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*Original Article*

# Prevalence of Diabetic Retinopathy and Associated Risk Factors in the Southern Region of Bangladesh

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## Abstract

***Background:*** Diabetes mellitus (DM) has already established itself as an important global non-communicable disease with a long-term complication. ***Objective:*** To assess the prevalence and risk factors related with diabetic retinopathy (DR) ***Methods:*** This cross-sectional study reviewed records of 3299 patients with diabetes mellitus (DM) who attended in retina clinic of eye department of Sher-e-Bangla Medical College, Barishal, Bangladesh from 2017-2021. Age, sex, anthropometric measurements, education, occupation, referral, current treatment protocol, registration history, visual acuity, random blood sugar was recorded from the patients. Logistic regression was done to assess the factors associated with DR. ***Results:*** The prevalence proportion of DR was 32.37 (95% CI: 30.78-33.97%). Out of this, 3.6% were proliferative DR (PDR), 10.1% were mild Non-PDR (NPDR), 11.2% were moderate NPDR and 7.4% were severe NPDR. Males (p=0.003), illiteracy (p=0.002), unemployed (p=0.03), registration information (p<0.001), patients on insulin (p<0.001), duration of DM (p<0.001), random blood sugar (p=0.009), BMI (p<0.001) were associated with DR. Middle age with moderate duration (OR=1.72, p=0.02), old age with long duration (OR=1.93, p=0.005), male gender (OR=1.42, p=0.01), random blood sugar (OR=1.07, <0.001) were positively associated with DR, while BMI was negatively associated (OR=0.96, p=0.03). ***Conclusion:*** DR is highly prevalent in Bangladeshi population. Health education, provision of employment, registry and regular follow up with DAB, controlling blood sugar and blood pressure and improving BMI could alleviate this important public health burden in our country.

***Keywords:*** diabetes mellitus, diabetic retinopathy, prevalence, risk factors, Bangladesh

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## Introduction

Diabetes mellitus (DM) has already established itself as an important global non-communicable disease with increased risk of morbidity and mortality. Important side effects of long-term diabetes include diabetic retinopathy (DR), diabetic neuropathy, and diabetic nephropathy (DN)[1]. Microaneurysm, hemorrhage, soft or hard exudates, venous alterations, cotton-wool patches, and new vascular creation in the macula and/or peripheral retina are indicative of the condition [2]. DR is a common eye problem in people with DM [3]. The number of diabetic patient is increasing rapidly where DR has come out as an important complication of DM [4]. Patients with prolonged DM, either type 1 or type 2 are more likely to develop preventable DR without well controlled blood sugar, which leads to irreversible vision loss if not treated properly [3,5]. Different complications of DR like macular edema, tractional retinal detachment and neovascularization are the common causes of visual impairment among uncontrolled diabetic patients [6].

Being the main cause of blindness in adults between

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the ages of 25 and 64, DR is also the second most common cause of legal blindness for developed nations [7]. There are about 463 million DM cases worldwide in 2019 and 35.4% of them have DR; it is expected to exceed 700 million by 2045 [8,9]. A report from World Health Organization (WHO) shows that 37 million people became blind due to DR [10] with a 27% estimated prevalence in diabetic patients [11]. A hospital-based study in Africa reports 31.6% prevalence (10), while in Jordan it is 64% [12]. If we look at the surrounding areas, we find that India describes a prevalence of 16.9% DR [13]. The number of DM patients are predicted to double by 2030, and about two thirds of them would suffer from DR[14].

The burden of diabetes-related blindness will undoubtedly provide enormous problems to the sustainable health care system due to the rising expense of treatment, especially in developing nations where the number of people with type 2 diabetes (T2D) is on the rise [10]. The duration of diabetes, systolic blood pressure (SBP), glycemic control, and urine albumin have all been linked to an increased risk of developing DR in epidemiological studies[15,16]. Studies exploring the impact of other variables, such as smoking, body mass index (BMI), serum lipids, and C-peptide, have produced a range of outcomes [16]. The identified risk factors for the development of DR have mostly been derived from US and European investigations. The risk factors for both the onset of diabetes and its consequences vary, as is now well established [17].

Bangladesh has one of the highest diabetes prevalence rates in the world, with diabetes or prediabetes being diagnosed in 35% of those over the age of 35[18-20]. Effective methods for establishing DR screening programs at the national level are lacking in Bangladesh's public and private healthcare systems. There is a good opportunity to excavate the factors related to DR as the research works are not much done because of the patient load and lack of initiative. We wanted to take this opportunity to assess the DR among diabetic patients in a remote and resource constraint community like Barishal Division in Bangladesh to refute the null hypothesis that the factors are homogeneously distributed between DR and non-DR patients.

## Methods

We conducted this cross-sectional study from 2017 to 2021 records in the eye department of Sher-e-Bangla Medical College Hospital (SBMCH), Barishal on 3299 patients with DM. The actual work was a part of an international project lead by Fred Hollows Foundation with government collaboration, who initiated the DR screening program in Barishal division and Brahmanbaria district of Bangladesh. We studied the demographic and clinical data including age, sex, anthropometric measurements like height and weight, address, family history of DM, duration of DM, educational and occupational status, BMI, present treatment type, visual acuity (converted in logMAR), random blood sugar (RBS), referral information, registration at Diabetic Association of Bangladesh (DAB). The fundus photographs of the patients were studied to classify the patients as having DR or not, according to Early Treatment Diabetic Retinopathy Study (ETDRS) classification. The DR was further classified into proliferative and non-proliferative DR (PDR and NPDR respectively). The NPDR was also classified into mild, moderate, and severe NPDR.

We entered the initial data in MS Excel, where the preliminary cleaning was done. Finally, we exported the data into statistical software SPSS 23 for final analysis. First, we checked the normality of the collected data. We decided to log transformation of visual acuity results for both eyes because of skewness. Also we decided to do Mann-Whitney U test though we showed the mean and standard deviation (SD) in the table as well as in the text. For the categorical variables association with DR, we did $\chi^2$ test. The significant variables from initial analysis were put into the model of binary logistic regression to determine the relation of those variables with DR. We also computed a new variable with age and duration of DM as we found significant interaction between these two variables. The new variable was classified as young age with short duration, middle age with moderate duration and old age with long duration. We calculated the prevalence proportion of DR with the 95% confidence interval (CI). We presented the qualitative data as frequency and percentage while the quantitative data was presented as mean, standard deviation (SD). The adjusted odds ratio (AOR) from the stepwise binary logistic regression analysis was done with all the significant variables from the univariate and bivariate analysis. We also showed the CI for all AOR with the p value in the regression model.

## Results

The prevalence proportion of DR in our study was 32.37% (95% CI = 30.78-33.97%), shown in Figure 1 with further classification. The highest share of DR was taken by moderate NPDR and mild NPDR followed by severe NPDR, and the lowest DR was PDR (3.6%). The demographic information is shown in Table 1. Age, BMI, age group, gender, education, occupation, had a significant relationship with DR though quantitative age (mean), residence, and family history had no such relations. The overall age of the patients was 53.61±11.98. We found high proportion of DR in 50-59 years of age group (n=349, 32.7%) and more than 4/5$^{th}$ of the patients was within 40-69 years of age. Males (n=586, 54.9%) were more significantly affected by DR compared to females. The illiterate (n=266, 24.9%) and low education (n=606, 56.7%) group up to SSC were suffering more from DR compared to better educated group (n=196, 18.4%). The unemployed (n=389, 36.4%), housewives (n=348, 32.6%) and the service holders (n=214, 20.0%) suffered more compared to other occupational groups. The patients with DR (25.23±4.66) had a low BMI compared to those without DR (25.88±4.48). We constructed Table 2 with the clinical features by DR. The long duration DM patients (9.90 ±7.68) had more DR compared to short duration DM patients (6.5 ±7.03). Patients with DR had higher visual acuity on both the right (0.74 ±0.70) and left (0.69 ±0.65) eyes than those who had no DR. Also the RBS (12.79 ±5.13) of DR patients was high compared to those with no DR (11.28 ±4.20). The DR patients were mostly referred from OPD (n=403, 37.7%) and private chamber (n=372, 34.8%) to SBMCH and most of them were not registered to DAB (n=661, 61.9%). In addition, DR patients were most likely to receive insulin (n=518, 48.5%) and oral anti-diabetic drug (n=402, 37.6%) compared to no DR patients (p<0.001). The quantitative age, residence, and family history of DM was homogeneously distributed among the two groups of patients. Table 3 shows the results from the multiple logistic regression model to assess factors associated with DR. Age with duration, gender, random blood sugar and BMI were predictive variables associated with DR. People with both middle age and moderate duration (AOR = 1.72, 95% CI = 1.35–2.65) and old age and long duration (AOR = 1.93, 95% CI = 1.22–3.07) had a higher likelihood of developing DR compared to those who were young and of short duration. Males (AOR = 1.42, 95% CI = 1.08–1.89) were more likely to develop DR than females. Furthermore, a one-unit increase in the random blood sugar had a 7% (AOR = 1.07, 95% CI = 1.04-1.11) higher likelihood of suffering from DR. Additionally, the AOR of BMI represents that a one-unit increase in BMI had a 4% lower likelihood (AOR = 0.96, 95% CI = 0.92-0.99) of developing DR.

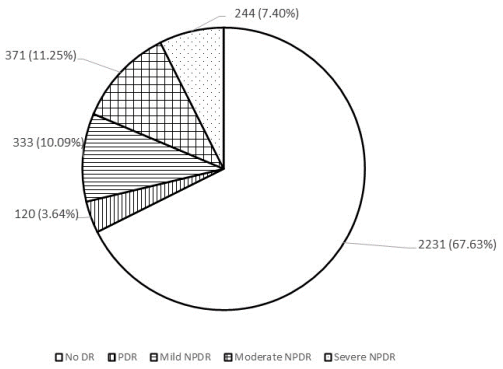


**Figure 1:** Prevalence proportion of different types of DR

of DR

## Discussion

Diabetic retinopathy (DR) is the commonest reason for impaired eyesight in working-age persons. In 2017, it was anticipated that 6.9 million people in Bangladesh have diabetes; by 2025, that number is expected to reach more than 10 million[16,21]. DR is one of the priority eye illnesses in Southeast Asia and other regions, according to the Right to Sight campaign [17,22-24]. It has been an important factor in early-onset blindness among working age people with diabetes globally [18]. Nearly all DR patients pose a risk to varying kinds of morbidity, the risk of mortality in DR subjects is 5 times higher than those of controls [19,25].

One third of our study subjects (32.4%) are suffering from DR. The prevalence in Ghana and Spain was substantially lower, with 17.9% and 12.3%, respectively, while in Kashmir, Saudi Arabia, Sri Lanka, and Brazil the prevalence were 30%, 31.3%, and 35.4%, respectively and in South Africa a little higher (40.3%).[19,21-30] Previous two studies done in Bangladesh found a low prevalence of around 18-19% DR in Bangladesh[31,32]. On the other hand, Muqit et al. did an opportunistic eye examination on 49,264

**Table 1:** Demographic factors of DR patients

| Variables | Total (N=3299) | No DR (n=2231) | DR (n=1068) | p |
|---|---|---|---|---|
| **Age (years)** | 53.61±11.98 | 53.65±12.47 | 53.52±10.90 | 0.76 |
| **BMI** | 25.68±4.55 | 25.88±4.48 | 25.23±4.66 | <0.001 |
| **Age group** | | | | |
| ≤40 | 369 (11.2) | 282 (12.6) | 87 (8.1) | <0.001 |
| 40-49 | 706 (21.4) | 442 (19.8) | 264 (24.7) | |
| 50-59 | 1060 (32.1) | 711 (31.9) | 349 (32.7) | |
| 60-69 | 790 (23.9) | 524 (23.5) | 266 (24.9) | |
| ≥70 | 374 (11.3) | 272 (12.2) | 102 (9.6) | |
| **Sex** | | | | |
| Female | 1613 (48.9) | 1131 (50.7) | 482 (45.1) | 0.003 |
| Male | 1686 (51.1) | 1100 (49.3) | 586 (54.9) | |
| **Residence** | | | | |
| Rural | 1175 (35.6) | 778 (34.9) | 397 (37.2) | 0.20 |
| Urban | 2124 (64.4) | 1453 (65.1) | 671 (62.8) | |
| **Family H/O DM** | | | | |
| No | 1527 (46.3) | 1042 (62.0) | 485 (43.2) | 0.49 |
| Yes | 1772 (36.1) | 1189 (30.7) | 583 (44.7) | |
| **Education** | | | | |
| Illiterate | 703 (21.3) | 437 (19.6) | 266 (24.9) | 0.002 |
| Low | 1961 (59.4) | 1355 (60.7) | 606 (56.7) | |
| Good education | 635 (19.2) | 439 (19.7) | 196 (18.4) | |
| **Occupation** | | | | |
| Unemployed | 1104 (33.5) | 715 (32.0) | 389 (36.4) | 0.03 |
| Day laborer | 79 (2.4) | 54 (2.4) | 25 (2.3) | |
| Service | 630 (19.1) | 416 (18.6) | 214 (20.0) | |
| Business | 296 (9.0) | 204 (9.1) | 92 (8.6) | |
| Housewife | 1190 (36.1) | 842 (37.7) | 348 (32.6) | |

**Table 2: Factors related to DR patients**

| Variables | Total (N=3299) | No DR (n=2231) | DR (n=1068) | p |
|---|---|---|---|---|
| **Duration of DM (years)** | 7.60 ±7.42 | 6.5 ±7.03 | 9.90 ±7.68 | <0.001 |
| **RBS (mg/dl)** | 11.75 ±4.56 | 11.28 ±4.20 | 12.79 ±5.13 | <0.001 |
| **Visual acuity (right)** | 0.58 ±0.63 | 0.50 ±0.58 | 0.74 ±0.70 | <0.001 |
| **Visual acuity (left)** | 0.55 ±0.60 | 0.49 ±0.56 | 0.69 ±0.65 | <0.001 |
| **Referral information** | | | | |
| OPD | 1257 (38.1) | 854 (38.3) | 403 (37.7) | 0.007 |
| Private Chamber | 1228 (37.2) | 856 (38.4) | 372 (34.8) | |
| All DAB | 492 (14.9) | 305 (13.7) | 187 (17.5) | |
| All Upazilla | 7 (0.2) | 7 (0.2) | 0 (0.0) | |
| Private Eye Hospital | 190 (5.8) | 132 (5.9) | 58 (5.4) | |
| All District Hospital | 4 (0.1) | 1 (0.0) | 3 (0.3) | |
| Indoor | 121 (3.7) | 76 (3.4) | 45 (4.2) | |
| **Registered at DAB** | | | | |
| No | 1744 (52.9) | 1083 (48.5) | 661 (61.9) | <0.001 |
| Yes | 1555 (47.1) | 1148 (51.5) | 407 (38.1) | |
| **Present Treatment Type** | | | | |
| Diet & Exercise | 719 (21.8) | 571 (25.6) | 148 (13.9) | <0.001 |
| Oral | 1379 (41.8) | 977 (43.8) | 402 (37.6) | |
| Insulin | 1201 (36.4) | 683 (30.6) | 518 (48.5) | |

**Table 3:** Logistic Regression Best Fit Model to Assess Factors Associated with DR

| Variable | AOR (95% CI) | p |
|---|---|---|
| **Age & Duration** | | |
| Young Age*Short Duration | Reference | |
| Middle Age*Moderate Duration | 1.72 (1.35-2.65) | 0.02 |
| Old Age*Long Duration | 1.93 (1.22-3.07) | 0.005 |
| **Gender** | | |
| Female | Reference | |
| Male | 1.42 (1.08-1.89) | 0.01 |
| **Random Blood Sugar** | 1.07 (1.04-1.11) | <0.001 |
| **BMI** | 0.96 (0.93-0.99) | 0.03 |

Type II DM patients to record a 33% prevalence of DR in Bangladesh[20], which is similar to our study finding. This finding gets support from the study by Begum et al. who found around 38% prevalence of DR in Bangladeshi population[33]. The prevalence is varying to a great extent in and outside Bangladesh, which needs to be explored with factor association in further studies.

There was a higher risk of DR among DM patients with a mean disease duration of 9.9 years in our study. Knowing that patients are exposed to several risk factors for a longer period as their

condition progresses and given that many chroni complications of diabetes are more common this outcome was anticipated[29]. Our study's DI prevalence proportion was highest in the 40-6 age group. One such study, which concentrate on screening practices in Iran, discovered tha the frequency of DR rose with age from 55 to 74 years[30]. According to research conducted in southern India, people aged 60 to 69 are the most frequent group to suffer from DR[34].

From our study, the prevalence proportion of DR among male patients is higher than among female patients. Begum et al. did not find such an association, rather they found a homogeneity o gender to be associated with DR[33]. But there ar studies that supports our finding[11,35,36] that male are suffering more than females from DR.

Uncontrolled fasting blood sugar (FBS) is found t be associated with DR which brings about the fac that the complication of uncontrolled DM shoul be monitored vigilantly [1,9,328,31-33,37,38]. Though w did not check for FBS rather RBS, it also showe a 7% increased risk to be associated with DR.

The negative relation of BMI producing protectiv odds-on DR is supported by two studies done in Bangladesh [31,32] Cui et al [39], Hwang et al.[40] and Navin Nishal et al.[41] found similar negative association of BMI with DR in Asian population, which is quite contrary to the previous knowledge. The 2015 US Behavioral Risk Factor Surveillance System survey revealed that BMI has a positive relation with DR[36]. The difference could be attributed to the behavioral characteristics of the US population. Some studies did not even find any relation of BMI with DR[41]. Because BMI shows a wide range of positive to negative association with no association as well, there is a need to study this variable in a cohort design to confirm its association[39].

The assessment of RBS instead of FBS is an important weakness in our study that we reckon. In addition, we do not have the data of DM controlled or not to assess uncontrolled DM as a risk factor for DR. We could not include serum creatinine, lipid profile, blood pressure in our study because of having plenty missing data, which is also an important weakness in our study. Nonetheless our sample is quite large enough to be reliable for future reference, which can be utilized for further research.

The assessment of RBS instead of FBS is a foremost weakness in our study that we reckon. We do not have the data of DM as controlled or not, to analyze uncontrolled DM as a risk factor for DR. We couldn't include serum creatinine, lipid profile, blood pressure in our study because of having plenty missing data, which is also an important weakness in our study.

## Conclusion

Our study showed that DR is an inevitable outcome of long duration of DM in aged population. Male gender and high random blood sugar are associated risk factors while BMI is inversely associated with it. We recommend a national level prevalence study for DR screening with possible factors responsible for it. Awareness of the general population to control blood sugar after 4$^{th}$ decade could lessen the community burden of this disease.

**Conflict of Interest:** The authors declare no conflict of interest.

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**Ethical Approval:** We obtained the ethical clearance from the institutional review board of SBMC (ref. no: SBMC/IRB/2255 (B) date October 30, 2023).

**Author's Contribution:** MSI, SMB has full access of all the data. MSI and SMB kept the integrity of the data. MSI initiated the concept and design. MSI, JIR collected the data, MIK entered the data, SMB analyzed the data and wrote the initial result, MSI, SMB, MTH, AD, MHN wrote the manuscript and did the literature search. All the authors read the manuscript and gave their comments to improve the quality of the script.

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