Migration Letters

Volume: 20, No: S10 (2023), pp. 1428-1449

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

Knowledge Of Ocular Complications Among Diabetic Patients Visiting Heraa General Hospital Ophthalmology Clinic In Makkah Al-Mokarramah, April To June 2022

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ABSTRACT

Aim of Study: *To assess diabetic patients' knowledge regarding ocular complications among diabetic patients.*

Methods: *This study followed an analytical cross-sectional research design. based on an online interview using a questionnaire during the period from April 2022 to June 2021 at Heraa Hospital in Makkah, Saudi Arabia. The inclusion criteria were adult type 2 diabetic subjects of both genders and any nationality. The minimum sample size was determined to be 214. However, the study sample was increased to 220, to compensate for any missing data.*

Results: *About half of the participants (46.8%) had poor knowledge about diabetic retinopathy, 34.1% had moderate knowledge, and 19.1% had good knowledge. Participants' main source of knowledge about diabetes-related ocular complications was the doctors at eye clinics (91.8%), while general practitioners and family physicians constituted only 4.5% of the knowledge sources for the participants. About half of the participants (41.4%) had a positive attitude toward the prevention of diabetes-related ocular complications. Participants' knowledge scores about the prevention of diabetes-related ocular complications correlated positively and significantly with their attitude scores (r=0.198, p=0.003). Participants' knowledge grades differed significantly according to their age groups (p=0.024), with older participants (aged >60 years) having the highest percentage of good knowledge. Male participants had significantly better knowledge grades than female participants (p<0.001). Less educated participants and those with the least monthly income had the highest percentages of poor knowledge (p=0.008, p<0.001, respectively). Participants who performed self-care had a significantly higher percentage of good knowledge than those whose caregivers were family members. Participants' attitudes toward the management of diabetic retinopathy differed significantly according to their nationality (p<0.001), with all non-Saudi participants having negative attitudes toward diabetic retinopathy. Less educated participants and those with the least monthly income had the highest negative attitudes toward the management of diabetic retinopathy (p<0.001 for both). However, participants' knowledge grades did not differ significantly according to the[1]ir age groups, gender or type of caregivers.*

Conclusions: *Diabetic patients' knowledge and attitude regarding diabetes-related ocular complications are suboptimal. The main risk factors associated with poor knowledge are being female, younger in age, those who are less educated, those with the least monthly income, and those whose caregivers were family members. The main sources of knowledge about diabetes and its related ocular complications are the physicians, especially the ophthalmologists, who should be well-trained to provide health education to diabetic patients and enforce their motivation toward regular eye check-ups.*

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Key Words: *Diabetes mellitus, ocular complications, diabetic retinopathy, knowledge, attitude, screening, Saudi Arabia.*

1. INTRODUCTION

Diabetes mellitus is a metabolic condition caused by abnormal insulin production, action, or both, and manifests as chronic hyperglycemia with abnormal carbs, lipids, and protein metabolism [1]. Diabetes mellitus was responsible for 1.5 million fatalities worldwide in 2012, making it the seventh-largest cause of mortality that year [4].

Nowadays, the latter issue is emerging as the primary cause of preventable visual impairments and blindness globally due to the increased incidence of diabetes [5]. Cataracts [6] and glaucoma [7] are two additional eye illnesses that may impair vision and are more common in diabetics [8].

Regular screening, proper control of risk factors, and appropriate treatment of diabetic retinopathy are all necessary for optimal management of the disease. Research on diabetic eye illness has shown that diabetic eye illness has been linked to low knowledge and/or practices in high-income and low-income countries, too [9-12]. The purpose of this study is to evaluate Knowledge of diabetic patients toward diabetic ocular complications in KSA. The researcher planned to conduct a descriptive cross-sectional study based on questionnaire that will be assessed from April 2022 to June 2022 at Heraa Hospital at Makkah in Saudi Arabia. The questionnaire will be handed to diabetic patients who were attending Heraa Hospital at Ophthalmology Department. The questionnaire will be handed to diabetic patients who were attending Heraa hospital at ophthalmology department.

1.1. BACKGROUND

Diabetes mellitus is a metabolic condition caused by abnormal insulin production, action, or both, and manifests as chronic hyperglycemia with abnormal carbs, lipids, and protein metabolism [1]. Worldwide prevalence estimates for diabetes mellitus in 2014 were 9% among males and 7.9% among females, which is high and is expected to duplicate owing to the increase in sedentary lifestyles and poor lifestyle choices [2]. This high pattern is connected to Saudi Arabia's recent economic boom, which has resulted in significant lifestyle modifications, with bad food patterns and a lack of physical activity becoming the usual among many subjects. As a consequence, the prevalence of diabetes mellitus has increased dramatically, now affecting 23.9 percent of the entire Saudi population [3]. Diabetes mellitus was responsible for 1.5 million fatalities worldwide in 2012, making it the seventh largest cause of mortality that year [4].

Nowadays, the latter issue is emerging as the primary cause of preventable visual impairments and blindness globally due to the increased incidence of diabetes [5]. Cataract [6] and glaucoma [7] are two additional eye illnesses that may impair vision and are more common in diabetics [8].

Regular screening, proper control of risk factors, and appropriate treatment of diabetic retinopathy are all necessary for optimal management of the disease. Furthermore, a critical component in achieving effective care is the enhancement of diabetes patients' knowledge and education [9]. Using these factors as a guide, preventative measures might be implemented with greater success.

Research on diabetic eye illness has shown that diabetic eye illness has been linked to low knowledge and/or practices in high-income and low-income countries, too [9-12]. The purpose of this study is to evaluate Knowledge of diabetic patients toward diabetic ocular complications in KSA. The researcher planned to conduct a descriptive cross-sectional study based on questionnaire that will be assessed from April 2022 to June 2022 at Heraa Hospital at Makkah in Saudi Arabia. The questionnaire will be handed to diabetic patients who were attending Heraa hospital at ophthalmology department. The

questionnaire will be handed to diabetic patients who were attending Heraa Hospital at the Ophthalmology Department.

1.2 RATIONALE:

There is a discussion that the proper knowledge of diabetes complications and ocular manifestations could result in proper practice pattern and prevention of diabetic retinopathy and its cost-effective management. The researcher has an interest in the subject of diabetic ocular complications because she had similar experience with her aunt blinded eye due to retinal diabetic complication. Diabetes mellitus was responsible for 1.5 million fatalities worldwide in 2012, making it the seventh largest cause of mortality that year [4].

The primary cause of preventable visual impairments and blindness globally due to the increased incidence of diabetes [5]. Cataract [6] and glaucoma [7] are two additional eye illnesses that may impair vision and are more common in diabetics [8]. So, it is a global problem throughout the world that can be discovered ad decreased through early screening. The researcher failed to lay hand on similar research topic regarding diabetic ocular complications in Saudi Arabia, except for few old studies. Further studies needed to be conducted to decrease the prevalence rate and improve our awareness.

Moreover, by knowing the burden of the problem, we could contact the policy makers to enhance practices and screening for diabetic ocular complications. From the researcher point of view, diabetic complications lay burden on governmental health system and proper patients' awareness is expected to allow us to achieve 2030 vision of our beloved prince Mohammed bin Salman for better society health.

1.3AIM OF THE STUDY

To assess diabetic patients' knowledge regarding ocular complications among diabetic patients.

1.4 OBJECTIVES

1- To Evaluate knowledge, and attitude toward ocular complications of diabetes among visitors of Heraa Diabetic center in Makkah al-Mukarramah during April to June 2022

2- To identify the determinants of diabetic ocular complications of diabetes among visitors of Heraa Diabetic center in Makkah al-Mukarramah during April to June 2022

2. METHODOLOGY (MATERIALS AND METHODS)

2.1 Study Design

It is an analytical cross-sectional study, based on an online interview using a questionnaire during the period from April 2022 to June 2021 at Heraa Hospital in Makkah, Saudi Arabia.

2.2 Study Population

The inclusion criteria were adult type 2 diabetic subjects of both genders and any nationality who approved to participate in the study and answered the questionnaire. The questionnaire was distributed through online interview to diabetic patients who were attending Heraa hospital at the Ophthalmology Department.

ELIGIBILITY CRITERIA

a. Inclusion criteria

Adults, type 2 diabetic subjects of both genders and any nationality who approved to participate in the study and answer the questionnaire. The study questionnaire was used

through online interview to diabetic patients who were attending Heraa hospital at the Ophthalmology Department.

b. Exclusion criteria
Diabetic children and adolescents aged below 18 years.

2.3 Study Area
The Kingdom of Saudi Arabia is located in the Arabian Peninsula in south-west Asia occupying about 80% of the peninsula. This study was conducted in Makkah Al-Mokarramah, which is the holy city for Muslims, and it is located in the Northwestern region of Saudi Arabia.

2.4 Sampling and sample size determination
The researcher conducted this research at Heraa General Hospital, which had been selected through a simple random sampling technique using the random number generator (http://www.random.org). The researcher selected two diabetes centers in Makkah Al-Mokarramah to be under the randomization (i.e., Alnoor, Heraa). Then, the researcher selected the two diabetes centers available in Makkah al-Mokarramah

Heraa General Hospital covers the northern region of Makkah Al-Mokarramah. It is one of the modalities hospitals at the Ministry of Health and had one of the pioneer diabetic centers provide services for adult with diabetic and endocrine diseases. It covers 43 medical clinics, 53 non-medical clinics. Ophthalmology clinics works daily with a target population of almost 25 patients per day.

The sample size was determined using the Raosoft Sample Size website (http://www.raosoft.com/samplesize.html). Assuming that the prevalence of diabetic ocular complications is 16.9% in both genders in Saudi Arabia, with a confidence level of 95% and a margin error of 5.17% and knowing that ophthalmology clinic covers about 500 patients per month, according to the following data:

- The Ophthalmology Clinic works 5 days per week.
- **Mother population**: 500
- **The prevalence of the problem (for cross sectional studies)**: 16.7%
- **Confidence level**: **95%**
- **Error**: 5.17%

Therefore, the estimated minimal sample size was 214. However, the study sample was increased to 220, to compensate for any missing data.

2.5 Sampling technique
The sample was chosen using a simple random sampling technique using random number generator (**http://www.random.org**). Each patient organized in their visiting time by code number (e.g., infant A coded by number 1 … etc.). The questionnaire was carried out with a trained Optometrist to fill it through days of ophthalmology clinics working days. The study framework was based on an online interview questionnaire sheet considering the knowledge of diabetic patients.

2.6 Data collection tool (instrument)
Questionnaire: Online interview questionnaire**.**

VALIDITY OF QUESTIONNAIRES/TOOLS:
A validated data collection tool was used. The validity of the questionnaire was assessed by 3 consultants.

2.7 Data Collection technique

The researcher visited the study hospital and gave the official acceptance paper from health affairs to the manager of Heraa General Hospital. The researcher then sent the study questionnaire link online interview to the trained optometrist in the study hospital through April to June 2022. Then, the optometrists filled out the online sheet through an interview with patients who met the inclusion criteria after taking their verbal consent.

2.8 STUDY VARIABLES:

Dependent variables: Participants' knowledge about diabetic-related complications among patients attending Heraa general hospital in Makkah Al-Mokarrramah. The study questionnaire included 10 "Yes/No" knowledge statements about diabetes and its related ocular complications. It also included 6 statements (Agree / Undecided / Disagree) on attitude toward diabetes and diabetes and its related ocular complications.

Independent variables: Socio demographic variables, such as age, gender, nationality, education, caregiver and income.

2.9 DATA ENTRY AND ANALYSIS

Data were collected through online interview then coded before entry. Then, data were entered using the Statistical Package for Social Sciences (IBM, SPSS Inc., Chicago, IL, USA).

Computer programs with versions: The statistical analysis was done using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA, version 25.0) using simple descriptive and analytical methods (Univariate statistic) as frequencies and percentages**.** Appropriate statistical tests were applied, Chi-square & Pearson's correlation coefficient. P–values less than 0.05 were considered as statistically significant.

Scoring of knowledge and attitude responses:

Responses to statements within the knowledge section were scored as one point for a correct response, and zero point for an incorrect response. The total scores for each participant's responses were summed up. Therefore, the participants total knowledge scores ranged from 0 to 10. Those with total scores <5 were considered to have poor knowledge level, while those with total scores >7 were considered to have good knowledge level, and those with total scores 5-7 were considered to have moderate level of knowledge.

Responses to statements with the attitude section were score as 0 for the agreement with a negative attitude, 1 for undecided and 2 for disagreement with a negative attitude. Then, the total attitude score was calculated by adding the participant scores for each attitude statement. Therefore, the total attitude scores ranged from 0 to 18. Those with scores <9 were considered to have negative attitude, while those with a score $\geq$9 were considered to have a positive attitude.

2.10 PILOT STUDY/PRETESTING

A pilot study was conducted on 22 diabetic patients, whose data were not included within the main study. The aim of the pilot study is to test the data collection tool for the clarity of its statements, applicability and the time needed for filling the study questionnaire. Moreover, the internal consistency of the included statements was assessed using Cronbach's alpha coefficient and the test-retest reliability was also assessed.

2.11 ETHICAL CONSIDERATIONS:

The researcher fulfilled the following official permissions and approvals:

- Permission from Makkah program of Diabetology.
- The General Directorate of Health Affairs of the Holy Capital primary health care.
- Local departmental approval.
- Written (or verbal) consents from all participants to be obtained.

Participant's autonomy and confidentiality were fully secured. Healthcare services were provided to all participants (e.g., health education materials, educational sessions). All supervisors, advisors, facilitators, participants and family members were acknowledged, indicating their role in the research process. Moreover, all collected data were kept confidential and results were submitted to the department as feedback.

2.12 . Budget, Fund or Grant:

The study protocol, papers, transportation, printing questionnaires, collecting data and the statistical analysis were self-funded by the researcher.

3. RESULTS

Table (1): Personal characteristics of the study sample (n=220)

Personal Characteristics	No.	%
Age groups		
<50 years	49	22.3
50-60 years	46	20.9
>60 years	125	56.8
Gender		
Male	127	57.7
Female	93	42.3
Nationality		
Saudi	204	92.7
Non-Saudi	16	7.3
Educational level		
Illiterate	21	9.5
Primary	41	18.6
Intermediate	38	17.3
High/University	120	54.5
Monthly income		
<5,000 SR	36	16.4
5,000-10,000 SR	119	54.1
>10,000 SR	65	29.5
Caregiver		
Self-care	179	81.4
Family members	41	18.6

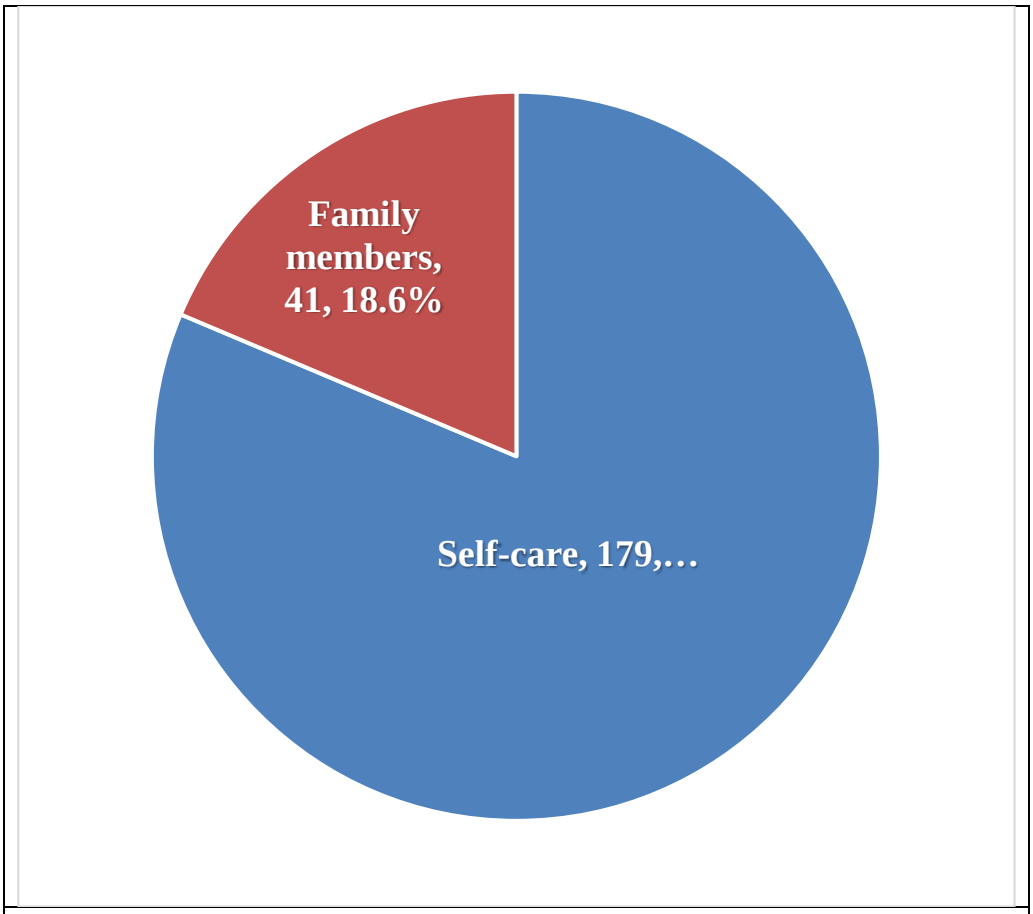

Figure (1): Patients' main caregivers

Table (1) shows that more than half of the participants (56.8%) were more than 60 years old, 57.7% were males, and the majority (92.7%) were Saudi. More than half of the participants (54.5%) had a high/university level of education, 54.1% had 5000-10,000 SR monthly income, while the majority of participants (81.4%) were practicing self-care for their disease (Figure 1).

Table (2): Participant's responses regarding their knowledge about diabetes

Knowledge statements	No.	%
How to keep diabetes controlled		
Diet	11	5.0
Weight reduction	2	0.9
Regular check-ups	2	0.9
Medications	113	51.4
All the Above	92	41.8
Body organs mostly affected by diabetes		
Eyes	9	4.1
Feet	4	1.8
Heart	29	13.2
Kidney	31	14.1
Nerves	47	21.4
All the above	16	7.3
Do not know	84	38.2

Duration of diabetes management		
Lifelong	202	91.8
Till blood sugar levels get under control	18	8.2
Ocular complications due to diabetes		
Retinopathy	84	38.2
Defective vision	68	30.9
Premature cataracts	24	10.9
Infections in the eye	8	3.6
Do not know	36	16.4
How long does it take for diabetic retinopathy to occur		
After 10 years	98	44.5
After 5 years	26	11.8
At the time of diagnosis	92	41.8
Less than 3 year	4	1.8
Can diabetic retinopathy lead to blindness?		
Do not know	79	35.9
Yes	102	46.4
No	39	17.7
What are the factors associated with diabetic retinopathy?		
Anemia	2	0.9
Hypertension	22	10.0
Poor control of diabetes	119	54.1
Do not know	77	35.0

Table (2 Continued): Participant's responses regarding their knowledge about diabetes

Knowledge statements	No.	%
How to treat diabetic retinopathy?		
Injections into the eye	23	10.5
Laser	72	32.7
Glasses	17	7.7
Surgery	26	11.8
Do not know	82	37.3
Can patients with diabetic retinopathy have normal vision?		
No	122	55.5
Yes	98	44.5
How often do diabetics need to have check-ups for their vision?		
Do not know	92	41.8
Once in 6 months	70	31.8
Once a year	50	22.7
Once in 2 years	4	1.8
Once in 5 years	4	1.8
Total knowledge score (Mean±SD out of 10)	5.51±2.04	

Table (2) shows that about half of the participants (51.4%) stated that medications are to be taken for the control of diabetes, while 41.8% stated that all treatment options (diet, weight reduction, regular check-ups, and medications) are necessary to keep diabetes controlled. Some patients (16.4%) did not know any diabetes-related ocular complication, while only 38.2% mentioned retinopathy, followed by and defective vision (30.9%), while cataracts only 10.9% stated premature cataracts. More than one-third of the participants (38.2%) did not know the impact of diabetes on body organs, while 21.4% stated that it affects the nerves, and only 4.1% stated that diabetes affects the eyes. The majority of the

participants (91.8%) knew that the duration of diabetes management is lifelong. About one-third of participants (38.2%) stated that retinopathy is a diabetes-related eye problem, while 30.9% stated that diabetes causes defective vision, and 10.9% stated that it causes cataracts. However, 16.4% of the participants did not know of any diabetes-related eye problems. Most participants incorrectly stated that it takes 10 years for diabetic retinopathy to occur (44.5%) while 41.8% stated that it occurs at the time of diagnosis of diabetes. Only 46.4% stated that diabetic neuropathy may lead to blindness, while 54.1% of the participants indicated that poor diabetes control is associated with diabetic neuropathy. However, 35% did not know the factors associated with diabetic retinopathy. Only 32.7% of the participants mentioned laser as the treatment for diabetic retinopathy, while 37.3% did not know how diabetic retinopathy is treated. Only 44.5% of the participants stated that patients with diabetic retinopathy may have normal vision. Almost half of the participants (41.8%) did not know how often diabetics need to have check-ups for their vision, while 1.8% stated that it is to be done every 5 years, or every 2 years (1.8%). Only 22.7% correctly identified that check-ups should be once yearly. Participants' mean knowledge score (mean±SD) was 5.51±2.04 (out of a maximum score of 10).

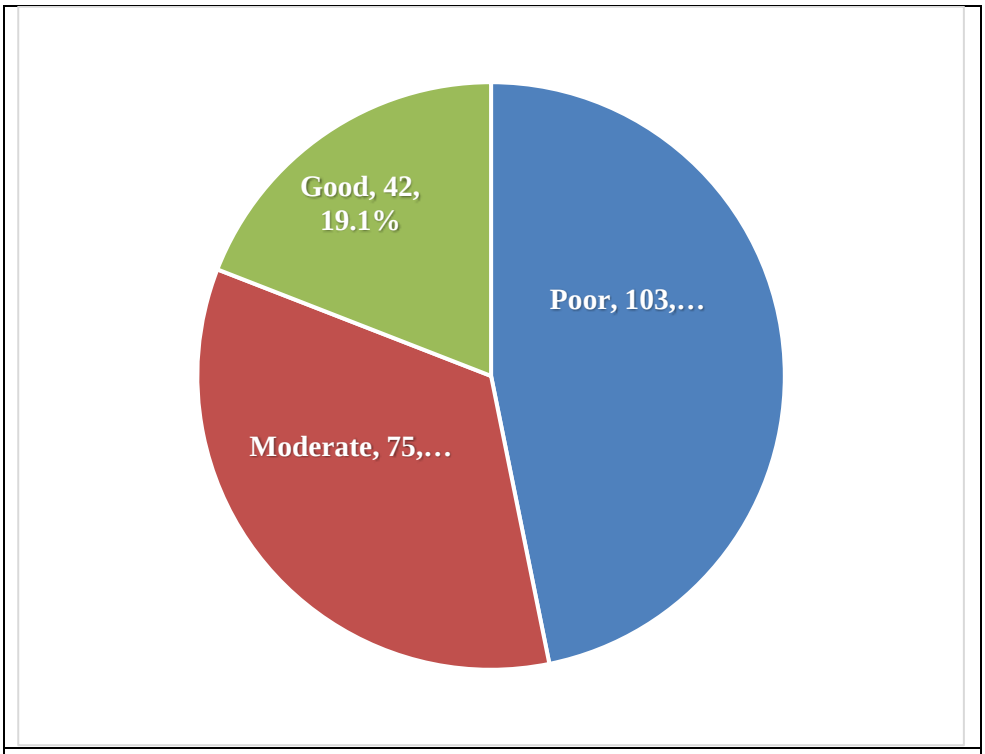

Figure (3): Participants' knowledge grades about diabetic retinopathy

Figure (3) shows that 46.8% of the participants had poor knowledge about diabetic retinopathy, 34.1% had moderate knowledge, and 19.1% had good knowledge.

Table (3): Participant's main sources of knowledge about diabetes-related ocular complications

Main Sources of Knowledge	No.	%
Family/friends	4	1.8
Mass media/books	4	1.8
Doctors at eye clinics	202	91.8
General practitioner/Family physician	10	4.5

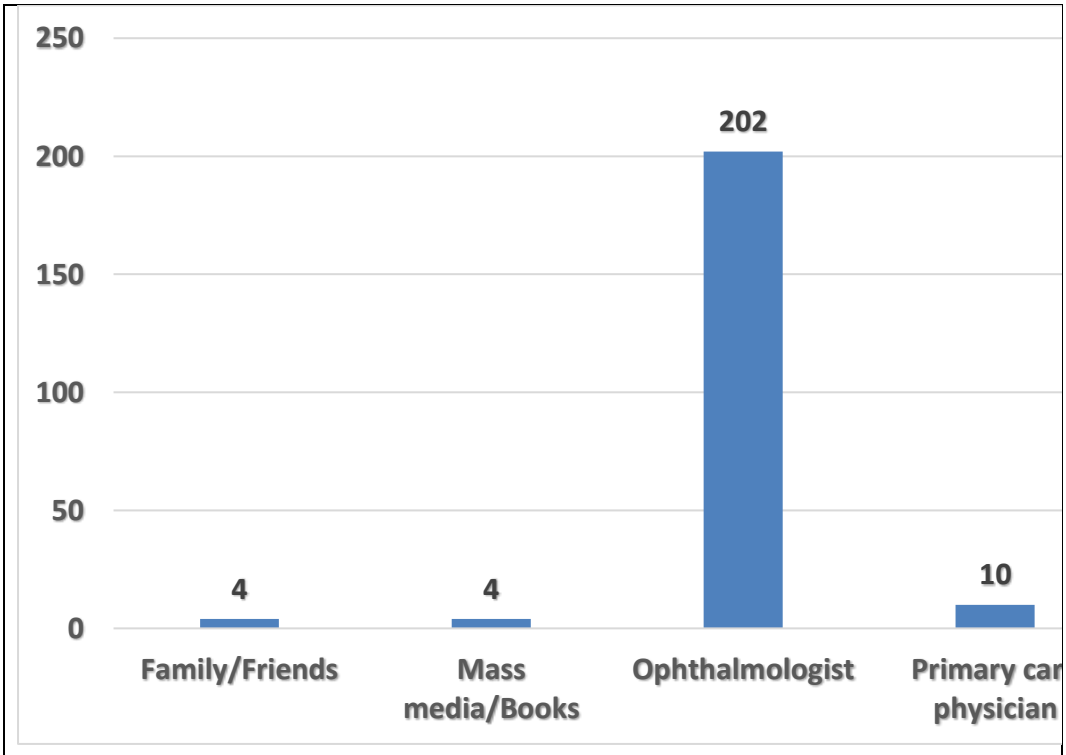

Figure (2): Main sources of knowledge about diabetes-related ocular complications

Table (3) and Figure (2) show that participants' main source of knowledge about diabetes-related ocular complications was the doctors at eye clinics (91.8%), while general practitioners and family physicians constituted only 4.5% of the knowledge sources for the participants. Mass media/books and participants' family members/friends constituted 1.8% each.

Table (4): Participants' responses regarding their attitude toward prevention of diabetes-related ocular complications

Attitude statements	Agree		Undecided		Disagree	
	No.	%	No.	%	No.	%
It is OK for diabetics to eat sweets	94	42.7	46	20.9	80	36.4
Missing medications is not a problem	62	28.2	51	23.2	107	48.6
Regular checkups should be as the doctor says	120	54.5	66	30.0	34	15.5
It is OK for diabetics not to do regular exercise	95	43.2	60	27.3	65	29.5
No need for regular eye checkup if the blood sugar is OK	71	32.3	56	25.5	93	42.3
I should regularly go for eye checkup	97	44.1	53	24.1	70	31.8
It is not possible to keep blood sugar controlled	83	37.7	59	26.8	78	35.5

No matter what I do, my vision may become poor	55	25.0	62	28.2	103	46.8
Total Score (out of 18)	8.81±3.67					

Table (4) shows that 42.7% of the participants agreed that it is OK for diabetics to eat sweets, while 48.6% disagreed that missing medications is not a problem, 54.5% agreed that regular checkups should be as the doctor says, 43.2% agreed that it is OK for diabetics not do regular exercise, 42.3% disagreed that there is no need for regular eye checkup if the blood sugar is OK, 44.1% agreed that they should regular go for eye checkup, 37.7% agreed that it is not possible to keep blood sugar controlled, and 46.8% disagreed that no matter what they do, their vision may become poor. Participants' percent total attitude score (Mean±SD) was 55.09±22.92%.

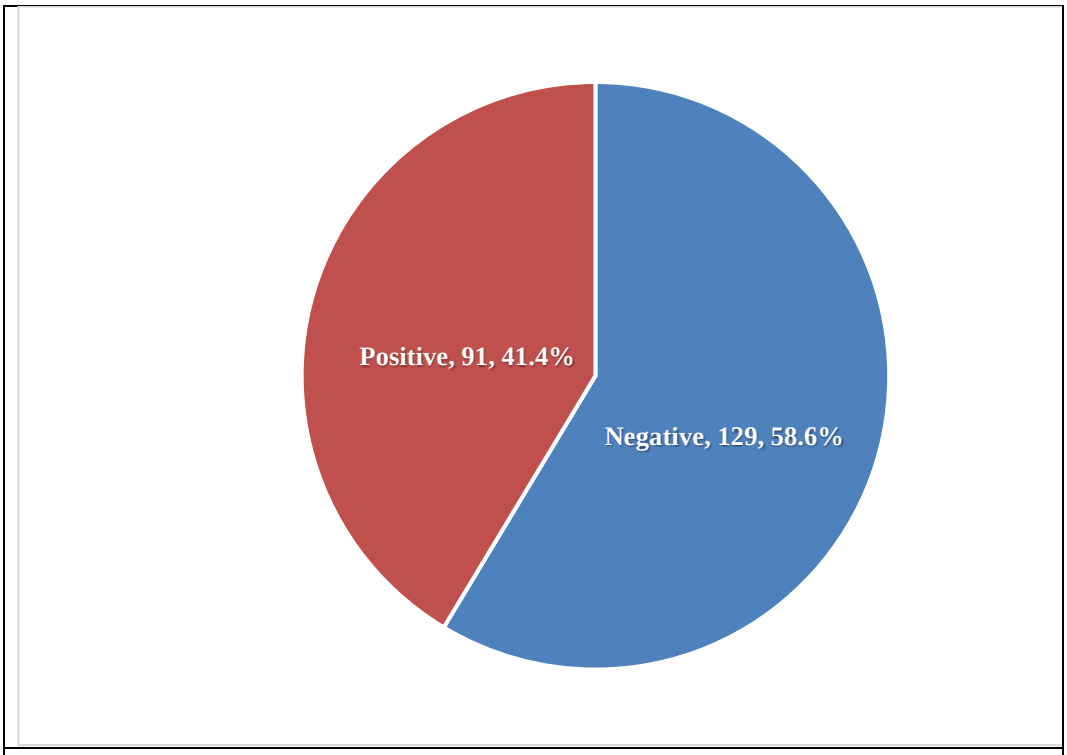

Figure (4): Participants' attitude toward prevention of diabetes-related ocular complications

Figure (4) shows that 41.4% of the participants had a positive attitude toward the prevention of diabetes-related ocular complications.

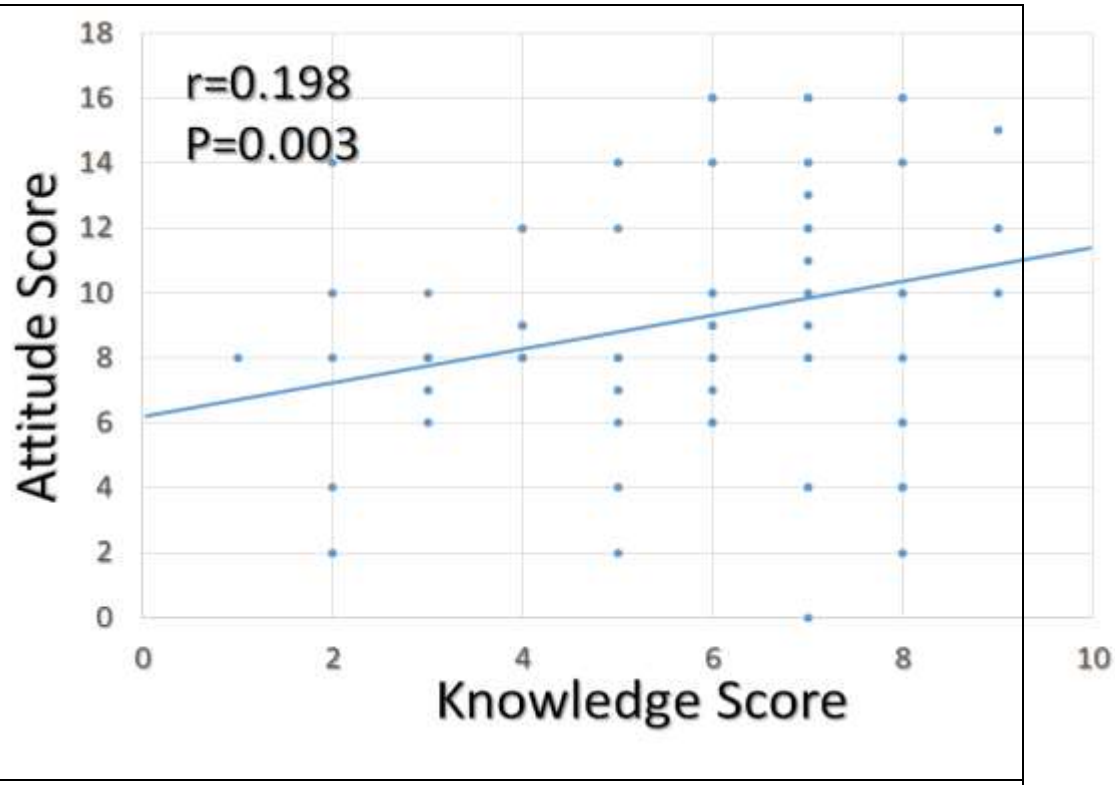

Figure (5): Scatterplot and regression line for participants' knowledge and attitude scores

Figure (5) shows that participants' knowledge scores about the prevention of diabetes-related ocular complications correlated positively and significantly with their attitude scores (r=0.198, p=0.003).

Table (5): Participants' knowledge grades according to their personal characteristics

Personal Characteristics	Poor		Moderate		Good		P Value
	No.	%	No.	%	No.	%	
Age groups							
<50 years	21	42.9	19	38.8	9	18.4	
50-60 years	16	34.8	24	52.2	6	13.0	0.024†
>60 years	66	52.8	32	25.6	27	21.6	
Gender							
Male	44	34.6	53	41.7	30	23.6	
Female	59	63.4	22	23.7	12	12.9	<0.001†
Nationality							
Saudi	91	44.6	73	35.8	40	19.6	
Non-Saudi	12	75.0	2	12.5	2	12.5	0.058
Educational level							
Illiterate	13	61.9	6	28.6	2	9.5	
Primary	23	56.1	8	19.5	10	24.4	
Intermediate	23	60.5	7	18.4	8	21.1	0.008†
High/University	44	36.7	54	45.0	22	18.3	
Monthly income							
<5000 SR	24	66.7	10	27.8	2	5.6	
5000-15000 SR	62	52.1	37	31.1	20	16.8	<0.001†
>10000 SR	17	26.2	28	43.1	20	30.8	

Sources of care							
Self-care	75	41.9	66	36.9	38	21.2	
Family members	28	68.3	9	22.0	4	9.8	0.009†

† Statistically significant

Table (5) shows that participants' knowledge grades differed significantly according to their age groups (p=0.024), with older participants (aged >60 years) having the highest percentage of good knowledge. Male participants had significantly better knowledge grades than female participants (p<0.001). Less educated participants and those with the least monthly income had the highest percentages of poor knowledge (p=0.008, p<0.001, respectively). Participants who performed self-care had a significantly higher percentage of good knowledge than those whose caregivers were family members. However, participants' knowledge grades did not differ significantly according to their nationality.

Table (6): Participants' attitude toward prevention of diabetes-related ocular complications according to their personal characteristics

Personal Characteristics	Negative		Positive		P Value
	No.	%	No.	%	
Age groups					
<50 years	24	49.0	25	51.0	
50-60 years	23	50.0	23	50.0	0.055
>60 years	82	65.6	43	34.4	
Gender					
Male	72	56.7	55	43.3	
Female	57	61.3	36	38.7	0.494
Nationality					
Saudi	113	55.4	91	44.6	
Non-Saudi	16	100.0	0	0.0	<0.001†
Educational level					
Illiterate	16	76.2	5	23.8	
Primary	32	78.0	9	22.0	
Intermediate	27	71.1	11	28.9	<0.001†
High/University	54	45.0	66	55.0	
Monthly income					
<5000 SR	32	88.9	4	11.1	
5000-15000 SR	76	63.9	43	36.1	<0.001†
>10000 SR	21	32.3	44	67.7	
Sources of care					
Self-care	103	57.5	76	42.5	
Family members	26	63.4	15	36.6	0.491

† Statistically significant

Table (6) shows that participants' attitudes toward the management of diabetic retinopathy differed significantly according to their nationality (p<0.001), with all non-Saudi participants having negative attitudes toward diabetic retinopathy. Less educated participants and those with the least monthly income had the highest negative attitudes toward the management of diabetic retinopathy (p<0.001 for both). However, participants' knowledge grades did not differ significantly according to their age groups, gender or type of caregivers.

4. DISCUSSION

Prolonged periods of high blood glucose levels can damage small blood vessels in the retina, causing hemorrhage, exudates, and retinal swelling. Over time, the retina becomes O_2-starved, abnormal blood vessels grow incorrectly, and retinal blood vessels leak causing diabetic retinopathy. Patients' knowledge and attitudes are important factors affecting their adherence to the recommendations related to eye care, regular screening, and prevention of retinopathy [13].

Therefore, the present study aimed to evaluate the knowledge and attitude of diabetic patients regarding ocular complications of diabetes.

In this cross-sectional study, more than half of the participants were 60 years old or above (56.8%), which reflects the increased prevalence of diabetes with age. This finding is similar to those noted by several studies [14]. Ahmad and Joshi [15] added that diabetes is a long-standing, continuously growing metabolic disease. Therefore, diabetic patients need, not only to control their blood glucose, but to prevent the incidence of diabetes-related disabilities, side effects, and difficulties in rehabilitation.

Our study revealed that the majority of participants (81.4%) were practicing self-care for the management of their diabetes.

Ahmad and Joshi [15] emphasized that self-care practices by diabetic patients have shown significantly positive results, such as reducing the incidence of diabetes-related complications and limiting its progression, leading to a significant reduction in their burden. Therefore, proper systematic and combined efforts are needed to enforce self-care practices in diabetic patients to reduce any possible side effects or complications

Mersha et al. [16] stated that proper awareness and knowledge of diabetic patients regarding eye care and prevention of diabetes-related ocular complications will help them have good practice regarding diabetes self-management, watching potential risk factors and allowing them to develop a positive attitude for early screening and timely management.

The present study revealed that participants' knowledge about diabetes-related ocular complications was suboptimal. Almost half of the participants had poor knowledge about ocular complications among diabetics. About one-third of the participants mentioned retinopathy and defective vision as diabetes-related ocular complications (38.2% and 30.9%, respectively), while premature cataract was stated by only 10.9% of the participants, and 16.4% did not know any diabetes-related ocular complication.

About one-third of the participants did not know the impact of diabetes on body organs, while only 38.2% knew that retinopathy is a diabetes-related eye problem. Only 46.4% stated that diabetic neuropathy may lead to blindness, while 54.1% of the participants indicated that poor diabetes control is associated with diabetic neuropathy, and 35% did not know the factors associated with diabetic retinopathy. Almost half of the participants (41.8%) did not know how often diabetics need to have check-ups for their vision.

Although the American Academy of Ophthalmology [17] recommended annual eye examinations for people with type 2 diabetes, our study revealed that almost half of the participants did not know how often diabetics need to have check-ups for their vision, while only 22.7% stated that check-ups should be once yearly, indicating the poor compliance among our patients with visiting the ophthalmology clinic for a routine eye check-up.

Al-Eryani et al. [18], in Yemen, reported that one-third of diabetic patients (32.2%) had a good level of knowledge regarding diabetic retinopathy, while 67.8% had a poor level of knowledge. Neama et al. [19] reported a poor level of knowledge among diabetic patients regarding diabetic retinopathy. Only one-third of the participants knew that diabetic

retinopathy is related to damage of retinal vessels and high blood and high blood sugar due to uncontrolled diabetes.

On the other hand, AlHargan et al. [20] reported a high level of self-reported knowledge regarding diabetes-related ocular complications (88%). This is also similar to the results of several other studies in Saudi Arabia, such as in Hail and Al Jouf (76%) [21] and Jeddah (83%) [22]. A lower knowledge level about diabetes-related ocular complications and their management (52.9%) was reported by Alqahtani et al. [13].

Regional and international studies reported variable results regarding diabetic patients' knowledge levels about diabetes-related ocular complications. Khandekar et al.[23] in Oman (93%), Bakkar et al. [24] in Jordan (88%), and Cetin et al. [25] in Turkey (88%) also showed high levels of patients' knowledge. Internationally, the studies of Konstantinidis et al. [26] in Switzerland (96%), and Tajunisah et al. [27] in Malaysia (86%) reported high knowledge levels, whereas the study of Balasubramaniyan et al. [28] in rural Tamil Nadu area of India showed the fewer knowledge levels with regards to diabetes-related ocular complications.

The wide variation between the results of the current study and the other studies may be due to differences in study population characteristics, study designs, or variations in the included sample sizes.

Cai and McGinnis [29] stated that diabetic patients often develop eye-related complications, with diabetic retinopathy being the most common. It has a slow onset and gradual progression, advancing from mild to moderate non-proliferative diabetic neuropathy. The severe form of diabetic neuropathy is characterized by hemorrhages and micro-aneurysms in four quadrants, with venous beading in at least two quadrants and intra-retinal microvascular abnormalities in at least one quadrant. Proliferative diabetic neuropathy is characterized by neovascularization, pre-retinal hemorrhages, hemorrhage into the vitreous, traction retinal detachments, or macular edema [30].

Congdon et al. [31] noted that, if left unsupervised or untreated for one year or longer, diabetic retinopathy may be complicated by severe and permanent loss of vision. Therefore, its timely detection and early management play a major role in saving the eyesight of diabetes patients.

Liu et al. [32] stressed that raising awareness about screening to detect diabetic retinopathy is essential for early management. Moreover, increasing diabetic patients' knowledge about diabetic retinopathy would help them change their attitude toward eye screening and regularly visiting diabetes care providers, which will lead to better management of diabetes and its related complications, and will prevent diabetic retinopathy-related vision loss [33]. Therefore, several studies highlighted the pressing need to support knowledge of diabetic patients about diabetic retinopathy screening as well as its associated factors, and the importance of early eye management [34-35].

The present study indicated that participants' main sources of knowledge about diabetes-related ocular complications were the physicians at eye clinics, while general practitioners constituted only 4.5% of their knowledge sources. Mass media/books and participants' family members/friends constituted the least knowledge sources for participants.

Similarly, Singh et al. [36], in India, reported that most diabetics are informed by their physicians regarding diabetes and its complications, while family members

constituted the main source of knowledge for 14% of patients, and 10.3% had their information through mass media and internet.

Mersha et al. [16], in Ethiopia, found that the sources of information about diabetic retinopathy for the majority of the participants were physicians, mass media, and eye doctors, followed by books and friends as a source of information while very few others heard from their friends and family members.

Several other studies in Saudi Arabia reported that physicians, eye doctors, and mass media were also identified as the most frequent sources of information for knowledge about diabetes-related ocular complications among diabetics. In Al-Ahsaa, Neama et al. [19] reported that the main sources of information were general practitioners and ophthalmologists (30.3% and 29.5% respectively), while the role of the Internet and television was limited to 19.1% and 11.2%, respectively. In Riyadh, AlHargan et al. [20] reported that the main sources of information about diabetes and diabetic retinopathy were doctors (58%), followed by family and friends (18%), while 15% stated they did not get any information.

Venugopal et al. [37] noted that physicians are usually the primary sources of knowledge for diabetes patients. They found that 47.4% of diabetics had their information from their treating physicians. This emphasizes the role of physicians in raising awareness about diabetes and its complications. Therefore, it is important to emphasize the role of physicians and other healthcare professionals in health education about diabetes and its complications. Hence, the a need for health programs to update and train physicians and healthcare providers on diabetes and its related complications.

Our study showed that knowledge grades differed significantly according to participants' age groups, with older participants having the highest percentage of good knowledge. Males had significantly better knowledge grades than females. Less educated participants and those with the least monthly income had the highest percentages of poor knowledge. Participants who performed self-care had a significantly higher percentage of good knowledge than those whose caregivers were family members. These categories of diabetic patients should be addressed with more concern to improve their knowledge to attain better control of their diabetes and prevention of diabetic retinopathy.

Al-Eryani et al. [18] reported significantly better levels of knowledge among male patients (37.3% vs. 27.1% for females), younger age (18-30 years) ($p=0.030$), and college-educated patients ($p=0.0001$), while patients older than 50 years, illiterate and those who attained high school education or less, showed poor levels of knowledge ($p<0.05$).

Ahmed et al. [14] reported that participants' knowledge levels did not differ significantly with patients' age ($p=0.137$) or gender ($p=0.377$) but with their level of education ($p=0.001$). Neama et al. [19] reported that females, the elderly, the illiterate, and those who were less educated had significantly lower levels of knowledge. Mersha et al. [16] stated that patients with higher educational status had significantly more good knowledge levels regarding diabetes-related eye complications.

Alqahtani et al. [13] reported that participants' higher education levels were significantly associated with higher knowledge levels. They explained that educated patients have more opportunities to learn and read about health and disease. Therefore, it is important to promote basic education at least through secondary schools as a part of health promotion efforts.

The present study revealed that less than half of the participants had a positive attitude toward the prevention of diabetes-related ocular complications. Their mean attitude score (Mean±SD) toward prevention of diabetes-related ocular complications was low

(8.81±3.67, out of a maximum score of 18). Participants' attitudes differed significantly according to their nationality, with all non-Saudi participants having negative attitudes toward diabetic retinopathy. Less educated participants and those with the least monthly income had the highest negative attitudes toward the management of diabetic retinopathy.

Alqahtani et al. [13] reported a high level of positive attitude in 80.8% of participant diabetic patients in Saudi Arabia. The factors associated with diabetic patients' attitudes toward diabetic retinopathy screening and management included the region of residence (p=0.038), patients' working or studying in the healthcare field, and the type of diabetes.

Hussain et al. [38] reported that the attitude score of participants toward the management of diabetes was low (Mean: 3.68, Range: 8–16). Although there were common misconceptions, such as the consumption of sweets could lead to diabetes (79.5%), 75.3% strongly agreed that diabetic patients should undergo periodic eye checkups. Better-educated patients were found to have a positive attitude toward the management of diabetes compared with their counterparts (P<0.001).

Lingam et al. [39], in India, reported that educational levels were the only significant factor associated with a positive attitude toward the management of diabetes and prevention of diabetic retinopathy. However, gender and age did not play a significant role in participants' attitude scores at any level.

The present study showed that the participants' knowledge scores correlated positively and significantly with their attitude scores (p=0.198, p=0.003).

This finding is in accordance with that of Alqahtani et al. [13], who reported a significant positive correlation between knowledge and attitude (r=0.140, p=0.001). Also Hussain et al. [38], in South India, reported a significant association between patients' knowledge and attitude scores (p<0.001).

These findings indicate the pressing need to improve diabetic patients' knowledge regarding the proper management of diabetes to potentiate their positive attitude toward the prevention of diabetes-related ocular complications.

Study Strengths and Limitations

Studies that assess the knowledge and attitude of diabetic patients regarding diabetes and its related ocular complications help to influence policymakers toward strategic interventions for the diseases.

However, the present study used an online self-administered questionnaire for collecting relevant data, which has the disadvantage of excluding most patients who cannot read without asking for support from family members, and those who are not familiar with internet technologies or do not have internet access. Moreover, the online collection of data may affect its credibility, by adding more probability of response bias.

5. CONCLUSIONS AND RECOMMENDATIONS

The present study found a suboptimal level of knowledge and attitude among diabetic patients visiting the Ophthalmology Clinic at Heraa General Hospital about diabetes-related ocular complications. The main risk factors associated with poor knowledge were being female, younger in age, those who are less educated, those with the least monthly income, and those whose caregivers were family members. All these categories should be addressed with more concern to improve their knowledge to attain better control of their diabetes and prevention of diabetic retinopathy. The main sources of knowledge about

diabetes and its related ocular complications are the physicians, especially the ophthalmologists, who should be well-trained to provide health education to diabetic patients and enforce their motivation toward regular eye check-ups.

It is recommended that the healthcare authorities in Saudi Arabia coordinate with the mass media to improve the public's knowledge regarding diabetes screening. Moreover, further qualitative research is needed to deeply understand the perceptions of diabetic patients about diabetic retinopathy screening.

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7. ANNEXES

Approval papers

Questionnaire

Appendix:

1- Demographics of included subjects:

- Age (years)
- Gender (male, female)
- Marital status (married, single, divorced)
- nationality
- smoking status
- self-reported health status (excellent, very good, good, medium, poor),
- Diabetes [type of diabetes (type 1, type 2, undetermined),
- Duration of diabetes at the time of recruitment (≤10 years, >10 years)
- Treatment (oral antidiabetic alone vs. insulin or other antidiabetic injection)]

2- Questionnaire:

a- Prevalence, Knowledge of types and preventive measures of ocular diseases:

- **Eye diseases**

Diabetic retinopathy

Cataract

Glaucoma

Age-related macular degeneration

Myopia, hyperopia, astigmatism, presbyopia

Other

No

Do not know

- **Number of eye diseases reported**

0 disease

1 disease

2 diseases

≥ 3 diseases

- **Treatment for diabetic retinopathy (among patients reporting diabetic retinopathy) b (n = 41)**

Laser therapy

Eye injection

Surgical intervention

Other

Retinopathy without having had treatment

Do not know

Preventive measures:

Maintaining good glycemic control
Having regular eye examination by an ophthalmologist
Maintaining good blood pressure control
Maintaining good lipid control
Nothing can be done, it is "bad luck"

b. Attitude and believes

1. If my vision is good, my eyes are not affected due to diabetes. Hence I need not visit eye doctor every year.

   I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

2. The information on eye problems due to diabetes should be given only by eye doctor.

   I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

3. If I am taking treatment for my eye problem, I need not worry about controlling my sugar & lipid.

I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

Please turn page for more questions on Page: 3

4. If my eye is treated with laser once, I don't need laser treatment again in that eye to treat complications of diabetes.

   I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

5. Patients with diabetes often waste their time and money in eye check ups as most of the time eyes of diabetics are normal.

   I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

6. One should not be treated with laser as eye treatment of diabetes is very painful.

I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

c. Questions related Practice:

1. I go to eye doctor regularly as advised by my family doctor

I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

2. I control my blood sugar and lipid even if my eye doctor has given treatment for eye problem due to diabetes.

I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

3. I was informed properly by staff in eye department about prevention measures and treatment options for eye complications of diabetes

I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐

4. My vision due to complications of diabetes is less. Hence I am using special low vision devices.

I fully agree ☐ I agree ☐ I am not sure ☐ I do not agree ☐ I totally disagree ☐