East African Medical Journal Vol. 84 No. 6 June 2007
REFRACTIVE ERRORS IN TYPE 2 DIABETIC PATIENTS
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ABSTRACT

Objectives: **To determine the prevalence and pattern of refractive errors among African type 2 diabetes mellitus patients and establish the relationship between baseline refractive status and degree of glycaemic control.**

Design: **A hospital based cross sectional study.**

Setting: **Diabetic medical and eye clinics at Kenyatta National Hospital (KNH).**

Subjects: **Ninety six type 2 diabetes mellitus patients.**

Results: **Ninety six patients aged 28 to 76 years were examined. The male to female ratio was 1:1.5 and about half of the patients (52.1%) had good glycaemic control. The prevalence of myopia was 39.5% and that of hypermetropia was 19.0%. Twenty two percent of the study patients had mild diabetic retinopathy (DR). Of the eyes with DR, 20% (15/75) were myopic, 19.4% (7/36) were hypermetropic and 26.6% (21/79) were emmetropic. There was no statistically significant correlation between baseline refractive status with DR (p = 0.358), or HBA1C (glycosylated haemoglobin) (rho = 0.130, p-value = 0.249 among myopes) or FBS (fasting blood sugar) (rho =0.089, p-value = 0.438 among myopes and rho = 0.158, p-value = 0.350 among hyperopes). However, there was a statistically significant correlation between baseline hypermetropic refractive status and HBA1C (rho = 0.401, p-value = 0.014).**

Conclusions: **Refractive errors were seen in 58.5% of the patients with myopia being the most common type (39.5%) followed by hypermetropia 19.0%. There was no statistically significant relationship between baseline refractive status and indicators of glycaemic control except for hypermetropic refractive status and HBA1C. According to the results of this study, it is not mandatory to ask for HBA1C or FBS results before issuing spectacle prescription to adult patients with type 2 diabetes mellitus who are already on treatment. However, there is need to emphasise the need for good glycaemic control to minimise the other ocular complications. A similar study should be done on young people with type I diabetes mellitus.**

INTRODUCTION

Diabetes mellitus may affect refraction with short-term fluctuations and more permanent alterations (1). No general agreement has been reached regarding the direction of these refractive changes (2). It has been suggested that there is a higher degree of myopia when there is a high blood glucose level, and a hyperopic shift when the blood glucose level normalises (3). Other studies, however, suggest alterations in a hyperopic direction at high blood glucose levels, as confirmed in animal

studies (4-6). In a study of the characteristics of the course of diabetic retinopathy, there were 88 eyes with myopia, 142 with hypermetropia, and 198 with emmetropia. Diabetic changes of the retina were detected in 40.9% of patients with myopic refraction, in 65.2% of emmetropics and in 70.4% of hypermetropic patients (7). The severity of DR was lesser in myopia than in other types of refractive errors (7-9). Fledelius *et al* found that the diabetes of the sample (representing 762 eyes) showed a shift towards myopic refraction (37.9% with myopia) as compared to non-diabetics (27.5%). The association between myopia and (well-controlled) diabetes seemed to be a new observation (10). Ching-Yu Cheng *et al* found that there was no significant difference in refractive errors between people with and without diabetes mellitus (11).

MATERIALS AND METHODS

A hospital based cross sectional study was conducted at the diabetic medical and eye clinics of KNH during the month of November, 2005. The statistically predetermined sample size was 94 patients. The first ten of the patients seen on each day at the diabetic medical clinic were included in the study. The principle investigator was not able to conduct full ophthalmic examination on more than ten patients in a day. These patients were randomly booked at the diabetic medical clinic and had no prior knowledge of the study, hence no bias in case selection. A case was defined as a patient with type 2 diabetes mellitus with clear optical media in at least one eye. Eyes with ocular conditions that could interfere with accurate refraction, such as corneal opacity or visually impairing opaque media, were excluded. The actual level of metabolic control was evaluated from measurement of glycosylated haemoglobin (HBA1 C) and fasting blood sugar (FBS). The study patients had full ocular examination including objective refraction and slit lump examination. Data from both eyes was reported and analysed using SPSS.

RESULTS

The monocular visual acuity without correction was better than or equal to 6/18 (normal vision by WHO definition) in 154 (81.0%) eyes. One eye with severe visual impairement had optic atrophy.

Table 1

Eye examination findings (No. = 190 eyes)

Monocular visual acuity without spectacle correction	No.	(%)
6/6	31	16.3
6/9	32	16.8
6/12	44	23.2
6/18	47	24.7
6/24	13	6.8
6/36	11	5.8
6/60	11	5.8
<6/60-3/60	1	0.5
Total	190	100
Monocular best corrected visual acuity (BCVA)		
6/6	139	73.2
6/9	30	15.8
6/12	15	7.9
6/18	3	1.6
6/24	–	
6/36	–	
6/60	2	1.1
6/60-3/60	1	0.5
Total	190	100

Table 2

Retinoscopy findings (No. = 75 eyes)

Retinoscopy findings of the study patients with myopia	No.	(%)
-0.75 to 1.75	58	77.3
-2.00 to -3.00	10	13.3
<-3.25	7	9.3
Total	75	100
Retinoscopy findings of the study patients with hypermetropia	No.	(%)
+0.75 to +1.75	32	88.9
+2.00 to +3.00	3	8.3
>+3.25	1	2.8
Total	36	100
Presbyopes		
+0.75 to +2.50	72	75.0
Total	72	75.0

Of the 190 study eyes, 75 (39.5%) were myopic, 36 (19.0%) were hypermetropic and 79 (41.6%) were emmetropic. Seventy two patients were presbyopic. Thirteen eyes with astigmatism all had a myopic spherical equivalent of -3.00 DS to -0.75 DS.

Table 3

Fundus examination findings (No. = 190 eyes)

Distribution of DM retinopathy by grading	Frequency No.	(%)
Normal	147	77.4
Diabetic Retinopathy	43	22.6
Total	190	100

The majority 77.4% of the study patients had normal fundus findings while 22.6% had mild NPDR. None of the patients had advanced stage of DR.

Only 52.1% (50/96) patients of the 96 were well controlled as per FBS and HBA1C. There was a myopic shift as the HBA1C% result increased beyond 8.0%. Overall, there was no statistically significant correlation between myopia and HBA1C results (rho = 0.130, p-value = 0.249). There was a statistically significant correlation between hypermetropia and HBA1C results (rho = 0.401, p – value = 0.014). There was a myopic shift as HBA1C% increased.

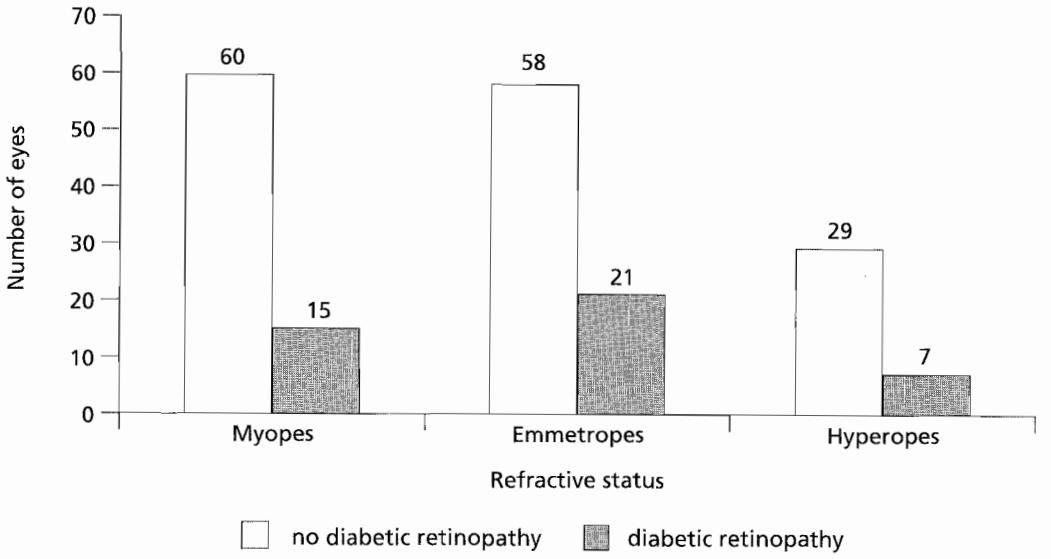
Table 4

Laboratory findings (No. = 96 patients)

Distribution of fasting blood sugar levels in mmol/l	No.	(%)
<3.3 (hypoglycaemia)	2	2.1
3.3 – 5.5 (very good control)	15	15.6
5.6 – 7.8 (good control)	24	25.0
7.9 – 10.1 (fair control)	9	9.4
> 10.1 (poor control)	46	47.9
Total	96	100
Distribution of glycosylated haemoglobin levels (%)		
<2.9 (hypoglycaemia)	3	3.1
2.9 – 4.2 (excellent control)	13	13.5
4.3 – 7.3 (good control)	34	35.4
7.4 – 11.4 (fair control)	30	31.3
> 11.4 (poor control)	16	16.7
Total	96	100

Figure 1

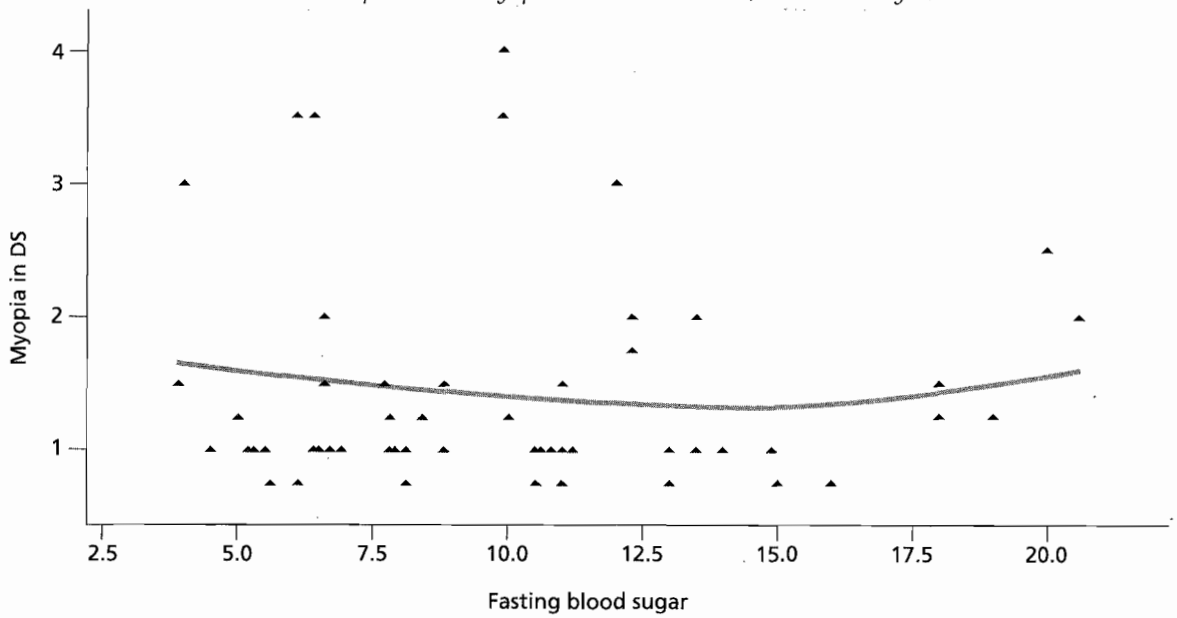
Distribution of refractive status and DR (No. = 190)



There was no statistically significant correlation between refractive status and diabetic retinopathy (p = 0.358)

Figure 2

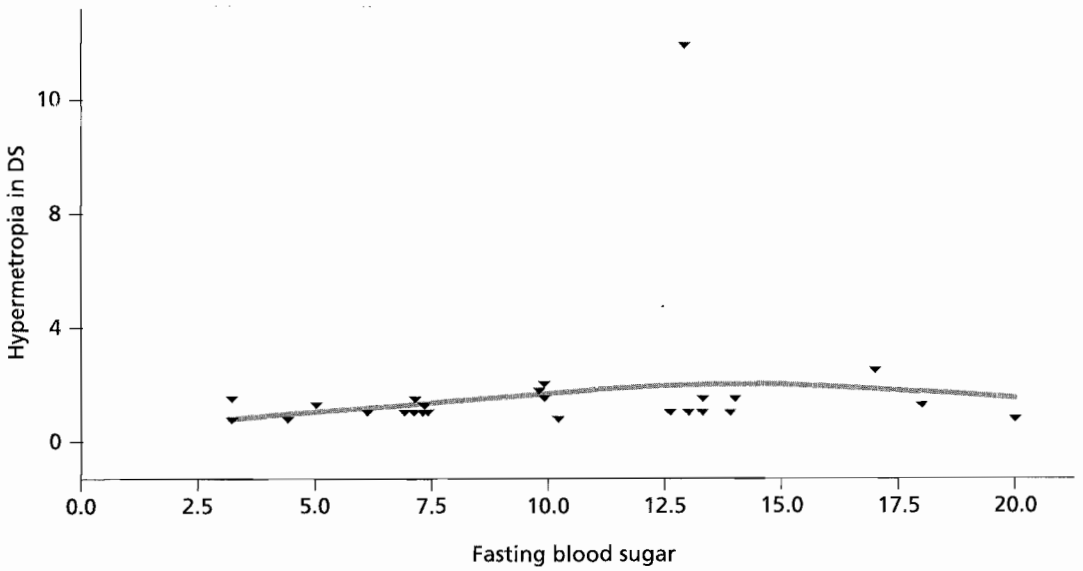
Relationship between myopia and FBS in mmol/l (No. = 75 eyes)



There was no correlation between myopic refractive status and FBS (rho = –0.087, P-value = 0.438). Overall, there was a slight myopic shift as the degree of hyperglycaemia reduced or increased from 12.5 mmol/l.

Figure 3

Relationship between hypermetropia and FBS in mmol/l (No. = 36 eyes)



There was a slight myopic shift as the FBS results increased or reduced from 12.5%. There was no statistically significant correlation between hypermetropia and FBS (rho = 0.158, p-value = 0.350).

DISCUSSION

Of the 96 type 2 diabetes mellitus patients who were included in the study, 38 were males and 58 were females. Two eyes from two different patients were excluded due to hazy media (dense cataracts). Monocular visual acuity without spectacle correction and monocular best corrected visual acuity was normal in 154 (81.1%) and 187 (98.4%) eyes respectively.

A study on diabetics by Sultanov *et al*, had 88 (20.6%) eyes with myopia, 142 (33.2%) with hypermetropia, and 198 (46.2%) with emmetropia, showing a higher prevalence of hypermetropia than in this study (7). The overall prevalence of myopia (39.5%) in this study is similar to that found by Fledelius *et al*, who had a prevalence of 37.9% among white DM patients who were already on DM treatment (10).

Cross tabulations of the refractive status and diabetic retinopathy were reviewed in 190 eyes. Diabetic changes were observed in 20.0% of myopic refractive cases, 19.4% in hypermetropic cases and 26.6% in emmetropic cases. However there was no statistical significance ($p = 0.358$). The prevalence of mild DR in this study was 22.6%. It has been reported that the optic disc and retinal neovascularisation are less prominent and less frequent in myopic eyes in patients suffering from diabetes mellitus (7-9). It was not possible to investigate the relationship between severity of diabetic retinopathy and refractive error since none of the patients in this study had advanced DR. The study by Sultanov *et al* (7) observed diabetic changes in the retina in 40.9% of myopic refraction patients, 65.2% of emmetropia cases and 70.4% of hypermetropia cases. The severity of involvement was less in myopia than in other types of refraction.

In this study, it was difficulty to control for metabolic influences on refractive status since it was a cross section study. To estimate the short-term fluctuation in refraction caused by current level of metabolic control, the power of patients' own distance glasses for 31(32.3%) patients and their actual refraction at presentation were correlated and statistically significant correlations were found (rho = 0.945, p = 0.001). There was no statistical significance between the correlation of baseline refractive power and indicators of glycaemic control for these 31 (32.3%) patients. Therefore, our analysis of the relations between power of glasses and actual measured refractive power and indicators of glycaemic control suggest that the results of our study may not have been influenced by acute dysregulation of diabetes mellitus.

Despite the fact that almost half of the patients had poor glycaemic control, correlations between baseline, refractive status with FBS/HBA1C at presentation did not reach statistical significance except for hypermetropia versus HBA1C. This implies that it is not mandatory to request for FBS or HBA1C results before issuing a spectacle prescription to type 2 DM patients who are already on DM treatment, but it should still be done to prevent other ocular complications of the disease. A similar study should be done in young patients with type 2 diabetes mellitus.

ACKNOWLEDGEMENTS

To the University of Nairobi, Kenyatta National Hospital and Lions Club of Bavaria-German.

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