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Exploring Diabetic Retinopathy Patterns in Saudi Arabia: Gender and Diabetes Type Comparison

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Abstract: Aims: To determine the prevalence and predictors of diabetic retinopathy (DR) in Saudi males and females with diabetes. **Methods**: This cross-sectional study enrolled 507 patients with diabetes between May and August 2018. The data extracted from patients' records included demographic and clinical information and laboratory investigations. The retinopathy data were based on fundus photography graded into five categories: no DR, NPDR, MNPDR, SNPDR, and PDR. **Results**: The patients' mean age was 47.3 years, the majority (59.3%) being female and T2DM being the most common type (52.4%). The prevalence of no DR was 51.4%; NPDR, 4.4%; MNPDR, 7.7%; SNPDR, 3.7%; and PDR, 5.1%. The duration of DM, as well as the severity of hypertension and neuropathy values rose significantly as DR progressed, underlining the pivotal role of hyperglycemia as the primary driver of diabetic complications. The odds ratio for the presence of hypertension was 1.8 (95% CI 0.9–3.5); hypertension showed the highest risk of DR. Stratification according to gender showed a significantly higher DR risk in females than males. Interestingly, nephropathy played a significant role in the DR risk in T1DM. **Conclusions**: Among T1DM and T2DM patients, the severity of DR is associated with risk factors including the DM duration, hyperglycemia, hypertension, and neuropathy. The impact of these factors varies with gender and diabetes type. Therefore, the severity of DR could define patients at a high risk of macro/microvascular complications and enable earlier interventions to reduce morbidity and mortality among T1DM and T2DM patients.

Keywords: diabetes; diabetic retinopathy; non-proliferative; mild non-proliferative; severe non-proliferative; proliferative

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1. Introduction

Diabetes mellitus (DM), considered a significant health problem worldwide, can be caused by the body either not producing enough insulin or not responding appropriately to insulin, causing poorly controlled blood sugar levels [1]. The International Diabetes Federation estimates that 700 million adults will have diabetes in 2045. Excess blood sugar (hyperglycemia) can also damage the nervous system (neuropathy), kidneys (nephropathy), and eyes (retinopathy), causing significant morbidity, disability, and reduced quality of life, with high economic costs [2,3].

Diabetic retinopathy (DR), a severe complication of the chronic microvascular system caused by diabetes, is the fifth most common cause of blindness worldwide. Moreover, as it causes leakages and blockages in the retina, it is the second most common cause, after strokes, of blindness and partial sight among working-age populations [4,5]. Although visual symptoms in the early non-proliferative stages are limited, the progression of the disease, via proliferative retinopathy or maculopathy to severe non-proliferative or proliferative DR, can lead to vision loss [6].

By the year 2010, the prevalence of diabetic retinopathy (DR) had emerged as a significant public health issue on a global scale, impacting around 93 million individuals across the globe. Out of this substantial population, an estimated 28 million persons had reached the advanced phases of the illness, which posed a significant risk to their vision [7]. The aforementioned number serves as a cause for concern, emphasizing the urgent requirement for extensive research and efficacious interventions aimed at reducing the detrimental effects of DR on individuals' visual well-being and general quality of life.

When we look at the situation in Saudi Arabia, we see that the prevalence of diabetic retinopathy is just as high as anywhere else. The prevalence of DR among people with type 2 diabetes mellitus (T2DM) was 19.7% in 2014, according to a study conducted in the Kingdom of Saudi Arabia [8]. This number highlighted the regional expression of a worldwide problem, highlighting the need for specific plans to combat DR among Saudi citizens. Diabetes retinopathy (DR) is a vision-threatening condition that can arise from improper diabetes management, and the prevalence rate acted as a call to action for healthcare providers, researchers, and legislators.

Microvascular complications such as DR result from vascular changes in the retinal circulation, affecting individuals who have had DM for several years. Thus, patients who have had diabetes for longer are more likely to develop retinopathy. Elevated blood pressure, serum levels of advanced glycation end products, and lipid profiles can also contribute to DR development and may predict DR since patients with one microvascular complication are likely to have a higher incidence of other micro- and macrovascular complications. A cross-sectional study of this association in Saudi Arabia [9] found that the prevalence of diabetic nephropathy increased with the increasing severity of DR. Likewise, Venkatesh et al. [10] reported the common co-existence of microvascular and macrovascular complications in patients with even early grades of DR. They found a high occurrence of overt nephropathy and neuropathy and observed hyperlipidemia, hypertension, cerebrovascular events, and cardiovascular disease in all patients, including those having non-proliferative retinopathy.

Prior research suggests frequent abnormal nerve conduction in T1DM patients, albeit without clinical neuropathy [11,12]. Venkatesh et al. [10] identified a high percentage of neuropathy among DR patients with some grades of retinopathy and a higher probability of coexisting neuropathy among those with clinically significant macular oedema in the non-proliferative diabetic retinopathy (NPDR) group.

Recognizing the risk factors for developing diabetic retinopathy (DR) and the relationships between the two conditions is crucial for effective diabetes management. Although retinopathy's prognostic usefulness for other diabetes problems has been the subject of several studies in Western populations, our knowledge of this connection within Saudi Arabia's specific setting is noticeably lacking. Particularly in the Saudi population, research investigating this connection between T1DM and T2DM patients has been lacking.

To address this knowledge gap, the current study aims to develop a predictive model of diabetic retinopathy by analyzing a wide variety of relevant variables. This includes factors like BMI, diabetes duration, hyperglycemia, dyslipidemia, nephropathy, hypertension, and neuropathy. Patients with diabetes mellitus who went through retinal screening at two top clinics in Riyadh, Saudi Arabia, provided the data for this study. In addition to identifying risk factors for diabetic retinopathy, our study examines how these factors affect the disease progression at various stages, taking gender variations and the fact that type 1 and type 2 diabetes are two very distinct diseases into account.

2. Material and Methods

2.1. Design and Study Population

A retrospective study was performed among the population attending two diabetic centers at King Fahad Medical City and King Salman Hospital in Riyadh, Saudi Arabia, between May and August 2018. Records were obtained for 507 patients (205 males, 302 females) meeting the sampling criteria, including patients' minimum age of 18 years,

diagnosed with T1DM at least five years or T2DM at least three years ago, and has a registration in the screening clinic. In addition, participants should have at least reported to the screening clinic, as the researcher obtained medical history data at diabetic centers along with demographic and clinical details. Figure 1 demonstrates the sampling criteria. All methods were performed following the relevant guidelines and regulations.

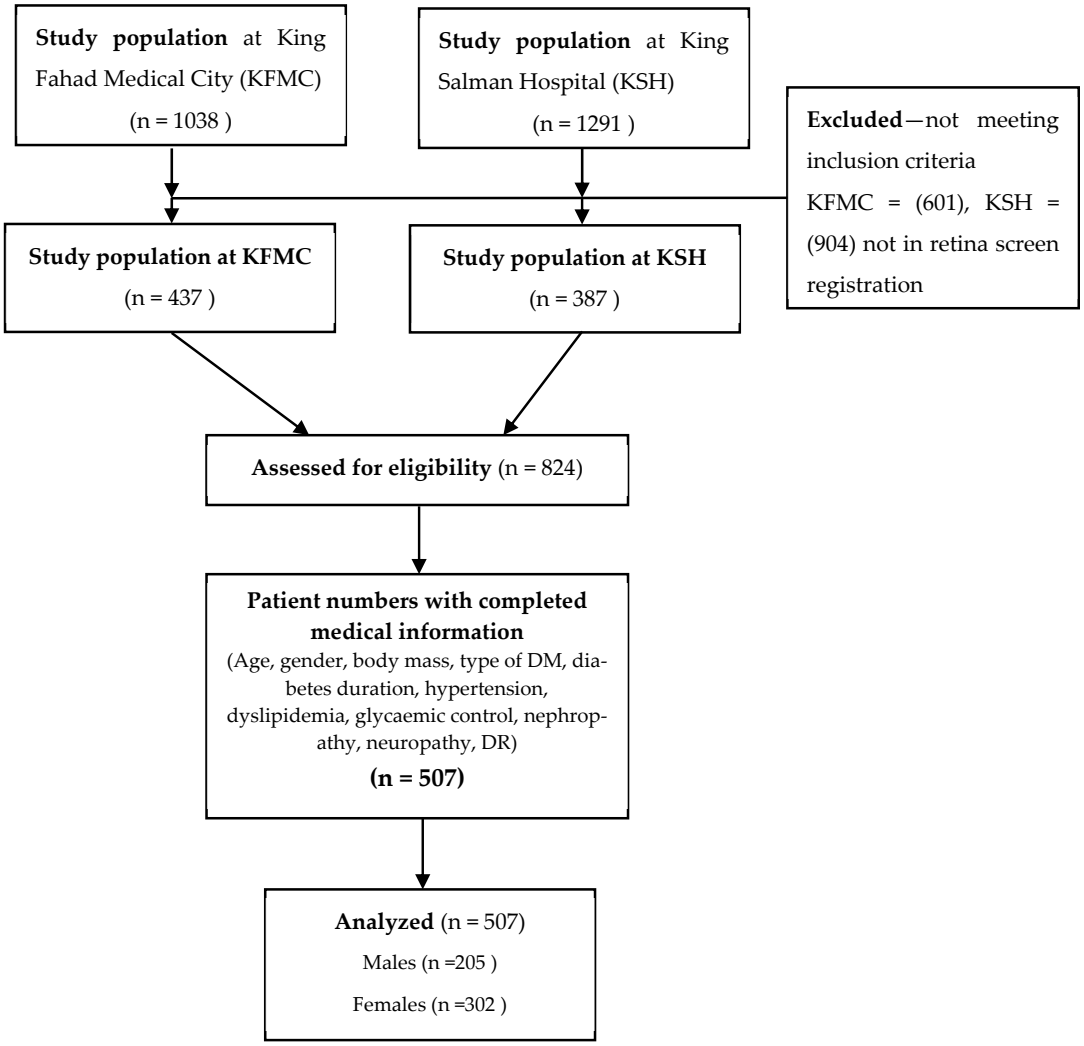

Figure 1. CONSORT diagram summarizing eligibility for the study.

2.2. Procedure and Measurements

Demographic and clinical data, including sex, age, type and duration of diabetes, BMI, and diabetic complications, were extracted from electronic medical files for each patient at the Diabetic Retinopathy Screening Clinic and usually recorded in the medical chart under the patient's medical history, medical diagnosis, or medications section.

Clinical details were obtained from the last available physician-made diagnosis and considered definitive evidence of diabetic complications. Clinical data in the record were presented as DM type (T1DM/T2DM), BMI (normal <25 kg/m^2 overweight 25–29.99 kg/m^2), hyperglycemia (haemoglobin A1c [HbA1c] $\geq$ 7.2 mmol/L), DM duration and presence of hypertension (systolic/diastolic pressure > 140/90 mmHg or patients under hypertensive drugs), dyslipidemia profile (triglyceride, total cholesterol, low-density lipoprotein cholesterol), and nephropathy (creatinine, estimated glomerular filtration rate, urine albumin–creatinine ratio). Diabetic retinopathy was detected through a digital retinal photography test and was graded according to the Early Treatment Diabetic Retinopathy Study scale. Thus, DR existence was recognized when the clinician reported the signs of each DR stage.

Accordingly, DR is defined as an ordinal response variable with five levels: NO DR, NPDR, MILD NPDR, SEVERE NPDR, and PDR.

2.3. Statistical Methods

Several statistical procedures were conducted. First, descriptive statistical analysis was performed to delineate the essential characteristics of the research population, such as the number and percentage of each variable. Second, ordinal logistic regression was used to determine the relative contribution to DR of each covariate predictor, based on the ordered logit function and odds ratio (OR) statistical paradigms.

The predictors' effects on DR stages were compared with the corresponding risk in the diabetes groups by gender and DM type. For this comparison, the study estimated the ordinal coefficient, OR, and 95% confidence interval (CI) values for each category. Finally, Stata statistical software was used to build predictive models.

3. Results

3.1. General Characteristics

A total of 507 diabetes patients who met the inclusion criteria had a mean age of 47 years. The study sample comprised 302 female participants (59.29%) and only 205 males (40.71%). There were 137 T1DM patients (27.02%) and almost three times as many with T2DM (N = 370; 72.98%). Table 1 shows respondents' demographic data and clinical characteristics as continuous and dichotomous variables. Notably, females outnumbered males by roughly 3:2 and more than two thirds of the participants had no DR. The proportions of the patients with no DR were significantly higher (51.43%), compared with the cases of NPDR, Mild NPDR, severe NPDR, and PDR, which were as follows (respectively): (4.43%), (7.71%), (3.71%), and (5.14%).

Table 1. Demographics and characteristics of participants.

Panel A: Continuous Variables						
Variables	**Mean**	**SD**	**Median**	**Skewness**	**Kurtosis**	**Number of Observations**
Age	47.319	17.477	51.000	−0.196	2.202	504
BMI	30.390	6.832	29.810	0.347	3.228	459
DM duration	11.910	6.370	11.000	0.705	3.012	410
Hyperglycemia	8.922	2.129	8.600	1.211	5.380	502
Panel B: Dichotomous Variables						
Variables	**Caption**	**Percent**	**Mean**	**SD**	**The Overall Number of Observations**	
Gender	Male Female	40.71% 59.29%	0.593	0.492	507	
DLP	No Yes	28% 44.29%	1.613	0.488	506	
Hypertension	No Yes	33.14% 39.29%	1.542	0.499	507	
Nephropathy	No Yes	51.29% 20.57%	1.286	0.452	503	
Neuropathy	No Yes	58.71% 13.43%	1.186	0.390	505	
DM type	Type one Type Two	19.57% 52.86%	1.730	0.445	507	
DR Stages	No DR NPDR Mild NPDR Severe NPDR PDR	51.43% 4.43% 7.71% 3.71% 5.14%	1.712	1.257	507	

Note: Data presented as mean for continuous variables with standard deviation (SD) in parentheses; percentages for frequencies. Percentages in the table depend on the data availability (i.e., some responses have missing values).

3.2. Predictors of Diabetic Retinopathy

The results of the multicollinearity test, which evaluated all of the covariance using the Pearson correlation coefficient and are provided in Table 2, indicated that all of the independent variables, except BMI, have a positive association with the severity of DR. There is not a perfect correlation between the predictors since there is no value higher than (0.9), which indicates that there are no problems with multicollinearity. In general, there is not a perfect correlation. The subsequent regression analysis will serve to support this statement.

Table 2. Correlation analysis—pairwise Pearson correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) DR Stages	1.000	0.280 **	0.199 **	0.084	0.141 **	0.155 **	0.192 **	0.240 **
(2) DM Duration	0.238 *	1.000	0.091 ***	−0.015	0.065	0.155 **	0.145 **	0.166 **
(3) DLP	0.229 *	0.147 *	1.000	0.318 **	0.043	0.117 **	0.142 **	0.580 **
(4) BMI	0.074	0.006	0.323 *	1.000	0.025	−0.086 ***	0.181 **	0.306 **
(5) Hyperglycemia	0.080 ***	0.037	0.041	−0.039	1.000	0.058	0.065	0.061
(6) Nephropathy	0.111 **	0.163 *	0.103 **	−0.056	0.080 ***	1.000	0.127 **	0.232 **
(7) Neuropathy	0.177 *	0.172 *	0.159 *	0.146 *	0.056	0.152 *	1.000	0.178 **
(8) Hypertension	0.259 *	0.206 *	0.574 *	0.316 *	0.077 ***	0.164 *	0.182 *	1.000

Note: Values below the diagonal of the Pearson correlation coefficients, while those above represent the Spearman correlation values. *, **, *** indicate statistical significance at $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively.

Several interesting correlations were uncovered by the data. Importantly, a Pearson value of 0.280 ** showed a positive association between DR phases and DM duration. This association shows that the severity of DR phases tends to rise with the length of DM. Similar associations were found between dyslipidemia (DLP) and more advanced DR stages (positive correlation = 0.199 **).

There was also a significant correlation between the BMI and DLP, suggesting that being overweight is linked to having a higher concentration of DLP in the blood. However, hyperglycemia showed a negative connection with the DM duration (−0.015), indicating that hyperglycemia tends to decrease as the DM duration increases.

In addition, we found substantial links between the various microvascular problems in our study. Hypertension (0.259 *), neuropathic pain (0.163 *), and nephropathy (0.1111 **) all showed strong correlations with the DR stage, highlighting the connection between these factors and DR development. Neuropathy may contribute to the severity of DR, as neuropathy showed positive relationships with the DR stage (0.155 **) and hypertension (0.206 *). With a Pearson value of 0.240 **, hypertension showed a strong positive connection with the DR stage, further underscoring the importance of this risk factor in determining DR's development.

The researchers wanted to learn more about the factors that have a role in determining how severe a case of DR will be. To do this, we used a five-level classification scheme to examine the relationships between the various degrees of DR and their respective predictors (no DR, NPDR, MILD NPDR, SEVERE NPDR, PDR). Table 3 contains the results of our investigation. It was discovered that the most influential factors were severe DR (PDR stage) and, specifically, comorbid hypertension (dy/dx = 0.0388). There was not observed to be any correlation between the severity of DR and the existence or severity of nephropathy or DLP.

A notable trend occurred among patients without DR, with the diabetes mellitus (DM) duration displaying a significant negative rate of change at −0.0126 ***. This meant that people who had diabetes for a longer period had a lower chance of being DR-free. Hyperglycemia also demonstrated a significant negative rate of change of −0.0142 **, emphasizing the link between high blood glucose levels and an increased risk of DR. The body mass index (BMI), dyslipidemia (DLP), and nephropathy, on the other hand, did not indicate the lack of DR in this specific cohort.

Table 3. Further analysis—to understand DR phases and predictors.

Variables	BMI	DM Duration	Hyperglycemia	DLP	Hypertension	Nephropathy	Neuropathy
	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
No DR	0.0003 (0.0029)	−0.0126 *** (0.0031)	−0.0142 ** (0.0067)	−0.0664 (0.0585)	−0.0970 * (0.0569)	−0.0527 (0.0430)	−0.08342 ** (0.0432)
NPDR	−0.0001 (0.0005)	0.0024 *** (0.0008)	0.0027 ** (0.0013)	0.0125 (0.0108)	0.0183 (0.0111)	0.0099 (0.0084)	0.01570 * (0.009)
MILD	−0.0001 (0.0008)	0.0034 *** (0.001)	0.0038 ** (0.0019)	0.0179 (0.0158)	0.0262 (0.0159)	0.0142 (0.0119)	0.0225 * (0.0120)
SEVERE NPDR	0.0000 (0.0004)	0.0018 *** (0.0007)	0.0020 * (0.0011)	0.0094 (0.0085)	0.0137 (0.009)	0.0075 (0.0061)	0.0118 * (0.0067)
PDR	−0.0001 (0.0012)	0.0050 *** (0.0013)	0.0057 ** (0.0029)	0.0266 (0.0244)	0.0388 * (0.0233)	0.0211 (0.0176)	0.033416 * (0.0179)

Note: standard errors are presented in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

NPDR (non-proliferative diabetic retinopathy) revealed unique patterns. In this study, the DM duration had a significant positive rate of change of 0.0024 ***, indicating an increased risk of NPDR with a prolonged DM duration. Hyperglycemia and neuropathy also showed significant positive rate increases at 0.0027 ** and 0.01570 *, highlighting their ties to NPDR. In contrast, no significant relationships were discovered between BMI, DLP, hypertension, or nephropathy and NPDR.

The mild non-proliferative diabetic retinopathy (MILD NPDR) trends closely followed those of NPDR, with the DM duration showing a significant positive rate of change at 0.0034 ***. The risk of MILD NPDR rose as the duration of diabetes increased. Similarly, hyperglycemia had a significant positive rate of change of 0.0038 **, supporting its association with MILD NPDR. Notably, BMI, DLP, hypertension, and nephropathy had no significant relationship with MILD NPDR.

The DM duration exhibited a statistically significant positive rate of change at 0.0018 ** in the severe non-proliferative diabetic retinopathy (SEVER NPDR) group, indicating an increased risk of SEVERE NPDR with a longer DM duration. Hyperglycemia had a positive rate of change of 0.0020 *, confirming its relationship with SEVERE NPDR. However, no significant links were found between BMI, DLP, hypertension, and nephropathy in this setting.

PDR (proliferative diabetic retinopathy) had unique connections. A longer DM duration was associated with an increased risk of PDR, as evidenced by a positive rate of change of 0.0050 ***. Hyperglycemia also demonstrated a substantial positive rate of change at 0.0057 **, emphasizing its link to PDR. Furthermore, elevated DLP levels, hypertension, and the presence of neuropathy were all linked to an increased risk of PDR. These data highlight the complex link between clinical factors and the evolution of DR at various stages.

The results of the first model are presented in Table 4, which demonstrates that the odds ratios for the DR severity go up as the duration of diabetes, hypertension, hyperglycemia, and neuropathy become longer. Hypertension had the strongest association with the DR severity among these factors, with an odds ratio of 1.789 (95% confidence interval: 0.9099–3.5186). In addition, the examination of the predictors' effects on the severity of DR indicated a more favorable influence in females than in males. This was the case when the analysis was conducted separately according to gender. In patients with type 1 diabetes, the length of their diabetes and the presence of nephropathy had a positive correlation with their DR stage. There was no significant evidence of a hyperglycemia impact in T1DM; however, the nephropathy effect was weakly significant in that group, and the hyperglycemia result was highly significant for T2DM. The diabetes mellitus duration was significantly connected in both types; however, there was no significant evidence of a hyperglycemia effect in T1DM. It is interesting to note that there was no substantial evidence for the overall effect of nephropathy on the DR severity. However, when the

sample was divided into groups according to the type of diabetes, an association with DR that was pronounced at 10% developed. Based on these findings, it appears that nephropathy played a significant influence in the type 1 diabetes group.

Table 4. Odds ratios for the DR stages and set of independent variables of interest.

	Baseline Model			Baseline with Gender						Baseline with DM Type					
				Male			Female			T1DM			T2DM		
Variables	Odds Ratio Values	[95% Conf. Interval Odds]		Odds Ratio Values	[95% Conf. Interval Odds]		Odds Ratio Values	[95% Conf. Interval Odds]		Odds Ratio Values	[95% Conf. Interval Odds]		Odds Ratio Values	[95% Conf. Interval Odds]	
BMI	0.998	0.9649	1.0322	1.045	0.9912	1.1030	0.971	0.9290	1.0159	1.039	0.9533	1.1335	0.970	0.9258	1.0175
DM Duration	1.078 ***	1.0368	1.1216	1.149 ***	1.0670	1.2371	1.0463 **	0.9966	1.0985	1.1313 **	1.0390	1.2318	1.067 ***	1.0194	1.1162
Hyperglycemia (HbA1c)	1.089 **	1.0060	1.1792	1.0772	0.8744	1.3269	1.0810 *	0.9861	1.1850	1.0122	0.8648	1.1847	1.162 ***	1.0381	1.3003
DLP	1.490	0.7507	2.9556	2.048	0.7284	5.7601	1.2401	0.4869	3.1580	1.3064	0.2598	6.5696	1.366	0.5854	3.1892
Hypertension	1.789 *	0.9099	3.5186	1.119	0.3460	3.6220	2.7681 **	1.1118	6.8923	1.7128	0.2817	10.4127	1.657	0.8160	3.3657
Nephropathy	1.372	0.8251	2.2822	1.720	0.6606	4.4813	1.167	0.6234	2.1837	2.896 *	0.9270	9.0463	1.137	0.6332	2.0433
Neuropathy	1.650 *	0.9816	2.7723	1.653	0.7177	3.8083	1.837 **	0.9387	3.5963	2.472	0.7138	8.5613	1.478	0.8301	2.6339

Note: The above table estimates the odds ratio for the DR stages as a dependent variable and set of independent variables. The first model is the baseline model which estimates the relationship between the DR stages and set of predictors. The second model represents the baseline model estimation after splitting the sample into two groups, where the first group is male, and the second group is female. The third model represents the baseline model estimation after splitting the sample into two groups based on the DM type, where the first group is T1DM and the second group is T2DM. Variance of inflation values were all <10, confirming that collinearity is not a concern [13]. Collinearity issue has been investigated and found that all values of the Variance of Inflation (VIF) lower than 10 confirm that the collinearity is not a concern over the empirical results. *, **, *** indicate statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively.

4. Discussion

The results show that several factors appear to influence the occurrence of DR as a complication among the T1DM and T2DM Saudi populations. The DR severity appears to be predicted by the DM duration, hyperglycemia, and the presence of hypertension and neuropathy in both diabetes types.

Many published studies have provided evidence of an association between DR and a long DM duration [14,15]. Some reports have linked this to advanced vision impairment, which is expected within 15 years of DR onset [16]. However, the data from a previous study indicated that patients with T1DM for >20 years were more likely to develop DR by 2.7 times and have vision-threatening DR by 8.7 times compared with those having T2DM for <10 years [17]. Consistent with this, our study found a positive effect of the DM duration, significant at $p < 0.01$, indicating that the DR severity was 1.0783 times more likely with a lengthier DM duration. The positive effect of duration on patients at the PDR stage is reported as higher than among patients at any other stage [18].

The current results are relatively consistent with the evidence from previous epidemiologic studies of associations between retinopathy and hypertension, nephropathy, and neuropathy [14,16]. However, few studies have clearly described the relationship with the DR severity, particularly in the Saudi population. This limitation is shown by a review of published studies investigating the risk factors of microvascular complications among Saudi diabetes patients [16]. One of these identifies hypertension as a risk factor of DR [15], although failure to conduct a predictive inference analysis constitutes a limitation.

Likewise, Al-Rubeaan et al. [8] found that hypertension, neuropathy, and nephropathy significantly increased the risk of DR, with OR 1.63 (1.56–1.70), 4.48 (4.26–4.70), and 5.10 (4.81–5.40), respectively. Thus, the risk was higher for all complications in PDR than NPDR patients. These findings are in line with the current study, which supports the conclusion that the DR severity is affected by the existence of hypertension and neuropathy.

Regarding the role of the diabetes type, the present study found that nephropathy was significantly associated with the DR severity, particularly among the T1DM group. Other studies have similarly suggested an association between the severity of nephropathy and of DR [9], especially in T1DM [11,19]. Furthermore, although a study of Korean T2DM patients indicated that DR was associated with overt nephropathy, it found that PDR was associated with microalbuminuria [14].

The present analysis found that the OR of the association between the DR stage and the predictors varied with gender: there was a significant association between the DR stage and hypertension among females only. Likewise, neuropathy was a significantly more robust factor in females. Interestingly, the OR of the diabetes duration was higher among males and increased with the DR severity. These results seem clearer than those reported in previous research, according to which, gender predicts the presence and severity of DR but does not mediate other predictors. However, not taking account of this point may explain the diversity of the published results concerning the effect of gender on high-risk factors [5,16,20].

The current study shows that the significant prevalence of NPDR, mild NPDR, severe NPDR, and NPDR among both T1DM and T2DM patients were 4.43%, 7.71%, 3.71%, and 5.14%, respectively. This is consistent with the locally published reports of a high incidence of DR onset, between 27.8% and 36.4% from a representative sample of studies [15,21–23].

This study has several limitations. First, the data were extracted from incomplete patient records; in particular, the DR grade was often not recorded, so that there was no marked increase in the value of the predictors from low- to high-severity DR. Second, the sample was smaller than in previous studies, which also included patients with macular oedema as an advanced DR stage and may thus have missed some information about the predictors at that retinopathy stage. Third, the study investigated the influence of hypertension, nephropathy, and neuropathy as co-morbidities, but not their severity, although their relationship with the DR severity might depend on the severity of these complications and could be consequences of the DR itself. Likewise, the contribution to the field would have been greater if the study had evaluated the impact of medication type on the DR severity.

5. Conclusions

This study investigated the association between risk factors and the severity of diabetic retinopathy (DR) in a population of individuals with diabetes mellitus (DM) in Saudi Arabia. The findings revealed that the risk factors for the DR severity differed based on the type of diabetes and gender. Hence, it is imperative for clinicians to diligently assess and document the severity of diabetic retinopathy (DR) during every patient encounter. However, this model has the potential to be a robust tool for predicting the clinical progression of diabetic retinopathy (DR) and other complications in various subgroups of individuals with diabetes.

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Abbreviations

Diabetes mellitus (DM), type 1 diabetes (T1DM), type 2 diabetes (T2DM), diabetic retinopathy (DR), non-proliferative diabetic retinopathy (NPDR), mild non-proliferative (MNPDR), severe non-proliferative (SNPDR) and proliferative (PDR), body mass index (BMI), odds ratio (OR).

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