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DIABETIC RETINOPATHY AND THE ASSOCIATED RISK FACTORS IN TYPE 2 DIABETIC PATIENTS IN RIYADH, SAUDI ARABIA

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ABSTRACT

Background: Diabetic Retinopathy, a potentially sight-threatening complication of diabetes, is a growing concern among Type 2 diabetic patients in Riyadh, Saudi Arabia.

Objective: To evaluate the prevalence and severity of retinopathy, as well as its associated risk factors, among individuals diagnosed with type 2 diabetes.

Methods: This was an observational cross-sectional study. It allows researchers to collect more data on exposure and outcome. This study was conducted at primary health care centers in Riyadh city, King Abdul-Aziz Medical City (KAMC). Data collection tool was designed to achieve study objectives. It consisted of demographic data, clinical characteristics, and information about diabetic retinopathy.

Results: The study included 363 participants. More than half of them were females (n= 203, 55.9%) and the rest were males (n= 160, 44.1%). The mean age among study participants was 58.5 ± 10.6 years with median age of 59 years. Majority of participants were non-smokers (n= 293, 80.7%) while 19.2% were smokers (n= 70). Third of study participants were overweight (n= 124, 34.2%) and another third were obese (n= 119, 32.8%). All study participants were diabetic with least duration of 1 year. About two thirds of participants have hypertension (n= 238, 65.6%). Two thirds of participants had uncontrolled glycemic state (n= 245, 67.5%) while the rest 118 participants (32.5%) had their diabetic status controlled. About two thirds of study participants had no retinopathy (n= 240, 66.1%). On the other hand, 45 cases had mild retinopathy (12.4%), 51 participants had moderate retinopathy (14%) and 27 participants had severe retinopathy (7.4%).

Conclusion: All participants in the investigation had diabetes. The majority utilized antihypertensive medication for hypertension. Two-thirds of those tested for glycemic control had uncontrolled diabetes. The laboratory results revealed albuminuria, elevated LDL cholesterol, and a diminished GFR. Some participants in the study developed mild, moderate, or severe retinopathy, while the majority did not. Retinopathy was more pronounced in the elderly. Smoking affected retinopathy less than gender. Hypertension increased the risk of retinopathy. Diabetes management and glomerular filtration rate were strong predictors of retinopathy. This study illustrates the intricate relationships between retinopathy and risk factors. Age, hypertension, glycemic management, and glomerular filtration rate affect diabetic retinopathy, according to the findings.

Keywords: diabetes mellitus, retinopathy, risk factor, KSA

INTRODUCTION

Diabetes mellitus (DM) is recognized as a chronic condition that may lead to disability and is associated with many consequences. In the Kingdom of Saudi Arabia (KSA), the prevalence of diabetes has become a significant public health concern, having escalated to an epidemic level. The prevalence of diabetes in Saudi Arabia has been reported to be 23.7%, affecting 37.8% of those aged 30 to 70 years. The life expectancy of diabetes individuals has grown due to the advancements in healthcare facilities inside the Kingdom [3]. Consequently, health care institutions are confronted with the issue of managing complications that arise as a result of the extended course of the condition.

Among the several problems, retinopathy, a retinal vascular condition, is widely recognized as the primary cause of visual impairment leading to blindness in individuals of working age. The aforementioned study [4] demonstrates that this condition is responsible for a significant amount of job impairment in adults. The existence of this condition may also serve as an indicator and predictor of other issues associated with diabetes [4]. According to established evidence, a significant proportion of people, namely over 77%, who have managed to live for a period over 20 years while living with diabetes mellitus (DM), experience the presence of retinopathy [5]. Untreated diabetic retinopathy (DR) not only results in visual impairment, which poses significant emotional challenges for affected individuals, but also contributes to the financial strain on healthcare systems within the community [5-7].

Diabetic retinopathy (DR) is distinguished by the presence of retinal ischemia, which is indicated by several symptoms such as retinal microvascular abnormalities, microaneurysms, hemorrhages, intra-venous diameter abnormalities, cotton-wool spots, and neovascularization. Additionally, DR may also exhibit evidence of heightened retinal vascular permeability. There are several factors that may contribute to the occurrence of vision loss, such as neovascularization leading to vitreous hemorrhage and/or retinal detachment, macular edema, and retinal capillary nonperfusion. Retinopathy may be categorized into two main types based on the presence of certain indicators: nonproliferative diabetic retinopathy (NPDR) and proliferative retinopathy (PDR). The Non-Proliferative Diabetic Retinopathy (NPDR) is categorized into three subtypes: mild, moderate, and severe [8-10].

Several studies have shown significant variations in the occurrence of retinopathy among individuals diagnosed with type 2 diabetes [9,10,11,12,13]. Among the about 10.2 million persons aged 40 years and above in the United States who have been identified as having diabetes mellitus (DM), the crude prevalence rates for retinopathy were found to be 40.3% [4]. In a separate research conducted in an urban population in India, the prevalence of diabetic retinopathy (DR) was recorded to be 18%.The reported prevalence rates in the United Kingdom and Spain are 50% and 26.11%, respectively [9, 10]. Similar to the variations in worldwide frequency, research conducted in the Middle East also provide diverse estimates about the prevalence of diabetic retinopathy (DR). The United Arab Emirates (UAE) accounts for 19% of the mentioned statistic [15], while Kuwait contributes 8-12% [15,16]. Oman represents 42.4% [11], Egypt contributes 42% [17], and Jordan accounts for 64% [15]. The prevalence rates of the condition in various locations of Saudi Arabia exhibit variability, as shown by research conducted in Al-Hassa (30%)[19], Madinah (36.8%)[20], Aseer region (11.3%) [21], Riyadh (31%) [19], and Taif (36.1%) [22].

Given the heterogeneity in the occurrence of diabetic retinopathy (DR) across various geographical locations, it is crucial to recognize its significance as a complication. This is because DR not only leads to severe effects but also serves as a significant signal of systemic diabetes microvascular problems. Hence, it is regarded as a crucial sign of the influence of diabetes. The primary objective

of this research is to provide a comprehensive description of the current prevalence of diabetic retinopathy (DR) and its associated risk factors among patients with type 2 diabetes who get follow-up care at the diabetes center in Riyadh, Kingdom of Saudi Arabia (KSA). The primary aim of the current investigation was to evaluate the prevalence and severity of retinopathy, as well as its associated risk factors, among individuals diagnosed with type 2 diabetes.

METHODS

Study design

This was an observational cross-sectional study. Researchers aimed to assess retinopathy and associated factors among diabetic patients simultaneously. This is the most appropriate design for this research objective. In addition, it allows researchers to collect more data on exposure and outcome.

Study setting

This study was conducted at primary health care centers in Riyadh city, King Abdul-Aziz Medical City (KAMC).

Population

Population of this study was adults with type two diabetes patients.

Sample and sampling

Epi Info epidemiologic software was used to calculate a representative sample. For sample calculations, we assumed a prevalence of DR 31.3% to 36% based on previous reports, 354 sample with 95% confidential level. Participants were selected via convenient sampling technique.

Eligibility criteria

Inclusion criteria

- Adults aged >18 years with type 2 diabetes mellitus.
- Attending primary health care centers for retinopathy screening

Exclusion criteria

- Pregnant women
- Type 1 diabetes patients
- Severely ill or mentally ill patients who cannot give consent.

Data collection

Data was collected from patients in either self-administered or administered manner.

Instruments

Data collection tool was designed after reviewing the literature and was prepared by researchers to achieve study objectives. It consisted of demographic data, clinical characteristics, and information about diabetic retinopathy.

Statistical analysis

Data are analysis using statistical package for the social sciences version 23 software (SPSS). Descriptive statistics are performed in the form of frequency and percentage for categorical variables while mean and standard deviation are used for description of continuous variables. Analytic statistics are done using Chi square test to assess the difference between categorical variable, statistical significance is set to 0.05 or less.

Ethical consideration

Participants' privacy and confidentiality were assured, no identifiers were collected and all data was kept in a secure place within NGHA premises both hard and soft copies. Written informed consent was obtained from participants. All information was confidential and used for research purposes only. The collected data were saved securely to protect the participants' privacy.

RESULTS

The study included 363 participants. More than half of them were females (n= 203, 55.9%) and the rest were males (n= 160, 44.1%). The mean age among study participants was 58.5 $\pm$ 10.6 years with median age of 59 years. Age ranged from 27 to 94 years. Majority of participants were non-smokers (n= 293, 80.7%) while 10.7% were smokers (n= 39) and 31 participants were ex-smokers (8.5%). The duration of smoking among smokers ranged from one to 45 years. Third of study participants were overweight (n= 124, 34.2%) and another third were obese (n= 119, 32.8%).

Table 1 shows demographic characteristics of study participants.

Table 1: Baseline characteristics of study participants

Characteristic		Frequency	Percent
Age	<60 years	200	55.1
	>60 years	163	44.9

Gender	Male	160	44.1
	Female	203	55.9
Body mass index	Normal	32	8.8
	Overweight	124	34.2
	Obese	119	32.8
	Morbid obesity	88	24.2
Smoking status	Smoker	70	19.3
	Non-smoker	293	80.7

All study participants were diabetic with various durations. The DM duration ranged from less than one year to 45 years. About two thirds of participants have hypertension (n= 238, 65.6%). Participants with hypertension took various medications. The most frequent one was Lisinopril (n= 55, 15.2%) followed by valsartan (n= 47, 12.9%). Two thirds of participants had uncontrolled glycemic state (n= 245, 67.5%) while the rest 118 participants (32.5%) had their diabetic status controlled. Participants had various abnormal laboratory values as presented in table 2.

Table 2: Laboratory findings among study participants

Laboratory finding	Frequency	Percent
Uncontrolled diabetes	245	67.5
Elevated LDL	151	41.6
Elevated cholesterol	62	17.1
Albuminuria	308	84.8
Reduced GFR	186	98.9

About two thirds of study participants had no retinopathy (n= 240, 66.1%). On the other hand, 45 cases had mild retinopathy (12.4%), 51 participants had moderate retinopathy (14%) and 27 participants had severe retinopathy (7.4%).

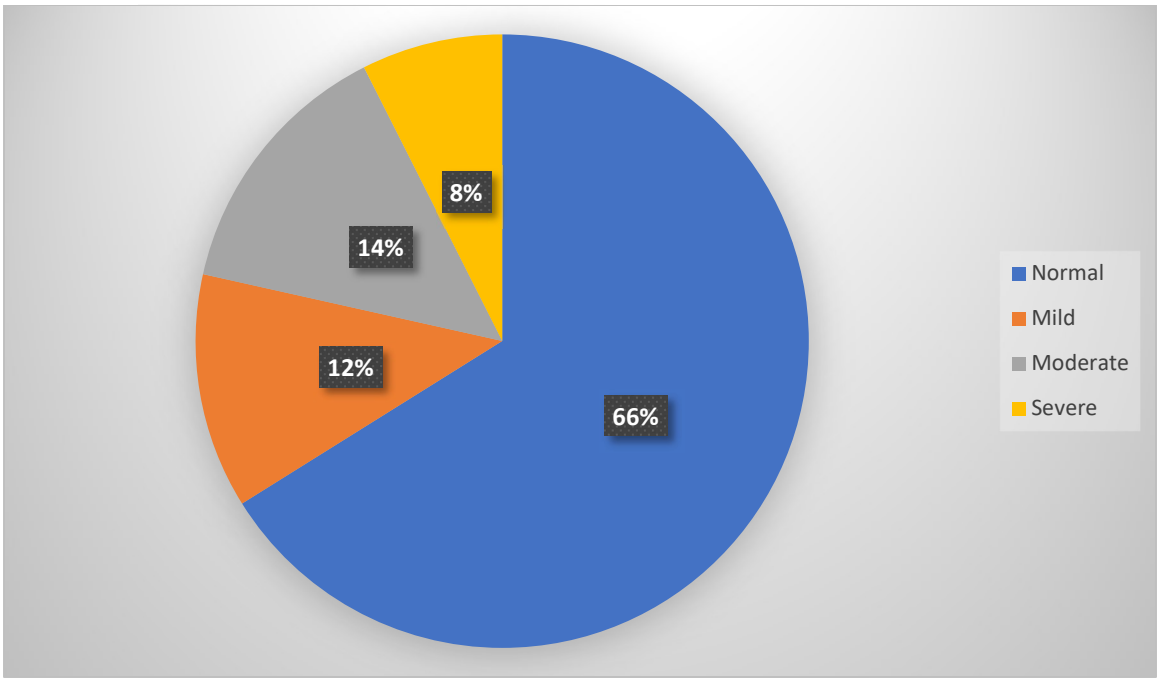

Figure 1: Retinopathy distribution among study participants

Table 3 provides valuable insights into the statistical relationships between the occurrence of retinopathy and a range of associated risk factors. Each row in the table corresponds to a specific variable, while the columns represent the presence or absence of retinopathy, and the associated p-value helps us understand the significance of these relationships. Regarding age, the table reveals a striking association between age and retinopathy. Individuals over the age of 40 demonstrate a significant discrepancy in retinopathy rates. In this group, only 5.4% of those without retinopathy contrast with a mere 1.6% of those with retinopathy, a relationship that is strongly significant with a p-value of less than 0.001. Furthermore, as age increases, so does the prevalence of retinopathy. Those between the ages of 61 and 80 exhibit a notable disparity, with 32.5% without retinopathy compared to a substantial 65% with retinopathy. Gender appears to exhibit less pronounced significance, with a p-value of 0.146. Males without retinopathy make up 46.3% compared to 39.8% with retinopathy, while females without retinopathy constitute 53.8% compared to 60.2% with retinopathy. This difference, while not strongly significant, does suggest a potential trend.

The impact of smoking status on retinopathy is not substantially significant ($p = 0.578$). Non-smokers without retinopathy account for 79.2%, compared to 83.7% with retinopathy. Likewise, the variations among ex-smokers and current smokers are not remarkably influential. Hypertension, on the other hand, demonstrates a substantial relationship with retinopathy. Those with hypertension have a notably higher occurrence of retinopathy, with 58.8% without retinopathy contrasted with a striking 78.9% with retinopathy ($p < 0.001$). Conversely, individuals without hypertension exhibit significantly lower rates of retinopathy, at 41.3% without retinopathy

and 21.1% with retinopathy. Glycemic control shows a remarkable correlation with retinopathy. Individuals with well-managed glycemic control have a considerably lower rate of retinopathy, with 41.7% without retinopathy versus a mere 14.6% with retinopathy ($p < 0.001$). On the contrary, those with poor glycemic control are associated with higher retinopathy rates, at 58.3% without retinopathy and 85.4% with retinopathy. Another substantial relationship is observed in relation to Glomerular Filtration Rate (GFR). Individuals with normal GFR levels have a notably lower occurrence of retinopathy, with 42.1% without retinopathy compared to 61.8% with retinopathy among those with reduced GFR ($p < 0.001$).

Table 3: Relationship between retinopathy and risk factors

Variables	No retinopathy	Retinopathy	P value
Age			
<40	13 (5.4%)	2 (1.6%)	<0.001
40-60	146 (60.8%)	39 (31.7%)	
61-80	78 (32.5%)	80 (65%)	
>80	3 (1.3%)	2 (1.6%)	
Gender			
Male	111 (46.3%)	49 (39.8%)	0.146
Female	129 (53.8%)	74 (60.2%)	
Smoking status			
Non-smoker	190 (79.2%)	103 (83.7%)	0.578
Ex-smoker	22 (9.2%)	9 (7.3%)	
Smoker	28 (11.7%)	11 (8.9%)	
Hypertension			
Yes	141 (58.8%)	97 (78.9%)	<0.001

No	99 (41.3%)	26 (21.1%)	
Body Mass Index			
Normal	22 (8.8%)	11 (8.9%)	0.387
Overweight	76 (31.7%)	48 (39%)	
Obese	83 (34.6%)	36 (29.3%)	
Morbid obesity	60 (25%)	28 (22.8%)	
Glycemic control			
Yes	100 (41.7%)	18 (14.6%)	<0.001
No	140 (58.3%)	105 (85.4%)	
LDL level			
Normal	144 (60%)	68 (55.3%)	0.226
Elevated	96 (40%)	55 (44.7%)	
Cholesterol level			
Normal	198 (82.5%)	103 (83.7%)	0.445
Elevated	42 (17.5%)	20 (16.3%)	
Albuminuria			
Yes	39 (16.3%)	16 (13%)	0.257
No	201 (83.8%)	107 (87%)	
GFR			
Normal	101 (42.1%)	76 (61.8%)	<0.001
Reduced	139 (57.9%)	47 (38.2%)	

DICUSSION

The incidence of diabetes in the Kingdom is now at 23.7%, signaling an epidemic of abnormal glucose metabolism [1]. As a result, the prevalence of diabetes-related complications like DR among adults in Saudi Arabia seems to have increased dramatically [24].

This research found that DR affected 33.9% of participants overall, which is quite similar to the worldwide estimated prevalence of 34.6% in people with diabetes based on available documentation [25]. It is also comparable to the results of research conducted in other parts of the Kingdom of Saudi Arabia, including Al-Hassa (30%), Madinah (36.8%), Taif (36.1%), and Riyad (31.1%) [19,20,22,24]. Compared to the stated prevalence in the UK (50%), the USA (40.3%), Oman (42.4%), Egypt (42%) and Jordan (64%), our findings reveal a lower prevalence of DR [9,11,17,18,28]. This study's prevalence of DR is greater than the results of several previous research, including those conducted in Australia (21.9%), Spain (26.11%), the United Arab Emirates (19%), Kuwait (8-12%), and India (18.0%) [10,14,15,26]. Most of these studies were population-based, and they may have measured prevalence differently because they utilized various instruments.

This study's prevalence estimates for DR in Riyadh are much higher than those reported by Al-Khaldi from same location (11.3%) [21]. Possible explanations for the discrepancy include variations in research setting and diagnostic approach. While they examined patients at a single PHCC, we examined patients at a diabetic clinic to which all patients from the PHCCs in the region are referred for annual screening. They used funduscopic examination to diagnose retinopathy, while the researchers used 3D Optical Coherence Tomography, the gold standard for retinopathy diagnosis in other studies [19,20,22,24]. When comparing our results to those from Oman and Madina (KSA) [11,20], researchers find that a greater percentage of this study patients had moderate retinopathy, although this study conclusion is consistent with that published in Hassa (KSA) [19]. In comparison to studies conducted in Madina (KSA) [20] and Hassa (KSA)[11,15], the current research found a decreased incidence of PDR. This research findings corroborate those of a review paper that found moderate visual impairment to be more prevalent than severe in DR patients [29].

This study findings, which are in line with the vast majority of the prior research, demonstrate a substantial correlation between DR and length of diabetes, and suggest that retinopathy rises with younger age at beginning of diabetes [11,15,16,19,20,22,24]. Swedish researchers found that after 30 years of diabetes, DR was present in every case [30].

Consistent with previous research primarily conducted in the Middle East and Saudi Arabia [4,7,11,28], this study found no significant gender difference in the development of DR, in contrast to a study from Sweden [30] that documents higher rates for women than men [20]; and studies

from Madina, India, and the United Arab Emirates(UAE) that observed DR to be more prevalent in male diabetics [10,15].

Chronic hyperglycemia (with high HbA1c) has been linked to the onset of DR in a number of studies [7,16,18,19,20,21,22,23,24]. However, Aiello et al. [31] found in a long-term research that the prevalence of DR in people with long-term diabetes does not change with how well the condition is managed. There was also no statistically significant correlation between glycemic control and DR in the samples from Madina (KSA) [20] and the United Arab Emirates [15]. In univariate analysis, we found a significant correlation.

Studies in Jordan [18], Oman [11], and a UK prospective longitudinal research group have all shown hypertension as a risk factor for diabetes. According to a report from the United Arab Emirates [32], DR has a weak but substantial link to hypertension [15]. Nevertheless, other research, such as those conducted in Hassa (KSA), and South India [27], has failed to identify a link between hypertension and DR. In this investigation, hypertension was determined to be a risk factor for DR in the univariate analysis but lost its significance after controlling for other factors. In contrast to reports from Madina [20] and South India [27] that showed smoking as being related with an elevated likelihood of DR, investigations conducted in the United Arab Emirates and Iran found that body mass index and smoking were not significant risk factors. The lower proportion of smokers in our sample might explain this outcome.

High total cholesterol and, aberrant LDL levels were not associated with the onset of DR, as was discovered in van Leiden's [34] and Riyadh's [24] investigations, but opposite findings were seen in studies conducted in Hassa (KSA), Jordan, and Oman [11,18,19]. This study findings highlight the importance of good lipid control as a preventative measure against the progression of retinopathy because total cholesterol was significantly higher in the severe grade of DR, suggesting that it may be a risk of the progression of DR to severe retinopathy. Patient age, the number of additional comorbidities, and the existence of nephropathy all showed up as significant hazards for DR in the univariate analysis. Multiple regression analysis showed that age, poor management of diabetes, high systolic blood pressure, and comorbidities were not significant in the Oman research [11].

Longer duration of diabetes, and other comorbidity were the main drivers of DR in the current research. This may be because most individuals with type 2 DM who have the disease for a long time end up using insulin. The vast majority of research on DR has shown these three risk variables to be present [11,15,16,19,20,22,24].

CONCLUSION

The current study participants were diagnosed with diabetes, with the duration of the disease varying from less than one year to 45 years. A considerable majority had hypertension (65.6%),

and diverse antihypertensive medications were observed among participants. Glycemic control assessment demonstrated that around two-thirds of participants had uncontrolled diabetes. Laboratory findings pointed to various abnormalities, including elevated LDL cholesterol, elevated total cholesterol, albuminuria, and reduced glomerular filtration rate. Regarding the occurrence of retinopathy, the distribution among study participants revealed that approximately two-thirds had no retinopathy, with the rest presenting mild, moderate, or severe cases. Notably, age showed a significant association with retinopathy, with older age groups demonstrating higher prevalence rates. While gender exhibited a less pronounced connection, the impact of smoking status on retinopathy was found to be less substantial. Hypertension emerged as a notable risk factor, with a strong correlation to the occurrence of retinopathy. Additionally, glycemic control and glomerular filtration rate were found to be significantly linked to retinopathy presence. This study's findings provide crucial insights into the intricate relationships between retinopathy and a range of associated risk factors. These results underscore the importance of age, hypertension, glycemic control, and glomerular filtration rate in contributing to the development of retinopathy in individuals with diabetes. Such insights could inform clinical management and interventions aimed at reducing the risk and progression of diabetic retinopathy.

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