-8.0	119	35.0
Unsatisfactory	8.1-10.0	48	14.1
Poor	>10	4	1.2

There was a significant correlation between fasting blood sugar and spherical equivalent ($p < 0.05$, $r = -0.115$). With the increasing blood sugar levels, there was a slight myopic shift.

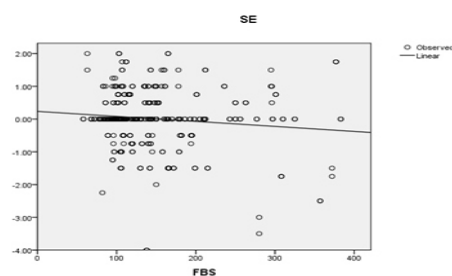


Fig. 1: Correlation between spherical equivalent and FBS in mg/dl

DISCUSSION

Refractive error in the diabetic population is considered one of the main cause of visual impairment. The present hospital based study found that the prevalence of all types of refractive errors in type 2 diabetes was about 50.3%. The mean age among 170 subjects was 51.09 ± 10.55 years. There was a preponderance of males (58.2%) over females (41.8%). Female patients were associated with hyperopia as compared to male patients. Rani *et al.* also reported female gender to be associated with hyperopia.² This may be because women's eyes have a shorter axial length and shallower anterior chamber depth than those of men and hence a higher probability of being hyperopic.²² The mean refraction was -0.132 ± 0.88 D, whereas it was -0.20 ± 1.72 D in Indian study² and -0.83 ± 2.49 D in Kinmen study.³

Table 5: Comparison of Distribution of Refractive Errors between the Present study and Various Published Studies (Diabetic Population)

Study	n	Population	Myopia	Hyperopia	Astigmatism
Present study	170	Diabetic	25.2	45.0	29.8
Rani <i>et al.</i> ²	1080	Diabetic	21	39	47
Kinmen Study ³	547	Diabetic	57	24	88
Mwale <i>et al.</i> ²¹	96	Diabetic	39.5	19	6.8

Rani *et al.*² and Sultanov *et al.*²¹ also reported a higher prevalence of hypermetropia (33.2%) as in this study whereas myopia was more prevalent than hypermetropia in Kinmen study.³ Ethnic variations are marked for the prevalence of refractive errors and this could possibly explain the higher prevalence of myopia in Kinmen study.³ This study revealed advancing age had hypermetropic shift. In order to prevent the confounding effect of nuclear sclerosis on the prevalence of refractive error, we excluded subjects with significant nuclear sclerosis (LOCS III \geq N2). Hyperopia and astigmatism was positively associated with age in Kinmen study,³ while Rani *et al.*² concluded advancing age as the most significant risk factor for all the refractive errors.

In our study 49.7% patients had good glycemic control. There was a significant correlation between fasting blood sugar and spherical equivalent. There was a slight myopic shift with increasing level of blood sugar. Mwale *et al.* revealed no significant correlation between both the types of refractive error and blood sugar level.²¹

As this study was hospital based, the patients did not represent a true sample of the population. Only 340 eyes of 170 patients were examined. Larger sample size would have been better to find the pattern of refractive errors.

CONCLUSION

One of the important causes of visual impairment in the diabetic population is uncorrected refractive error. There are no available data on the prevalence of refractive error among diabetic patients in Nepal. However, in a study that was conducted in India, refractive error in the diabetic population over 40 years of age was as high as 60% and visual impairment due to refractive error in 1 eye was 6% and 3% in both the eyes.² Extrapolating these estimates to approximately 511,000 subjects with diabetes mellitus in Nepal in 2010,²³ around 3 lakh subjects will have refractive error, around 30,000 subjects will have visual impairment in 1 eye and around 15,000 subjects will have visual impairment in both the eyes due to diabetes. Therefore, raising awareness and correcting refractive errors with suitable glasses will significantly reduce the magnitude of visual impairment in subjects with diabetes mellitus.

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