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Research Article

The Prevalence of Diabetic Retinopathy Among Type 2 Diabetic Patients in Primary Health Care Center in Riyadh, Saudi Arabia

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Abstract

Background: Diabetic retinopathy (DR) is one of the preventable serious complications of diabetes mellitus and if not properly discovered and managed may lead to blindness.

Objectives: To determine the prevalence of DR and its severity among type 2 diabetic patients.

Patients and methods: Cross-sectional study was carried out among a consecutive sample of type 2 diabetic patients, who were followed up in Retina clinic WAZARAT primary healthcare (PHC), Prince Sultan Military Medical Center (PSMMC), Riyadh. A well-structured data sheet form was used to collect data, included demographic factor and clinical parameters.

Results: The study included 376 patients. Their age ranged between 31 and 84 years with an arithmetic mean of 58.03 years and standard deviation of (±) 10.06 years. Prevalence of DR among type 2 diabetic patients was 45.2%. The most frequently reported type was non-proliferative diabetic retinopathy (NPDR) (74.1%). Macular edema was observed among 43.5% of patients with DR and 19.7% of the total patients. Multivariate logistic regression analysis results revealed that with increase in patient`s age by one year, there was increase in the risk of developing DR by 8% (AOR = 1.08; 95% CI: 1.05-1.12), $p < 0.001$. Female patients were at almost double risk for developing DR compared to male patients (AOR = 1.92; 95% CI: 1.05-1.12), $p < 0.001$. Compared to patients whose HbA1c% ranged between 6.5 and 7.9% as a reference category, those with HbA1c% level ranged between 8 and 9.9% and ≥10% were at higher significant risk for developing DR (AOR = 2.23; 95%CI: 1.31-3.80, $p = 0.003$ and AOR = 22.62; 95%CI: 9.78-52.35, $p < 0.001$), respectively.

Conclusion: Diabetic retinopathy is a prevalent complication among type 2 diabetic patients followed up in Retina clinic WAZARAT primary healthcare (PHC), PSMMC, Riyadh.

Keywords: Retinopathy; Type 2 Diabetes; Prevalence; Associated Factors

Introduction

Background and literature review

Diabetes mellitus (DM) is known to be a global public health challenge with its serious complications and its effect on the quality of life [1,2]. It is considered by the World Health Organization (WHO) to be an epidemic, with numbers of cases rising from 108 million in 1980 to an estimation of 425 million in 2017 [2].

The incidence of type 1 diabetes (T1D) and Type 2 diabetes (T2D) increased over the last decade by 21% and 30%, respectively [3,4]. In 2015, The International Diabetes Federation (IDF) estimated that 1 in 11 adults had diabetes mellitus globally [5]. By the year 2040, recent studies predict the number of diabetes mellitus worldwide will be over 600 million [2,6].

Diabetic retinopathy (DR) is a complication of diabetes, caused by high blood sugar levels that cause damage to blood vessels in the retina, causing vessels to swell, leak, and close. It is the most common cause of blindness in the working class in developed countries and one of the leading causes of blindness worldwide [7]. Approximately 1 in 3 persons with DM has DR, making it the most common complication of DM [8,9].

The Diabetic Retinopathy Preferred Practice Pattern guideline, suggest that people with type 1 diabetes should have annual screenings for diabetic retinopathy beginning 5 years after the onset of their disease, whereas those with type 2 diabetes should have a prompt screening at the time of diagnosis and at least yearly screenings thereafter [10]. Unfortunately, patients do not comply with diabetic retinopathy screening [11]. This is thought to be because of poor knowledge and lack of education on the issue [11,12].

In Saudi Arabia, little is known about the prevalence of DR among Type 2 Diabetic Patients. Some reports the prevalence of DR among DM in Saudi Arabia ranges from 30% to 36% [13-15]. However, to the best of our knowledge, there is no recent study form Riyadh (the capital and the largest city in Saudi Arabia) in Type 2 Diabetic Patients. The aim of the study is to estimate the prevalence of Diabetic Retinopathy and its risk factors among Type 2 diabetic patients attending Prince Sultan Military Medical City (PSMMC) primary health care center in Riyadh, Saudi Arabia.

Rationale of the study

Diabetic retinopathy is one of the preventable serious complications of diabetes mellitus and if not properly discovered and managed may lead to blindness.

Despite the importance of the subject, it is not sufficiently investigated in Saudi Arabia, and particularly in Riyadh.

Aim of the Study

To assess the magnitude and severity of retinopathy and its associated factors among type 2 diabetes mellitus patients attending primary care in Prince Sultan Military Medical City (PSMMC), Riyadh.

Specific objectives

To determine the prevalence of diabetic retinopathy among type 2 diabetic patients in primary care in Prince Sultan Military Medical City (PSMMC), Riyadh.

To evaluate the severity of diabetic retinopathy among uncontrolled diabetic patients.

Materials and Methods

Study area and settings

The study was carried out in WAZARAT primary healthcare (PHC), Prince Sultan Military Medical City (PSMMC), Riyadh, Kingdom of Saudi Arabia.

Study design

Cross sectional study design was adopted.

Target population

All patients with type 2 diabetes who were following up in Retina clinic WAZARAT primary healthcare (PHC), PSMMC, Riyadh constituted the target population for the study.

Inclusion criteria

All type 2 diabetes patients from all age groups and all genders who were following up in WAZARAT PHC in PSMMC in Retina clinic.

Exclusion criteria

All diabetes mellitus patients of Type 1.

Sample size

The sample size was calculated using the Cochran's formula for estimating sample size equation as follows [16]:

$$N = \frac{Z_{\alpha/2}^2 \times p(1-p)}{D^2}$$

Where:

N = Minimum sample size

$Z_{\alpha/2:}$ the critical value of the normal distribution at α/2 (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96)

P: Prevalence of diabetic retinopathy: It is estimated as 30% based on another previous Saudi study [13].

D: Degree of precision

So, the calculated minimum sample size was:

$$N = \frac{(1.96)^2 \times 0.30 \times 0.70}{(0.05)^2} = \sim 323$$

The sample was increased by approximately 10% to compensate for possible none or incomplete response, thus it will be ~355 type 2 diabetic patients.

Sampling technique

Purposive non-probability consecutive sampling technique was adopted to select type 2 diabetic patients attending WAZARAT primary healthcare center in PSMMC, Riyadh throughout the study period.

Data collection/form

A well-structured data sheet form was used to collect data. The data included demographic factor (age and gender) and clinical parameters (duration of diabetes, value of HbA1c, and stage of Diabetic Retinopathy).

Statistical analysis

The data were collected and verified by hand then coded before computerized data entry. The statistical Package for Social Sciences (SPSS) software version 26.0 was used for data entry and analysis. Descriptive statistics in the form of number and percentage for categorical variables & mean and standard deviation "SD" for quantitative continuous variables were applied. Analytic statistics, using chi-square and student` t-tests were applied and p-values <0.05 were considered as statistically significant. Multivariate logistic regression analysis was performed to control for confounding effect and its results were expressed as adjusted odds ratio (AOR) and 95% confidence interval (CI).

Administrative consideration

The researcher fulfilled all the required official approvals, particularly the approval of the regional Research and Ethics committee and that of the director of WAZARAT primary healthcare (PHC), PSMMC, Riyadh.

Ethical consideration

The protocol was submitted prior the start of our study. The Institutional Review Board (IRB) of Prince Sultan Military Medical City, once approved we proceeded. Data that were collected from this study after obtaining full Consent only were used in purpose of this research with insuring the patient data confidentiality.

Results

The study included 376 type 2 diabetic patients. Table 1 presents their age and gender distribution. Their age ranged between 31 and 84 years with an arithmetic mean of 58.03 years and standard deviation of (±) 10.06 years.

The duration of diabetes exceeded 20 years among one-third of the participants (33.3%) whereas it ranged between one and five years among 11.4% of them. Glycated hemoglobin level was 10% or more among 19.9% of the participants (Table 2).

Variables	Description
Age	
Range	31-84
Mean	58.03
Standard deviation	±10.06
Gender (N; %)	
Males	193; 51.3%
Females	183; 48.7%

Table 1: Age and gender distribution of type 2 diabetic patients, PMMMC, Riyadh.

	Frequency	Percentage
Duration of type 2 diabetes (years)		
1-5	43	11.4
6-10	61	16.2
11-15	73	19.4
16-20	74	19.7
>20	125	33.3
HbA1c% value		
6.5-7.9	158	42.1
8-9.9	143	38.0
≥10	75	19.9

Table 2: Diabetes-related characteristics of the participants.

Prevalence of diabetic retinopathy

Prevalence of diabetic retinopathy among type 2 diabetic patients was 45.2% as displayed from figure 1. The most frequently reported type was non-proliferative diabetic retinopathy (NPDR) (74.1%). Macular edema was observed among 43.5% of patients with DR and 19.7% of the total patients (Figure 2).

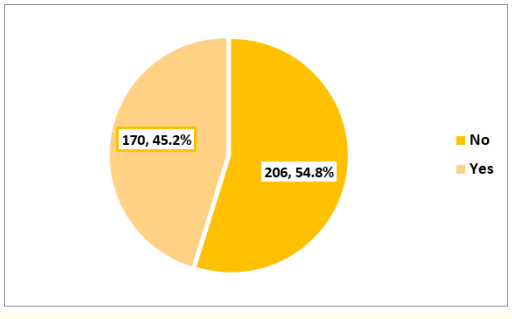

Figure 1: Prevalence of diabetic retinopathy among type 2 diabetic patients, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

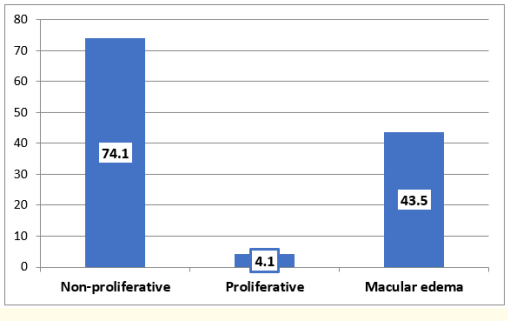

Figure 2: Type of diabetic retinopathy among type 2 diabetic patients, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

Factors associated with diabetic retinopathy

Patient`s gender

Female patients were more likely to develop DR compared to male patients (51.4% vs. 39.4%), p = 0.020 (Table 3).

Patient`s age

The age of type 2 diabetic patients with DR was significantly higher than that of those without DR (60.2±9.5 vs. 56.2±10.1), p < 0.001 (Table 4).

Duration of diabetes

The highest rate of DR was observed among patients whose disease duration ranged between 11 and 15 years (56.2%) while the lowest rate was observed among those whose disease duration was over 20 years (34.4%). The association between duration of diabetes and development of DR was statistically significant, p = 0.028.

Level of glycated hemoglobin

There was a steady increase in the rate of DR with increase in the level of HbA1c% as the rate was 27.8% with HbA1c% level ranged between 6.5 and 7.9% and reached 86.7% with HbA1c% level of 10% and above, p < 0.001.

	Diabetic retinopathy		p-value
	No N = 206 N (%)	Yes N = 170 N (%)	
Male (n = 193)	117 (60.6)	76 (39.4)	0.020
Female (n = 183)	89 (48.6)	94 (51.4)	

Table 3: Association between type 2 diabetic patient`s gender and the development of diabetic retinopathy.

	Diabetic retinopathy		p-value
	No N = 206 Mean ± SD	Yes N = 170 Mean ± SD	
Age in years	56.2 ± 10.1	60.2 ± 9.5	<0.001

Table 4: Association between type 2 diabetic patient`s age and the development of diabetic retinopathy.

SD: Standard deviation.

Duration of diabetes in years	Diabetic retinopathy		p-value
	No N = 206) N (%)	Yes N = 170 N (%)	
1-5 (n = 43)	21 (48.8)	22 (51.2)	0.028
6-10 (n = 61)	30 (49.2)	31 (50.8)	
11-15 (n = 73)	32 (43.8)	41 (56.2)	
16-20 (n = 74)	41 (55.4)	33 (44.6)	
>20 (n = 125)	82 (65.6)	43 (34.4)	

Table 5: Association between duration of type 2 diabetes and the development of diabetic retinopathy.

Level of glycated hemoglobin (HbA1c%)	Diabetic retinopathy		p-value
	No N = 206 N (%)	Yes N = 170 N (%)	
6.5-7.9 (n = 158)	114 (72.2)	44 (27.8)	<0.001
8-9.9 (n = 143)	82 (57.3)	61 (42.7)	
≥10 (n = 75)	10 (13.3)	65 (86.7)	

Table 6: Association between level of glycated hemoglobin and the development of diabetic retinopathy.

Multivariate logistic regression analysis

Multivariate logistic regression analysis results revealed that with increase in patient`s age by one year, there was increase in the risk of developing DR by 8% (AOR = 1.08; 95% CI: 1.05-1.12), p < 0.001. Female patients were at almost double risk for developing DR compared to male patients (AOR = 1.92; 95% CI: 1.05-1.12), p < 0.001. Compared to patients whose HbA1c% ranged between 6.5 and 7.9% as a reference category, those with HbA1c% level ranged between 8 and 9.9% and ≥10% were at higher significant risk for developing DR (AOR = 2.23; 95%CI: 1.31-3.80, p = 0.003 and AOR = 22.62; 95%CI: 9.78-52.35, p < 0.001), respectively (Table 7).

	B	SE	AOR	95%CI	p-luev
Age (years)	0.081	0.016	1.08	1.05-1.12	<0.001
Gender Male[a] Female	 0.652	 0.252	 1.0 1.92	 --- 1.17-3.15	 --- 0.010
HbA1c% 6.5-7.9[a] 8-9.9 ≥10	 0.806 3.119	 0.272 0.428	 1.0 2.23 22.62	 --- 1.31-3.80 9.78-52.35	 --- 0.003 <0.001

Table 7: Predictors of diabetic retinopathy: Results of multivariate logistic regression analysis

[a]: Reference Category; B: Slop; SE: Standard Error; AOR: Adjusted Odds Ratio; CI: Confidence Interval.

Term of duration of diabetes was removed from the final logistic regression model (not significant).

Discussion

Diabetic retinopathy (DR) is one of the main microvascular complications of diabetes mellitus and can result in blindness, if not early detected and promptly treated [17]. order to achieve better management of DR in early stages, its magnitude and risk factors should be identified. Therefore, the current study was performed to assess the magnitude and severity of retinopathy as well as its associated factors among type 2 diabetes mellitus patients attending primary care in Prince Sultan Military Medical City (PSMMC), Riyadh, Saudi Arabia.

The prevalence of diabetic retinopathy in the prevent study is relatively high (45.2%). It is higher than figures observed in other Saudi studies carried out in Abha (36.4) [18], Taif (36.8% and 16%) [15,19], Al-Hassa (30%) [13], Al-Madinah Al-Munawarah (36.1%) [20], and Jazan (27.8%) [21].

Concerning studies carried out in regional countries, the prevalence rate of DR in the present study was higher than those reported in Kuwait (12%) [22], UAE (19%) [23], Jordan (34.1%) [24], Egypt (20.5%) [25], and Iran (26.6%) [26]. However, it was comparable to the rate reported in Oman (42.4%) [27]. However, it was lower than the rate reported in another Jordanian study (64%) [28]. Internationally, lower rates than that reported in the present study were observed in India (21.7%) [29], Spain (12.2%) [30], China (27.9%) [31],) and USA (40.3%) [32]. Yau., *et al.* (2012) revealed a global prevalence of 34.6% [33].

The difference between the aforementioned studies, including the present one as regards the prevalence of DR and the relatively higher prevalence in the current study could be attributed to using different tools in DR diagnosis as in the present study we depended on diagnosis of ophthalmologists in retina clinic, without specification of the tool used in diagnosis. The same has been applied in most of the aforementioned studies. Additionally, difference in the socio-demographic and clinical characteristics of patients in various studies could partially explain this difference in the prevalence rate.

In the present study, non-proliferative (NP) type was present in most of cases (74.1%) whereas proliferative type was present in only 4.1% of patients with DR. In another Saudi study conducted in Abha [18], 57.5% of the patients with DR had mild NPDR, 19.9% had moderate NPDR and 11.0% had severe NPDR and 11.6% of diabetic patients had PDR. In Al-Madinah Al-Munawarah [20], 13.6% of diabetic patients had mild NPDR, 8% had moderate NPDR, 8.1% had severe NPDR and 6.4% had proliferative diabetic retinopathy. Some other studies also revealed that the mild type of NPDR was the commonest and sever form of NPDR and PDR were the least reported [13,19,21].

In his study, the prevalence of macular edema among DR diabetic patients was 43.5% whereas among all type 2 diabetic patients, it was 19.7%. Some studies reported a rate very close to ours (19%) [33,34]. In a study carried out in Unites States (2014), a low prevalence has been reported for macular edema (3.8%) [35]. In the Multi-Ethnic Study of Atherosclerosis (MESA), the prevalence of 9% has been documented [36]. Yau., *et al*. estimated a global prevalence rate of 6.8% [33]. In a recent Saudi study, the prevalence of macular edema was estimated as 5.7% [37]. It has been reported that macular edema affecting about 40% of diabetic patients within 30 years from the disease onset [38]. Difference in demographics of patients as well as in quality of care delivered could explain the difference between our finding and those of others.

In the current study, although duration of diabetes was a significant factor associated with DR in univariate analysis, for after controlling for confounders in multivariate logistic regression analysis, duration of diabetes became not significantly related to the development of DR. In other studies [18-20,23,26], patients with longer duration of DM were at higher risk for having DR.

In accordance with findings of a similar Saudi study carried out in Abha [18], older patients in the present study were more likely to have DR. The role of aging in the development of DR was established recently and attributed to the retinal changes in the form of reduced blood flow, thinning of the retina, and microglial changes as these changed as the effect of aging make the retina more vulnerable to ischemic and oxidative damage produced by diabetes [39].

In agreement with others [35,40,41], female patients were at higher risk for DR than males, even after controlling for confounders in multivariate logistic regression analysis. The reason for that is not clear, however, it might be related to accessibility to healthcare facilities as well as difference in life style and pattern of living between males and females.

In accordance with several studies [18-20,42], the current study revealed that patients with uncontrolled diabetes were at higher risk to develop DR compared to those with controlled disease.

Among limitations of the present study is being a single-center study which could affect the generalizability of findings. Also, the cross-sectional design of the study is considered another limitation due to its problems in the cause-effect temporal relationship. Finally, some important risk factors for DR were not investigated in the present study such as patients` body mass index, type of treatment and history of co-morbid diseases.

Conclusion

Diabetic retinopathy is a prevalent complication among type 2 diabetic patients followed up in Retina clinic WAZARAT primary healthcare (PHC), PSMMC, Riyadh. Older diabetic patients, females and those with uncontrolled disease as evidenced by high HbA1c level were more likely to develop DR compared to their peers. The most frequently reported type was non-proliferative diabetic retinopathy (NPDR). Macular edema was observed among a considerable proportion of patients.

Recommendations

Based on the findings of the present study, the following are recommended:

- Regular annual screening of type 2 diabetic patients for the development of DR to reduce the burden caused by blindness.

- Specific attention should be given to older patients, females and those with uncontrolled blood glucose level.
- Physicians should encourage and help diabetic patients to have controlled blood sugar level.
- Further longitudinal study is warranted including patients from other healthcare facilities in Riyadh.

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