

Assessment Of The Knowledge Diabetic Retinopathy Among Patients With Type 2 Diabetes At Makkah, Saudi Arabia 2019. Cross-Sectional Study

Adel Saeed Ali Alzahrani¹, Nawaf Suhaim Al-Atiani², Saeed mohmmad saeed alzahrani³, Hani Faisal Abdulaziz Hassanain⁴, Aishah jamaan Al-Hadrami⁵, Hanoof Mohammad Hawsawi⁶, Faisal abdulalaah Mohammed Hanif⁷, Hashem Jubeir Jaber Al-Mujairishi⁸, Ibrahim Mohamed salhe althubyani⁹, Zahia Obaid Almowalad¹⁰, Ghalib Ibrahim Alsallmi¹¹.

¹Family medicine consultant, Batha quraish PHC in Makkah, Saudi Arabia.

²Director of Human Resources, Health and hospital administration, Ministry of Health, Makkah, Saudi Arabia.

³Dental hygienist, Batha Quraish, Saudi Arabia.

⁴lab specialist, Poison Control Center in Makkah, administration in Makkah region, Saudi Arabia.

⁵Technical nurse, Maternity and chilled Hospital, Saudi Arabia.

⁶Technical nurse, PHC, Saudi Arabia.

⁷Social worker, health affairs in Makkah Al-Mukarramah, Saudi Arabia.

⁸Nursing technician, Maternity and Children Hospital in Makkah Al-Mukarramah, Saudi Arabia.

⁹pharmacist, Maternity and Children Hospital, Health Affairs in Makkah Al-Mukarramah, Saudi Arabia.

¹⁰Nursing Technician, PHC Al-Jumum, Saudi Arabia.

¹¹Pharmacy Technician, Batha quraish PHC in Makkah, Saudi Arabia.

Abstract:

1. Background

Diabetic retinopathy (DR) is a well-known complication of diabetes mellitus (DM) and a major cause of vision loss. Increased knowledge of DR is crucial for the prevention and early diagnosis of the disease and preservation of vision, diabetes mellitus is a disorder, characterized by an imbalance in blood glucose levels. The prevalence of diabetes mellitus is increasing globally. The global diabetes prevalence in 2019 is estimated to be 9.3% (463 million people), rising to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045. Long term, continuous hyperglycemia leads to vasculature-related disorders, including those affecting the eyes, such as retinopathy, diabetes mellitus is an endocrine disease with chronic elevation in blood glucose levels. If not managed, it can lead to multi-organ damage also diabetes mellitus is a metabolic disease that is characterized by distortion in the metabolism of carbohydrates, lipids, and proteins and involves hyperglycemia. Diabetes mellitus has different types. Several complications are associated with diabetes including diabetic retinopathy.

This study aimed: This study aims to assess the knowledge of diabetic retinopathy and compliance with diabetic retinopathy patients in Makkah, Saudi Arabia.

Methods: cross-sectional study was conducted among the diabetic population from May to September 2019 in Makkah, Saudi Arabia. The patients were selected randomly from the general population visiting the Makkah diabetic center and primary healthcare clinics in Makkah. A self-administered questionnaire was distributed to assess the knowledge of diabetes and its complication diabetic retinopathy. Our total participants were (300)

Results: Conclusion: The level of knowledge regarding diabetic retinopathy among participants with diabetes type 2 in Makkah is relatively high. However, participants' motivation to attend an ophthalmology clinic for an eye assessment was poor in the study, thus delay early diagnosis and management.

Keywords: knowledge, diabetic, retinopathy, patients, type 2 diabetes, Makkah, Saudi Arabia.

Introduction

According to the latest report of Vision Loss Expert Group of the Global Burden of Disease Study, the crude prevalence (at all ages) of visual impairment and blindness caused by diabetic retinopathy increased significantly between the years 1990 and 2015 in respect to global population [1]. The number of people affected by blindness due to diabetic retinopathy increased from 0.2 million to 0.4 million, however, by moderate to severe vision impairment increased from 1.4 million to 2.6 million. An increase in the age-

standardized prevalence of blindness and visual impairment caused by diabetic retinopathy was observed in the high income sub-regions, North Africa and Middle East. [2]

Diabetes mellitus is an endocrine disorder characterized by a chronic elevation in blood glucose levels. If not managed, it can lead to multi-organ damage. Examples of organs that can get damaged include, but are not limited to, the heart, the kidneys, blood vessels, nerves, and the eyes (causing diabetic retinopathy and possible vision loss). [3] Of the various types of diabetes, type 2 is the most common one. In this type, insulin levels are usually normal or increased. The problem lies in the body's inability to respond to insulin (insulin resistance). However, in the long run, insulin levels may decrease in this type as well.[4] Diabetes mellitus affects more than 170 million people globally, and the numbers are on the rise.[2,5,6] In fact, 8% of the global population was diagnosed with Diabetes mellitus in 2011. That percentage predicted to rise to 10% by the year 2030. [7,8]

Diabetic retinopathy, one of the many complications of DM, can eventually lead to vision loss.[9] World-wide statistics of diabetic retinopathy prevalence among those diagnosed with DM are as follows: US (28.5%)[10], Australia (32.2%)[11], Indonesia (43.1%) [12], India (21.7%)[13], Jordan (34.1%)[14] and Egypt (20.5%) [15] In Saudi, diabetic retinopathy is found in 28-36% of those diagnosed with DM. [16,17,18]

It is crucial to increase awareness among diabetic's about diabetes and its complication diabetic retinopathy. Diabetic patients need to understand the importance of managing diabetes to decrease/prevent diabetic retinopathy and possible vision loss. It is also essential for such patients to understand the importance of regular eye checkups and how early diagnosis can help decrease/prevent diabetic retinopathy progression to vision loss.[19]

Lack of awareness regarding the importance of managing DM and diabetic retinopathy leads to poor compliance with the guidelines and an unnecessary delay in diagnosing diabetic retinopathy. Such a case would not only affect the patient's quality of life but will also increase the financial costs and burden on the healthcare system.[20]

A lack of awareness about DM, DR, ordinary eye assessments, and the advantages of treatment can lead to poor compliance with the guidelines and delays in referrals to ophthalmology.[21] It was found that adequate knowledge, increased duration of diabetes, and presence of neurological complications increased independent adherence to screening.[22] From a financial point of view, the investigations and treatment of advanced diseases may influence the patient's personal satisfaction and increase the money-related expenses for his/her health.[23]

Diabetes mellitus, its management, and its closely related complication, diabetic retinopathy, is a growing problem in Saudi Arabia. In Saudi, diabetic retinopathy is found in 28-36% of those diagnosed with diabetes mellitus. [24,25] diabetic retinopathy in the entire region.7 Complications resulting from diabetes mellitus can be mitigated with appropriate education and management, which could significantly prevent end organ damage and halt the progression of the disease.[26] This study aims to assessment of the knowledge diabetic retinopathy among patients with type 2 diabetes at Makkah, Saudi Arabia, there is a lack of studies assessing the level of knowledge among people with diabetes.

2. Literature review:

In Saudi Arabia, over 25% of the adult population is suffering and that figure is projected to more than double by 2030.[27] There are many complications of diabetes mellitus, such as nephropathy, cardiovascular problems, neuropathy, and diabetic retinopathy.[4] Diabetic retinopathy is the most common cause of blindness and is the most frequent microvascular complication of diabetes mellitus. Globally, the prevalence of diabetic retinopathy has markedly increased.[28] The prevalence ranged from 19.7% to 26.1% in the central region, whereas studies in other regions of Saudi Arabia suggested a prevalence ranging from 27.8% to 36.4%. [19,26]

The most of systematic review has shown that there is generally low knowledge of diabetic retinopathy among patients with type 2 diabetes and about the risk factors and its complications among the Saudi population in particular. Most diabetes mellitus patients had low to moderate knowledge scores in Riyadh, Jeddah, Al Hasa, Al-Khobar, and Makkah. Also unexpectedly, health professionals in Saudi Arabia also had

low knowledge scores about diabetes mellitus especially type 2.[28]

The results of one study in the Kuwait showed that diabetes is a global issue. Kuwait is among the high prevalence countries (20%) and has been ranked 5th. This suggests that one-fifth of the studied sample would be diagnosed complications in particular diabetic retinopathy in the future as diabetic. Taking into consideration this high prevalence of diabetes, it is highly recommended to increase the knowledge about diabetic retinopathy in the Saudi population.[29]

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. In this study, follow-up with healthcare professionals (based on recommended guidelines) and level of awareness were significantly associated. [30]

Study in Poland (2017) evaluates the characteristics and trends of the prevalence of diabetic retinopathy in the population with both type 1 and type 2 diabetes mellitus, in the years 2013–2017. Since it is based on the overall population of Poland, it is the first study in Europe and in the world to provide data concerning the prevalence of DR on such a scale. This study reported the rate of registered patients with diabetes mellitus and DR in the entire population of Poland on the level about 6.80% and 0.81%, respectively, in 2017.

During the study period, the total number of individuals with DM in Poland increased by 26.3%. Our finding is in agreement with the estimation of World Health Organization which projected that the total number of people with diabetes mellitus will double from 2000 to 2030.

With the increasing number of people with diabetes, the number of DR and vision-threatening DR, has been estimated to rise to 191.0 million and 56.3 million, respectively, by 2030[24]. The mean prevalence of DR in Poland was 9.70% in the population with type 2 DM, and it increased significantly from 7.8% in the year 2013 to 11.0% in the year 2017, respectively.[23] in a global review that 34.6% of all diabetic patients have some forms of DR.[31] The prevalence of DR was reported to be 28.5%, 30.3%, 32.2%, 39.6%, and 39.3% in USA, UK, Australia, Japan, and Malaysia, respectively.[32]. The prevalence of DR in KSA was found to be 31.3% in the capital Riyadh; the prevalence was estimated in other Saudi regions including Al-Taif, Al-Hasa which was found 33% in the both region, but the highest prevalence was found in Al-Madinah 36%.[33,34]

A study from Saudi Arabia reported that 36.4% of T2DM patients suffered DR. [35] The level of awareness about DR varies among different countries and different regions; a study from Australia [16] reported there were 37% only of diabetes mellitus patients who knew about ocular complications of diabetes mellitus. A lower level of awareness was reported from India (27%),[35] and the highest level of awareness was reported from the USA, where 65% of diabetes mellitus patients were aware of DR. [10]

In other recently published studies, the prevalence of DR among type 2 diabetes mellitus patients ranged from 20.1% per over 64 thousand patients from German/Austrian Diabetes Prospective Documentation Initiative, through 21.0% in over 11 thousand patients from the greater Wellington region in New Zealand [36], to 28.3% per over 7.7 million subjects in the Clinical Practice Research Datalink (CPRD) database in Great Britain [37]. The prevalence of DR among type 1 diabetes mellitus patients was higher and ranged from 13.4% in India [35], through 29.0% in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) from the USA and 42.3% in the greater Wellington region in New Zealand[36], to 48.4% in the CPRD database in Great Britain[37]

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) [26]. The overall prevalence of diabetic retinopathy in the KSA ranges between 33 and 36% in different regions [16]. The proportion of participants (66.9%) diagnosed with diabetic retinopathy in this 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%) [35]. 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 diabetes mellitus causing eye diseases, whereas the authors of a hospital-based study conducted in India concluded that only 51% people had knowledge of the association between diabetes mellitus and eye diseases [38]

A study from Jordan demonstrated that there was a high level of awareness among diabetic patients regarding DR.[16] A study from KSA among physicians in Riyadh showed that the mean score of their

awareness regarding DR was 57 out of 100.[38] A study from AlJouf and Hail province, KSA reported that 75.62% of diabetic patients were aware that diabetes can result in eye diseases.[36] A study from Taif, KSA showed that two-thirds of screened T2DM patients had good knowledge about DR.[37] A study from Jeddah, KSA demonstrated that DM patients had a good awareness about DM and its effects on eye; however, they showed the lack of awareness regarding DR.[30] Another study from Jeddah, King Abdul Aziz University found that 61% of diabetic patients had awareness about DR.[37]

2.1. Rationale:

There may be a gap between knowledge of diabetes and perceptions of diabetes among patients in Saudi Arabia. The researcher expects low the knowledge of diabetic retinopathy among patients with type 2 diabetes generally high in our study in Makkah, Saudi Arabia. This study will add significantly to the knowledge of diabetic retinopathy among patients with type 2 diabetes. knowledge of diabetes mellitus and diabetic retinopathy, along with their health impacts and treatment, can be considered vital in motivating patients to pursue appropriate eye care and may, therefore, assist in dealing with visual impairment. In addition, for early diagnosis and treatment of diabetic retinopathy, it is crucial to have a strong knowledge of diabetic retinopathy and its risk factors.

2.2 Aim of the Study

This study aims to assess the knowledge of diabetic retinopathy and compliance with diabetic retinopathy at Makkah, Saudi Arabia 2019.

2.3 Objectives:

The objective of this study was to assess the knowledge diabetic retinopathy among patients with type 2 diabetes at Makkah, Saudi Arabia 2019.

3. Subjects and Methodology:

3.1 Study design:

This study is descriptive type of cross-sectional study was conducted among **300** diabetic type II enrolled in our research study. The patients were selected randomly from the general population visiting the Makkah diabetic center and primary healthcare clinics in Makkah.

3.2 Study setting / study area:

Makkah is the holiest spot on Earth. It is the birthplace of the Prophet Mohammad and the principal place of the pilgrims to perform Umrah and Hajj. It is located in the western area in Kingdom of Saudi Arabia and called the Holy Capital. Study participants has been recruited on Makkah. The patients were selected randomly from the general population visiting the Makkah diabetic center and primary healthcare clinics in Makkah. under supervision of Directorate of Health Affairs of Makkah. in Saudi Arabia. They are distinguished by their environment and the large number of residents in them, one of the most important characteristics of Makkah is its locations, which is characterized good environment and the large number of residents in them.

3.3 Study population:

The study has been conducted among the general population visiting the Makkah diabetic center and primary healthcare clinics in Makkah. During the May to September 2019

3.4 Study design:

A cross-sectional study has been conducted to assess the knowledge diabetic retinopathy among patients with type 2 diabetes at Makkah, Saudi Arabia 2019, to the population visiting the diabetic center and primary healthcare clinics in Makkah in 2019.

3.5 Selection criteria:

3.5.1 Inclusion criteria

- Population visiting the diabetic center and primary healthcare clinics in Makkah.
- The T2DM patients who read and speak Arabic as a first language .
- All nationalities

3.5.2 Exclusion criteria :

- No specific exclusion criteria.

3.6 . Sample size

- Population visiting the Makkah diabetic center and primary healthcare clinics in Makkah

- The sample size has been calculated by applying Raosoft sample size calculator based on (The margin of error: 5%, Confidence level: 95%, and the response distribution was considered to be 20%) accordingly the Sample size is (300) the diabetic participants (male and female) after official communication with the administrator, after that, The researcher has been Permission from the regional Research, in the Makkah and adding 10 more to decrease margin of error. After adding 5% oversampling, the minimum calculated sample has been 300. Computer generated simple random sampling technique was used to select the study participants.

3.7 Sampling technique:

Systematic random sampling technique is adopted. After that, by using random number generator, then simple random sampling technique has been applied to select the participants population. Also, convenience sampling technique will be utilized to select the participants in the study. By using systematic sampling random as dividing the total participants by the required sample size; (300).

3.8 Data collection tool

An electronic survey adapted from previous literature research developed in the Arabic version used for data collection, and frameworks to assess the level of knowledge of diabetic retinopathy and compliance with diabetes and diabetic retinopathy management. The questionnaire has been developed in Arabic version. The questions were first pre-tested and were revised and finalized after it has been pilot tested. Before completing the survey, participants were required to indicate their consent using a forced response question followed by the survey questionnaires. Permission was obtained through personal communication with the principle author before using the questionnaire form. The survey is estimated to take 10 min to complete .

To collect the information, a set of questions were constructed and developed. All questions were closed-ended, with tick boxes provided for responses; participants answered the questionnaires from the May to September 2019.

The questionnaire consisted of questions that

First part General and Socio demographic information. These variables included contact data (email or mobile phone number),(age, gender, Sources of information). Other variables were education level, economic level.

A questionnaire has been developed that had Socio demographic data and questions related to knowledge respectively. The two senior faculty members checked the questionnaire's validity and comprehension, and it was revised according to their suggestions. A pilot study has been conducted on 20 participants to check the questionnaire's understanding and responses further, and its Cronbach's alpha was 0.75. The results of the pilot study were not included in the final analysis.

Data entry and analysis were carried out using the Statistical Package for the Social Sciences. Pearson's Chi-square tests were performed to explore if there is any significant association between the awareness of diabetic retinopathy and compliance with diabetes and diabetic retinopathy management and their (i) gender, (ii) age, and (iii) level of education.

3.9 Data collection technique:

Researcher has been visits the selected diabetic center and primary healthcare clinics in Makkah after getting the approval from the ministries of health. The researcher has been obtained permission from primary healthcare clinics director and participants in the Makkah

After the arrival of the participants has been explained the purpose of the study to all participants attending

3.10 Data entry and analysis:

Data were analyzed using (SPSS version 24). Percentages and numbers were calculated to summarize nominal and categorical information. The chi-square test (χ^2), Anova test (F), and T-test (t) were used to study the significance of association and significant differences. 95% confidence intervals (CI) were calculated. P-value <0.05 was considered statistically significant.

4. Pilot study

A pilot study has been conducted in diabetic retinopathy using the same questionnaire to test the methodology of the study. As a feedback, the questionnaire has been clear and no defect has been detected in the methodology.

5. Ethical considerations

Informed Consent from all participants considered before participation. The survey includes questions about basic socio demographic data, knowledge about DM and DR, source of knowledge and management. The survey also includes questions about routine visits to ophthalmology clinics for retina screening and early eye check-up. Lastly, participants asked about possible barriers that prevented them from regular visits to ophthalmology clinics .

Our study and procedures performed according to ethical principles and standards of the Makkah ethical committee. Approval for conducting our research study granted by the Makkah ethical committee in Makkah region, Ministry of Health .

6. Budget: Self-funded

3. Results

A total of 300 T2DM patients (147 females, 153 males) were invited to participate.

Table1: Distribution of demographic characteristics of study population (N = 300)

Variables	N	%
Age		
<25	54	18
25-35	66	22
35-45	114	38
>45	66	22
Range	19-65	
Mean \pm SD	46.155 \pm 13.211	
Gender		
Female	147	49
Male	153	51
Level of education		
None	33	11
Elementary	54	18
High School	69	23

Intermediate education	27	9
Higher education	117	39
Duration of DM		
Less than 5 years	105	35
6 to 10 years	87	29
More than 11 years	108	36
Family history of DM		
Yes	237	79
No	63	21
Blood glucoses levels		
Controlled	231	77
Uncontrolled	69	23
main source of information (knowledge) about DM and DR		
Doctor	105	35
Internet /social media	96	32
Friends and relatives	60	20
Not received any information	39	13

In our study showed that the only (38.0%) of the participated were(35-45) years while (25-35) years were(22.0%) while range (19-65) and Mean \pm SD (46.155 \pm 13.211), regarding the gender the majority of the participated male were (51.0%)while female (49.0%), regarding the level of education the majority of the participated the level of education were higher education (39.0%) follow by high School were(23.0%) and the majority of duration of DM more than 11 years were work (36.0%) follow by less than 5 years were(35.0%), regarding Family history of DM the majority of the participated Yes were(79.0%), regarding blood glucoses levels the majority of the participated controlled were(77.0%), regarding main source of information (knowledge) about DM and DR the majority of the participated from doctor were(35.0%) follow by internet /social media were (32.0%).

Table 2 Compliance behavior regarding DM and DR management

Compliance behavior regarding DM and DR management	N	%
Do you think the information you get about diabetes is sufficient?		
Yes	165	55
No	135	45
Are you fully adherent to your current DM treatment?		
Yes	267	89
No	33	11
Do you measure your blood sugar at home?		
Yes	258	86
No	42	14
How frequent do you measure your blood sugar at home?		
Every month	21	7
Every week	36	12

Every day	111	37
Once I feel unwell	66	22
Never	66	22
When you did last time had your vision exam?		
I did not review	126	42
During the past 6 months	57	19
During the past year	117	39

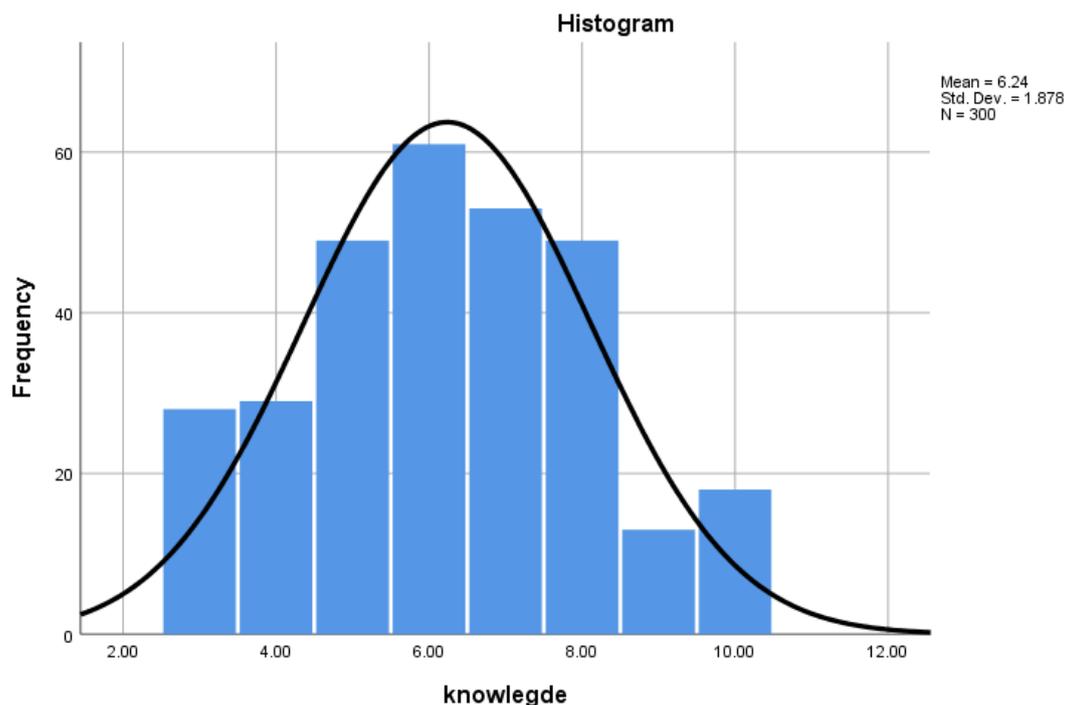
Most Participants (89.0%), were adherent to your current DM treatment. However (55.0%) think there was a lack of information about DM and its sufficient.(86.0%) reported measuring blood sugar at home. The frequency of measuring the level of blood sugar was varying from participant to participant. The majority of patients measure their blood glucose level daily (37.0%), followed by those who were performing the test only when feeling unwell (22.0%), (12.0%) measure the sugar level weekly. (42.0%) of participants did not review an eye exam while during the past year were(39.0%) those who examined their eyes in the past six months (91.0%).

Table(3) Distribution of the Knowledge about DM and DR Score.

Knowledge			Score	
	N	%	Range	Mean+SD
Weak	66	22.00	3-10.	6.241+1.878
Average	125	41.67		
High	109	36.33		
Total	300	100.00		
Chi-square	X²	18.62		
	P-value	<0.001*		

Table 3 Regarding Knowledge of the participants about DM and DR results show the majority of participant had **average** information were(41.67%) while weak of the Knowledge about DM and DR were(22.0%) while high Knowledge were (36.33%) the data ranged from(3-10) by mean \pm SD(6.241+1.878) and a statistical significant relation While Chi-square X^2 18.62 and P=value 0.001

Figure (1) Distribution of the Knowledge Score about DM and DR Score

**Table 4: Association between knowledge of DR and Demographic data**

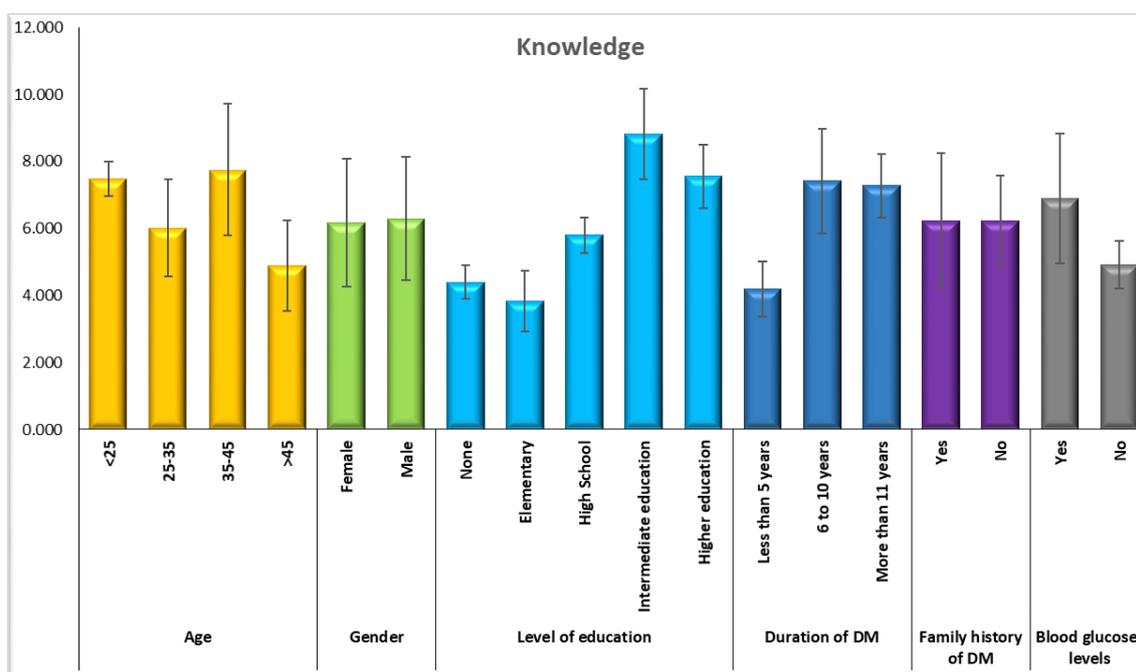
Demographic data		N	knowledge		F or T	ANOVA or T-test	
			Mean	± SD		Test value	P-value
Age	<25	54	7.481	± 0.504	F	72.037	<0.001*
	25-35	66	6.015	± 1.452			
	35-45	66	7.758	± 1.962			
	>45	114	4.895	± 1.359			
Gender	Female	147	6.177	± 1.915	T	-0.540	0.590
	Male	153	6.294	± 1.846			
Level of education	None	33	4.394	± 0.496	F	271.987	<0.001*
	Elementary	56	3.839	± 0.910			
	High School	67	5.806	± 0.529			
	Intermediate education	27	8.815	± 1.360			
	Higher education	117	7.556	± 0.951			
Duration of DM	Less than 5 years	105	4.190	± 0.833	F	266.791	<0.001*
	6 to 10 years	87	7.414	± 1.559			
	More than 11 years	108	7.278	± 0.946			
Family history of DM	Yes	237	6.236	± 2.001	T	-0.007	0.995
	No	63	6.238	± 1.329			
Blood glucoses levels	Yes	201	6.886	± 1.934	T	9.788	<0.001*
	No	99	4.919	± 0.710			

Table (4) show that is a significant relation between knowledge of DR and demographic data regarding

age (increase in 35-45 years follow by age < 25) where $F=72.037$ and $P\text{-value} < 0.001$ by mean \pm SD (7.758 ± 1.962 , 7.481 ± 0.504). Regarding gender In our study the majority of our participants were noticed in male more than female with Mean \pm SD (6.294 ± 1.846) with not significant relation between knowledge of DR and gender were $T=-0.540$ and $P\text{-value}=0.590$, regarding level of education show that a significant relation between knowledge of DR and level of education (increase in intermediate education) were $F=271.987$ and $P\text{-value}=0.001$ by mean \pm SD (8.815 ± 1.360).

Regarding duration of DM show that a significant relation between knowledge of DR and Duration of DM (increase in 6 to 10 years) were $F=266.791$ and $P\text{-value}=0.001$ by mean \pm SD (7.414 ± 1.559). Also regarding the family history of DM show that not significant relation between knowledge of DR and family history of DM (increase in the NO) were $T=-0.007$ and $P\text{-value}=0.995$ by mean \pm SD (6.238 ± 1.329). Regarding blood glucoses levels show that a significant relation between knowledge of the DR and blood glucoses levels (increase in Yes) were $T=9.788$ and $P\text{-value}=0.001$ by mean \pm SD (6.886 ± 1.934).

Figure 2 show association between knowledge of DR and Demographic data



Discussion

Diabetes Meletus is a major metabolic and endocrine problem worldwide. Diabetic retinopathy is one of the microvascular complications of DM. However, if DR is not diagnosed and managed early, it can lead to irreversible blindness. Lack of awareness about DR is a significant health problem that can delay early screening, management, and prevention. Our study aimed to assess the knowledge of diabetic retinopathy and compliance with diabetic retinopathy patients in Makkah, Saudi Arabia. compliance behaviors to routine visits to ophthalmology clinics.

A study conducted in Jazan showed that 27.8% of people with diabetes suffered from diabetic retinopathy. [16] The prevalence of DR in Jazan is less than most of the results reported in regional and international studies.[12,13]

Our obtained data showed that out of 300 participants enrolled in the study, were aware that the uncontrolled DM leads to retina and eye problems. Among all participants reported that DR leads to blindness. Bakkar et al found 81.9% of participants reported that DR leads to blindness. [8] Furthermore, Katrina et al noted 75% of diabetic participants reported that DR is a risk factor for blindness [37]

In regards to knowledge of diabetic retinopathy about DR and ocular complication we observed our result was a higher than that study in USA (52%) , India (50%), Oman (72%), and North of Saudi Arabia (75.62%). [6] However, the level of knowledge of diabetic retinopathy in our study noted to be less than that of Japan (98%) [31], Australia (96%) and Jordan (88.2%) [16]. Our result of level of knowledge of diabetic

retinopathy is average, also other studies conducted in the Kingdom of Saudi Arabia as follow: Taif 64% [37], Jeddah 82.6% [16], also another study conducted in Jeddah at King Abdul-Aziz University hospital 61% of participants were aware [35].

In respect to knowledge of DM control, Participants were aware that control of blood glucose level can decrease the risk of DR development. Though, only Participants were aware that prognosis of DR can be controlled by laser treatment. Similarly, Bakkar et al found 82.7% of participants were aware that the risk of DR complication can be reduced by controlling blood glucose and 38.4% were aware that DR risk can be controlled by laser treatment [8]. In accordance to routine retinal examination, reported regular examination should be considered. In contrast, reported retinal examination should be done only when the vision is affected. According to the Al Zarea et al noted in his study 73.8% aware about importance of regular retinal assessment. [6] Lian et al conducted study to assess awareness level about retinal examination and systematic screening in Hong Kong and he found 75.7% were aware about importance of retinal screening and regular visits. [32] These results agree with the findings of Bakkar et al and Manu et al. [8] In contrast, Alrashedi et al found significant association between female gender and level of awareness (p -value = 0.04). [39] Furthermore, Alsaidan et al found significant correlation of awareness with male gender. [40]

Significant association found between level of awareness and age ($P < 0.001$). Level of awareness noted to be higher among the young adult age group in comparison to older ages. High awareness among all ages observed in those who are between 30 and 40 years old. Similarly, Alrashedi et al noted a correlation between age and level of awareness. [39] On the contrary Bakkar et al observed poor association between age and knowledge level. [8]

The awareness was significantly associated with the age among urban and rural residential population but not with residential area. The awareness was significantly associated with the age among urban and rural residential population but not with residential area.

The knowledge was significantly associated with the age among population. Buari et al conducted study in Malaysia to study level of knowledge and she noted the awareness was significantly associated with the age among urban and rural residential population. Moreover, she observed higher level of awareness among 35-45 age group. [41]

Likewise, Bakkar et al found no association with the duration of DM. On other hand, Almalki et al found duration of DM was significantly associated with those who known as T2DM who diagnosed for at least 10 years. [8] Furthermore, Tegegne et al observed significant association between duration of DM and Knowledge of participants.

Control of blood glucose level reported of participants. level of knowledge found among those who controlled their sugar level ($P < 0.001$). Also, other studies noted the correlation between the maintaining blood glucose level and high knowledge.

Doctors are the main source of information in our study. This is similar to reported information source in Jordanians. Additionally, the result consistent with study conducted in Pakistan showed the physicians were the main source of information about diabetic retinopathy. [37]

Conclusion

The knowledge of diabetic retinopathy among patients with diabetes in Makkah patients' the participants' eye assessment was poor in the, thus delay early diagnosis and management, high knowledge observed in participating patients. Risk factors that associated significantly were age, level of education, blood glucose level control. In contrast, the variables that observed not to be associated with DR in our study were gender, family history, duration of DM. Compliance behaviors and measures that statistically associated with the level of knowledge were noted among those who are fully adherent on antidiabetic medications, regularly visiting eye clinics, and those who were interested to know and read about diabetes complications. Compliance behaviors that not to be associated with DR awareness in our study were found among those who measure their blood sugar at home. Also, frequency of measuring blood glucose level was not associated with level of awareness. Regarding the possible barriers that prevent the participants from regular visits for retinal assessment, lack of knowledge about importance of regular follow up were the major barrier. Despite high level of awareness, we recommended for further educations, campaigns to educate about prognosis of

DR and importance of regular follow up.

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