# Ocular Complications in diabetic children in Aseer region

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## Abstract

Background: Diabetes mellitus (DM), a multi-systemic disease marked by hyperglycaemia, is becoming more common around the world. Diabetes mellitus (DM) is a well-known cause of many ophthalmic problems, including diabetic retinopathy (DR), macular oedema, cataract, refractive change, and micro-vascular paralytic strabismus. A significant public health effort has been made to create ocular screening regimens for diabetic patients, beginning at a young age.

Aim: to assess the knowledge of diabetic children regarding the risk of ocular complications and prevalence of ocular complications among diabetic children.

Methodology: A descriptive cross-sectional study was used targeting all accessible diabetic children aged less than 18 years or their care givers in Aseer region. Data were collected from participants using an online pre-structured questionnaire. The questionnaire covered the following data: participants' socio-demographic data, diabetes related clinical data. The third part covered participants' knowledge using multiple responses and mutually exclusive questions. The questionnaire was uploaded online using social media platforms by the researchers during the period from 17 November 2021 to 2 June 2022. All accessible and eligible population in the study setting were invited to fill in the attached tool.

Results: A total of 499 children fulfilling the inclusion criteria completed the study questionnaire. Exactly 275 (55.1%) were males and 224 (44.9%) were females. None of the sampled children had other co-morbidities. Exactly 188 (37.7%) children had been diagnosed with DM for 6-10 years, 179 (35.9%) diagnosed for 11-15 years while 43 (8.65%) were diagnosed for less than 5 years. About 88% of the study participants agreed that diabetes may cause eye-related complications, and 87.6% agreed that early detection of eye diseases associated with diabetes may reduce their complications. A total of 85.2% think that the annual visit to the ophthalmologist for diabetics is important. Good control of HbA1c as the best method to prevent diabetic eye complications was known by 67.3% of the study participants.

Conclusions: In conclusion, the study revealed that diabetic eye complications among children were not frequent with poor diabetic control. Participants' knowledge regarding diabetes eye related complications was on average especially for the significance of ophthalmologist visits and early detection of the disorders.

Keywords: Diabetes, eye complications, children, care givers, knowledge, awareness, Saudi Arabia

## Introduction

The chronic metabolic disorder diabetes mellitus is a fast-growing global problem with huge social, health, and economic consequences [1-2]. In 2000, 171 million people were diagnosed with diabetes, and it is predicted that this number may reach 366 million within the next three decades, with a higher burden in the developing countries [3]. Nowadays, Type 1 diabetes mellitus (T1DM) has been detected among nearly half a million children globally, with annual incidence of 80,000 cases [4]. Recently, T1DM and its complications were one of the most challenging public health problems, besides being a primary source of morbidity and high mortality [5].

Patients with T1DM experience many complications including ocular problems such as retinopathy, retinal oedema, papillopathy, cataract, glaucoma, strabismus, and refractive alterations which are well documented [6-7]. Annually, diabetic retinopathy and macular oedema end with blindness in 12,000 to 24,000 new patients in the United States [8].

In a recent study, a decreased retinal thickness was detected among patients with Type 1 DM with associated diabetic retinopathy compared with nondiabetic controls [9]. Thus, diabetes-associated neuronic lesions may have a significant role in the development of DR, dry eye syndrome (DES), and glaucoma that may cause clinical or subclinical microvascular changes [10].

Early detection and treatment of diabetic macular oedema and proliferative diabetic retinopathy (PDR) in individuals with DM will lower the risk of moderate and severe vision loss [11]. As a result, a significant public health effort has been made to create ocular screening regimens for diabetic patients, beginning at a young age. The purpose of this study was to assess diabetes-related ocular complications and knowledge level among diabetic children and their caregivers.

## Methodology

A descriptive cross-sectional study was used targeting all accessible diabetic children aged less than 18 years, or their care givers in Aseer region, Southern Saudi Arabia. A total of 620 individuals received the study survey. Exactly 499 respondents were eligible and completed the study questionnaire with a participation rate of 80.4%. After obtaining permission from the Institutional ethics committee, data collection started. Data were collected from participants using an online pre-structured questionnaire. The researchers constructed the survey tool after comprehensive literature review and expert's consultation in the field of the study. The study questionnaire was reviewed, using a panel of 3 experts, for validity and clarity. Tool reliability was assessed using a pilot study of 35 participants with reliability coefficient (α-Cronbach's) of 0.73 for knowledge items. The questionnaire covered the following data: participants' socio-demographic data such as gender, medical history, family history of DM, history of eye diseases. The second section covered diabetes related clinical data including duration of DM, treatment received, HbA1c, and complications with medical consultation. The third part covered participants' knowledge using multiple responses and mutually exclusive questions. The questionnaire was uploaded online using social media platforms by the researchers during the period from 17 November 2021 to 2 June 2022. All accessible and eligible population in the study setting were invited to fill in the attached tool.

**Data analysis**

After data were extracted, it was revised, coded, and fed into Statistical Software IBM SPSS version 22(SPSS, Inc. Chicago, IL). All statistical analysis was done using two tailed tests. P value less than 0.05 was statistically significant. For knowledge and awareness items, each correct answer was scored one point and total summation of the discrete scores of the different items covering general knowledge regarding diabetes related ocular complications. Participants with a score less than 60% of the total score were considered to have poor knowledge level while good knowledge was considered if they had a score of 60% of the total or more. Descriptive analysis based on frequency and percent distribution was done for all variables including participants' socio-demographic data, medical history, family history of DM, and diabetes related data including duration, treatment received and complications. Also, participants' knowledge regarding diabetes related ocular complications are shown in frequency tables. Cross tabulation was used to assess distribution of participants' knowledge level regarding diabetes related ocular complications according to their personal data, and disease history. Relations were tested using Pearson chi-square test and exact probability test for small frequency distributions.

## Results

A total of 499 children fulfilling the inclusion criteria completed the study questionnaire. Exactly 275 (55.1%) were males and 224 (44.9%) were females. None of the sampled children had other co-morbidities. A total of 288 (57.7%) children had a family history of DM which was type 1 DM among 182 (63.2%), and type 2 DM among 106 (36.8%). Medical history of eye diseases was reported among 133 (26.7%) children (Table 1).

Table 2. Diabetes related data and its complications among study children, Aseer region, Saudi Arabia. Exactly 188 (37.7%) children had been diagnosed with DM for 6-10 years, 179 (35.9%) diagnosed for 11-15 years while 43 (8.65) were diagnosed for less than 5 years. As for diabetes control, 203 (40.7%) children reported that their last HbA1c was 6.5-7.5% while 132 (26.5%) had HbA1c of 7.5-8.5% while 58 (11.6%) had HbA1c of 8.5% or more. A total of 228 (45.7%) children were on oral hypoglycaemics, 181 (36.3%) were on insulin and 90 (18%) were on both. Regarding diabetes complications, the most reported were retinopathy (12.2%), followed by DKA (7%), thrombosis (5.6%), and renal problems (4.6%). A total of 339 (67.9%) had no complications. A total of 275 (55.1%) children visited an ophthalmologist due to eye complications and myopia was diagnosed among 165 (33.1%) while 35 (7%) had hyperopia.

Table 3. Knowledge regarding diabetic eye complications among study patients, Aseer region, Saudi Arabia. Exactly 88% of the study participants agreed that diabetes may cause eye-related complications, and 87.6% agreed that early detection of eye diseases associated with diabetes may reduce its complications. A total of 67.1% reported that an ophthalmologist should be visited immediately after DM diagnosis. Exactly 85.2% think that the annual visit to the ophthalmologist for diabetics is important. Good control of HbA1c as the best method to prevent diabetic eye complications was known by 67.3% of the study participants and 57.5% think that eye complications for diabetics are very serious while 37.9% think it is only serious.

Figure 1. Overall knowledge regarding diabetic eye complications among study participants, Aseer region, Saudi Arabia. Exactly 218 (43.7%) participants had good knowledge level regarding diabetes related ocular complications while 281 (56.3%) had poor knowledge level.

Table 4. Distribution of participants knowledge level regarding diabetes ocular complications by their bio-demographic data. Exactly 51.3% of male participants had a good knowledge level compared to 34.4% of females with recorded statistical significance (P=.001). Also, 73% of children with diabetes for 16-17 years had good knowledge level regarding ocular complications versus 41.9% of those with diabetes for less than 5 years (P=.001). Exactly 47.6% of participants had family history of DM versus 38.4% of others without (P=.041). Also, good knowledge level was detected among 67.7% of participants with medical history of eye diseases versus 35% of others without (P=.001). Additionally, 56% of participants who visited ophthalmologists due to eye complications had good knowledge regarding ocular complications compared to 28.6% of others who did not (P=.001). A total of 68.5% of participants with myopia had good knowledge level versus 17.1% of those with hyperopia (P=.001).

**Table 1. Socio-demographic data of sampled children with diabetes mellitus, Aseer region, Saudi Arabia**

| Socio-demographic data | No | % |
|---|---|---|
| **Gender** | | |
| *Male* | 275 | 55.1% |
| *Female* | 224 | 44.9% |
| **Have other diseases** | | |
| *No* | 499 | 100.0% |
| **Family history of DM** | | |
| *Yes* | 288 | 57.7% |
| *No* | 211 | 42.3% |
| **If yes, type of DM?** | | |
| *Type 1* | 182 | 63.2% |
| *Type 2* | 106 | 36.8% |
| **Have medical history of eye diseases** | | |
| *Yes* | 133 | 26.7% |
| *No* | 366 | 73.3% |

**Table 2. Diabetes related data and its complications among study children, Aseer region, Saudi Arabia**

| Diabetes related data / complications | No | % |
|---|---|---|
| **Child age at diagnosis with DM** | | |
| *< 5 years* | 43 | 8.6% |
| *6-10* | 188 | 37.7% |
| *11-15* | 179 | 35.9% |
| *16-17* | 89 | 17.8% |
| **Last value of HbA1c** | | |
| *6-6.5%* | 39 | 7.8% |
| *6.51-7.5%* | 203 | 40.7% |
| *7.51-8.5%* | 132 | 26.5% |
| *8.51-9.5%* | 58 | 11.6% |
| *Don't know* | 67 | 13.4% |
| **Treatment received** | | |
| *Oral hypoglycaemics* | 228 | 45.7% |
| *Insulin* | 181 | 36.3% |
| *Both of them* | 90 | 18.0% |
| **Have diabetes related complications?** | | |
| *Retinopathy* | 61 | 12.2% |
| *DKA* | 35 | 7.0% |
| *Thrombosis* | 28 | 5.6% |
| *Renal problems* | 23 | 4.6% |
| *Peripheral neuropathy* | 11 | 2.2% |
| *Vascular complications* | 2 | .4% |
| *None* | 339 | 67.9% |
| **Have visited ophthalmologists due to eye complications?** | | |
| *Yes* | 275 | 55.1% |
| *No* | 224 | 44.9% |
| **Do you have visual problems?** | | |
| *Myopia* | 165 | 33.1% |
| *Hyperopia* | 35 | 7.0% |
| *None* | 299 | 59.9% |

**Table 3. Knowledge regarding diabetic eye complications among study patients, Aseer region, Saudi Arabia**

| Knowledge items | No | % |
|---|---|---|
| **Diabetes may cause eye-related complications?** | | |
| *Strongly agree* | 265 | 53.1% |
| *Agree* | 174 | 34.9% |
| *Disagree* | 23 | 4.6% |
| *Strongly disagree* | 1 | .2% |
| *Don't know* | 36 | 7.2% |
| **Early detection of eye diseases associated with diabetes may reduce its complications?** | | |
| *Strongly agree* | 284 | 56.9% |
| *Agree* | 153 | 30.7% |
| *Disagree* | 21 | 4.2% |
| *Don't know* | 41 | 8.2% |
| **When you should visit ophthalmologist?** | | |
| *Immediately after DM diagnosis* | 335 | 67.1% |
| *When have visual problems* | 154 | 30.9% |
| *No need at all* | 10 | 2.0% |
| **The annual visit to the ophthalmologist for diabetics is important?** | | |
| *Strongly agree* | 257 | 51.5% |
| *Agree* | 168 | 33.7% |
| *Disagree* | 23 | 4.6% |
| *Strongly disagree* | 1 | .2% |
| *Don't know* | 50 | 10.0% |
| **What is the best way to prevent diabetic eye complications?** | | |
| *Good control of HbA1c* | 336 | 67.3% |
| *Frequent visits of ophthalmologist* | 139 | 27.9% |
| *Eye complications cannot be prevented* | 24 | 4.8% |
| **How serious are eye complications for diabetics?** | | |
| *Very serious* | 287 | 57.5% |
| *Serious* | 189 | 37.9% |
| *Not serious at all* | 23 | 4.6% |

**Figure 1. Overall knowledge regarding diabetic eye complications among study participants, Aseer region, Saudi Arabia**

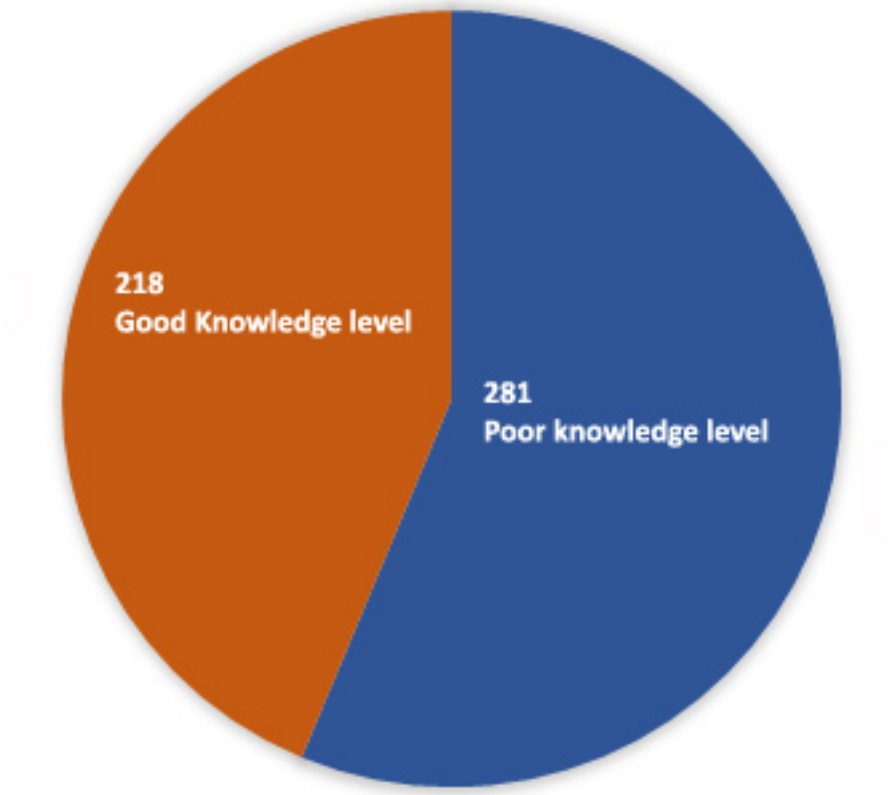

**Table 4. Distribution of participants knowledge level regarding diabetes ocular complications by their bio-demographic data**

| Factors | Knowledge level | | | | p-value |
|---|---|---|---|---|---|
| | Poor | | Good | | |
| | No | % | No | % | |
| **Gender** | | | | | |
| *Male* | 134 | 48.7% | 141 | 51.3% | .001* |
| *Female* | 147 | 65.6% | 77 | 34.4% | |
| **Child age at diagnosis with DM** | | | | | |
| *< 5 years* | 25 | 58.1% | 18 | 41.9% | |
| *6-10* | 135 | 71.8% | 53 | 28.2% | .001* |
| *11-15* | 97 | 54.2% | 82 | 45.8% | |
| *16-17* | 24 | 27.0% | 65 | 73.0% | |
| **Family history of DM** | | | | | |
| *Yes* | 151 | 52.4% | 137 | 47.6% | .041* |
| *No* | 130 | 61.6% | 81 | 38.4% | |
| **Have medical history of eye diseases** | | | | | |
| *Yes* | 43 | 32.3% | 90 | 67.7% | .001* |
| *No* | 238 | 65.0% | 128 | 35.0% | |
| **Have visited ophthalmologists due to eye complications?** | | | | | .001* |
| *Yes* | 121 | 44.0% | 154 | 56.0% | |
| *No* | 160 | 71.4% | 64 | 28.6% | |
| **Do you have visual problems?** | | | | | |
| *Myopia* | 52 | 31.5% | 113 | 68.5% | .001*$ |
| *Hyperopia* | 29 | 82.9% | 6 | 17.1% | |
| *None* | 200 | 66.9% | 99 | 33.1% | |

P: Pearson X2 test $: Exact probability test * P < 0.05 (significant)

## Discussion

The retina is the interior coating at the back of each eye. The retina senses light and turns it into signals that the brain decodes, so people can see [12]. Diabetes associated damage of blood vessels is a hazard to the retina, causing a disease called diabetic retinopathy [13]. In early stage of diabetic retinopathy, blood vessels are weakened, swell, or leak into the retina. This stage is called non-proliferative diabetic retinopathy [14]. With more advanced stages, some blood vessels close off with growing of new blood vessels, or they proliferate, on the surface of the retina. This stage is called proliferative diabetic retinopathy. These abnormal new blood vessels can lead to serious vision problems [14-15]. Eye complications with diabetes are quickly evolving as a global health challenge that may threaten patients' visual acuity and visual function. Proper management of diabetic retinopathy can decrease the hazard of visual loss by 60% [16]. Diabetic retinopathy still remains the leading cause of blindness among working-age adults. The current study aimed to assess diabetes-related ocular complications and knowledge level among diabetic children and their caregivers.

The study results showed that more than half of the children were males and two thirds of them had type 1 DM. About one quarter of the children had a medical history of eye diseases. As for diabetes clinical data, it was recent (less than 5 years) among a very low percentage of the children while more than half of them had been diagnosed with DM for more than 10 years. About half of the children were on oral hypoglycaemics and others on insulin. More than half of the children reported that their HbA1c exceeded 7.5% which means poor diabetic control. The global average HbA1c in DM children was 9.09 ± 2.12%. On average, there were 23.6% (95% CI 23.1–24.1%) children who had good glycemic control with HbA1c <7.5%, and 46.9% (95%CI 46.0–47.7%), [17] children with DM had HbA1c ≥9.0% which is in concordance with the current study findings. The American Diabetes Association (ADA) recommended HbA1c <7.5% in 2015 [18], the National Institute for Health and Care Excellence (NICE) suggested HbA1c <6.5% in 2016 [19], and the International Society for Paediatric and Adolescent Diabetes (ISPAD) recommended HbA1c <7.0% for children with DM in 2018 [20].

Regarding diabetes related complications, retinopathy was the most reported among the current study participants (nearly 1 out of each 10 children), followed by DKA, and thrombosis. More than half of the children visited ophthalmologists due to eye complications and myopia was the most diagnosed visual problem (nearly one third of the patients). This is against literature findings and recommendations where a study of DM among children reported that having DM type 1 at a very young age may protect against the development of DR [21]. Even less is known about DR risk and incidence in children with type 2 DM, which is a progressively significant population to study given the rising magnitude of children with this disorder. The current study included one third of the children with type 2 DM for long duration (more than 10 years) which may explain DR cases.

Regarding children and caregivers' knowledge of diabetes related eye complications, the study results showed that less than half were knowledgeable regarding these complications. In more details, the vast majority of the study participants agreed that diabetes may cause eye-related complications, and also agreed that early detection of eye diseases associated with diabetes may reduce their complications. About two thirds of the participants said that an ophthalmologist should be visited immediately after DM diagnosis. More than three quarters of the respondents think that the annual visit to the ophthalmologist for diabetics is important. Good control of HbA1c as the best method to prevent diabetic eye complications was known by two thirds of the study participants and more than half of them think that eye complications for diabetics are very serious while one third think it's only serious. Knowledge was significantly higher among male participants, with long duration diabetes, positive family history, and those with eye diseases who visited an ophthalmologist. Ramke J et al. [22] reported that correct nomination of at least one symptom, risk factor, prevention or treatment of diabetes was made by 6.1% of adolescents. Also, 6.8% supposed that diabetes caused problems with the body and 3.6% reported diabetes caused eye problems. AlHargan MH in Riyadh found that there was good awareness about DR, diabetes was well controlled among 61% of the patients, but less than half (45%) had their eyes checked within 1 year. Good awareness regarding diabetes associated eye complications was shown in other studies in Hail and Al Jouf (76%) and Jeddah (83%) [23-25]. Also, studies from Oman (93%), [26] Jordan (88%), [27] and Turkey (88%), [28] showed a similarly high level of awareness regarding DM affecting the eyes.

## Conclusions and Recommendations

In conclusion, the study revealed that diabetic eye complications among children were not frequent with poor diabetic control. Participants' knowledge regarding diabetes eye related complications was on average, especially for the significance of ophthalmologist visits and early detection of the disorders. Long duration of diabetes, family history of DM, with ophthalmologists' visits were the most significant determinants of knowledge level. More effort should be paid to increase the incentive of the patients for regular eye examination. The physicians can be the superlative source for providing this motivation since a high proportion of patients report that they received their information from their doctors.

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