VISUAL IMPAIRMENT IN TYPE 2 DIABETES MELLITUS IN COMPARISON WITH NON DIABETIC POPULATION IN A SUBURBAN AREA OF TAMILNADU, INDIA

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ABSTRACT

Introduction: Type 2 Diabetes mellitus (T2DM) with increased prevalence is associated with complications in eyes. Visual impairment arises as a result of correctable or an uncorrectable factor. The refractive errors, one of the correctable factors can be effectively resolved. The present study was conducted to compare the visual acuity in T2DM and non diabetic subjects and also to evaluate the association between plasma glucose levels and visual impairment.

Subjects and Methods: This was a cross sectional study was conducted among the 180 T2DM patients and 160 non diabetic patients and the visual acuity for distance vision were evaluated. The estimation of FPG (Fasting plasma glucose) and PPPG (Postprandial plasma glucose) were done among the study participants using standard methods.

Results: Among the T2DM patients the prevalence of mild and moderate visual impairment was found to be 25% and 45%. Meanwhile in non diabetic participants the prevalence of mild and moderate visual impairment was 11% and 18%. No severe or blind case was reported. Visual acuity of both the eyes showed a positive correlation with the FPG (p<0.05) fasting and PPPG (p<0.05) levels. The overall prevalence of visual impairment among the T2DM was 70% and in non-diabetics it was 29%. Conclusions: Type 2 diabetes mellitus is associated with increased prevalence of visual impairment in comparison with non-diabetic population.

KEYWORDS Visual impairment, Type 2 Diabetes mellitus, FPG, PPPG ETDRS chart

Introduction

The prevalence of diabetes is estimated to be 72.96 million among Indian adults, with an estimate of 10.9% in the urban population and 3.0-7.8% in rural areas [1]. T2DM is one of the major causes of visual impairment, next to cataracts and glaucoma in the general population. [2]

In a nutrition based survey conducted in the USA, the prevalence of visual impairment due to correctable and uncorrectable causes in the diabetic population is 11%. The structures in the eye responsible for a good quality of vision are the cornea, lens, retina and tear film. This structure may undergo numerous physiological and structural changes due to diabetes mellitus [3]. Patients with diabetes have an increased chance of visual impairment, and it may lead to diabetic retinopathy, one of the microvascular complications of diabetes mellitus [4]. The refractive eye power depends on the corneal curvature, thickness and refractive index, depth of the anterior chamber, the thickness of the lens, axial length, aqueous, lens and vitreous. The previous report on the effect on the anterior structures of the eye is limited compared to its effect on the retina [2]. The physiological ocular changes in the anterior part of the eye during diabetes can also lead to refractive errors [5]. Fluctuations of plasma glucose levels among diabetic patients also lead to refractive errors [6]. The visual impairment in diabetic patients leads to psychosocial and affects the quality of life [7]. The visual impairment in diabetic subjects remains undiagnosed due to lack of awareness and also...
not involved in the routine eye examination. A large population of diabetic patients are not treated adequately for visual impairment. There is limited data available on the complications of diabetes on the anterior ocular segment concerning refractive errors [8]. With increased prevalence and incidence of diabetes mellitus and its complications in India, preventive measures have to be taken to decrease the visual impairment in diabetes mellitus as it is associated with increased morbidity. Against this backdrop, the present study was carried out to compare the visual acuity in diabetics and non-diabetics and correlate with plasma glucose levels.

Materials and methods:

Study design:

This was a cross-sectional study conducted in the ophthalmology department of a tertiary care hospital in a suburban part of India. Data was collected from the ophthalmology outpatient department.

Study population:

About 180 newly diagnosed T2DM participants in the age group 30-55 years and 160 non-diabetic participants in the age group 30-55 years were included in the study.

Study duration:

The study duration was six months, from June 2019 to December 2019.

Ethical consideration:

The study was approved by the Institutional ethics committee. The participant’s consent was recorded before collecting the data.

Data collection procedure:

The study was explained to the participants, and basic information from the participants was collected using a questionnaire. Ophthalmologists examined the subjects for Visual Acuity (VA) and VA after the refractive correction was measured using the ETDRS chart (Light House Low Vision Products, USA) [8]. Uncorrected refractive error is a presenting visual acuity in the better eye worse than 6/12. Participants with visual impairment were graded as mild, moderate and severe according to the WHO criteria. Blindness was considered when VA (with glasses for distance if normally worn or unaided if glasses for a distance not worn) of <3/60 in the better eye. Severe visual impairment (SVI) was categorised as VA of <6/60 to 3/60 in the better eye. Moderate visual impairment (Mod VI) was categorised as VA of <6/18 to 6/60 in the better eye. Mild visual impairment (Mild VI) was categorised as when VA of <6/12 to 6/18 in the better eye [9]. Emmetropia was when a spherical equivalent between -0.50 D and +0.50 D [12]. Participants blood samples were collected as a usual procedure at the medicine department for diabetic patients and the controls on the day of test for refraction. FPG and PPPG values were estimated and recorded from case sheets. Study participants with FPG ≥ 126 mg/dl and PPPG ≥ 200 mg/dl was considered diabetic. Symptoms of diabetes and random plasma glucose of ≥ 200 mg/dl was considered diabetic according to ADA[10]. Anthropometric measurements such as height were measured using a stadiometer, and weight was measured using the standard weighing machine without the foot ware. BMI was calculated with the formulae of Height/Weight².

Statistical analysis:

The comparison between the two groups was carried out using an independent student T-test. The prevalence of refractive error was studied with the chi-square test. Pearson’s correlations were done to determine the relationship between fasting and post prandial blood glucose influence on visual acuity, body mass index, height, and weight of diabetic subjects. SPSS version 24 was used for the statistical analysis. A p-value < 0.05 was considered statistically significant.

Results

The prevalence of mild and moderate visual impairment in our study was 25% and 45% in the diabetic population. 30% of diabetic participants were emmetropic. No case of severe visual impairment or blindness was reported. The prevalence of mild and moderate visual impairment in non-diabetic population was 11%, 18%, and 71% were emmetropic. No case of severe visual impairment, nor blindness was reported in the control group. The BMI of diabetic and non-diabetics were 23.21 and 23.85. The visual acuity in the right eye was considerably reduced in diabetic 6/12.34 compared to 6/9.09 of non-diabetics, and it was not significant (p=0.095). The visual acuity of the left eye in diabetic was 6/15.21, and in non-diabetic, it was 6/10.52, and it was not significant (p=0.063). The mean FPS in diabetics was 161.18 mg/dl, and non-diabetics was 89.10 mg/dl, and it was significant (p=0.000). The mean postprandial plasma glucose in people with diabetes and non-diabetics was 228.22 mg/dl and 105.24 mg/dl, respectively, and it was significant (p=0.000). The Pearson’s correlation, as displayed in table 2, shows a significant positive correlation on visual acuity in the right and left eye with fasting and postprandial plasma glucose (p<0.05). The visual acuity in the right and left eye showed a negative correlation with height, weight, body mass index.

Discussion

The prevalence of visual impairment due to a correctable cause of a refractive error, including a mild and moderate case in our study group, was 70%. In contrast, no cases of severe visual impairment were reported. The increased prevalence of visual impairment observed in the present study was concurrent with a study done by Huntjens et al. with a prevalence of 61.11% of visual impairment in a diabetic population. In comparison, in the general population, it was 16.63% [11]. In a study done in urban India among the diabetic population, the prevalence of uncorrected refractive error was 4% [1]. In a four year follow up study conducted in Chennai, India, 47% of visual impairment in diabetes was reported due to refractive error, a percentage less than our study, but that had not evaluated the relationship between plasma glucose and visual acuity [8]. The cause of impaired visual acuity was demonstrated as the refractive optics of the eye, which changed with a change in plasma glucose [11]. The present study substantiated the association between visual acuity and plasma glucose. The elevated plasma glucose levels elicit marked myopic changes in the vision due to increased lens thickness and thus causes an increase in refractive power [6]. Hyperopic changes have also been demonstrated when plasma glucose was reduced, as shown by Somez et al. [13]. In a study done by Li et al., there was a marked association between daily
Table 1  Anthropometric and Biochemical parameters of the study participants.

| Parameters          | T2DM     | Non-T2DM | P Value |
|---------------------|----------|----------|---------|
| n                   | 180      | 160      | 0.003   |
| Age                 | 50.14±12 | 52.55±8.7| 0.000** |
| Height (Cms)        | 166.41±6.3| 160.13±9.8| 0.312   |
| Weight (Kg)         | 64.61±9.5| 61.26±10.9| 0.006   |
| BMI (Ht/wt²)        | 23.21±2.7| 23.85±3.7| 0.346   |
| VA R                | 6/12.34±7.3| 6/9.09±6.1| 0.095   |
| VA L                | 6/15.21±9.9| 6/10.52±9.0| 0.063   |
| FPG mg/dL           | 161.18±6.0| 89.10±7.3| 0.000** |
| PPPG mg/dL          | 228.22±52.6| 105.24±6.5| 0.000** |

T2DM-Type2 Diabetes mellitus; Non-T2DM-Non type 2 Diabetes mellitus; VA R-Visual acuity Right eye; VAL-Visual acuity left eye; FPG- Fasting plasma glucose; PPPG- Postprandial plasma glucose. All the data given are expressed as mean±SD. * denotes statistically significant p<0.05.

Table 2  Correlation between visual acuity and plasma glucose levels.

| Parameters   | VA R     | VA L     |
|--------------|----------|----------|
| Age          | 0.264    | 0.123    |
| Height (cm)  | -0.108   | -0.122   |
| Weight (kg)  | -0.155   | -0.166   |
| BMI (kg/m²)  | -0.246*  | -0.180   |
| FPG (mg/dl)  | 0.666**  | 0.683**  |
| PPPG (mg/dl) | 0.416**  | 0.496**  |

VAR-Visual acuity Right eye; VAL-Visual acuity left eye; FPG; Fasting Plasma Glucose; PPPG- Postprandial Plasma glucose. **: Significant two tailed , p value <0.05

Conclusion

The prevalence of visual impairment in the present study was 70% in the diabetic population, and the prevalence in the non-diabetic population was 30%. Thus participants with diabetes displayed a higher prevalence of visual impairment. The relation of visual acuity with elevated fasting and postprandial plasma glucose in diabetes mellitus showed that plasma glucose is a cardinal factor responsible for visual impairment in diabetes. The current study emphasises the importance of early detection of visual impairment among T2DM to prevent morbidity and mortality.

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Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

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