Diabetes Retinopathy Prevalence and Risk Factors among Diabetic Patients Seen at Highland Eye Clinic Mutare Zimbabwe: A Retrospective Study

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Abstract

Objective: To determine the prevalence of diabetic retinopathy and its association with hypertension, age, gender, and fasting blood glucose level.

Methods: This retrospective study assessed the prevalence of diabetic retinopathy with its associated risk factors on 135 diabetic patients, aged 18 years and above, visiting the Highland Eye Clinic Mutare, Zimbabwe. Data were collected on the age, sex, and type of retinopathy. Based on the identified retinopathy, subjects were divided into no retinopathy, non-proliferative diabetic renopathy, and proliferative diabetic retinopathy groups. Analysis were then performed using multivariate and univariate regression analyses to test the association between the presence of retinopathy and several risk factors, and results were presented in percentages, with $p<0.05$ considered to show statistical significance.

Results: The average age of the subjects this study was 60.8±14 with female subjects constituted more than half of the total number of subjects (58.5%). Forty four percent were overweight (BMI 25–30), 34.8% were obese, and the overall prevalence of diabetic retinopathy was 31.1% (non-proliferative diabetic renopathy, 20%; proliferative renopathy, 11.1%). The proportion of subjects with retinopathy increased with duration of DM, being 23.3% in those with a DM duration of less than 10 years and 46.6% in those with a DM duration of more than 10 years. Age and hypertension were significantly associated with the presence of diabetic retinopathy ($p<0.05$) in univariate analysis, but no association was identified between retinopathy and fasting blood glucose (chi-square test, $p=0.0965$)

Conclusion: The prevalence of diabetic retinopathy (DR) is high (31.1%), Non-proliferative DR is more common than the proliferative (DR). There is a strong association between diabetic retinopathy, hypertension, and age.

Keywords: Diabetes, hypertension, prevalence, retinopathy

Introduction

Diabetes mellitus is a chronic heterogeneous metabolic disorder with complex pathogenesis. Its main characteristics is hyperglycemia due to abnormalities in either insulin secretion or insulin action, or both. Long-term Diabetes mellitus leads to various microvascular and macrovascular diabetic complications, including retinopathy which is mainly responsible for diabetes-associated morbidity and mortality.[1] . The most prominent risk of diabetes mellitus is diabetic retinopathy, which is recognized as a disorder of the smallest blood vessels in the eye. It soon becomes a global

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public health issue.[2-4] Diabetic retinopathy is one of the most common microvascular complications of diabetes and irreversible blindness-causing disease in the population. In particular, proliferative retinopathy is a unique complication of diabetes and is rarely associated with other diseases.[4] I2020, the number of adults worldwide with Diabetic retinopathy (DR), vision-threatening diabetic Retinopathy (VTDR), and clinically significant macular edema (CSME) was estimated to be 103.12 million, 28.54 million, and 18.83 million, respectively. By 2045, these numbers are projected to increase to 160.50 million, 44.82 million, and 28.61 million, respectively. This report highlighted DR as a potential global challenge. Diabetic retinopathy prevalence is highest in Africa (35.90%) and North American and the Caribbean (33.30%) and lowest in South and Central America (13.37 %).[5] Diabetic retinopathy is known to have a long latent asymptomatic phase during which patients do not report any signs and symptoms. As a result, patients in the later stages may experience floaters, hazy vision, distortion, and gradual visual acuity loss. Therefore, early detection of the ophthalmic complication achieved through developing tools that can be incorporated into diabetes mellitus management could be of valuable contribution in preventing ophthalmic complications, which opens an avenue for this study. According to the Vision Loss, Expert Group of Collaborators, diabetic retinopathy accounts for 0·86 million cases of blindness in those aged 50 years and older in 2020.[6] Previous studies in Saudi Arabia have identified risk factors of DR, including age, duration of diabetes, glycemic control, obesity, dyslipidemia, and nephropathy.[7,8] In Saudi Arabia, nephropathy, neuropathy, insulin use, poor glycemic control, hypertension, and male gender were found to be associated with a significant increase in the risk for DR, whereas obesity was associated with a significant reduction in the risk for DR among Saudi type 2 diabetics.[7] Only a few studies evaluated the prevalence of DR in Zimbabwe, leaving a gap in risk factors.[9] Currently, in Mutare Zimbabwe, the Prevalence of DR and its association with various risk factors have not yet been described despite an increasing number of diabetic patients admitted to the hospital for ophthalmic complications among other comorbidities including hypertension. Therefore, the present study aimed to determine the prevalence of diabetic retinopathy, the degree to which it affects the retina and macula and its potential association with risk factors, including hypertension, BMI, age, duration of diabetes, and fasting blood glucose level.

Methods

This retrospective study was performed on a total of 135 diabetic patients, both males and females. aged 18 and above attending the Highland eye clinic located at 123 Herbert Chitepo Street Mutare Zimbabwe in the period of early November 2021 to December 2021. Permission was obtained from the Highlands Eye Clinic to access the patient registry. The basic characteristics studied in the 135 patients enrolled in this study were age, sex, diabetes mellitus, type of diabetes, duration of diabetes, BMI, and blood pressure. Diabetes individuals visiting the outpatient diabetic clinic, and patients over the age of 18 were included in this study. Patients with an exterior eye disease that obstructs retinal vision were excluded. Patients who attended the diabetic clinic regularly and met the inclusion criteria were involved in the participation. The inclusion criteria used were: no apparent diabetic retinopathy meaning no abnormalities, non- proliferative diabetic retinopathy where micro aneurysms, dot & blot hemorrhages were found,and proliferative diabetes retinopathy where one or more of the followings were found: definite neovascularization preretinal or vitreous hemorrhage.

Demographic data were recorded and medical data were extracted from the outpatient booklet. The following sample size formula was used to compute the sample size: n= (Z^2 x P (1 – P))/e^2, where Z = value from standard normal distribution corresponding to the desired confidence level (Z=1.96 for 95% Confidence Interval). P was expected true proportion and e was the desired precision.[10] The hypothesis was that the prevalence of diabetes retinopathy was ≤18.6% and the presence of retinopathy did not significantly associated with diabetes duration, Body Mass Index, and Hypertension. The alternative hypothesis was the prevalenceofdiabetesretinopathywas≥18.6% and the presence of retinopathy significantly associated with diabetes duration, Body Mass Index, and hypertension. (18.6% was the prevalence of diabetic retinopathy found in a similar study by Tesfaye S, in Tanzania).[11]

The population of study is grouped into 3 groups: No diabetics retinopathy, proliferative

diabetic retinopathy, and non-proliferative diabetic retinopathy. Data collected were recorded onto an excel sheet. Each participant was allocated an identity number and his or her true identity was concealed. Excel was used to electronically manage the data.

All data were analyzed using the SPSS. Data were presented in percentages descriptively to characterize the prevalence. The dependent variable, the existence of diabetic retinopathy, and related independent variables were assessed using the Logistic Regression analysis. In addition, the statistical significance in terms of association was measured by Chi-square test. Variables with a p-values less than 0.05 were considered significant. The odds ratio based on the confidence interval of the risk factors was explained using intervals. Confidentiality was maintained and only the first author was cognizant of the patients' identity. The research has been conducted under the approval of the ethical committee Africa University with the approval code of Ref: AU2266/21.

Results

Males were the most affected by this condition based on the result of the sociodemographic analysis. The average age for both men and females were 60.8±14 with no significant age difference between the two (male mean age was 60.2 and female mean age was 61.2). Hypertension was the most common comorbidity, affecting more than two-thirds of the patients. (Table1) Only about a third of the patients in this study had had diabetes for more than 10 years.

The majority of patients were overweight (44.4%) based on their BMI, this was followed by (34.8%) who were obese, and (20.7%) with a BMI within the recommended range. The overall prevalence of diabetic retinopathy among the study population was 31.1% (n=42), with 15 participants (11.1%) discovered to have proliferative diabetic retinopathy and required urgent ophthalmologic referral, while 27 (20 %) had non-proliferative diabetic retinopathy.

Furthermore, there was an association between diabetic retinopathy and duration of diabetes. Less than a third of the participants, 45 (33.3%) had had diabetes for a period longer than ten years while two- thirds 90 (66.7%) had had diabetes for ten years or less (Table 2). The majority of the study participants were in the sixth decade of life, with a mean age of 60.8±14 years (Fig. 2). The development of diabetic retinopathy was significantly associated with age (p=0.048). In

Table 1 Socio-demographic and Clinical Characteristics of the Study Population (n=135)

Characteristic	Frequency n (%)
Male	56 (41.5%)
Female	79 (58.5%)
Hypertensive	97 (71.9%)
AGE (Mean±SD)	60.8±14
DM duration <10 years	90 (66.6%)
DM Duration >10 years	44 (33.3%)
BMI Normal	28 (20.7%)
BMI Overweight	60 (44.4%)
BMI Obese	47 (34.8%)

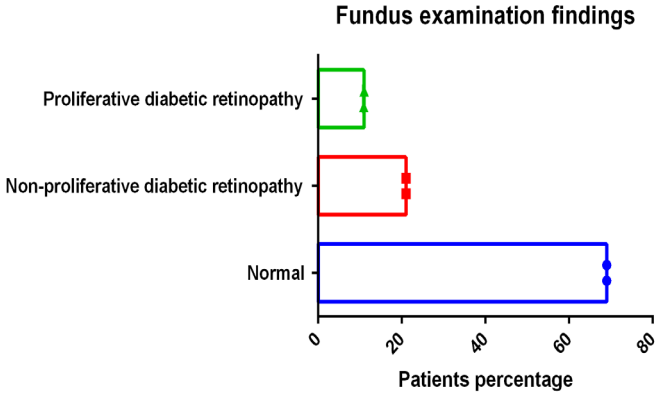

Fig. 1 Prevalence of Diabetes Retinopathy by Fundus Examination

Table 2 Proportional Relationship between Diabetic Retinopathy and Duration of Diabetes Mellitus

Duration (Years)	Number	Retinopathy Present	Retinopathy Absent	Prevalence Of Diabetic Retinopathy (%) (N_1=90, N_2=45)
0–10	90	21	69	23.3%
>10	45	21	24	46.6%

Table 3 Prevalence of Hypertension in Diabetic Retinopathy Patients (n=135)

Hypertension	Retinopathy Present n (%)	Retinopathy Absent n (%)
Yes (n=97)	30 (22.2%)	67 (49.6%)
No (n=38)	12 (8.9%)	26 (19.3%)
<40 years hypertensive	2 (1.5%)	1 (0.7%)
<40 years not hypertensive	0 (0%)	6 (4.4%)
40–59 years hypertensive	10 (7.4%)	22 (16.3%)
40–59 years not hypertensive	9 (6.7%)	16 (11.9%)
60–80 years hypertensive	13 (9.6%)	39 (28.9%)
60–80 years not hypertensive	2 (1.5%)	3 (2, 2%)
>80 years hypertensive	5 (3.7%)	5 (3.7%)
>80 years not hypertensive	1 (0.7%)	(0.7%)

this study, the prevalence was only 1.5% in the young group of under the forties, 14.1% in the 40–59 year age group, and 11.1% in 60 years and above group (Table 5).

The majority of the study participants over two-thirds had co-existing hypertension (Table 3). There was an increase in the prevalence of diabetic retinopathy in a hypertensive setting (Table 3).

Association between diabetic retinopathy and fasting blood glucose level was also examined (Table 4). However, due to some missing data, our analysis was based on 119 instead of 135 patients. A fasting blood sugar level of less than 100 mg/dL (5.6 mmol/L) is considered normal while a fasting blood sugar level from 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is considered prediabetes. A fasting blood sugar level of 126 mg/dL (7 mmol/L) or higher on two separate tests was indicative of

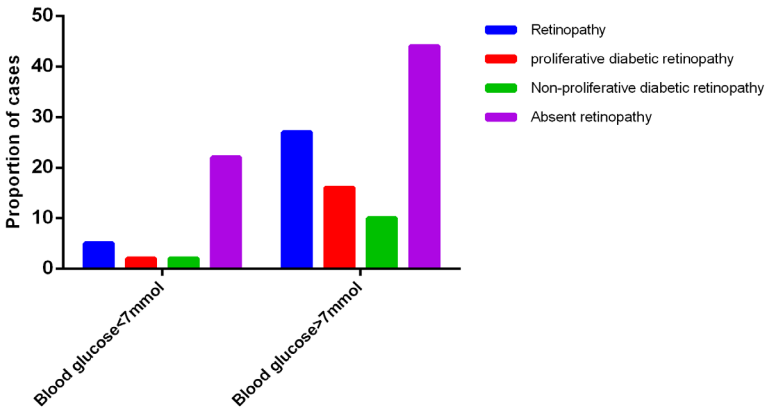

Fig. 2 Association of Diabetes Retinopathy with Fasting Blood Glucose (Chi-square test; p=0.0965)

Table 4 Diabetic Retinopathy and Fasting Blood Glucose Level (n=119)

Fasting Blood Glucose level (mmol/L)	n=119	Retinopathy Present n (%)	Non-proliferative diabetes retinopathy (n %)	Proliferative retinopathy (n %)	Retinopathy Absent n (%)
<7 mmol/L	33(27.7%)	6(5.04%)	3(2.52%)	3(2.52%)	27(22.69%)
> 7mmol/L	86(72.26%)	33(27.7%)	20(16.8%)	13(10.92%)	53(44.53%)

diabetes.[12]

In this study, 33 out of 119 patients had a fasting glucose level of 0–7 mmol/L and six patients (5%) had retinopathy, of which three (2.5%) experienced non- proliferative retinopathy. Eighty-six (86) (72.26%) patients have a fasting blood glucose above 7 mmol/L out, where 33 (27.7%) and 20 (16.8%), 13 (10.92%) had proliverative retinopathy, and non-proliferative retinopathy, respectively (Table 4). The retrospective analysis of their proportion using Chi-square test (p=0,0965) indicated no statistical significance difference in the fasting blood glucose level; thus, fasting blood glucose level was not associated with the development of retinopathy (Fig. 2).

The univariate logistic regression analysis was done on the study participants assessing the association of having diabetes retinopathy and various baseline characteristics. The results were shown in (Table 5).

Discussion

According to the World Health Organization (WHO), it is estimated that DR accounts for 4.8% of the number of cases of blindness (37 million) worldwide.[13] The prevalence of diabetic retinopathy (Fig. 1) was found to be 31.1 percent (42 cases) at the Highlands Eye Clinic in Mutare, with 11.1 percent (15 cases) cases of proliferative diabetic retinopathy and 27 cases (20 percent) of non-proliferative diabetic retinopathy. This finding is in line with the 9–55 percent prevalence rates of diabetic retinopathy reported in Africa.[14]

Approximately a third of the participants (Table 2) (n=45, 33.33%) had had diabetes for a period longer than ten years while two-thirds (n=90, 66.7%) had diabetes for ten years or less. The opposite finding where found in a study by Margarete Voigt et al. where 12% have a duration of diabetes below (<)10 years, and 24% have had diabetes for 10<15 years.15 It is suggested that patients with a longer duration of diabetes are at the highest risk of complications, as shown in this study that those with a disease duration of less than 10 years have a lower prevalence of DR (23.3%) and while the prevalence of those who have had the disease more than 10 years is 46.6%. This difference in findings between the

Table 5 Univariate and Multivariate Analysis of Risk Factors For Retinopathy

Factor	Retinopathy		Univariate Analysis		Multivariate Analysis	
	Yes	No	Or (95% Ci)	p-value	Or (95% CI)	p-value
Gender						
Male	21	35	1.65 (0.80–3.38)	0.175	1.59 (0.49–5.12)	0.436
Female	21	58	1		1	
Age, Mean (SD)	61.5±13.2	60.4±13.9	1.02 (1.00–1.04)	0.048	1.01 (0.97–1.06)	0.615
Hypertension						
Yes	30	67	2.80 (1.23–6.42)	0.015	1.92 (0.50–7.37)	0.002
No	12	26	1		1	

two studies might be a reflection of ashifting diabetes environment, which is ascribed to a global increase in the diabetes pandemic caused by sedentary lifestyles, urbanization, high-calorie diets (carbohydrates are cheaper than protein in Zimbabwe), and obesity. Additionally, the socio-economic changes in Zimbabwe have impacted healthcare delivery negatively and, consequently, the quality of diabetes care is deteriorating due to the increasing inflation taking place.

In this study, it was found that men (37.5%) are more affected than women (26.6%) (Table 5). This study's finding is in agreement withthe findings of a study conducted in rural southern China where a higher prevalence of diabetic retinopathy was found in men.[16] It is important though to note that the role of gender alone as a determinant of diabetic retinopathy is yet to be unraveled since the fulcrum to which gender has an effect is solely based on hormones, when race, diet, and lifestyle may also affect this condition.

The majority of the study participants were in the sixth decade of life with a mean age of 60.8±14 years. Thedevelopmentof diabeticretinopathy is strongly associated with age as observed in another study[17] Maladaptive alterations and complicated interactions between the autonomic nervous system, a maladaptive immune system, increased activation of the renin-angiotensin-aldosterone system (RAAS), and unfavorable environmental variables are all involved in the pathogenesis of hypertension in diabetes. The majority of the study participants, which is more than two-third,had co-existing hypertension (Table 5). There was a strong association of diabetic retinopathy in the setting of hypertension with 97 of the 135 participants of this study being hypertensive, Similar findings are observed in other investigations which also found a strong association between diabetic retinopathy and hypertension.[18,19] Studies have shown that the relative risk of diabetic retinopathy for diabetics to also have hypertension is 1.7.[20, 21] In a univariate logistic regression analysis, the prevalence of diabetic retinopathy was higher in those who had had diabetes for more than 10 years vs. less than 10 years, and this is statistically significant (OR 1.10 (95 percent C1 1.00–1.01), p=0.011). This was similar to a study by Basal et al. indicating an increasing prevalence of DR with an increase in the duration of DM.[22] In a multivariate logistic regression study, the duration of diabetes mellitus — OR 1.01 (95 percent CI 1.00–1.01) and being hypertensive OR 1.92 (95 percent 0.50–7.37) — were found to be highly linked with developing diabetic retinopathy. The discovery of a substantial link between the development of diabetic retinopathy and the period of having diabetes mellitus reflects the pathophysiology of diabetic retinopathy and the influence of long-term hyperglycemia exposure. This study supported previous results that the longer a person has diabetes, the greater the chance of developing diabetic retinopathy, emphasizing that the progression of retinopathy is accelerated by long-term hyperglycemia.[23]

Out of the 119 participants, 18 (15.1%) haduncontrolled fasting blood glucose, and of these. 9 (7.6%) had diabetic retinopathy (Table 3, 5). A study done by Yumi Matsushita NT et al.[24] clarified that the higher the level of fasting blood glucose is, the higher the prevalence of retinopathy, with no clear threshold. This also suggests that it is possible to detect the risk of retinopathy using the fasting blood glucose level only. In addition, a previous study indicated that decreased retinopathy risk could be achieved with stricter blood glucose control.[25] This present study revealed contradictory results when compared to the aforementioned study as the prevalence of diabetes retinopathy associated with uncontrolled blood glucose levels was only about 7%. To prevent retinopathy, it is clear that fasting blood glucose levels should remain at a low level. In this present study, 44.4 percent of the individuals were overweight, followed by 34.8 percent who were obese, and 20.7 percent with a BMI that within the recommended range. A previous study stated that there is no solid evidence that obesity causes DR, as neither being overweight nor obese is associated with an increased risk of DR.[26] However another report indicated that increased body mass index is associated with an increased risk of diabetic retinopathy.[27] However another report indicated that increased body mass index is associated with an increased risk of diabetic retinopathy.27 Obesity (BMI>31.0 kg/m^2 for men and 32.1 kg/m^2 for women) is linked to retinopathy development and severity in T2DM patients, where higher BMI is associated with retinopathy.[13] Documented records of patients in this present study indicated they have mainly type II diabetes mellitus.

This study was able to evaluate the prevalence of diabetic retinopathy among

135 diabetic patients attending Highlands

Eye Clinic in Mutare, Zimbabwe, and found that the prevalence was 31.1%. In addition, Non-proliferative diabetic retinopathy is more common than proliferative retinopathy. Age and hypertension, are significantly associated with diabetic retinopathy. Age, Hypertension, are significantly associated with diabetic retinopathy. However, this study also carries limitations that the population is limited as the study was only conducted on a few participants that were available in the Highland Eye clinic, and only in Mutare, in Manicaland province. Therefore, generalization of these findings to the country of Zimbabwe should be made with caution.

In conclusion, the overall prevalence of diabetes retinopathy is found to be 31.1% Non-proliferative diabetes retinopathy is more common than proliferative diabetes retinopathy, with strong associations between diabetic retinopathy, hypertension, and age. The risk factors associated with the development of retinopathy revealed in this study should be properly taken into account to reduce the visual damages caused by diabetic retinopathy during the asymptomatic period.

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