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Prevalence and risk factors for Diabetic Retinopathy in a tertiary institution in South Eastern Nigeria

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Abstract

This study aimed to determine the prevalence and risk factors for Diabetic Retinopathy (DR) in subjects attending a tertiary health center in Enugu, Southeast Nigeria. This cross-sectional study was carried out during a three-day screening exercise among 147 diabetic patients at Enugu State University Teaching Hospital, a referral center in Enugu, Nigeria. A total of 147 patients with diabetes were recruited, and underwent direct fundoscopy as well as slit lamp examination for Diabetes Mellitus (DM)-induced ocular abnormalities. Socio-demographic, clinical and anthropometric indices were also obtained from each subject. The prevalence of DR was 18.7% in this study. Poor glycemic control (HbA1c>7%) was positively associated with the prevalence of DR. There was, however, no significant association between DR and known risk factors, including prolonged duration of DM, hypertension, Body Mass Index (BMI) and central obesity, fruit intake, alcohol use, and smoking. DR, a serious microvascular complication of DM, is present in a significant number of diabetic subjects. Primary prevention, by optimal glycemic control, is highly recommended to prevent largely irreversible retinal damage and visual loss.

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Introduction

Diabetes Mellitus (DM) is a major medical problem throughout the world. Complications of DM account for the increased morbidity, disability, and mortality and represent a threat to the economics of all countries, especially the developing ones.[1] Diabetic retinopathy, which involves microaneurysms or worse lesions affecting at least a single eye, is one of the most pervasive secondary microvascular complications intrinsic in DM.[2] In 2020, the number of adults worldwide with Diabetic Retinopathy (DR), Vision Threatening DR (VTDR), and Clinically Significant Macular Oedema (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.[3] Identification and timely management of modifiable risk factors such as glycaemic control, concurrent hypertension, hyperlipidemia, nephropathy, anemia, and smoking could help reduce the associated sight-threatening complications.[4,5]

Although evidence from epidemiological studies suggests that the incidence of vision-threatening stages of DR is decreasing in high-income countries as a consequence of improved therapies and better DM management,[6] such trends are counterbalanced by increasing DM trends and are not mirrored in low and medium-income countries.[7,8]

Diabetic retinopathy has been considered to be correlated with many other diabetes-related complications, such as nephropathy, peripheral neuropathy, low bone density, and cardiovascular events, all of which lower the quality of life and produce a high rate of mortality.[9] Therefore, early diagnosis and proper management of DR would be of great significance.

There are inconsistent data on this subject in Nigeria. While Akaraiwe *et al.* found prevalence of 32.1% in a screening center in Enugu,[10] another study in Ilorin found a prevalence of 12.1%,[11] hence the need for our study. This study aims to investigate the prevalence of diabetic retinopathy and assess the risk factors associated with this condition in a tertiary hospital in Enugu, South-East Nigeria. With the increasing prevalence of DM, especially in Nigeria, it would be important to ascertain if the prevalence of DR is also increasing. The possibility of regional differences in the prevalence of DR is worth studying as well.

Materials and Methods

This was a cross-sectional study conducted during a three-day eye screening exercise among patients with type 1 and type 2 DM, which took place in October 2020, at the Enugu State University Teaching Hospital (ESUTH). Participants presented voluntarily for the screening tests following repeated announcements for the exercise at the out-patient diabetes clinic, as well as Diabetes Association of Nigeria information dissemination channels. Informed verbal consent was obtained from each patient. Ethical clearance (ESUTHP/C-MAC/RA/034/Vol. 1/309) was obtained from the ethics committee of ESUTH.

Socio-demographic and clinical information including the type and duration of diabetes, methods of treatment and associated co-morbidities were documented. Anthropometric indices including weight, height and waist circumferences were measured by standard methods and Body Mass Index (BMI) calculated as a ratio of weight to the square of height and recorded in kg/m^2.[12]

Visual acuity was evaluated using Snellen's chart. Slit lamp examination of the ocular adnexia and anterior segment was done by the ophthalmologist. Visual acuities were classified according to the WHO grading of visual impairment as follows: 6/5-6/9 = normal; 6/12-6/18 = mild visual impairment; 6/24-6/36 = moderate visual impairment; 6/60 or worse = severe visual impairment.[13]

Pupillary dilatation was achieved with 1% tropicamide instilled into both eyes and left for at least 15 minutes. Direct fundoscopy was first carried out by the ophthalmologist. Subjects with vertical cup/disc ratio of 0.7 or more and those with suspicious disc were evaluated further by Slit lamp and 78D lens examination of the optic disc. Subjects who achieved satisfactory pupillary dilatation and have clear lens in at least one eye then underwent fundus photography using a CenterVue DRS (CenterVue Inc., San Jose, CA, USA) fundus camera. The images obtained were interpreted by two independent ophthalmologists who were conducting another survey. DR was diagnosed if there is microaneurysm, hard exudates, cotton wool spots, dot/blot haemorrhage, flame-shaped haemorrhages or neovascularization. Diabetic Macular Edema (DME) was diagnosed if retinal thickening or hard exudates involving the center of the fovea or within half disc diameter of the center of fovea. The severity of DR was graded according to the Diabetic Retinopathy Severity Scale as follows: 0 = no abnormality, 1 = microaneurysms only, 2 = microaneurysms, hard exudates, cotton wool spots, few intraretinal haemorrhages that are not in all quadrants, 3 = >20 intraretinal hemorrhages in all quadrants, venous beading in 2quadrants, Intraretinal Microvascular Aneurysms (IRMA) in one quadrant, 4 = neovascularization, vitreous hemorrhage or pre-retinal hemorrhage.[14] Venous blood samples were drawn from each participant for measurement of Glycated Hemoglobin (HbA1c).

Data were analyzed using the Statistical Package for Social Sciences (IBM version 23.0; SPSS Inc., Chicago, IL, USA). Categorical variables were presented as numbers and percentages. Chi-Square test was used to test differences in categorical proportions. Univariate predictors of a dichotomous dependent variable were tested by logistic regression. Statistical significance was established at $p<0.05$.

Results

The sociodemographic characteristics of the participants are presented in Table 1. The majority (56.5%) of the participants were within the age range of 45-64 years (middle age), and nearly two-thirds were women. Almost all (98.6%) had type 2 DM, 66.7% were hypertensive, and about half were obese. Over half of the subjects had never had dilated eye examination since diagnosis of DM. Poor glycaemic control was positively associated with the presence of DR, while variables like age category, gender, the presence of hypertension, smoking, and alcohol use did not (Table 2).

Discussion

Ninety-eight (66.7%) of the patients screened were of the young and middle-aged category, while 49, representing the 33.3%, were elderly. This is similar to findings in studies which reveal that diabetes affects more people under the age of 64 years in Africa as compared to the developed world, where it affects mainly people over the age of 64 years.[15,16] The reasons for this age discrepancy include lower life expectancy, poverty, inadequate funding of health institutions, such that many diabetic patients die of its complications before the age of 65 years in low and middle-income countries.

Table 1. Demographic characteristics.

	Frequency	Percent
Age category		
Young	15	10.2
Middle-aged	83	56.5
Elderly	49	33.3
Gender		
Male	54	36.7
Female	93	63.3
Hypertension		
Yes	98	66.7
No	49	33.3
Cigarette smoking		
Yes	36	24.5
No	111	75.5
Alcohol consumption		
Yes	8	5.4
No	139	94.6
BMI category		
Normal	30	20.4
Overweight	51	34.7
Obese	66	44.9
Central obesity		
Present	80	54.4
Absent	67	45.6
DM type		
Type 1	2	1.4
Type 2	145	98.6
DM duration		
5 yrs and below	77	52.3
6-10 yrs	32	21.8
>10 yrs	38	25.9
DM treatment		
Diet only	9	6.1
OHA	120	81.6
Insulin	2	1.4
Both	16	10.9
Ever had dilated eye exam		
Yes	70	47.6
No	77	52.4

BMI, Body Mass Index; DM, Diabetes Mellitus.

DR was found in 27 (18.7%) subjects in this study (Figure 1). This is comparable with the findings in other studies done in Nigeria, where the prevalence rate was between 18.5-21.3%.[17,18] There are inconsistent data on the prevalence in other studies done in Nigeria. While Olokoba found a prevalence of 12.1% in a hospital-based study in Ilorin, North-Central Nigeria,[11] Omolase *et al.* had a prevalence of 15% in another study done at a medical center in Owo, Southwest Nigeria.[19] However, other researchers found a higher prevalence of DR amongst DM patients. In Enugu, Southeast Nigeria, Akaraiwe *et al.* found a prevalence of 32.1%,[10] while the prevalence was 36% in a study done in Kano, Northern Nigeria, by Lawal *et al.*[20] These discrepancies may be due to differences in sample size and methods of screening the subjects for DR. Omolase *et al.* examined the retina with only direct ophthalmoscope, others employed +90D or 20D slit lamp machines, while we used 78D machine for fundal examination. These have different retinal field-of-view properties, which may have affected the results. This study found poor glycaemic control (HbA1c>7%) as a risk factor for diabetic retinopathy (p=0.001). This is similar to findings in other studies done in Nigeria,[17,19,21] but contrasts with other studies done in Pakistan and Iran, where poor glycaemic control was not associated with increased incidence and diabetic retinopathy.[22,23] These unusual findings in Iran may be from the fact that the samples from the study were the same as that of another survey done three years earlier. The subjects would have undergone better glycaemic control, hence the normal HbA1c. The finding in Pakistan could have been due to the fact that their study excluded subjects with good glycaemic control (HbA1c<7%), and only compared the subjects with HbA1c>7% with or without retinopathy.

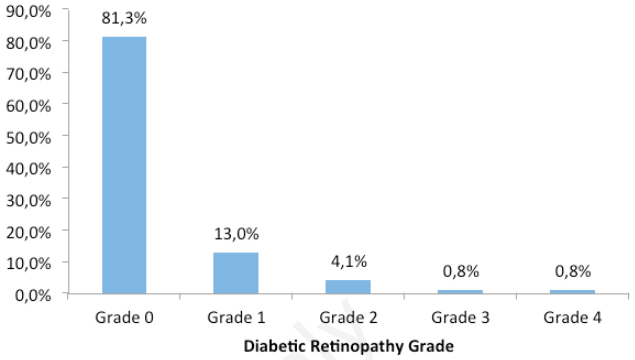

Figure 1. Prevalence and distribution of Diabetic Retinopathy by grade. The majority (81.3%) had no abnormality, while a few (0.8%) had advanced disease.

Table 2. Univariate predictors of Diabetic Retinopathy.

Variable	Retinopathy		p	OR	95% CI for OR
	Present	Absent			
Age category					
>50	16 (17.6)	75 (82.4)	0.593	0.762	0.281-2.065
≤50	7 (21.9)	25 (78.1)			
Gender					
Male	9 (18.8)	39 (81.3)	0.991	1.005	0.397-2.545
Female	14 (18.7)	61 (81.3)			
Hypertension					
Yes	13 (15.7)	70 (84.3)	0.217	0.557	0.220-1.410
No	10 (25.0)	30 (75.0)			
Cigarette smoking					
Yes	5 (17.2)	24 (82.8)	0.800	0.868	0.291-2.588
No	18 (19.4)	75 (80.6)			
Alcohol					
Yes	2 (28.6)	5 (71.4)	0.496	1.810	0.328-9.971
No	21 (18.1)	95 (81.9)			
Daily fruit intake					
Yes	9 (21.4)	33 (78.6)	0.577	1.305	0.512-3.326
No	14 (17.3)	67 (82.7)			
BMI category					
Normal	5 (20.8)	19 (79.2)			
Overweight	5 (12.8)	34 (87.2)	0.402	0.559	0.143-2.179
Obese	13 (21.7)	47 (78.3)	0.933	1.051	0.329-3.356
Central obesity					
Present	12 (17.6)	56 (82.4)	0.739	0.857	0.346-2.126
Absent	11 (20.0)	44 (80.0)			
DM type					
Type 1	2 (100.0)	0 (0.0)	NA	NA	NA
Type 2	21 (17.4)	100 (82.6)			
DM duration					
>10 years	8 (28.6)	20 (71.4)	0.133	2.133	0.794-5.730
≤10 years	15 (15.8)	80 (84.2)			
HbA1c					
≥7%	20 (32.3)	42 (67.7)	0.001	8.413	2.341-30.235
<7%	3 (5.4)	53 (94.6)			

BMI, Body Mass Index; DM, Diabetes Mellitus

There was an increased prevalence of diabetic retinopathy among patients with a longer duration of diabetes in this study, even though the relationship was not statistically significant (p=0.13). Other studies across Nigeria found a significant positive correlation between DR and the duration of DM.[18,24] This could have been due to the fact that our study had a lower sample than those, and we could have missed subjects with a long duration of DM.

This study did not find any association between alcohol intake and diabetic retinopathy. This may be because some studies found that alcohol may be protective against the emergence of diabetic retinopathy.[25,26] There was no statistically significant association between daily fruit intake and diabetic retinopathy in this study. This is rather strange because the pathogenesis of diabetic retinopathy is closely linked to oxidative stress, and the antioxidants in fruits should prevent or reduce the incidence of diabetic retinopathy. This may be explained by the fact that we did not ascertain the duration of fruit intake by the subjects. It may be that most of them just recently started taking fruits as at the time of the study. No significant association was found between cigarette smoking and diabetic retinopathy in our study. Studies have shown that smoking is not a risk factor for diabetic retinopathy, and may even be protective against the condition.[27,28] However, this result did not change the importance of smoking cessation for public health.

There was no association between hypertension and diabetic retinopathy in this study. This was similar to the findings in other studies.[29-31] In contrast, other authors found hypertension to positively correlate with the presence of diabetic retinopathy.[18,21,32,33] These differences may be attributed to genetic, environmental, and hereditary factors.[32,34-36]

There was no association between central obesity and BMI with the incidence of DR in this study. This is similar to the findings in other studies,[37,38] but contrasts with those in similar studies by other researchers in Sweden, Australia, and China.[39-41]

These discrepancies might be explained by differences in study methodology, ethnic differences in study participants, as well as the limitation of BMI as a measure of obesity.[38,42,43]

Conclusions

Diabetic retinopathy is common among subjects with DM in our institution, and is commoner in those with poor glycaemic control. This calls for strict glycaemic control and early referral for eye checks aimed at diagnosis and early intervention to forestall preventable sight loss.

References

1. Naslafkih A, Sestier F. Diabetes mellitus related morbidity, risk of hospitalization and mortality. Journal of Insurance Medicine 2003;35:102-13.
2. Ansari P, Tabasumma N, Snigdha NN, et al. Diabetic Retinopathy: An Overview on Mechanisms, Pathophysiology and Pharmacotherapy. Diabetology 2022;3:159-75.
3. Teo ZL, Tham YC, Yu M, et al. Global Prevalence of Diabetic Retinopathy and Projection of Burden through 2045: Systematic Review and Meta-analysis. Ophthalmology 2021;128:1580-91.
4. Thapa R, Twyana SN, Paudyal G, et al. Prevalence and risk factors of diabetic retinopathy among an elderly population with diabetes in Nepal: the Bhaktapur Retinal Study. Clin Ophthalmol 2018;12:563-8.
5. Moss SE, Klein R, Klein BE. Association of cigarette smoking with diabetic retinopathy. Diabetes Care 1991;14:119-26.
6. Liew G, Wong VW, Ho IV. Mini review: changes in the incidence and progression of proliferation and sight-threatening diabetic retinopathy over the last 30 years. Ophthalmic Epidemiol 2017;24:73-80.
7. Klein R, Klein BE. Is the prevalence of visual impairment rising or falling in people with diabetes mellitus? It depends on who you study. JAMA Ophthal 2013;131:948-50.
8. Lee R, Wong TY, Sabanayagam C. Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. Eye Vis 2015;2:17.
9. Liu Y, Song Y, Tao L, et al. Prevalence of diabetic retinopathy among 13437 patients with diabetes mellitus in China: a cross-sectional epidemiological survey in six provinces. BMJ 2017;7:e013199.
10. Kizor-Akaraiwe NN, Ezegwui IR, Oguego N, et al. Prevalence, Awareness and Determinants of Diabetic Retinopathy in a Screening Centre in Nigeria. J Community Health 2016;41:767-71.
11. Tutunchi H, Ebrahimi-Mameghani M, Ostadrahimi A, Asghari-Jafarabadi M. What are the optimal cut-off points of anthropometric indices for prediction of overweight and obesity? Predictive validity of waist circumference, waist-to-hip and waist-to-height ratios. Health Promot Perspect. 2020;10:142-7.
12. Olokoba LB, Mahmud AO, Adepoju FG, et al. Diabetic retinopathy in Ilorin: a hospital-based study. Afr J Med Sci 2019;48:63-8.
13. World Health Organization. Blindness and Vision Impairment. Available from: https://www.who.int/news-room/fact-sheets/detail/ blindness-and-visual-impairment
14. Wilkinson CP, Ferris FL III, Klein RE et al. Proposed international clinical diabetic retinopathy and diabetic macular edema disease severity scales. Ophthalmology 2003:9;1677-82.
15. Shittu RO, Kasali FO, Biliaminu SA, et al. Prevalence of Diabetes and Pre-diabetes in Oke-Ogun Region of Oyo state, Nigeria. J Med Res Health Educ 2017;1:1.
16. Wild S, Roglic C, Green A, et al. Global prevalence of diabetes: Estimates for the year 2000 and projection for 2030. Diabetes Care 2004;27:1047-53.
17. Ewuga RO, Adenuga OO, Wade PD, Edah JO. Prevalence and risk factors for diabetic retinopathy in North-central Nigeria. Ghana Med J 2018;52:215.
18. Azeez TA, Adediran OA, EguzozieEC, Ekhaiyeme E. Prevalence and risk factors for diabetic retinopathy in Nigeria: A systematic review and meta-analysis. Pan Am J Ophthalmol 2021;3:17.
19. Omolase CO, Adekanle O, Owoeye JF, Omolase BO. Diabetic retinopathy in a Nigerian community. Singapore Med J 2010;51:56-9.
20. Lawal A, Muhammed TB. Pattern of diabetic retinopathy in Kano, Nigeria. Ann Afr Med 2012;11:75-9.
21. Olamoyegun M, Ibraheem W, Iwuala S, et al. Burden and pattern of micro vascular complications in type 2 diabetes in a tertiary health institution in Nigeria. Afri Health Sci 2015;15:1136-41.
22. Hussain S, Qamar MR, Iqbal MA, et al. Risk factors of retinopathy in type 2 diabetes at a tertiary care hospital, Behawalpur Pakistan. Pak J Med Sci 2013;29:536-9.
23. Javadi MA, Katibeh M, Rafati N, et al. Prevalence of diabetic

retinopathy in Tehran province: a population-based study. BMC Ophthalmology 2009;9:12-9.
24. Erasmus RT, Alanamu RA, Bojuwoye B, et al. Diabetic retinopathy in Nigerians: relation to duration of diabetes, type of treatment and degree of control. East Afr Med J 1989;66:248-54.
25. Zhu W, Meng Y, Wu Y, et al. Association of Alcohol intake with risk of diabetic retinopathy: meta-analysis of observational studies. Sci Rep 2017;7:4.
26. Fenwick EK, Xie J, Man RE, et al. Moderate consumption of white and fortified wine is associated with reduced odds of diabetic retinopathy. J Diabetes Complications 2015;29:1009-14.
27. Cai X, Chen Y, Yang W, et al. The association of smoking and risk of diabetic retinopathy in patients with type 1 and type 2 diabetes: a meta-analysis. Endocrine 2018;62:299-306.
28. Moss SE, Klein R, Klein BE. Cigarette smoking and ten-year progression of diabetic retinopathy. Ophthalmology 1996;103:1438-42.
29. Yan ZP, Ma JX Risk factors for diabetic retinopathy in northern Chinese patients with type 2 diabetes mellitus Int J Ophthalmol 2016;9:1194-9.
30. Lima VC, Cavalieri GC, Lima MC et al. Risk factors for diabetic retinopathy: a case-control study. Int J Retin Vitr 2016;2:21.
31. Yang JY, Kim NK, Lee YJ, et al. Prevalence and factors associated with diabetic retinopathy in a Korean adult population: the 2008–2009 Korea National Health and Nutrition Examination Survey. Diabetes Res Clin Pract 2013;102:218-24.
32. Achigbu EO, Agweye CT, Achigbu KI, Mbatuegwu AI. Diabetic Retinopathy in Sub-Saharan Africa: A Review of Magnitude and Risk Factors. Niger J Ophthalmol 2021;29:3-12.
33. Liu L, Quang ND, Banu R, et al. Hypertension, blood pressure control and diabetic retinopathy in a large population-based study. PLoS One 2020;15:e0229665.
34. Petrovic D. Candidate genes for proliferative diabetic retinopathy. Biomed Res Int 2013;2013:540416.
35. Arar NH, Freedman BI, Adler SG, et al.; Family Investigation of Nephropathy and Diabetes Research Group. Heritability of the severity of diabetic retinopathy: the FIND-Eye study. Invest Ophthalmol Vis Sci 2008;49:3839-45.
36. Hietala K, Forsblom C, Summanen P, et al. Heritability of proliferative diabetic retinopathy. Diabetes 2008;57:2176-80.
37. Zhou Y, Zhang Y, Shi K, Wang C. Body mass index and risk of diabetic retinopathy: a meta-analysis and systematic review. Medicine (Baltimore) 2017;96:e6754.
38. Hwang C, Bae JH, Kim JM Relationship between body fat and diabetic retinopathy in patients with type 2 diabetes: a nationwide survey in Korea. Eye 2019;33:980.7.
39. Henricsson M, Nyström L, Blohmé G, et al. The incidence of retinopathy 10 years after diagnosis in young adult people with diabetes: results from the nationwide population-based Diabetes Incidence Study in Sweden (DISS). Diabetes Care 2003;26:349-54.
40. Dirani M, Xie J, Fenwick E, Benarous R, Rees G, Wong TY, et al. Are obesity and anthropometry risk factors for diabetic retinopathy? The diabetes management project. Invest Ophthalmol Vis Sci 2011;52:4416-21.
41. Yi QX, Zhu LN, Ma J, et al. Use of Anthropometric Measures of Obesity to Predict Diabetic Retinopathy in Patients with Type 2 Diabetes in China. Diabetes Metab Syndr Obes 2021;14:4089-95.
42. Misra A. Ethnic-Specific Criteria for Classification of Body Mass Index: A Perspective for Asian Indians and American Diabetes Association Position Statement. Diabetes Technol Ther 2015;17:667-71.
43. Raman R, Rani PK, Gnanamoorthy P, et al. Association of obesity with diabetic retinopathy: Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetics Study (SN-DREAMS Report no. 8). Acta Diabetol 2010;47:209-15.