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ORIGINAL RESEARCH

Knowledge, Awareness, and Eye Care-Seeking Behavior in Diabetic Retinopathy: A Cross-Sectional Study in Jeddah, Kingdom of Saudi Arabia

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ABSTRACT

Introduction: Diabetes mellitus (DM) is common metabolic disorder that is characterized by increased circulating blood glucose levels. Long-term, continuous hyperglycemia leads to vasculature-related disorders, including those affecting the eyes, such as retinopathy. The objective of this study was to assess the awareness of diabetic complications, specifically diabetic retinopathy, among diabetic patients attending the Jeddah Eye Hospital.

Methods: This was a cross-sectional study targeting the outpatient clinics of Jeddah Eye Hospital for a period of 2 months. A total of 380 participants were randomly selected based on sample size calculations. A closed-ended questionnaire, generated after an extensive literature review, was distributed among the selected individuals. The questions focused on the participants' clinical status of DM, socio-demographic characteristics, awareness of eye complications secondary to DM, eye screening, and eye care-seeking behavior.

Results: The mean age of the patients was 58.3 (standard deviation 10.9) years, and 52.4% of patients were female. The majority (89.7%) of participants had type II DM (T2DM). The level of awareness was satisfactory (92.4%); however, only 10.5% of participants knew the recommended frequency for eye check-ups. The level of awareness of related complications was directly influenced by education level, source of patient information, place of residence, and frequency of follow-up visits.

Conclusion: The results of this study indicate that although the awareness of diabetes-related eye complications was satisfactory in the patient population, eye care-seeking behavior and frequency of eye check-ups were not optimal. Efforts are needed to promote eye care-seeking behavior in this patient group.

Keywords: Awareness; Diabetes; Eye-care-seeking behavior; Retinopathy

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INTRODUCTION

Diabetes mellitus (DM) is the most common metabolic disease worldwide [1]. It is characterized by disturbances in the circulating blood glucose levels that ultimately lead to hyperglycemia. DM is diagnosed based on specific

circulating blood plasma glucose levels. The most commonly employed diagnostic indicators of DM are fasting plasma glucose levels of ≥ 126 mg/dl, an oral glucose tolerance test result of ≥ 200 mg/dl, checked 2 h after a glucose loading of 75 g (2-h plasma glucose), and glycosylated hemoglobin (HbA1c) levels of ≥ 6.5% [2].

According to the World Health Organization, there are currently approximately 280 million diabetic individuals globally, with the expectation that the prevalence of DM will double by the year 2025 [1]. Alarmingly, the areas of the Middle East and North Africa have a higher prevalence of DM than other parts of the world [3], which means that patients in these regions are also at a higher risk of developing diabetes-related complications. The Kingdom of Saudi Arabia (KSA) is among the top-ten countries with the highest prevalence of DM in the world [4], a dubious honor that is mainly attributed to lifestyle changes [3]. Physical inactivity and a sluggish lifestyle, secondary to economic betterment, are the main contributors to the decreased life expectancy in the KSA [5].

There are two main types of DM, namely, type 1 DM (T1DM) and type 2 DM (T2DM), and these differ in terms of age of onset and pathology. T1DM, or insulin-dependent DM (sometimes known as juvenile diabetes), is a consequence of autoimmune disease. In T1DM, the natural immune system of the body damages beta cells of the pancreas, rendering them unable to produce insulin. In comparison, T2DM, or insulin-independent DM, occurs at a later age and has a multifactorial etiology [6]. T2DM is much more common than T1DM 1 [7].

DM affects the vasculature of the eyes, which leads to various disorders, such as glaucoma, vitreous hemorrhage, cataracts, diabetic retinopathy, and blindness. Diabetic retinopathy, the most common disorder affecting the eyes of patients with DM [8], is a progressive blood vessel disorder of the retina that is becoming one of the main causes of blindness in the age group of 20–60 years worldwide [1]. It is estimated that, worldwide, 15,000–39,000 patients will lose their vision due to DM [1].

Assessing awareness among diabetics is a necessary educational measure to help in the control of DM. Eye complications due to DM, such as retinopathy, can lead to high social and economic burdens. Currently, information on the level of such awareness in Jeddah City is lacking. Therefore, the aim of this study was to assess the level of awareness of DM complications, specifically eye complications, among adult diabetic patients attending the Jeddah Eye Hospital.

METHODS

A cross-sectional study was conducted in Jeddah Eye Hospital, which is a government-funded hospital located in Jeddah (the commercial capital of KSA).

The sample size was calculated by using Jeddah Eye Hospital statistics from 2014, which showed that 85,000–95,000 patients visited the outpatient clinics of this hospital during that year. OpenEpi (http://www.openepi.com), an open-source software program, was used to calculate the sample size for a confidence interval (CI) of 95% and a margin of error of 0.05, and indicated that 380 participants would be necessary.

Consequently, 380 patients were recruited from the outpatient department of the hospital, either by referral from a primary healthcare center or through an appointment/consultation in the department. Patients were included in the study by choosing the first patient of the day and thereafter every third patient on the appointment list. Visitors of any nationality and gender who attended the outpatient department of Jeddah Eye Hospital during June to July 2015 and who had been previously diagnosed with DM were eligible for inclusion in the study. Patients who were seriously ill, inpatients, and those not able to give valid informed consent were excluded.

A 26-item closed-ended questionnaire was administered to the 380 randomly selected participants (see Electronic Supplementary Material Appendix). The questionnaire was designed after a detailed literature review; the main sources were the Behavioral Risk Factor Surveillance System Questionnaire (2012 and 2014) [9, 10] and the questionnaire developed

by Tajunisah et al. for evaluating awareness of eye complications among patients with T2DM [1]. The questionnaire was translated into Arabic for ease of use by the participants. There were two sets of questions; one set was used to obtain demographic data, the type of DM, modality of treatment, and time between diagnoses and referral to the eye clinic; the second set was used to assess the knowledge of the patient regarding diabetic eye complications, eye screening, and eye care seeking behavior.

The data provided by the completed questionnaires were transferred by the author into an electronic format using the electronic form functionality in Adobe Acrobat X Pro (Adobe Systems Incorporated, Austin, TX, USA) and subsequently exported as an XML file that was analyzed using SAS version 9.4 software (SAS Institute, Cary, NC, USA). The Chi-square test was utilized to test the association of dependent and independent variables and association of all independent variables. *t* tests were utilized to test the association between continuous variables. *P* values of < 0.05 were considered to indicate statistical significance.

Compliance with Ethics Guidelines

All procedures performed in studies involving human participants were in accordance with the institutional review board (IRB) of Emory University (Atlanta, GA, USA) and with the 1964 Helsinki declaration and its later amendments, or comparable ethical standards. It was classified as public health practice and therefore not subject to review as "human subjects research" (IRB00081503). It was also approved by the local IRB of the Ministry of Health, KSA, (MOH trial registration no. 00611, approval no. A00277). Informed consent was obtained from all individual participants included in the study.

RESULTS

The mean age of the patients was 58.3 years (standard deviation 10.9 years). Of the 380 participants, 291 resided in Jeddah, and 52.4% were female (Table 1). Among the total patient group, 89.7% had T2DM; the remainder had T1DM. In terms of treatment, 41.9% of participants were on insulin. In total, 91.8% of patients had visited the doctor for an assessment of their DM before the year in which this study was conducted (Table 2).

In terms of knowledge of DM complications, 92.4% of the participants were aware that DM

Table 1 Demographic characteristics of the 380 study participants

Variables	Value
Age (years)	
0–45	31 (8.2)
45–55	86 (22.6)
55–65	154 (40.5)
≥ 65	109 (28.7)
Sex	
Male	181 (47.6)
Female	199 (52.4)
Nationality	
Saudi	332 (87.4)
Non-Saudi	48 (12.6)
Residency	
Inside Jeddah	291 (76.6)
Outside Jeddah	89 (23.4)
Primary healthcare center	
Followed up	255 (67.1)
Not followed up	125 (32.9)
Educational level	
Illiterate	168 (44.2)
Primary school	70 (18.4)
Preparatory school	146 (12.1)
Secondary school	49 (12.9)
University and higher degree	47 (12.4)

Values in table are presented as a number with the percentage of total patient population (N = 380) in parenthesis

Table 2 Association between different clinical variables and sex

Clinical variables	Female	Male	Total	*p* value
Diabetes type				
Type 1	15 (8.3%)	8 (4.0%)	23 (6.1%)	0.217
Type 2	159 (87.8%)	182 (91.5%)	341 (89.7%)	
Unknown	7 (3.9%)	9 (4.5%)	16 (4.2%)	
Use of insulin				
Yes	79 (43.9%)	79 (40.1%)	158 (41.9%)	0.45
No	101 (56.1%)	118 (59.9%)	219 (58.1%)	
Seen by doctor in past 12 months				
Yes	168 (92.8%)	181 (91.0%)	349 (91.8%)	0.326
No	13 (7.2%)	18 (9.0%)	31 (8.2%)	
Follow-up recommendation				
< 4 visits in the last 12 months	76 (43.7%)	62 (31.8%)	138 (37.4%)	0.015
≥ 4 visits in the last 12 months	98 (56.3%)	133 (68.2%)	231 (62.6%)	
Glucose check-up frequencies	31 (17.3%)	26 (13.1%)	57 (15.1%)	0.196
Never	46 (25.7%)	78 (39.2%)	124 (32.8%)	
< 4 times a day	6 (3.4%)	2 (1.0%)	8 (2.1%)	
> 4 times a day	31 (17.3%)	34 (17.1%)	65 (17.2%)	
< 4 times a month	61 (34.1%)	58 (29.1%)	119 (31.5%)	
> 4 times a month	4 (2.2%)	1 (0.5%)	5 (1.3%)	
Eye screening referral				
Yes	121 (33.2%)	134 (67.3%)	255 (67.1%)	0.784
No	60 (66.8%)	65 (32.7%)	125 (32.9%)	
Time between diagnosis and eye screening				
Between 0 and 10 years	79 (44.6%)	73 (37.6%)	152 (41.0%)	0.219
Between 10 and 20 years	51 (28.8%)	72 (37.1%)	123 (33.1%)	
> 20 years	47 (26.6%)	49 (25.3%)	96 (25.9%)	
Wear eyeglasses or contact lenses				
Yes	109 (60.2%)	129 (65.5%)	238 (62.9%)	0.259
No	72 (39.8%)	68 (34.5%)	140 (37.1%)	

Table 2 continued

Clinical variables	Female	Male	Total	*p* value
Last eye examination				
Never	14 (7.8%)	15 (7.5%)	29 (7.6%)	0.29
Don't know/not sure	8 (4.4%)	4 (2.0%)	12 (3.2%)	
Within past year	142 (78.9%)	169 (85.0%)	311 (82.1%)	
> 1 year	16 (8.9%)	11 (5.5%)	27 (7.1%)	
Retinopathy				
Yes	119 (66.1%)	134 (67.7%)	253 (66.9%)	0.739
No	55 (30.6%)	56 (28.3%)	111 (29.4%)	
Don't know/not sure	6 (3.3%)	8 (4.0%)	14 (3.7%)	
HbA1C (glycosylated hemoglobin A1c)				
> 6.5%	52 (96.3%)	76 (96.2%)	128 (96.2%)	0.978
< 6.5%	2 (3.7%)	3 (3.8%)	5 (3.8%)	

Values in table are presented as a number with the percentage of total patient population (N = 380) in parenthesis

can lead to eye disease; 5% thought that DM has no effect on eyes, whereas 2.6% did not know anything about diabetes-related eye diseases (Table 3).

Of the participants, 81.7% agreed to have their eyes checked, even when their blood glucose was in the normal range (Table 4). Similarly, when asked about the frequency of eye check-up visits, 69.5% of participants answered

Table 3 Knowledge of diabetes-related complications among participants

Complication	Yes, patient was aware that diabetes can lead to eye disease	No, patient was not aware that diabetes has an effect on eyes	Patient knew nothing about diabetes-related eye diseases
Coronary artery disease	246 (64.7)	65 (17.1)	69 (18.2)
Stroke	228 (60.2)	72 (19.0)	79 (20.8)
Peripheral vascular disease	236 (62.3)	61 (16.1)	82 (21.6)
Neuropathy	259 (68.5)	67 (17.7)	52 (13.8)
Eye disease	351 (92.4)	19 (5.0)	10 (2.6)
Nephropathy	269 (70.8)	69 (18.2)	42 (11.0)

Values in table are presented as a number with the percentage of total patient population (N = 380) in parenthesis

Table 4 Knowledge of eye check-up frequency when blood sugar levels are controlled

Eye check-up even though blood sugar levels are normal	Values
Yes	308 (81.7)
No	52 (13.8)
Sometimes	17 (4.5)

Values in table are presented as a number with the percentage of total patient population (N = 380) in parenthesis

that they considered that eye check-ups should be conducted at 6-month intervals, 19.2% answered that eye check-ups should be performed when there is a problem with vision, while 10.5% considered that yearly eye check-ups were adequate (Table 5).

When asked about the source of information from which they obtained knowledge about the complications of DM, 67.2% participants answered that health-care workers were their source of information, 18.0% answered that routes of mass communication provided them with information, while 14.8% obtained their information from their relatives or friends (Table 6).

The level of awareness about complications of DM was significantly associated with level of education ($p < 0.05$) (Fig. 1). The source of the patient's information was also significantly associated with awareness ($p < 0.05$). Participants who gained their knowledge from mass media had a higher level of awareness than those who gained their knowledge from healthcare professionals (Fig. 2). The area of residency was also significantly associated with the patient's awareness ($p < 0.05$). Residents of Jeddah had a higher awareness of DM eye complications than those from outside this city.

Table 5 Knowledge about eye check-up frequency

Eye check-up frequency	Value
Every 6 months	264 (69.5)
Only when vision is affected	73 (19.2)
Two-yearly interval	3 (0.8)
Yearly	40 (10.5)

Values in table are presented as a number with the percentage of total patient population (N = 380) in parenthesis

Table 6 Source of knowledge about complications

Source of information	Value
Doctor/nurse/ophthalmologist/optometrist	254 (67)
Family member/friends/relative with diabetes	56 (14.8)
Television/radio/newspaper/Internet	68 (18)

Values in table are presented as a number with the percentage of total patient population (N = 380) in parenthesis

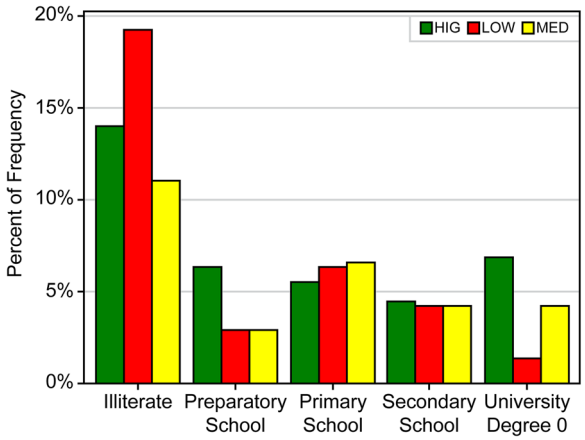

Fig. 1 Level of awareness about complications of diabetes mellitus according to level of education. *HIG* High level of awareness, *LOW* low level of awareness, *MED* medium level of awareness

DISCUSSION

A study published in 2016 showed that the prevalence of pre-diabetes among the adult population of Jeddah was 9.0% (8.6% in women and 9.4% in men) [11]. The overall prevalence of diabetic retinopathy in the KSA ranges between 33 and 36% in different regions [12].

The proportion of participants (66.9%) diagnosed with diabetic retinopathy in this

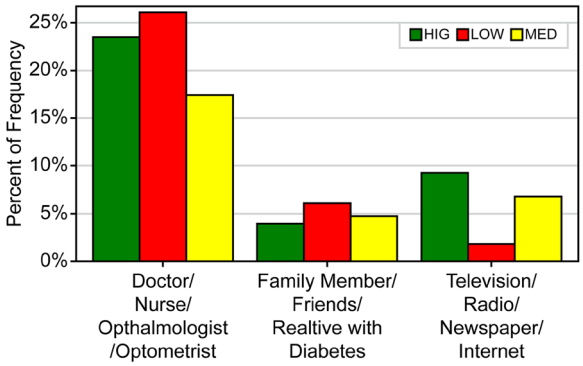

Fig. 2 Level of awareness about complications of diabetes mellitus according to source of knowledge. *HIG* High level of awareness, *LOW* low level of awareness, *MED* medium level of awareness

study was higher than that reported in 2012 in a study conducted by El-Bab et al. in the city of Al-Madinah Al-Munawarah (36.1%) [13]. However, 92% of the participants in the present study were aware of the effects of DM on eyes, which is higher than ever previously reported in a study conducted in the KSA. Tajunishah et al. reported that 86.1% participants were aware of DM causing eye diseases [1], whereas the authors of a hospital-based study conducted in India concluded that only 51% people had knowledge of the association between DM and eye diseases [14].

In the present study, follow-up with healthcare professionals (based on recommended guidelines) and level of awareness were significantly associated. In contrast, Addoor and Bhandary reported that among the diabetics attending peripheral diabetic clinics in Melaka, Malaysia, there was no statistically significant effect of previous follow-up visits for DM on the level of awareness [15].

Educated individuals participating in this study had a better understanding of the need for follow-up and the frequency of eye check-ups. Education enhances awareness and thus plays a key role in the development of a healthy society [1]. The patients with secondary or graduate level education in our study were well aware of diabetes-related conditions. Malaysian and South African studies have also demonstrated similar results [9, 16]. Clearly, individuals who are well educated have better access to different modes of mass communication and are better empowered to understand their health condition.

In the present study, 67.2% of the patients had obtained information about diabetes-related eye complications from healthcare providers, while 18% of the patients had obtained this information from mass media. In a U.S. study on Hispanics, around 60% of the patients had obtained their diabetes-related knowledge from healthcare providers [17]. In the present study it was also evident that although the proportion of individuals obtaining this knowledge from mass media was smaller than that obtaining information from healthcare providers, the former had a better understanding of their disease. This result clearly questions the level of awareness instilled by healthcare providers as it would appear that mass media was more effective in conveying its message across the population. This finding also suggests that healthcare workers should be trained in developing effective communication skills, as they have to deal with many illiterate patients; the percentage of illiterate individuals in this study was 44.2%.

Inadequate awareness of diabetic eye complications is the main barrier preventing patients from having earlier eye check-ups, as indicated by the prevalance of inadequate awareness in the present study (62.8%). Lack of knowledge was also the main barrier to attending regular check-ups in the above-mentioned Malaysian study [9]. Clearly, an increase in public awareness will lead to a decreased incidence of diabetic retinopathies [5].

Limitations

Actually the study was conducted from June 1 to July 30, which included the Muslims' month of fasting (Ramadan). Data collection may have been affected by factors related to this observance, such as type of patients showing up for appointments during this month and the reduced working hours. Moreover, the study was a hospital-based study conducted in one specialized eye hospital; a similar study might need to be conducted in a public or non-specialized hospital to validate the results. Very

limited access to medical records was a barrier to obtaining data on HbA1c levels, and the study relied on participants to report this data, which may have introduced a recall bias.

CONCLUSIONS

The results of this study show that although a high percentage of the participants were aware of diabetes-related complications in general and eye diseases specifically, they did not have sufficient knowledge to prevent and manage these. The awareness that is instilled via healthcare providers, such as doctors and nurses, is inefficient. Different courses and lectures should be designed for healthcare workers to improve their communication skills. The results reported here indicate that mass media is more effective in instilling awareness and understanding of diabetes-related complications due to its ability to raise important health issues that reflect public concerns. Health messages delivered through mass media should be simple, creative, use different formats, and be repeated many times. It should be noted that these messages are unlikely to lead to the development of skills or to change behaviors, but they can provide the right information, which is a step toward increasing the patient's level of awareness.

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Compliance with Ethics Guidelines. All procedures performed in studies involving human participants were in accordance with Emory University IRB and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. It was classified as public health practice and therefore not subject to review as "human subjects research" (IRB00081503), it was also approved by the local IRB of the Ministry of Health, KSA, (MOH trial registration number 00611, approval number A00277). Informed consent was obtained from all individual participants included in the study.

Data Availability. The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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