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 path oogenesis. It is the 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 for the smallest blood vessels in the eye. It's soon becoming 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] In 2020, 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, the numbers are projected to increase to 160.50 million, 44.82 million, and 28.61 million, respectively. This report highlighted DR as a potential challenge worldwide. Diabetic retinopathy prevalence was highest in Africa (35.90%) and North American and the Caribbean (33.30%) and was 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 its 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 Vision Loss, Expert Group of Collaborators reported that diabetic retinopathy accounted for 0·86 million cases of blindness in those aged 50 years and older in 2020.[6] Previous studies in Saudi Arabia identified risk factors of DR including age, the 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

The present study is retrospective where a total of 135 diabetic patients both male and female aged 18 and above attending Highland eye clinic located at 123 Herbert Chitepo Street Mutare Zimbabwe are enrolled in the study from the period of early November 2021 to December 2021. By means of having informed consent from the Highlands Eye Clinic to access the patient registry. The base characteristics being looked for in the 135 patients enrolled in this study are 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 used as the inclusion criteria. As for the exclusion criteria people with an exterior eye disease that obstructs retinal vision. Patients who attend the diabetic clinic regularly and meet the inclusion criteria were involved in the participation. The inclusion criteria used were: no apparent diabetic retinopathy which means no abnormalities found, non-proliferative diabetic retinopathy where micro aneurysms, dot & blot hemorrhages are found and proliferative diabetes retinopathy where one or more of the following: definite neo vascularization preretinal or vitreous hemorrhage found.

Demographic data were recorded and medical data was extracted from the outpatient booklet. The following sample size formula is used to compute the sample size: n=(Z^2 x P (1 – P))/e^2 , where Z = value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% Confidence Interval) P is expected true proportion e is desired precision [10] Null hypothesis: we hypothesize a retrospective study of consented diabetic patients records at the Highlands Eye clinic the prevalence of diabetes retinopathy was ≤18.6% and the presence of retinopathy not significantly associated with diabetes duration, Body Mass Index and Hypertension Alternative hypothesis: A retrospective study of consented diabetic records of participants attending the Highlands Eye clinic the prevalence of diabetes retinopathy was ≥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 was recorded onto an excel sheet. Each participant was allocated an identity number and his or her true identity is concealed. Excel was used to electronically manage the data.

All data were analyzed using SPSS. Data are present in percentages in descriptive patterns to characterize the prevalence. The dependent variable, the existence of diabetic retinopathy, and related independent variables were assessed using Logistic Regression analysis in addition statistical significance in terms of association was measured by Chi-square test. Variables with p-values less than 0.05 are considered significant, but those with p-values more than 0.05 are not. The odds ratio based on their confidence interval of the risk factors was explained using intervals that were created. The Africa University Health Research Ethics Committee, College of Health Sciences, and Highlands Eye clinic approved this study. Patient numbers were made used instead of their real names for the security of the patient's identities. One hundred percent confidentiality was done by me during this research. The research has been conducted under the approval of the ethical committee Africa University and all participants provided informed consent, reference of the relevant review board(s) and approval code(s) are here below. Ref: AU2266/21

Results

This study aimed to determine the prevalence of diabetes retinopathy and determination of its risk factors. The socio-demographic and clinical information of the study population indicated in term of prevalence the majority of participants are female being the most affected The average age for both men and females were 60.8±14 with no significant age difference between the two groups (male mean age was 60.2 and female mean age was 61.2). Hypertension was a common comorbidity, affecting more than two-thirds of the patients. (Table1) Only about a third of the people in the study had diabetes for more than 10 years.

The majority of the population their BMI indicated that they are overweight (44.4%), followed by (34.8%) who were obese, and (20.7%) who had a BMI that was within the recommended range. The overall prevalence of diabetic retinopathy amongst the study population was 31.1% (n=42), with 15

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%)

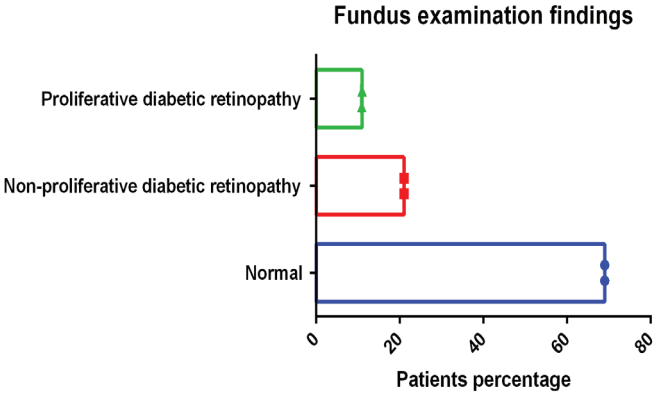

Fig. 1 Prevalence of Diabetes Retinopathy by Fundus Examination

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%)

participants (11.1%) discovered to have proliferative diabetic retinopathy and required urgent ophthalmologic referral, and 27 (20 %) had non-proliferative diabetic retinopathy.

Furthermore, there was an association between diabetic retinopathy and the 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 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 univariate analysis as observed in this study in addition the prevalence was just 1.5% in the young group of under the forties, 14.1% in the 40–59 year age group and 11.1% in the above '60s (Table 5).

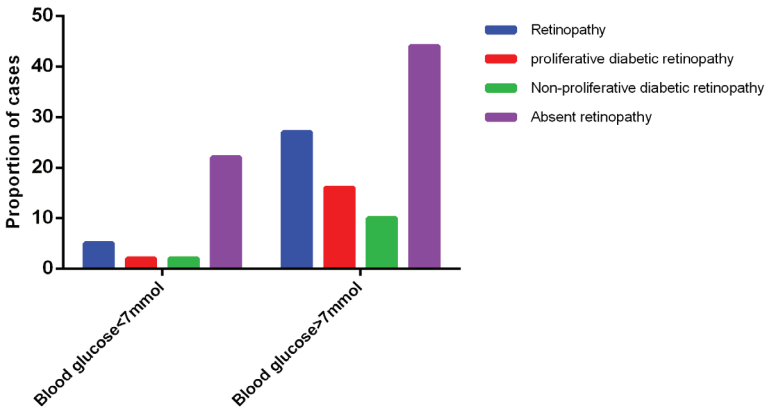

Fig. 2 Association of Diabetes Retinopathy with Fasting Blood Glucose (Chi-square test; p=0.0965)

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%)

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).

Furthermore, we determine the association between diabetic retinopathy and fasting blood glucose level (Table 4). However, due to some missing data, our analysis is based on 119 instead of 135. A fasting blood sugar level of less than 100 mg/dL (5.6 mmol/L) is normal. A fasting blood sugar level from 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is considered prediabetes. If it's 126 mg/dL (7 mmol/L) or higher on two separate tests, is indicative of diabetes.[12]

In this study 33 patients out of 119 had a fasting glucose level of 0–7 mmol/L, 6 (5%) had retinopathy of which 3 (2.5%) was non-proliferative retinopathy and the other 3 (2.5%) was proliferative retinopathy. 86 (72.26%) have a fasting blood glucose above 7 mmol/L out of 119 participants, 33 (27.7%), 20 (16.8%), 13 (10.92%) have retinopathy, proliferative, and non-proliferative retinopathy respectively are found also to have a fasting blood glucose above 7 mmol/L (Table 4). Furthermore, retrospective analysis of their proportion using Chi-square test, (p=0,0965) indicated there was no statistical significance in terms of fasting blood glucose level therefore fasting blood glucose is not associated with the development of retinopathy (Fig. 2).

We further determine diabetes retinopathy risk factors. Univariate logistic regression analysis was done on the study participants assessing the association of having diabetes retinopathy and various baseline characteristics, which are associated with the development of diabetes retinopathy as covariates (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 Highlands Eye Clinic in Mutare, with 11.1 percent (15 cases) having

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	

proliferative diabetic retinopathy and 20 percent (27) having non-proliferative diabetic retinopathy. The findings of this study are in line with the 9-55 percent prevalence rates of diabetic retinopathy reported in Africa [14]. Less than a third of the participants, (Table 2) 45 (33.33%) had diabetes for a period longer than ten years while two-thirds 90 (66.7%) had diabetes for ten years or less. The opposite finding where found in a study by Margarete Voigt et al, with 12% having a duration below (<)10 years, and 24% after 10<15 years.[15] The finding was that those with a longer duration of diabetes are the highest risk of complications apply to this study as those with a duration less than 10 years have a lower prevalence of DR (23.3%) and those with a duration greater than 10 years had a prevalence percentage of 46.6%. The disparity between the research might be a reflection of the shifting 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 negatively healthcare delivery and consequently the quality of diabetes care that is putting into account the increasing inflation taking place.

In this study, it was found males (37.5%) are more affected than females (26.6%) (Table 5). This study's finding is in agreement with the 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 and these differ in consideration to race, diet, and lifestyle. The majority of the study participants were in the sixth decade of life with a mean age of 60.8±14 years. The development of diabetic retinopathy was 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 in excess of two-thirds had co-existing hypertension (Table 5). There was a strong association of diabetic retinopathy in the setting of hypertension with 97 of the 135 diabetic patients looked at in this study being hypertensive, Similar findings were observed in investigations which found also a strong association between diabetic retinopathy and hypertension [18] [19]. Studies have shown that the relative risk of diabetic retinopathy for diabetics also having hypertension is 1.7.[20, 21] In a Univariate logistic regression analysis, the prevalence of diabetic retinopathy was higher in those who had diabetes for more than 10 years vs. less than 10 years, and this was statistically significant (OR 1.10 (95 percent C1 1.00–1.01), p=0.011). This was similar to Basal et al, study indicating there is 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 length of 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 had diabetes, the greater the chance of developing diabetic retinopathy.[22] The progression of retinopathy is accelerated by long-term hyperglycemia.[23]

Out of the 119 participants, 18 (15.1%) had uncontrolled fasting blood glucose and of these 9 (7.6%) had diabetic retinopathy. (table3, 5) A study done by Yumi Matsushita NT et.al[24] clarified that the higher the level of fasting blood glucose, the higher the prevalence of retinopathy, and there was no clear threshold, also suggesting that it is possible to detect the risk of retinopathy using fasting blood glucose only. In addition, a study indicated that decreased retinopathy risk could be achieved with tighter blood glucose control.[25] While our study revealed contradictory results when compared to the afford mentioned study since in our research setting the prevalence of diabetes retinopathy is associated with uncontrolled blood glucose levels is only about 7%. To prevent retinopathy, it is clear that fasting blood glucose levels should remain at a low level. Only about a third of the people in the study had diabetes for more than 10 years. 44.4 percent of the individuals were overweight, followed by 34.8 percent who were obese, and 20.7 percent who had a BMI that was within the recommended range. Although there is no solid evidence that obesity causes DR as indicated by a recent study where 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] Obesity (BMI>31.0 kg/m2 for males and 32.1 kg/m2 for women) was linked to retinopathy development and severity in T2DM patients where higher BMI is associated with retinopathy.[13] Documented records of those patients' medical history at high land eye clinic indicated they have mainly type II diabetes mellitus.

This study was able to evaluate the prevalence of diabetic retinopathy among the 135 participating diabetic patients attending Highlands Eye Clinic in Mutare, Zimbabwe as 31.1%. In addition, Non-proliferative diabetic retinopathy is more common than proliferative retinopathy. Age, Hypertension, are significantly associated with diabetic retinopathy. The present study has some limitations as follows: our population is limited, the study was only conducted on a few participants that were available in the Highland Eye clinic, and in addition due to limited resources this study was only in Mutare, in Manicaland province, therefore, we cannot generalize our findings to the country of Zimbabwe.

In conclusion, the overall prevalence of diabetes retinopathy was found to be 31.1% Non-proliferative diabetes retinopathy is more common than proliferative diabetes retinopathy. There was a strong association between diabetic retinopathy, hypertension, and age. The present report uncovers risk factors associated with the development of retinopathy which if properly taken into account will attenuate visual damage caused by diabetic retinopathy during the asymptomatic period.

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