OPEN ACCESS Freely available online

Journal of Clinical and Experimental Ophthalmology

Case Report

# Spectrum of Ocular Features in Type 1 Diabetes Mellitus

**Modupe Medina Balogun[1*], Ibironke Jadesola Akinola[2]**

*[1]Department of Ophthalmology, Lagos State University Teaching Hospital, Lagos, Nigeria; [2]Department of Paediatrics and Child Health, Lagos State University College of Medicine, Lagos, Nigeria*

## ABSTRACT

**Introduction:** Type 1 Diabetes Mellitus (T1 DM) accounts for most of the Diabetes Mellitus (DM) that occurs in children and adolescents. Features of T1 DM include ocular changes, nephropathy and neuropathy among others. The study aimed to identify the early ocular signs of T1 DM most especially those that can cause blindness and the age at which they manifest.

**Case presentation:** The study was a prospective case-control one. Study subjects were recruited from the Pediatric Endocrine clinic and the children's general outpatient clinic. Information obtained from patients with type 1 diabetes mellitus and controls was entered into a proforma. An ophthalmic examination was performed on the subjects. Statistical analysis was done with the Software Package for Social Sciences (SPSS) version 20.

**Results:** The mean age of the cases and control groups was 11.13 ± 3.52 years (range 5-19 years) and 11.00 ± 3.46 years (range 5-18 years) respectively. The average duration of time since diagnosis of TIDM was 1.8 ± 2.03 years (median 1 year) and the mean HbA1 for cases and controls was 10.16% ± 3.68 and 5.22% ± 0.862 respectively. The Tear-film Break-Up Time (TBUT), Central Corneal Thickness (CCT) and Intra-Ocular Pressure (IOP) in the cases and controls were 13.96 ± 5.6 *vs.* 11.35 ± 6.10 secs, 560.35 ± 36.03 µm *vs.* 566.56 ± 38.09 µm and 16.77 ± 4.9 mmHg *vs.* 16.19 ± 5.4 mmHg respectively.

**Conclusion:** Ocular features of T1 DM revealed in our study were increased TBUT, IOP and reduced CCT. There were no cases of dry eyes, cataract or diabetic retinopathy. We recommend a larger sample size with a multi-center study that will show if our findings truly reflect that of the population of children with T1 DM. We also recommend that screening for ocular features of diabetes commence from one year after the diagnosis of T1 DM or at the age of ten years, whichever comes first.

**Keywords:** Ocular; Type 1 diabetes; Children; Retinopathy

## INTRODUCTION

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by the presence of hyperglycemia in the absence of treatment. According to the World Health Organization (WHO) classification of DM published in 1999, there are two major types, Type 1 Diabetes Mellitus (T1 DM) and Type 2 Diabetes Mellitus (T2 DM) [1].

The global diabetes prevalence in 2019 was estimated to be 9.3% (463 million people) and higher in urban (10.8%) than in rural (7.4%) areas [2]. In the United Kingdom, there are 3.5 million people diagnosed with diabetes [3]. While in Nigeria from a study done by Andrew E Uloko, et al. [4], it was estimated that 11.2 million people are living with the disease.

Complications of diabetes include neuropathy, nephropathy and ocular disorders such as Diabetic Retinopathy (DR), cataract, glaucoma and maculopathy. These can progress to blindness if not identified and treated early. Early recognition and treatment of diabetic macula edema and proliferative diabetic retinopathy

**Correspondence to:** Modupe Medina Balogun, Department of Ophthalmology, Lagos State University Teaching Hospital, Lagos, Nigeria, Telephone: +2348033123069; E-mail: dupebal@yahoo.co.uk

**Received:** 22-Feb-2024, Manuscript No. JCEO-24-29721; **Editor assigned:** 26-Feb-2024, PreQC No. JCEO-24-29721 (PQ); **Reviewed:** 11-Mar-2024, QC No. JCEO-24-29721; **Revised:** 18-Mar-2024, Manuscript No. JCEO-24-29721 (R); **Published:** 25-Mar-2024, DOI: 10.35248/2155-9570.24.15.972

**Citation:** Balogun MM, Akinola IJ (2024) Spectrum of Ocular Features in Type 1 Diabetes Mellitus. J Clin Exp Ophthalmol. 15:972

to reduce the risk of moderate and severe vision loss is advocated [5].

T1 DM usually starts early in children with the peak incidence at 11-13 years and ten percent (10%) of all people with diabetes have T1 DM. The risk of proliferative retinopathy is twice as high in males as in females when the onset of T1 DM occurs before age 15 years. Screening must be tailored towards finding the earliest ocular signs of DM and the age at manifestation and to determine the frequency of screening [6-10].

Our study aimed to find the early ocular signs of T1 DM most especially those that can cause blindness and the age at manifestation to determine when ocular screening should start in children with T1 DM.

## CASE PRESENTATION

The study was a prospective cross-sectional case-control clinical study in which patients with type 1 DM in the age range of two to seventeen years were recruited from the endocrine unit of the pediatric department of the Lagos State University Hospital (LSUH) and later examined by an ophthalmologist. Patients with chronic ophthalmic diseases causing retinopathy such as sickle cell disease, those who had previous ocular surgery or who were on topical or systemic steroids were excluded from the study. Healthy gender and age-matched children were enrolled from the children's out-patients clinic as controls in the study. HbA1c obtained within three months was extracted from the files of the cases while venous blood samples were taken to determine the HbA1c levels in controls.

An ophthalmic examination of all study participants was done. Visual acuity was checked with the Early Treatment Diabetic Retinopathy (ETDR) study chart at four meters from the chart. Intraocular pressure was measured with a rebound tonometer. The anterior segment of the eye and its adnexa were examined for the conjunctiva, cornea, anterior chamber, pupil and lens with the use of a pen torch. The posterior segment was examined after dilatation of the pupil with 1% Tropicamide with the Indirect Ophthalmoscope (IO) and 20 Diopter (D) lens to view the vitreous, retina, its blood vessels and the optic nerve. Diabetic Retinopathy (DR) was defined as the presence of hemorrhages, exudates, macula edema, damaged nerve tissue (cotton-wool spots) and changes in the blood vessels (neovascularization). Dry eye was confirmed by performing the Schirmer 1 test (without anesthesia) which will measure both the reflex and basic tearing. With the patient in a sitting position, the inferior cul-de-sac of each eye was dried with a cotton swab then one end of the Whatman 41 filter paper strip (5 mm by 35 mm) folded at the 5 mm mark then inserted over the lateral third of the lower fornix then asked the patient to close the eyes. After 5 minutes, the strips were removed and the length of the strip wet by the tears was measured. Wetting of less than 15 mm of a Schirmer strip indicated dry eyes. Tear-film Break-Up Time (TBUT) was done by measuring the time interval between a complete blink and the formation of dry spots in the form of black spots or lines on the cornea in a fluorescein-stained tear film. A value of 10 seconds or less was considered abnormal Central Cornea Thickness (CCT) was measured by ultrasound pachymeter.

## RESULTS

The mean age of the cases and controls were 11.13 ± 3.52 years (range 5-19 years) and 11.00 ± 3.46 years (range 5-18 years) respectively. There were more males (53.30%) in both groups. The average duration of time since diagnosis of TIDM was 1.8 ± 2.03 years (median 1 year) and the mean HbA1c for the cases and controls was 10.16% ± 3.68 and 5.22% ± 0.862 respectively. The mean weight of children with TIDM and controls were 38.31 kg and 41.92 kg respectively while the mean heights were 145.38 cm and 149.05 cm respectively. The mean age of the mothers of T1 DM and the control groups was 43 years and 42.04 years respectively while the mean paternal age was 49.35 years and 49.92 respectively (Table 1).

| Variable | Mean | | Standard deviation | | P-value |
|---|---|---|---|---|---|
| | T1 DM patients | Controls | T1 DM patients | Controls | |
| Age | 11.13 | 11 | 3.52 | 3.46 | 0.882 |
| Weight | 38.31 | 41.92 | 12.734 | 11.669 | 0.285 |
| Height | 145.38 | 149.05 | 13.662 | 17.943 | 0.464 |
| Maternal age | 43 | 42.04 | 6.357 | 6.832 | 0.588 |
| Paternal age | 49.35 | 49.92 | 7.735 | 5.729 | 0.765 |

**Note:** T1 DM: Type 1 Diabetes Mellitus; P:Probability.

**Table 1:** Descriptive data and p-value for the T1 DM and control groups: Anthropometry and parents' age.

Visual acuity for cases and controls was within the normal range. The Schirmer's test in the diabetic group was 24.9 ± 9.6 mm while in the control group, it was 26.40 ± 8.220 mm. The TBUT in the diabetic group was 13.96 ± 5.6 sec, while in the control group, it was 11.35 ± 6.10 sec. Central corneal thickness in the diabetic group was 560.35 ± 36.03 µm while 566.56 ± 38.09 µm in the control group. The IOP in the diabetic group was 16.77 ± 4.9 mmHg and 16.19 ± 5.4 mmHg in the control group. Ophthalmic examination findings indicated that all ocular features were normal in both diabetic and control groups on all the features as lids, conjunctiva, cornea, iris, pupil, lens vitreous, fundus, extraocular muscles and orbit. CCT and Schirmer's test were higher in the control group than in the diabetic group and TBUT and IOP were higher in the diabetic group than in the control group. There were no significant differences between both groups (Table 2).

| Variable | Mean | | Standard Deviation (SD) | | P-value |
|---|---|---|---|---|---|
| | Diabetic group | Control group | Diabetic group | Control group | |
| CCT | 560.34 | 566.56 | 36.03 | 38.09 | 0.541 |

| | | | | | |
|---|---|---|---|---|---|
| Schirmer's test | 24.9 | 26.4 | 9.6 | 8.16 | 0.517 |
| TBUT | 13.96 | 11.35 | 5.62 | 6.11 | 0.101 |
| IOP | 16.77 | 16.19 | 4.94 | 5.38 | 0.69 |
| Optic nerve | 0.27 | 0.32 | 0.14 | 0.13 | 0.195 |

**Note:** CCT: Central Corneal Thicknes; TBUT: Tear Break-Up Time; IOP: Intraocular Pressure; P: Probability.

**Table 2:** Descriptive data and p-value from the diabetic and control groups: Ophthalmic features.

Univariate regression analysis conducted showed that in the diabetic group between HbA1c and each of CCT, Schirmer's test, TBUT, IOP and fundus examination showed a statistically significant correlation between HbA1c and IOP (R=0.427, P=0.048). The implication of this is that a high HbA1c might present with a high IOP. While there was no statistically significant correlation between HbA1c and other measures. The univariate regression analysis conducted in the diabetic group between HbA1c and weight, height, maternal age and paternal age showed no statistically significant correlation between HbA1c and each of the measured parameters (Table 3).

| | | CCT | Schirmer's | TBUT | IOP | Optic nerve |
|---|---|---|---|---|---|---|
| HbA1c | Correlation coefficient (R) | 0.072 | 0.176 | -0.049 | 0.621 | 0.099 |
| | P-value | 0.721 | 0.369 | 0.811 | 0.002 | 0.622 |
| Duration | Correlation coefficient (R) | -0.039 | -0.175 | 0.242 | 0.087 | -0.192 |
| | P-value | 0.839 | 0.356 | 0.215 | 0.686 | 0.319 |

**Note:** CCT: Central Corneal Thicknes; TBUT: Tear Break-Up Time; IOP: Intraocular Pressure; P: Probability.

**Table 3:** Spearman's correlations.

## DISCUSSION

Patients with diabetes are prone to systemic complications including those of the eyes that may cause blindness as cataract, glaucoma, retinopathy and macular degeneration. More than half of our participants were males. A study in Sweden from 1983 to 2002 found an annual incidence rate of 16.4/100,000for males and 8.9/100,000 for females [11-15]. This is contrary to other studies that showed more females than males [16].

While older literature suggested that males were preferentially targeted by environmental factors associated with the rising incidence of T1 DM, others reported that there was no sex predilection for T1 DM [17,18].

The average duration of diabetes was 1.8 ± 2.03 years. HbA1c is an important indicator of long-term glycemic control with the ability to reflect the cumulative glycemic history of the past two to three months [19]. The HbA1c for the diabetic group was 10.16%. This suboptimal glycemic control could be a result of poor compliance due to the unavailability of insulin, the high cost of the medication or lack of appropriate diet or exercise in our patients [20].

The average height of the children with diabetes was shorter than that of the control group even though the difference was not statistically significant. This is similar to the report from other studies [21-23]. One study showed that children who were diagnosed with T1 DM below the age of five years were shorter than children without diabetes, while those diagnosed above the age of ten years were similar in height to the control group [24].

The participants in the diabetic group were found to be lighter in weight than the control group. A study done in Iraq showed that more than half of children with T1 DM were underweight [25]. Another study in Germany observed that weight was significantly higher in patients at diagnosis of T1 DM than in the controls [26].

## CONCLUSION

Our study showed that there was no visual impairment in our cases or controls. While increased intra-ocular pressure was slightly more in the cases than controls, central corneal thickness was lower in the cases compared with the controls. We did not record any cases of dry eyes, cataract or diabetic retinopathy. We recommend a larger sample size with a multi-center study that will show if our findings truly reflect that of the population of children with T1DM. We also recommend that screening for ocular features of diabetes commence from one year after the diagnosis of T1 DM or at the age of ten years, whichever comes first considering our findings.

## REFERENCES

1. World Health Organization. Classification of diabetes mellitus. 2019.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation (IDF) Diabetes Atlas. Diabetes Res Clin Pract. 2019;157:107843.
3. Whicher CA, ONeill S, Holt RG. Diabetes in the UK: 2019. Diabet Med. 2020;37(2):242-247.
4. Uloko AE, Musa BM, Ramalan MA, Gezawa ID, Puepet FH, Uloko AT, et al. Prevalence and risk factors for diabetes mellitus in Nigeria: A systematic review and meta-analysis. Diabetes Ther. 2018;9:1307-1316.
5. Whitehouse PJ. Photocoagulation therapy for diabetic eye disease. JAMA. 1985;254(21):3086.

6. Romesh K, Griffing GT. Type 1 Diabetes Mellitus-Overview. 2023.
7. International Diabetes Federation (IDF). IDF diabetes atlas ninth edition. 2019.
8. Harjutsalo V, Maric C, Forsblom C, Thorn L, Waden J, Groop PH, et al. Sex-related differences in the long-term risk of microvascular complications by age at onset of type 1 diabetes. Diabetologia. 2011;54:1992-1999.
9. Aaoor P. Preferred practice pattern 2014: Diabetic retinopathy. Am J Ophthalmol. 2003.
10. Rice J. Screening for diabetic retinopathy. Contin Med Educ. 2013;31(4):123-126.
11. Akil H, Buluş AD, Andiran N, Alp MN. Ocular manifestations of type 1 diabetes mellitus in pediatric population. Indian J Ophthalmol. 2016;64(9):654.
12. Basilio A, Proenca R, Crisostomo S, Paixao A, Ferreira C, Xavier A, et al. Ocular Disease in Children with Type 1 Diabetes. Oftalmologia. 2016;40:295-299.
13. Ogugua CF, Chikani UN, Ibekwe MU, Ngwieri T, Allen H. Early signs of microvascular complications in pediatric patients with short duration of type 1 diabetes mellitus seen in Southeast Nigeria. Ann Afr Med. 2019;18(4):200-205.
14. Pasi R, Ravi KS. Type 1 diabetes mellitus in pediatric age group: A rising endemic. J Family Med Prim Care. 2022;11(1):27.
15. Tatti P, Pavandeep S. Gender difference in type 1 diabetes: An underevaluated dimension of the disease. Diabetol. 2022;3(2): 364-368.
16. Priatna AS, Fadil RM, Susanto NH. Blood glucose level and HbA1C in pediatric patients with diabetes mellitus type 1. Althea Med J. 2017;4(2):217-220.
17. Gale EA, Gillespie KM. Diabetes and gender. Diabetol. 2001;44:3-15.
18. Klein R, Klein BE, Moss SE, Davis MD, de Mets DL. The Wisconsin epidemiologic study of diabetic retinopathy: II. Prevalence and risk of diabetic retinopathy when age at diagnosis is less than 30 years. Arch Ophthalmol. 1984;102(4):520-526.
19. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c Test in Diagnosis and Prognosis of Diabetic Patients. Biomark Insights. 2016;11:95-104.
20. Essais O, Sandi M, Ziadi M, Yahyaoui R, Machghoul S, Zidi B. HbA1c in the monitoring of type 1 diabetic patients. Tunis Med. 2004;82(5):420-424.
21. Khadilkar VV, Parthasarathy LS, Mallade BB, Khadilkar AV, Chiplonkar SA, Borade AB. Growth status of children and adolescents with type 1 diabetes mellitus. Indian J Endocrinol Metab. 2013;17(6):1057.
22. Malone JI. Influence of type 1 diabetes on childhood growth and development. Springer .2000;161-164.
23. Areekal SA, Khadilkar A, Goel P, Cole TJ. Longitudinal height growth in children and adolescents with type-1 diabetes mellitus compared to controls in Pune, India. Pediatr. Diabetes. 2023.
24. Brown M, Ahmed ML, Clayton KL, Dunger DB. Growth during childhood and final height in type 1 diabetes. Diabetic Medicine. 1994;11(2):182-187.
25. Qadir KJ. Growth status of adolescents with diabetic type 1 and its associated factors. Med Res Arch. 2023;11(7).
26. Knerr I, Wolf J, Reinehr T, Stachow R, Grabert M, Schober E, et al. The accelerator hypothesis: Relationship between weight, height, body mass index and age at diagnosis in a large cohort of 9,248 German and Austrian children with type 1 diabetes mellitus. Diabetologia. 2005;48:2501-2504.