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ORIGINAL ARTICLE

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Knowledge, Attitudes and Practices Regarding Diabetes-Related Ocular Complications among Type 2 Diabetics in Sana'a City, Yemen

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ABSTRACT

Background: Ocular complications of diabetes mellitus (DM), including diabetic retinopathy (DR), progress silently, underscoring the need for patient awareness and screening. However, there is a lack of studies assessing diabetic patients' knowledge, attitudes, and practices (KAPs) regarding the ocular complications of DM. Therefore, this study assessed KAPs regarding diabetes-related ocular complications among type 2 DM patients in Sana'a city to inform preventive strategies.

Methods: A descriptive cross-sectional study was conducted in 2024 among 400 type 2 diabetic patients recruited via convenience sampling from public and private healthcare facilities in Sana'a city, Yemen. A pilot-tested, structured questionnaire was used to collect patients' demographic and clinical characteristics, as well as their KAPs regarding diabetes-related ocular complications. Data were then summarized using descriptive statistics.

Results: Most patients (88%) recognized the ocular effects of DM, primarily visual impairment (31%) and DR (22.4%), with fewer identifying cataracts (5.7%) or eye infections (4%). While 74.3% acknowledged the importance of regular eye exams, 39.3% were unaware of recommended frequencies, and 63% reported not undergoing regular screenings. Notably, 52.8% had never undergone dilated eye exams, 57% consulted optometrists/opticians, 37.7% never examined their eyes, and 52.8% never underwent dilated exams. Among 57 patients with DR, 98.2% received treatment recommendations, with 73.7% adhering to them and 97.6% attending follow-ups.

Conclusion: In Sana'a, most type 2 diabetes patients are generally aware of diabetes' ocular effects but lack specific knowledge of complications like DR. Many value regular eye exams, but few adhere to guidelines, rarely undergoing routine or dilated screenings. Addressing the gap between awareness and practices requires targeted education to improve preventive practices and reduce the risk of blindness.

Keywords: Knowledge ▪ Attitudes ▪ Practices ▪ Ocular complications ▪ Yemen

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1. Introduction

Diabetes mellitus (DM) is one of the most common chronic metabolic disorders worldwide, which is caused by insufficient insulin secretion by the pancreas (type 1 diabetes) or resistance to insulin (type 2 diabetes). The global prevalence of DM surged dramatically between 1990 and 2022, rising from 200 million to 830 million cases.[1] Type 2 diabetes accounts for more than 95% of DM cases.[1] In Yemen, it is estimated that 4% of the adult population is diabetic, totaling approximately 613,900 cases in 2021.[2]

Diabetic retinopathy (DR), a serious microvascular complication of uncontrolled DM, leads to ischemia, increased vascular permeability, retinal neovascularization, macular edema, and irreversible blindness.[3, 4] In 2020, the global prevalence of DR was estimated to occur among 22.3% of diabetic patients.[5] Approximately 2% of diabetic patients go blind within 15 years of diagnosis, and the condition accounts for 5.8% of blindness worldwide.[6] In Yemen, 7.7% of diabetic patients attending a tertiary care eye hospital in Sana'a were found to be unilaterally blind, while 11.2% were found to be bilaterally blind.[7] Patients with DR typically remain asymptomatic in the early stage, but early screening and intervention can prevent vision loss.[8] Therefore, raising awareness of DR is crucial to early detection and appropriate management.[8]

In Yemen, DR prevalence among diabetic patients is 55%, with 16% experiencing blindness.[9] Nevertheless, there is a paucity of studies on the knowledge, attitudes and practices (KAP) of diabetic patients in the country regarding the ocular complications of DR. For instance, a recent study found that 59% of diabetic patients had heard of DR, with 46% correctly identifying it as a blindness-causing complication of DM.[10] KAP surveys are essential tools for understanding the awareness of diabetic patients about the ocular complications of DM like DR, their perception of its risks, and adherence to recommended management strategies. Therefore, this study aimed to assess the KAPs of type 2 diabetic patients regarding the ocular complications of DM in Sana'a city, Yemen.

2. Methods

2.1. Study design, population and setting

A descriptive cross-sectional KAP study was conducted among type 2 diabetic patients seeking healthcare at one public referral hospital, one private referral hospital, and two private diabetes clinics in Sana'a city in 2024. Patients older than 18 years of both genders were included in the study if they gave written informed consent to participate voluntarily in the study.

2.2. Sample size and sampling method

Based on an expected proportion of 50% for diabetic patients with adequate knowledge about the ocular complications of DM, a minimum sample size of 384 patients was calculated using OpenEpi, version 3.01 (www.openepi.com) with a 95% confidence level and 5% precision. Nevertheless, the final sample size was increased to 400. Patients were selected using a convenience sampling approach until the required sample size was reached.

2.3. Data collection

Data about sociodemographic characteristics and KAP regarding the ocular complications of DM were collected using a structured questionnaire. The questionnaire was pilot tested on 10% of the sample (40 patients) to assess the comprehensibility of all sections and evaluate the clarity of the questions. It was then modified in light of their feedback.

2.4. Data analysis

The data were analyzed using IBM SPSS Statistics, version 25 (IBM Corp., Armonk, NY, USA). Continuous data were summarized using the mean

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and standard deviation (SD), while categorical data were described using frequencies and percentages.

3. Results

3.1. Characteristics of participants

Table 1 shows that more than half of diabetic patients enrolled in this study were males (52.7%) and unemployed (52.8%). The mean age of patients was 50.8 ± 11.7 years, with the majority (64.3%) being under the age of 55 years. The majority of patients were married (84.2%), and most patients were illiterate (32%) and were university-educated or higher (27.7%).

Table 1: Characteristics of diabetic patients enrolled in the survey*

Characteristics	*n* (%)
Gender	
Male	211 (**52.7**)
Female	189 (**47.3**)
Age (years)	
Mean ± SD: 50.8 ± 11.7	
<55	257 (**64.3**)
≥55	143 (**35.7**)
Marital status	
Married	337 (**84.2**)
Unmarried	63 (**15.8**)
Employment status [a]	
Unemployed	196 (**52.8**)
Employed or self-employed	175 (**47.2**)
Educational status	
Illiterate	128 (**32.0**)
Primary education	84 (**21.0**)
Secondary education	77 (**19.3**)
University and above	111 (**27.7**)
Duration since diabetes diagnosis (years)	
<5	156 (**40.0**)
5–15	186 (**47.7**)
16–25	36 (**9.2**)
≥26	12 (**3.1**)
Diabetes control status	
Controlled	209 (**52.3**)
Not controlled	191 (**47.7**)
Ever diagnosed with retinopathy	
Yes	57 (**14.2**)
No	343 (**85.8**)

* The total number of participants was 400. SD, standard deviation. [a] 29 missing cases; [b] 10 missing cases.

3.2. Knowledge and attitudes regarding diabetes effects on the eyes

Table 2 shows that the majority of diabetic patients (88%) were aware of the effects of diabetes on the eyes. Among patients aware of the ocular effects of diabetes, visual impairment (VI) (31%) was the most commonly recognized ocular complication, followed by DR (22.4%). However, cataracts (5.7%) and eye infections (4%) were the least commonly recognized complications. On the other hand, the most commonly recognized combination of complications was VI and DR (6.8%), followed by the combination of all four complications (6.3%). However, the proportion of patients aware of other complication combinations ranged from 0.6% for DR and eye infections to 4.3% for VI, DR and cataracts. Regarding the importance of regular eye exams, 74.3% agreed that diabetic patients should have regular eye exams even if both eyes appear normal, while 7.5% disagreed, and 18.2% were unaware. Most patients (39.3%) were unaware of the frequency of regular eye exams that a diabetic patient should have. However, those who cited the need for eye exams once every six months and once a year were 27% and 22.8%, respectively (Table 2).

3.3. Practices to prevent diabetes-related ocular complications

Table 3 shows that most patients (63%) did not have their eyes regularly examined, and more than half of the patients (57%) sought to have their eyes examined by an optometrist or optician, while 37.7% of patients had never had an eye exam, and only 2.5% of patients visited an ophthalmologist for an eye exam. Most patients (45%) reported never having undergone a retinal exam, followed by those who underwent a retinal exam once every year (18.8%) or as recommended by an ophthalmologist (15.8%). However, 6.8% and 13.8%, respectively, reported

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having exams every three months and every six months.

Table 2: Knowledge and attitudes towards diabetes effects on the eyes among diabetic patients in Sana'a city, Yemen (2024)*

Items	n (%)
Diabetes can affect the eyes	
Yes	352 (88.0)
No	17 (4.2)
Unaware	31 (7.8)
Ocular complications associated with diabetes [a]	
Single complications	
VI	109 (31.0)
DR	79 (22.4)
Cataracts	20 (5.7)
Eye infections	14 (4.0)
Two complications	
VI and DR	24 (6.8)
DR and cataract	9 (2.6)
VI and cataracts	6 (1.7)
VI and eye infections	5 (1.4)
DR and eye infections	2 (0.6)
Three complications	
VI, DR and cataracts	15 (4.3)
VI, DR and eye infections	9 (2.6)
DR, cataracts, and eye infections	1 (0.3)
Four complications	
VI, DR, cataracts and eye infections	22 (6.3)
Regular eye exams are important even if both eyes are normal	
Yes	297 (74.3)
No	30 (7.5)
Unaware	73 (18.2)
The diabetic patient should have a regular eye exam	
Once every six months	108 (27.0)
Once every year	91 (22.8)
Once every two years	39 (9.8)
Once every five years	5 (1.3)
Unaware	157 (39.3)

* The total number of participants was 400. DR, diabetic retinopathy; VI, visual impairment. [a] Calculated for 352 patients aware of the effect of diabetes on the eyes.

Regarding the timing of the first dilated eye exam after diabetes diagnosis, more than half of the patients (52.8%) reported that they had never had a dilated eye exam. Conversely, 14.5% of patients reported having the exam between one and five years after diagnosis, followed by those examined after five years (11.8%), within three months (11.3%), and between three months and one year (9.8%). Among the 57 patients diagnosed with retinopathy, 56 (98.2%) were advised to undergo retinal treatment, and 73.7% adhered to the treatment recommendations. Among those who received treatment, 42 attended follow-up visits, while only one (2.4%) did not (Table 3).

Table 3: Preventive practices against diabetes-related ocular complications among diabetic patients in Sana'a city, Yemen (2024)*

Practice items	n (%)
Regular eye exam	
Yes	148 (37.0)
No	252 (63.0)
Eye care provider visited	
Optometrist/optician	228 (57.0)
Ophthalmologist	10 (2.5)
General practitioner	10 (2.5)
Mobile eye clinic	1 (0.3)
Never visited an eye care provider	151 (37.7)
Frequency of retinal exam	
Once every three months	27 (6.8)
Once every six months	55 (13.8)
Once a year	75 (18.8)
As recommended by the ophthalmologist	63 (15.8)
Never undergone any exam	180 (45.0)
Timing of first dilated eye exam after diabetes diagnosis	
Within three months	45 (11.3)
Between three months and one year	39 (9.8)
Between one and five years	58 (14.5)
After five years	47 (11.8)
Never undergone any exam	211 (52.8)
Advice to undergo retinal treatment [a]	
Yes	56 (98.2)
No	1 (1.8)
Advice for retinopathy treatment by the ophthalmologist [a]	
Yes	42 (73.7)
No	15 (26.3)
Follow-up visits after your retinal treatment [b]	
Yes	41 (97.6)
No	1 (2.4)

* The total number of participants was 400. DR, diabetic retinopathy. [a] Calculated for 57 patients who were diagnosed with retinopathy. [b] Calculated for 42 patients who underwent retinopathy treatment

4. Discussion

The present study revealed that a substantial proportion of diabetic patients (88%) recognized that DM can affect their eyes and cause ocular complications.

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Nevertheless, many lack awareness of the specific complications and the importance of regular eye checkups. Consequently, general awareness of diabetes effects on the eyes does not necessarily translate to knowledge of specific complications or adherence to recommended eye care practices. The finding of the present study aligns with the findings reported among diabetic patients from different regions of Saudi Arabia (82.2–96.4%),[11-14] India (84.3-93.7%),[15,16] Jordan (85.2%),[17] Damascus, Syria (93.8%),[18] Switzerland (96%),[19] and Japan.[20] In contrast, lower rates of awareness regarding the effects of DM on the eyes were reported among diabetic patients in other regions, including India (72.5–76.3%),[21-23] Ethiopia (72.6%),[24] Al-Jouf and Hail provinces of Saudi Arabia (75.6%),[25] and 80.2% in Ghana.[26] Much lower proportions of awareness were documented among diabetic patients in Sahiwal city in central Punjab (30.6%) and Azad Jammu & Kashmir (16.2%) of Pakistan,[27, 28] in Parakou, Benin (48%),[29] and 53% in Riyadh, Saudi Arabia.[30] These disparities in awareness highlight the necessity of context-specific educational programs to improve understanding and encourage adherence to eye care practices among diabetic populations in various countries.

The gap between the broad awareness of diabetes effects on the eyes and the specific understanding of complications is notable in the present study. In this context, approximately one-third of patients recognized DM as a cause of visual impairment, while only 22.4% identified DR as a complication of DM. This finding suggests that patients may associate DM with nonspecific visual symptoms like blurring but lack awareness of the role of DR as the underlying pathology of visual impairment or even blindness. In contrast, a recent study in Sana'a city reported that 59% of diabetic patients reported that they had heard of DR, and 46% correctly identified it as a blindness-associated complication of DM.[10] Generally, there is a variation in the rates of awareness of DR as a complication of DM across different countries. For instance, the proportion of diabetic patients who recognized DR as a complication of DM was 13.7% to 66.6% in Saudi Arabia,[12, 31, 32] 48.8% in Ghana,[26] 80.1% in Uttar Pradesh, India,[33] 86.1% in Malaysia,[34] and 88.2% in Jordan.[35] Notably, in the present study, cataracts (5.7%) and eye infections (4%) were poorly recognized, and only a small proportion of patients (6.3%) were aware of the combination of visual impairment, DR, cataracts and eye infections. Similarly, in Saudi Arabia, 10% of diabetic patients cited cataracts as a complication of DM.[32]

The present study showed that most patients held positive attitudes toward the necessity of regular eye exams, with 74.3% affirming the importance of such exams even in the absence of apparent ocular symptoms. Similarly, in Saudi Arabia, 73.8% of patients in Al-Jouf and Hail and 73.3% in Tabuk agreed that diabetic patients should undergo regular eye checkups.[14, 25] Further supporting this finding, a Saudi Arabian online KAP survey reported that 80.8% of diabetic patients had positive attitudes toward eye exams for early detection of DR,[32] and 93.5% of diabetic patients in Jazan region of the country agreed on the need for regular eye exams.[11] In contrast, 66.5% of diabetics in Ethiopia acknowledged the importance of regular eye checkups.[24] Regular ophthalmologist visits were also considered important for diabetic patients by 86.9% of those surveyed in Damascus, Syria.[18]

While a majority of patients in the study acknowledged the importance of regular eye exams for diabetic patients, 39.3% were unaware of how often these exams should be done. Furthermore, the remaining patients cited inconsistent intervals, with 27% suggesting exams every six months and 22.8% suggesting them annually. According to the

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American Optometric Association (AOA), diabetic patients are advised to undergo at least annual dilated eye exams, with increased frequency of exams as needed.[36] Therefore, there is a need for education regarding the recommended frequency of these exams among diabetic patients. Regular eye exams are crucial for diabetic patients to detect conditions like DR early and hence prevent blindness. Consistent with the present study, 26% of patients in Goa, India acknowledged the necessity of eye exams every six months.[23] Conversely, 77.8% of Syrian diabetic patients believed that eye exams should be done annually,[18] and 63% of diabetic patients in Jeddah, Saudi Arabia, reported the need for biannual or annual eye exams.[37] Moreover, according to more recent data from Jeddah, 96% of attendees at a diabetes awareness camp reported the need for annual eye exams.[12]

The present study revealed considerable deficiencies in the adoption of recommended eye care practices among diabetic patients. In this respect, just over one-third (37%) of patients reported undergoing regular eye exams. In line with this finding, 34.9% of diabetic patients in Sana'a reported regular annual visits to an ophthalmologist.[10] Lower proportions were reported among diabetic patients in Benin (27.3%)[29] and Syria (21.5%)[18] reported getting regular eye exams. Moreover, this finding can be observed in developed countries like Japan, where 30.5% of diabetic patients reported not undergoing periodic ocular exams.[20] In contrast, 55.6% of diabetic patients in Sahiwal, Pakistan,[27] 61.1% in Tamil Nadu, India,[38] and 70% in Jeddah, Saudi Arabia,[12] reported undergoing annual eye checkups. In the present study, over one half (57%) sought care from optometrists or opticians rather than ophthalmologists (2.5%), raising concerns about the adequacy of screening for DR. This finding reflects the decreased level of awareness among diabetic patients regarding the choice of the healthcare provider to check retinal problems. In contrast, 65% of diabetic patients in Al-Jouf and Hail, Saudi Arabia preferred to consult ophthalmologists compared to 33.5% who chose optometrists.[25] While optometrists and opticians play critical roles in refractive error management and basic eye health assessments, their training in diagnosing and managing retinal diseases like DR may be limited compared to ophthalmologists, particularly retinal specialists.

A concerning issue regarding eye care among diabetic patients in the present study is that over one-third of diabetic patients (37.7%) reported never having visited an eye care provider. Furthermore, 45% of patients reported never having had a retinal exam, compared to 18.8% who had an annual retinal exam, 15.8% as recommended by an ophthalmologist, 13.8% biannually, and 6.8% once every three months. These findings highlight a critical failure in preventive care for a population at high risk of vision-threatening complications like DR, particularly in resource-limited countries. In agreement with this finding, 32% of diabetic patients in Sana'a reported not visiting an ophthalmologist.[10] Similarly, 32.9% of diabetic patients in Jordan and 37% in Syria reported never visiting an ophthalmologist,[18,35] and 56.7% of diabetic patients in Parakou, Bennin and 53.8% in India reported never undergoing a fundus exam for retinal problems.[15,29]

Regarding the first dilated eye exam after diabetes diagnosis, over half of the patients with DR (52.8%) in the present study reported never having a dilated eye exam after their diabetes diagnosis. This finding is critical since dilated eye exams are essential for detecting diabetic retinopathy early. It is noteworthy that the American Academy of Ophthalmology (AAO) recommends that patients with type 2 DM receive their first dilated eye exam at diagnosis, followed by yearly follow-up.[39] Nevertheless, the pre-

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sent study revealed poor compliance with the recommended guidelines, with a variation in retinal exams for the remaining patients from three months to over five years. Likewise, only 28.1% of diabetic patients in Saudi Arabia reported DR screening and management.[32] A lower proportion (9.2%) of diabetic patients in Karachi, Pakistan, reported asking for retinal screening.[40] DR is asymptomatic in its early stages, making delayed screening a critical public health concern because patients with delayed diagnosis often present with advanced disease, where treatments like laser therapy, injections, or surgery are less effective, more invasive, and costly.[41] Therefore, diabetic patients should be advised on the importance of initial dilated eye exams at diagnosis and periodic eye exams. There is also a need to implement national screening programs for retinal exams to reach diabetic patients in the community.

The present study demonstrated that a vast majority (98.2%) of diabetic patients diagnosed with DR had been advised to undergo treatment, indicating strong adherence of healthcare providers to clinical guidelines. However, only 73.3% of patients adhered to such treatment recommendations. Therefore, it is recommended to provide diabetic patients with effective educational programs about the irreversible consequences of untreated DR and the availability of treatment options. In contrast, 94% of patients recommended for DR treatment in the United States initiated treatment.[42] The non-adherence to treatment recommendations could be attributed to several factors, including financial constraints and misconceptions about treatment efficacy or safety, but further research is needed to investigate the barriers to undergoing retinal treatment. Among those who underwent retinal treatment in the present study, the follow-up was high, with 97.6% of treated patients attending follow-up visits. In contrast, 41% of patients in the United States adhered completely to follow-up after retinal treatment.[42]

This study provides valuable insights into the KAPs regarding the ocular complications of DM among type 2 diabetic patients in Sana'a city. However, a number of limitations should be acknowledged and considered when interpreting its findings. Firstly, it adopted a descriptive, cross-sectional design with a convenience sampling approach from healthcare facilities. This design may introduce selection bias, potentially affecting the generalizability of its findings to the broader diabetic population in the community. Therefore, community-based surveys based on probability sampling approaches are recommended to investigate the KAPs of diabetic patients regarding ocular complications of DM and identify the factors associated with these KAPs. Secondly, the study was based on self-reported awareness and practices, which may introduce social desirability bias.

5. Conclusion

While most type 2 diabetic patients in Sana'a city demonstrate broad awareness of the ocular effects of DM, their understanding of specific sight-threatening complications, such as DR, remains limited. Meanwhile, a majority express positive attitudes toward regular eye exams, but their adherence to the recommended guidelines is poor, with many never undergoing regular eye exams or receiving a dilated eye exam. There is a need to bridge the gap between their awareness, attitudes and practices through targeted educational interventions. The establishment of a national DR screening program or partnerships with ophthalmologists could address systemic gaps.

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Ethical approval and consent

This study was approved by the Research Ethics Committee of the Faculty of Medicine and Health Sciences, University of Science and Technology, Sana'a, Yemen. In addition, permission was obtained from the health facilities where the study was conducted. Informed consent was also obtained from the study participants before data collection and after explaining to them the purpose of the study. The privacy and confidentiality of data were ensured.

Conflict of Interest

The authors declare no conflict of interest associated with this article.

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