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

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**Ethics approval and consent to participate:** 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.

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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

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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

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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

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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.

DR was found in 27 (18.7%) subjects in this study. 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

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good glycaemic control (HbA1c<7%), and only compared the subjects with HbA1c>7% with or without retinopathy.

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]

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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.

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**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 |

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| | | |
|---|---|---|
| ***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.

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**Table 2.** Univariate predictors of Diabetic Retinopathy.

| Variable | Retinopathy | | p value | 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*** | | | | | |

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| | | | | | |
|---|---|---|---|---|---|
| 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

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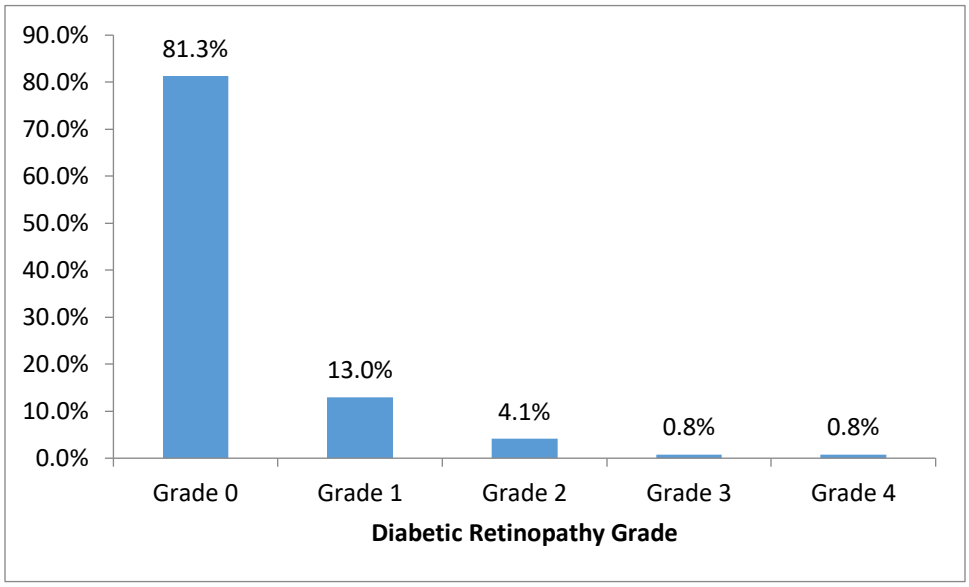


**Figure 1.** Prevalence and distribution of Diabetic Retinopathy by grade. The majority (81.3%) had no abnormality, while a few (0.8%) had advanced disease.

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