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Original article

Prevalence and Predictors of Diabetic Retinopathy among Newly Diagnosed Type 2 Diabetes Mellitus Patients in Benghazi, Libya: A Cross-Sectional Study

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Abstract
Diabetic Retinopathy [DR] is a leading cause of visual impairment among adults with diabetes. Early detection is crucial, as retinal changes may be present at the time of Type 2 diabetes mellitus [T2DM] diagnosis. Limited data exist regarding the early occurrence of DR in the Libyan population. This study was conducted to assess the prevalence of DR and identify associated risk factors among newly diagnosed T2DM patients. A cross-sectional observational study among 89 newly diagnosed T2DM patients attending the Ophthalmology Outpatient Department at Benghazi Eye and Ophthalmic Surgery Teaching Hospital. Comprehensive ophthalmological examinations were performed, including dilated fundus assessment. Sociodemographic and clinical variables such as age, gender, duration since diagnosis, smoking status, hypertension, hyperlipidemia, BMI, and HbA1c were recorded. The mean age of participants was 52.66 ± 7.4 years, with a female predominance [60.7%]. The prevalence of DR was 13.5% [12/89]. No significant association was observed between DR and gender, age, smoking status, BMI, hypertension, or hyperlipidemia [$p > 0.05$]. Logistic regression indicated a borderline association between elevated HbA1c levels and DR [AOR = 1.25, 95% CI: 0.98–1.59, $p = 0.068$]. DR is present in a notable proportion of patients at T2DM diagnosis, highlighting the likelihood of delayed disease recognition. Early retinal screening and strict glycemic control are essential strategies to prevent progression of sight-threatening complications. Further multicenter studies with larger sample sizes are recommended for broader generalization.
Keywords. Diabetic, Retinopathy, Type 2 Diabetes Mellitus, Hba1c.

Introduction

Diabetes mellitus [DM] is a major chronic metabolic disorder that has reached epidemic proportions globally, exerting a substantial burden on public health systems. Based on International Diabetes Federation [IDF] estimates, approximately 537 million adults [20–79 years] were living with diabetes in 2021, equivalent to 1 in 10 people, and this number is projected to rise to 643 million by 2030 and 783 million by 2045 [1,2]. A considerable 87.5% of undiagnosed diabetes cases occur in low- and middle-income countries, where delayed diagnosis frequently leads to advanced complications at presentation [2,3]. Type 2 diabetes mellitus [T2DM] is the most common form of DM, accounting for about 85–90% of cases worldwide [4,5]. It is characterized by a gradual and often asymptomatic onset, allowing hyperglycemia to persist unnoticed for years while microvascular and macrovascular complications progress silently [6]. Among these complications, diabetic retinopathy [DR] remains one of the most frequent and most devastating, representing a leading cause of preventable blindness and visual impairment in the working-age population worldwide [7–9].

The pathophysiology of DR involves chronic hyperglycemia-induced microvascular damage, leading to increased vascular permeability, capillary occlusion, ischemia, and neovascularization [10,11]. These changes can result in retinal hemorrhages, macular edema, and, in advanced cases, retinal detachment with permanent vision loss [12,13]. Nearly all type 1 diabetic patients and approximately 60% of those with T2DM develop some degree of retinopathy within the first two decades of their disease [14]. Recognized risk factors include long duration of diabetes, uncontrolled glycemia, hypertension, dyslipidemia, obesity, pregnancy, cataract surgery, and genetic predisposition [14–16].

The global prevalence of diabetic retinopathy has been estimated at around 22.2% among patients with T2DM [17] and 34.6% in the general diabetic population [8]. In the Eastern Mediterranean Region [EMR], which comprises several low- and middle-income countries, including those in North Africa, diabetes prevalence is among the highest worldwide [18]. DR prevalence in EMR nations shows a wide variation: 28% in Pakistan [19], 37.8% in Iran [20], 27.8–36.4% in Saudi Arabia [21,22], 50% in Kuwait [23], and 48.4% in Jordan [24]. In Libya, studies have reported DR prevalence rates of 30.6% in Benghazi [25] and 16.2% in Misurata [26]. The prevalence of DR at the time of diabetes diagnosis is an important indicator of health system performance, reflecting delays in screening and detection [27]. When T2DM remains undiagnosed for extended periods, a substantial proportion of patients may already develop DR by the time diabetes is first confirmed [7,28]. Yet, most studies have focused on patients with previously known diabetes, with limited research assessing DR prevalence and incidence at first diagnosis, contributing to challenges in health policy planning [29–34].

Given the growing diabetes epidemic in Libya and the burden of related visual impairment, understanding the incidence of diabetic retinopathy among newly diagnosed diabetic patients is essential for timely

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screening, early intervention, and resource allocation. Therefore, this study aims to determine the incidence of diabetic retinopathy in newly diagnosed diabetes mellitus cases in Benghazi, Libya, and to evaluate associated demographic and clinical risk factors. This study aimed to determine the prevalence of diabetic retinopathy and explore associated clinical and demographic risk factors among newly diagnosed Type 2 diabetes mellitus patients attending Benghazi Eye and Ophthalmic Surgery Teaching Hospital, Benghazi, Libya.

Methods

Study Design and Setting

This cross-sectional observational study was conducted among 89 newly diagnosed type 2 diabetes mellitus patients attending the Ophthalmology Outpatient Department at Benghazi Eye and Ophthalmic Surgery Teaching Hospital, Benghazi, Libya. Ethical approval was received from the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrollment.

Study Population

A purposive sampling method was used to include suitable patients within the study period. Eligible participants were adults aged 40 years or older who had been diagnosed with type 2 diabetes mellitus within the previous 12 months and who consented to undergo a full ophthalmic evaluation.

Eligibility Criteria

Patients with a prior diagnosis of diabetic retinopathy or other retinal disorders, a history of ocular trauma or intraocular surgery, or systemic diseases known to affect the retina were excluded. Pregnant women and individuals under chronic corticosteroid therapy were also excluded from the study.

Ophthalmological Examination

All participants underwent a comprehensive ophthalmic assessment, including visual acuity testing, slit-lamp biomicroscopy, refraction, and dilated fundus examination using an indirect ophthalmoscope. Suspected cases of diabetic retinopathy were further evaluated and confirmed.

Data Collection and Statistical Analysis

Sociodemographic and clinical data, including age, sex, duration since diabetes diagnosis, smoking status, hypertension, hyperlipidemia, hemoglobin A1c levels, and body mass index, were recorded. Data entry was performed using Microsoft Excel, and statistical analyses were carried out using SPSS version 25. Quantitative variables were reported as mean ± standard deviation, whereas categorical variables were expressed as frequencies and percentages. Group comparisons were performed using the chi-square test for categorical variables and the Mann–Whitney U test for non-normally distributed quantitative variables. Binary logistic regression analysis was applied to identify factors associated with the presence of diabetic retinopathy. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 89 newly diagnosed T2DM patients were enrolled. The mean age was 52.66 ± 7.4 years, and 60.7% were female. The mean BMI was 31.64 ± 6.35 kg/m². Nearly half of the patients were either active or passive smokers (46.1%), while 31.5% had hypertension and 31.5% had hyperlipidemia. The mean duration since diabetes diagnosis was 310 ± 257 days (range: 7–730), and the mean HbA1c was 8.64 ± 2.66%, indicating poor glycaemic control. There were 12 individuals (13.5%) were found to have diabetic retinopathy, while 77 patients (86.5%) showed no signs of retinopathy. This indicates that the overall prevalence of diabetic retinopathy in the studied sample was 13.5%.

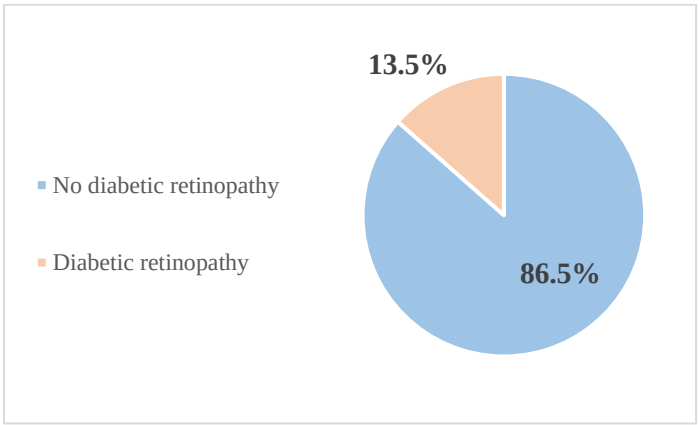

Figure 1. Prevalence of diabetic retinopathy among the study population

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Table 1. Baseline Characteristics of the Study Participants (n = 89).

Variable	Category	Frequency	Percent (%)
Gender	Male	35	39.3
	Female	54	60.7
Age (years)	Mean ± SD	52.66 ± 7.4	
	40–44	14	15.7
	45–49	18	20.2
	50–54	23	25.8
	55–59	13	14.6
	≥60	21	23.6
Smoking	Yes	41	46.1
	No	48	53.9
Hypertension	Yes	28	31.5
	No	60	67.4
Other Diseases	Yes	12	13.5
	No	77	86.5
Hyperlipidemia	Yes	28	31.5
	No	61	68.5
Duration since diabetes	Mean ± SD (Range)	310 ± 257 (7-730)	
HbA1C	Mean ± SD	8.64 ± 2.66	
BMI	Mean ± SD	31.64 ± 6.35	

No statistically significant differences were observed between patients with and without DR in terms of gender, smoking status, hypertension, hyperlipidemia, or presence of other systemic diseases ($p > 0.05$ for all). Although the proportion of males and smokers was slightly higher among DR patients (17.1% and 15% respectively), these differences were not significant.

Table 2. Comparison of Clinical and Demographic Variables According to the Presence of Diabetic Retinopathy (n = 89)

Variable	Category	No DR (n=77)	With DR (n=12)	p-value
Gender	Male	29 (82.9%)	6 (17.1%)	x^2= 0.238
	Female	48 (90.4%)	6 (9.6%)	P = 0.238
Smoking	Yes	35 (85.0%)	6 (15.0%)	x^2= 0.386
	No	42 (89.4%)	6 (10.6%)	P = 0.386
Hypertension	Yes	25 (89.3%)	3 (10.7%)	x^2= 0.490
	No	51 (86.2%)	9 (13.8%)	P = 0.490
Hyperlipidemia	Yes	26 (92.9%)	2 (7.1%)	x^2= 0.242
	No	51 (84.7%)	10 (15.3%)	P = 0.242
Other Diseases	Yes	12 (100.0%)	0 (0.0%)	x^2= 0.175
	No	65 (85.3%)	12 (14.7%)	P= 0.175
Variable	**Mean Rank**			**p-value**
Age (years)	45.99 / 38.67			U = 386.0 P= 0.360
Duration since diagnosis (days)	45.35 / 42.75			U = 435.0 P= 0.743
HbA1c (%)	43.18 / 56.71			U = 321.5 P= 0.091
BMI (kg/m²)	45.85 / 35.96			U = 353.5 P= 0.21

Binary logistic regression analysis revealed that none of the investigated variables were significantly associated with the presence of diabetic retinopathy ($p > 0.05$ for all). However, higher HbA1c levels showed a borderline association with increased odds of developing DR (AOR = 1.25; 95% CI: 0.98–1.59; $p = 0.068$), suggesting that poorer glycaemic control may contribute to early retinal changes. Other factors, including gender, age, smoking status, BMI, and duration since diagnosis, were not significant predictors of DR.

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Table 3. Binary Logistic Regression Analysis for Factors Associated with Diabetic Retinopathy among Patients with Newly Diagnosed Type 2 Diabetes Mellitus (n = 89)

Variable	Adjusted OR	95% CI for OR	p-value
Gender (Male vs. Female)	2.34	0.59 – 9.28	0.228
Age (years)	0.94	0.86 – 1.04	0.216
Duration since diagnosis (days)	1.00	0.997 – 1.003	0.940
Smoking (Yes vs. No)	0.80	0.22 – 2.94	0.742
BMI (kg/m²)	0.89	0.78 – 1.02	0.093
HbA1c (%)	1.25	0.98 – 1.59	0.068

Discussion

In this study, we evaluated 89 newly diagnosed patients with type 2 diabetes mellitus [T2DM], with a mean age of 52.66 ± 7.4 years and a predominance of females [60.7%]. The mean BMI was 31.64 ± 6.35 kg/m², and nearly half of the patients were either active or passive smokers [46.1%]. Hypertension and hyperlipidemia were present in 31.5% of patients each, and the mean HbA1c was 8.64 ± 2.66%, reflecting poor glycaemic control. Diabetic retinopathy [DR] was detected in 12 patients [13.5%], indicating a prevalence similar to previously reported studies.

The prevalence of DR in our study [13.5%] aligns closely with pooled prevalence estimates from earlier systematic reviews, which reported rates ranging from 14% to 15% at diagnosis of T2DM [35]. This is consistent with several population-based studies reporting DR prevalence between 10% and 20% in newly diagnosed T2DM patients [27,35–39]. Our findings are slightly lower than some studies from South Asia, where prevalence ranged from 20% to 42.5% [40,41], likely reflecting differences in population demographics, healthcare access, and timing of diagnosis. No statistically significant differences were observed between patients with and without DR in terms of gender, smoking, hypertension, hyperlipidemia, or other systemic diseases [$p > 0.05$]. Although the proportion of males and smokers was slightly higher among DR patients [17.1% male VS 9.6% female] and [15.0% smokers VS 10.6% nonsmokers], these differences were not significant. These results contrast with findings from the Swedish nationwide study, where DR was more common in men and those with higher HbA1c levels, hypertension, and other comorbidities [42]. Similarly, other studies have reported male gender, hyperglycemia, and hypertension as risk factors for DR at diagnosis [13,35,43,44].

The mean age in our cohort was lower than in other studies, where older age was significantly associated with DR [62.96 vs. 55.53 years; $p<0.05$] [45]. In our study, age was not a significant predictor of DR [AOR = 0.94; 95% CI: 0.86–1.04; $p = 0.216$], which may be due to the narrower age range and smaller sample size compared to larger population-based studies [46,47]. Higher HbA1c showed a borderline association with DR [AOR = 1.25; 95% CI: 0.98–1.59; $p = 0.068$], suggesting that poor glycaemic control may contribute to early retinal changes. This aligns with previous evidence indicating that hyperglycemia is a major risk factor for DR development [48]. Similar associations were reported by many previous studies [44,49–51], which found no significant association between HbA1c and DR at diagnosis. BMI and duration since diagnosis were not significantly associated with DR in our cohort, consistent with some previous studies [45].

Although this study was limited by its single-center design and small sample size, and its cross-sectional nature restricts conclusions regarding causality or disease progression, the findings provide valuable insight into early diabetic retinopathy among newly diagnosed T2DM patients. The duration of diabetes was based on patient recall, and some potential risk factors were not assessed; therefore, larger multicenter studies are recommended to improve generalizability. Overall, our results indicate that the prevalence of DR at the time of T2DM diagnosis in this population is comparable to global estimates. The borderline association with HbA1c underscores the importance of early glycemic control to prevent retinal complications. Since most demographic and clinical variables were not significantly associated with DR, early detection and strict monitoring of glycemic status remain key strategies for reducing the risk of diabetic complications.

Conclusion and recommendations

In this study, 13.5% of newly diagnosed T2DM patients had diabetic retinopathy, with higher HbA1c showing a borderline association, while age, gender, BMI, smoking, hypertension, and duration since diagnosis were not significant predictors. This underscores that DR can develop early, likely due to prolonged undetected hyperglycemia. Therefore, early retinal screening and strict glycemic control from diagnosis are essential. Public awareness and structured programs for early detection of T2DM should be strengthened, and larger studies are needed to identify additional risk factors for DR.

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Conflicts of Interest

The authors declare that they have no conflicts of interest related to this study.

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