Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2021 18(3): 2331-2335. **OPEN ACCESS**

Prevalence of Ocular problems among children with diabetes mellitus type 1 in Sinnar state, Central Sudan

Mahagoub AM[1*], Mohammed Ahmed A Ahmed[2], Abubakar YF[2], Massaad SO[2], Omer SM[2], Ehab Kamal Ahmed Sogeir[4], Ibrahim Ginawi[3], Malik Asif Hussain[4], Junaid Amin[5], Rai Ahmad Khan kharl[6]

[1]Faculty of Medicine, Sinnar University, **Sudan**
[2]Faculty of Medicine and Health Sciences, University of Gadarif, **Sudan**
[3]General Directorate of Public Health Hail, Ministry of Health, **Saudi Arabia**
[4]College of Medicine, University of Hail, **Saudi Arabia**
[5]Department of physiotherapy, College of Applied Medical Science, University of Hail, **Saudi Arabia**
[6]Armed Forces Hospital Taif, **Saudi Arabia**

***Correspondence:** Juanid768@hotmail.com **Received 24-04-2021, Revised: 27-07-2021, Accepted: 09-08-2021 e-Published: 25-08-2021**

Type 1 diabetes mellitus in childhood is becoming a major concern in health management communities. Furthermore, the increasing number of these patients has a considerable contribution to hospital admissions. This increase in diabetic population is usually associated with an increase in diabetes-related complications. Our aim was to study the prevalence of eye complication in children with type 1 diabetes in Sinnar hospital, central Sudan. It was a descriptive, cross-sectional and facility–based study. It was conducted from 1st January, 2016 to 31th December, 2016. The study investigated the prevalence of ocular problems among children with type 1 diabetes. A total of 50 children (age < 18 years old) attended Sinnar hospital with confirmed diagnosis of type 1 diabetes. They were selected through non-probability convenient sampling method for the study. Out of all investigated children 22 (44%) were males and 28 (56%) were females. Their ages ranged between 1 year and 18 years which makes it a mean age of 9.5 years. A family history of type 1 diabetes was present in only one child (2%), and the most common cause of hospitalization was diabetic ketoacidosis (DKA).Ocular complications were identified were; cataract in 2 patients (4%), refractive error in 8 patients (16%) and noticeably no case of retinopathy. We acknowledge that we could not find more data related to complications of type 1 diabetes in Sudanese children during our study period. We recommend conducting more research and data collection in this category of patients particularly related to the prevalence of eye complications as current research and literature evidence is not enough to understand nature of ocular complications in diabetic children.

Keywords: children, diabetes mellitus, ocular problems, prevalence, Sudan

INTRODUCTION

The number of people suffering from diabetes mellitus (DM) has increased worldwide in previous few decades. DM is a condition associated with metabolic derangement of glucose in the body, resulting in a state of chronically increased level of glucose in the blood. Clinically three types of diabetes are important which are; type 1 diabetes mellitus (T1DM), type 2 diabetes mellitus (T2DM) and gestational diabetes mellitus (GDM). T1DM is

an issue with insulin production, which results in low level of insulin secretion due to destruction of pancreatic island cell. T2DM is associated with insulin resistance, which means the target cells do not respond to the available insulin. GDM is a special type of diabetes mellitus affecting women during pregnancy (Akil, Buluş, Andiran, & Alp, 2016).

It has been reported that over half a million children are suffering from T1DM and about 80,000 annual new cases are reported which is increasing prevalence of the disease in children (Akil, Buluş, Andiran, & Alp, 2016). As a systemic disease, DM has several well-known microvascular complications such as diabetic retinopathy (DR), neuropathy, and nephropathy (Akil et al. 2016). As mentioned earlier, the prevalence of T1DM in childhood is increasing which is resulting in significant rise in ocular problems and risk of visual loss in children (Ibanez-Bruron, Solebo, Cumberland, & Rahi, 2017). Unfortunately, the available information and data related to prevalence as well as exact pathophysiological relationship of T1DM with ocular problems is not sufficient (Hamid et al. 2016).

One of the major ocular complications related to diabetes is diabetic retinopathy (DR), which has a strong association with duration of the diabetes in a patient. It is a leading cause of blindness, which affects over 4 million people globally. Diabetic children usually do not develop sight-threatening DR (STDR) until old age, around puberty. (Hamid et al. 2016). DR can be non-proliferative (NPDR) or proliferative (PDR). The former does not affect the vision while later does. It is also important to know that NPDR would ultimately progress to PDR. The clinical goal is to delay this progression with good glycemic control (Control, Interventions, and Group, 2000) . The medical literature shows variability in prevalence of DN in children which requires further evidence to estimate exact prevalence of DN in this this age group. The variation is probably due to various factors including the target population, the criteria for DN diagnosis and diagnostic / screening tests used. There is great need to make global criteria for screening and other parameter so that we can have more clear information regarding natural history and real burden of diabetes in children (Ibanez-Bruron et al. 2017).

Cataract is among the major causes of visual problems in diabetics. Type 1 diabetes associated cataract is defined as true diabetic cataract characterized by diffuse posterior and/or anterior, subcapsular or cortical 'snow-flake opacities (Pakhetra & Jyotsna, 2009) Although cataract surgery is safe and has high rate of success in healthy individuals but this is not the case with diabetics (Pakhetra & Jyotsna, 2009).

Under normal physiological conditions, light rays reflected from any object are transmitted through cornea and lens to get accurately focussed on the retina. Refractive errors are problems with this normal focussing and image is usually not accurately focussed on retina. Astigmatism, hyperopia and myopia are different types of refractive errors. The diabetics can suffer from transient refractive changes because of fluctuating glucose levels (Coats & Paysse). Likewise, poorly controlled diabetes and undiagnosed cases of diabetes can present with blurring of the vision (Rappoport, Greenwald, Pollack, & Kleinmann, 2011).

The above literature shows that T1DM is an important clinical condition and its complications particularly related to ocular system are significantly important in children. Our research focused on investigating the prevalence of ocular complications in children who have been diagnosed with T1DM.

MATERIALS AND METHODS

This was descriptive cross sectional facility-based study conducted from first January, 2016 to 31st December, 2016 to investigate the prevalence of ocular problems (retinopathy, cataract and refractive errors) among children with type 1 diabetes in Sinnar paediatric teaching hospital, central Sudan. A total of 50 children <18yr old, who attended Sinnar paediatric teaching hospital with confirmed diagnosis of type 1 diabetes, were selected through Non-probability convenient sampling method for this study. Structured questionnaire was used to gather data from a parent or a guardian. The information sought by the questionnaire included; the socio - demographic characteristics (age gender and residence), the mean age at time of diagnosis, duration of illness, frequency of urine and blood glucose monitoring, number of insulin shots per day and type of insulin used by the patient. All patients underwent proper systemic examination including weight, height, BP and clinical examination (CNS, abdominal, chest and CVS). Complete eye examination including dilated fundoscopy and cycloplegic refraction were performed by an experienced ophthalmologist.

Basic laboratory tests were performed for every child on admission and repeated when

clinically required. These included urine analysis, RBS, CBC, RFT, thyroid function tests and celiac screening. For all patients, we also conducted HBA1c checking every 3 month. Overall, all patients were under multidisciplinary care supervised by a psychologist, nutritionist, ophthalmologist and paediatrician. Furthermore, we closely followed every patient on monthly basis in a clinic focusing on these patients included in this study. All patients were on premixed and some of them received short acting and long acting formulation of insulin.

Table 1: Characteristics of Participants

Characteristics	Sub-division	n(%)
Gender	Male	22 (44)
	Female	28 (56)
Age (Years)	0-4	1 (2)
	5-11	22 (42)
	12-18	8 (6)
Follow up Visits to Diabetic Clinics	Regular visits	37 (74)
	No visits	13 (26)
City of Residence	Sinnar	18 (36)
	Eldindir	5 (10)
	Sinja	15 (30)
	East Sinnar	7 (14)
	Alsuki	1 (2)
	Dalli	2 (4)
	Mazmum	2 (4)
Health Center	Sinnar	47(94)
	Dindir	2 (4)
	Abu Hojar	1 (2)

Table 2: Ocular complications

Ocular complications	n(%)
Cataract	2(4)
High Refractory Error	8(16)
Retinopathy	0

RESULTS

Among a total of 50 investigated children, 22 (44%) were males and 28 (56%) were females, making a male to female ratio of 0.9, age range between 9 months to 18 year with mean age of 9.5 years. In total 37 children (74%) attended our diabetic clinic regularly, but unfortunately 13 children (26%) did not have a regular follow up. The age distribution of study participants was as follow 0-4yrs was 1 patient (2%), 5-11 years were 22 patients (42%) and finally 12-18 years were 28 patients (6%). The mean age at time of diagnosis was 7.1 years. The family history was available in only one child (2%). The residency data was also collected and 18 children were from Sinnar (36%), 5 form Eldindir (10%), 15 from Sinja (30%), 7 from East Sinnar (14%), 1 from Alsuki (2%), 2 from each Dalli (4%) and Mazmum (4%). Urine glucose check was performed every month in the most of the children 23 (46%), once per week in 2 patients (4%), every two weeks in 2 patients (4%), every 8 weak in 6 patients (12%), every 12 week in 3 patients (6%), every 16 weeks in 2 patients (4%), every 20 weeks in 2 patients (4%) and every 24 weeks in 1 patient (2%). Blood glucose monitoring was also performed every month in the most of the children 31 (62%), once per week in 2 patients (4%), every 2 weeks in 2 patients (4%), every 3 weeks in one patient (2%), every eight weeks in 5 patients (10%), every 12 weeks in 3 patients (6%), every 16 weeks in 3 patients (6%), every 20 weeks in 2 patients (4%), every 24 weeks one patient (2%). HbA1c was also checked in all patients. Only 2 children (4%) had good glycaemic control with HbA1c less than 8, and 18 children (36%) with poor control with HbA1c value more than 12.

All patients received premixed insulin. There were 24 patients (48%) who received two insulin shots per day which were premixed, and 26 children (52%) received 3 shots of insulin per day (2 premixed morning and evening and one soluble insulin at midday). Admission with DKA occurred in 33 children (66%). Out of these children, 16 were admitted once, 10 admitted 2 times, 6 admitted 3 times and one child admitted 4 times. The frequency of admission among study children with severe hypoglycaemia during last year was 4 children (8%). Out of these 4 children, 2 were admitted once and one child was admitted 2 times and one child admitted 3 times.

Amongst the children included in this study, we found two case of cataract (4%), 8 cases (16%) with high refractory error and no case of retinopathy. There was no significant relation between the level of HBA1c and occurrence of ocular complication as per our analysis.

DISCUSSION

This study described the prevalence of ocular complications (cataract, retinopathy and refractive errors) among children with type 1 diabetes in Sinnar paediatric teaching hospital, central Sudan. It also highlights some epidemiological factors and frequency of admissions with DKA and severe hypoglycaemia.

The numbers of cases of children with diabetes are increasing in Sudan and the reported

numbers of cases are even higher compared to other Arab countries (Elamin, Omer, Zein, & Tuvemo, 1992) . As the details related to natural history of T1DM and its complication are still thus the exact depth of the problem is still ambiguous For instance, the reported number of cases in Tanzania according to some studies is 1.5/100,000 which is far less than the prevalence in Western countries. This indicates the possibility of low rate of testing and diagnosis in African countries. Likewise, in Sudan 10% children developing T1DM are not admitted to any hospital at time of diagnosis. These children usually present to clinics only after developing some complications of diabetes. The study also reports undiagnosed cases of T1DM in children particularly those who die before reaching 5 years of age(Majaliwa et al. 2007).

Clinically DR is very important as it indicates the level of treatment provided and control of the glucose level in early stages of the disease. Furthermore, controlling or delaying DR is also important form treatment point, as it is a preventable reason for impairment of vision and blindness(Ibanez-Bruron et al., 2017). In our study group we found no cases of diabetic retinopathy, this finding is similar to study done by Megan *et al.* (2015) who investigated 370 children with DM between 1 year and 17.5years (Mean 11.2 years)(Geloneck, Forbes, Shaffer, Ying, & Binenbaum, 2015) . In contrast to this, another study by Hletala et al. (2010) presents different results. They investigated 1117 patients and found 367 cases (33%) of proliferative retinopathy. Furthermore, they reported that children who develop diabetes prior to 4 years of age were suffering from retinopathy in highest proportion (47.0% [95% CI 39.5–54.6]) (Hletala, Harjutsalo, Forsblom, Groop, & Group, 2010) . We think the huge variation in various studies like the two mentioned could be due to multiple factors. As mentioned earlier in this document, the difference could be due to study subjects, their ages, duration of disease, diagnostic and screening methods.

The patients who suffer from diabetes in early life are more prone to develop cataract and it progresses rapidly (Pakhetra & Jyotsna, 2009) The exact mechanism of this is not clear but polyol pathway is reported to be involved in start of cataract development (Pollreisz & Schmidt-Erfurth, 2010)..

Although cataract is one of the most common ocular problem faced by diabetics but it is hard to diagnose its development particularly in early stages of disease in children below age of puberty.

Various studies from different countries and regions have reported prevalence of diabetic cataract from 0.7% to 16% amongst children and adults(Jin et al. 2012). It is interesting to notice a higher prevalence of T1DM in males compared to females but diabetic cataract is observed more in female patients. Although the reason for this is not known yet (Pakhetra & Jyotsna, 2009). In our study we found two of the cataract cases (4%)which were in the range stated above .Other study done by Falck A1, Laatikainen L 1998, in Oulu university in Finland, 600 paediatric diabetics were followed up during the years 1975 to 1995, Six patients (1%) were found to have cataract aged between 9.1 to 17.5 years. These children were suffering from diabetes for 0 months (newly diagnosed) to about 4 years. Noticeably, all of these patients had similar type of cataract characterized by deposits in cortical and posterior sub-capsular regions.

In our study we found 8 patient (16%) with high refractive errors, with 3 (6%) having myopia, 3 (6%) having high hyperopia, and 2 (4%) having astigmatism.

CONCLUSION

We could not find more data related to complications of type 1 diabetes in Sudanese children during our study period. We recommend conducting more research and data collection in this category of patients particularly related to the prevalence of eye complications as current research and literature evidence is not enough to understand nature of ocular complications in diabetic children.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEGEMENT

We really appreciate the support of administrative and medical staff of hospitals and clinics during our data collection.

AUTHOR CONTRIBUTIONS

Conceptualization, MAM. and MAA.; methodology, JA and AYF.; software, MAA formal analysis, EKAS and MSO.; investigation, MAM. and AYF; resources, IG and OSM data curation, JA and OSM.; writing—original draft preparation, MAM,MAA,AYF,EKAS,MSO and IG; writing—review and editing, JA, MAH and RAKK.;

supervision, MAM and MAH.; project administration, IG and MAM; All authors read and approved the final version.

REFERENCES

Akil, H., et al.Ocular manifestations of type 1 diabetes mellitus in pediatric population. Indian journal of ophthalmology,2016. 64(9): p. 654.

Coats, D.K. and E.A. Paysse,Refractive errors in children.Control, D., C.T.E.o.D. Interventions,and C.R. Group, Retinopathy and nephropathy in patients with type 1 diabetes four years after a trial of intensive therapy. New England Journal of Medicine, 2000.342(6): p. 381-389.

Elamin, A., et al. Epidemiology of childhood type I diabetes in Sudan, 1987–1990. Diabetes care, 1992. 15(11): p. 1556-1559.

Falck A, Laatikainen L. Diabetic cataract in children.Acta Ophthalmologica Scandinavica. 1998 Apr 1; 76(2):238-40.

Geloneck, M.M., et al. Ocular complications in children with diabetes mellitus. Ophthalmology, 2015.122(12): p. 2457-2464.

Hamid, A., et al. Diagnosis of retinopathy in children younger than 12 years of age: implications for the diabetic eye screening guidelines in the UK. Eye,2016. 30(7): p. 949.

Hletala, K., et al.Age at onset and the risk of proliferative retinopathy in type 1 diabetes. Diabetes care, 2010. 33(6): p. 1315-1319.

Ibanez-Bruron, M.C., et al. Prevalence of diabetic retinopathy in children and young people living with diabetes: protocol for a systematic review. BMJ Open, 2017. 7(11).

Jin, Y.Y., et al. Reversible cataract as the presenting sign of diabetes mellitus: report of two cases and literature review. Iranian journal of pediatrics, 2012. 22(1): p. 125.

Majaliwa, E.S., et al. Survey on acute and chronic complications in children and adolescents with type 1 diabetes at Muhimbili National Hospital in Dar es Salaam, Tanzania. Diabetes care, 2007. **30**(9): p. 2187-2192.

Pakhetra, R. and V. Jyotsna, Bilateral early cataracts in type 1 diabetes. Medical journal, Armed Forces India, 2009. **65**(1): p. 71.

Pollreisz, A. and U. Schmidt-Erfurth, Diabetic cataract—pathogenesis, epidemiology and treatment. Journal of ophthalmology, 2010. 34(2): p 32.

Rappoport, D., et al. Ocular Complications of Type 1 Diabetes, in Type 1 Diabetes Complications2011. 23(1): p 13.