Original Article

DIABETIC RETINOPATHY AND ASSOCIATED RISK FACTORS AMONG DIABETIC PATIENTS ATTENDING EYE CAMPS IN NORTHERN BANGLADESH

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ABSTRACT

***Background*:** Diabetic retinopathy (DR) is one of the leading causes of vision loss which occurs as a result of micro-vascular complication of diabetes. The aim of the study is to assess the prevalence and factors associated with development of diabetic retinopathy among diabetic patients attending eye camps in a diabetic hospital of northern Bangladesh.

***Methods*:** This was a population-based cross-sectional study, conducted through five comprehensive eye camps at diabetic association hospital in Nilphamari, Bangladesh. Previously diagnosed patients with Diabetes Mellitus attending eye camps were the sample of this study which included a total of 254 participants. All participants underwent complete eye examination to check for any signs of DR with any other ocular abnormalities. Retinopathy was determined by fundus photography and direct ophthalmoscopy. Participants were also interviewed and examined to determine their demographic characteristics, clinical conditions, awareness on diabetic retinopathy and regularity of their eye visits.

***Results*:** A total of 254 subjects were screened for diabetic retinopathy. Of them, 64 (25.2%) had diabetic retinopathy including, including 53 (20.9%) with non-proliferative retinopathy (NPDR) and 11 (4.3%) with proliferative diabetic retinopathy (PDR). Clinically significant macular edema (CSME) was detected in 7 patients (2.7%). The prevalence of diabetic retinopathy was higher among patients with greater duration of diabetes (p=< 0.001), poor glycemic control (p=0.002) and presence of hypertension (p=0.05).

***Conclusion*:** Regular screening in patients with diabetes for early detection of diabetic retinopathy by effective screening program and increasing public awareness are highly recommended in Bangladesh.

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INTRODUCTION

Diabetes mellitus (DM) is the most common non-communicable diseases, becoming a global epidemic and emerging public health problem worldwide. The number of people (aged 20-79 years) with DM globally is projected to increase from 415 million in 2015 to 642 million in 2040.[1]The increased prevalence of Diabetes means that more and more people are also developing diabetes complications, Diabetic Retinopathy (DR) is one of them.[2] Diabetic retinopathy is the specific micro-vascular complication of DM and leading cause of vision loss, which occurs as a result of long-term accumulated damage to the small blood vessels in the retina.[3-4] There are approximately 93 million people worldwide have DR, overall prevalence of 34.6%.[5] It is estimated that DR develops in more than 75% of diabetic

patients within 15 to 20 years of diagnosis of diabetes.[6-7] According to International diabetes Federation (IDF) report, there were 7.1 million cases of diabetes in Bangladesh in 2015 with prevalence of 7.4% where 1.54 million people are at risk of diabetes-related blindness.[1,8] Epidemiological studies and clinical trials have shown that optimal control of blood glucose, blood pressure and timely controlled photocoagulation reduce the risk of developing retinopathy and slow its progression.[3,9-10] These findings highlight the importance of regular screening for early detection and treatment.[11] Many people with diabetes are unaware about their visual condition or undergo regular eye screening, and by the time their vision deteriorates which is often too late for treatment.[12] Several population based studies reported the increasing trend of Diabetes Mellitus in Bangladesh,[13-16] but there is a lack of population based studies on Diabetic Retinopathy. Present study was therefore undertaken to find out the prevalence and factors associated with development of DR among the diabetic patients attending eye camps in northern part of Bangladesh.

MATERIALS AND METHODS

This cross-sectional population-based study was conducted at five eye camps in Diabetic Association Hospital, Nilphamari during the period of May 2019 to September 2019, organized by Deep Eye Care Foundation, Rangpur. Only previously diagnosed diabetic patients attending the eye camps were requested to participate in the study. All of them (n=254) agreed to participate. Previously diagnosed diabetic patient was defined as use of diabetic medication, or a physician's diagnosis or have a registered guide book of diabetic association hospital as diabetic patient, considered eligible for the study. Informed consent was obtained, following which basic demographic data and details regarding the duration of diabetes and treatment history were recorded. Awareness on diabetic related eye diseases and regularity of their visit to eye hospital or ophthalmologist were also recorded. Every patient underwent a complete ocular examination including visual acuity, anterior segment and fundus examination.

Eye camp center was selected on the basis of the accessibility of the diabetic population. A day long announcement one-day prior of commencing the camp was done, where diabetic patients with eye sight problems were called. More over the services like diabetic test, diabetic retinopathy screening, refraction, primary eye examination and treatment were announced to be done. Medical Team was comprised of Two Medical officer who trained on Primary eye diseases and Diabetes treatment, One Optometrist trained on eye diseases and Retinal diseases as well, one refractionist for providing refraction services, two lab technologists, one counselor, two ophthalmic assistants, one organizer and one driver. To achieve a comprehensive evaluation all patients passed along several counters. The algorithm of the study is shown in Figure 1. All the patients reporting to the camp were also provided with appropriate health education about diabetes and diabetic retinopathy and its complications. All those with any grade of diabetic retinopathy were registered and referred to the base hospital.

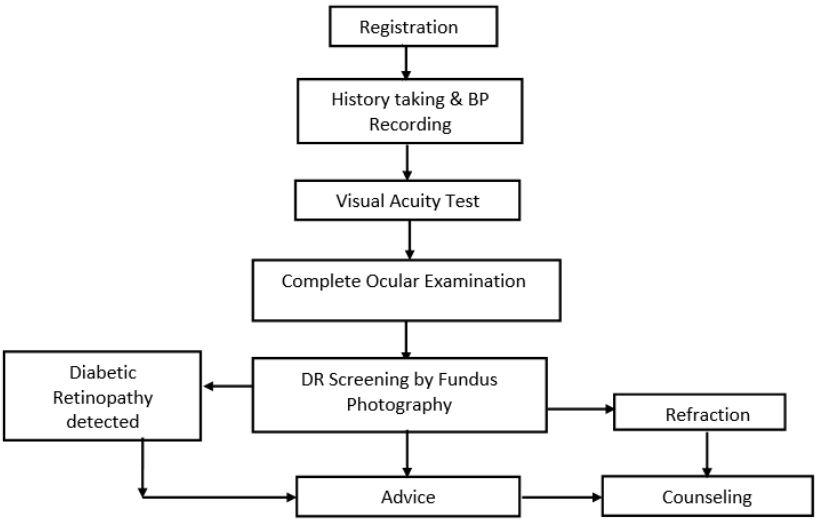

Figure 1. Algorithm of the study

Blood pressure was measured in the seated position using standard mercury sphygmomanometers and hypertension was defined as a systolic blood pressure of 140 mm Hg or more and/or a diastolic blood pressure of 90 mm Hg or more; or ongoing treatment with antihypertensive drugs.[17] Blood glucose status was collected from their diabetic guide book as they were registered diabetic patient of Bangladesh Diabetic association. Those who had no guide book or any documents for their last blood glucose results, we sent them for diabetic test (2HABF) at the lab of Nilphamari Diabetic Association Hospital. We found 2HABF more frequently than FBS in their diabetic guide book, so we took this value.

The ophthalmic examination included measurement of Snellen's visual acuity, direct ophthalmoscopy and fundus photography. Screening for DR was performed using fundus photography with a non mydriatic ophthalmic screening device named '3nethra'. It was a single, intelligent, portable and easy to operate pre-screening ophthalmology device which provides digital image of the anterior and posterior segments. Fundus Images were captured in true color (24 bits) at a resolution of 2048×1536 pixels, with 40-45 degrees' field of view. Handling of the fundus camera and the image acquisitions were performed by a qualified professional. During image evaluation, the signs and the stages of DR were classified according to international classification of Diabetic Retinopathy by International Council of Ophthalmology as shown in Table-1. Vision-threatening retinopathy was defined as the presence of severe Non-proliferative diabetic retinopathy (NPDR), Proliferative diabetic retinopathy (PDR) or Clinically significant macular edema CSME.[18] Among all diabetic subjects recruited, we could not comment on the retinal status using fundus photography for some of the subjects, primarily due to age-related cataracts precluding fundus views. But, they were examined by using direct Ophthalmoscope after dilation of pupil.

Table 1. Classification of Diabetic Retinopathy according to ICO guideline

Diabetic Retinopathy	**Findings Observable**
No apparent DR	No abnormalities
Mild nonproliferative DR	Microaneurysms only
Moderate nonproliferative DR	Microaneurysms and other signs (e.g., dot and blot hemorrhages, hard exudates, cotton wool spots), but less than severe nonproliferative DR
Severe nonproliferative DR	Moderate nonproliferative DR with any of the following: Intraretinal hemorrhages (≥20 in each quadrant); Definite venous beading (in 2 quadrants); Intraretinalmicrovascular abnormalities (in 1 quadrant); and no signs of proliferative retinopathy
Proliferative DR	Severe nonproliferative DR and 1 or more of the following: Neovascularization Vitreous/preretinal hemorrhage
Diabetic Macular Edema(DME)	**Findings Observable**
No DME	No retinal thickening or hard exudates in the macula
Noncentral-involved DME	Retinal thickening in the macula that does not involve the central subfield zone that is 1mm in diameter
Central-involved DME	Retinal thickening in the macula that does involve the central subfield zone that is 1mm in diameter

Prior to the commencement of the study, the research protocol was approved by the ethical institutional review board of Deep Eye Care Foundation. The data was entered in the pre-designed Microsoft office excel format which was imported later into the statistical software SPSS (version 19.0). The prevalence rates of

diabetic retinopathy were determined by simple percentages. Statistical comparisons between categorical variables were made by using $\chi 2$ test with 95% confidence interval (CI). Simple logistic regression was used to find out odds ratio. P-values less than 0.05 were considered statistically significant.

RESULTS

A total of 254 diabetic patients were screened, of them 102 were male (40.2%) and 152 were female (59.8%). More than half of the respondents were housewife (54.7%). Respondents were aged between 20 and 80 years; mean age was 51.3 (±12.34) years. It was seen that 32% respondents were in the age group of 60 years and above. Table-2 shows the frequency distribution and the prevalence rate of DR by different characteristics of the patients. Among all the study subjects, majority of the respondents were type II diabetics (93.7%). The mean duration of diabetes was 6.5 years in patients without retinopathy in comparison with 9 years in patients with any type of retinopathy. Around one-third of the respondents had a familiar history of diabetes (33.5%) while majority of the patients (81.9%) were taking treatment either insulin or oral medication for their diabetes.

Ophthalmic examination revealed that 190 (74.8%) patients had no retinopathy, 64 patients had some degree of DR (prevalence rate of 25.2%), including 53 patients with non-proliferative retinopathy (NPDR) and 11 patients with proliferative diabetic retinopathy (PDR). Clinically significant macular edema (CSME) was detected in 7 patients. Among patients with CSME, 4 patients had NPDR (7.5% of the NPDR patients), and 3 had PDR (27.3% of PDR patients). The distribution of different stages of DR in the screened population based upon international classification of DR by ICO is shown in Table-4 & Figure-2. There are significant relationships between the presence of DR and patients' duration of diabetes, blood glucose level, treatment status and presence of hypertension (Table-2, 3).

Visual Acuity of 6/6 to 6/12 was found in 152 cases, 95 had visual acuity from 6/18 to 6/60 and 7 had less than 6/60. Statistically significant association between visual acuity of the patients and presence of diabetic retinopathy was also found (p=< 0.001) (Table-2). The study revealed that patients with a longer history of diabetes (p <0.001), patients using treatment or medication for diabetes control (OR=3.24; 95% CI = 1.22–8.61; p= 0.001), patients with hypertension (OR=1.79; 95% CI= 0.98–3.26; p= 0.05) or high blood glucose level (OR= 2.83; 95% CI= 1.55–5.17; p= 0.001) had a statistically significant increase in risk of any grade of DR as compared to other subjects (Table-3).

Among the patients studied (254 cases), only 57 patients (22.4%) had a history of dilated fundus examination or fundus photography. Knowledge about diabetic retinopathy was also significantly poorer among the respondents. 114 (44.8%) were 'aware' that eyes could be affected by diabetes, but only 12 patients (4.7%) were 'aware' of diabetic retinopathy as an ocular complication of diabetes. 247 (97.2%) patients had no knowledge regarding the treatment options available for diabetic retinopathy (Table-5).

Table 2. Prevalence rate of DR by different characteristics of the patients

Characteristic	Total		DR		No DR		p-value
	N	%	n	%	n	%	
Total Respondents	254	100.0	64	25.2	190	74.8	
Sex							
Male	102	40.2	28	27.5	74	72.5	0.498
Female	152	59.8	36	23.7	116	76.3	
Age (y), Mean (SD)	51.3	12.3	51.9	10.7	51	12.9	
Age group							
Less than 30	9	3.5	1	11.1	8	88.9	
30-39 years	35	13.8	7	20	28	80	0.285
40-49 years	68	26.8	18	26.5	50	73.5	
50-59 years	61	24	21	34.4	40	66.6	

60 years and above	81	31.9	17	21	64	79	
Duration of DM (y), Mean (SD)	7.1	5.8	9	5.7	6.5	6	
Duration of DM							
Less than 1 Year	16		1	6.3	15	93.8	
1-5 Years	113		16	14.2	97	85.8	< 0.001
6-10 Years	67		30	44.8	37	55.2	
11-15 Years	35		10	28.6	25	71.4	
More than 15 Years	23		7	30.4	16	69.6	
Occupational Status							
Unemployed	10	3.9	6	60	4	40	
Service	37	4.6	26	70.3	11	29.7	
Student	3	1.2	3	100	0	0	
Business	23	9.1	17	74	6	26	0.87
Agriculture	21	8.3	16	76.2	5	23.8	
Laborer	4	1.6	3	75	1	25	
Retired	17	6.7	14	82.4	3	17.6	
House wife	139	54.7	105	75.5	34	24.5	
***Visual Acuity**							
6/6 to 6/12	152	59.8	127	83.6	25	16.4	< 0.001
6/18 to 6/60	95	37.4	59	62.1	36	37.9	
Less than 6/60	7	2.8	4	57.1	3	42.9	
*The vision in the lesser seeing eye was considered for the purpose of evaluation							

Table 3. Relationship between diabetic retinopathy and associated factors

Variables	**Having retinopathy**			**OR**	**95% CI**		**p-value**
	Yes	**No**	**Total**		**Lower**	**Upper**	
Type of Diabetes Mellitus							
Type I	6 (37.5)	10 (62.5)	16 (6.3)	1.86	0.64	5.34	0.24
Type II	58	180	238 (93.7)				
Family History							
Known	26	59	85 (33.5)	1.51	0.84	2.72	0.16
Unknown	38	131	169 (66.5)				
Taking treatment for DM							
Yes	59	149	208 (81.9)	3.24	1.22	8.61	0.001
No	5	41	46 (18.1)				
Presence of Hypertension							

Yes	25	50	75 (29.5)	1.79	0.98	3.26	0.05
No	39	140	179 (70.5)				
Blood glucose status 2 hours after breakfast							
< 11.1 mmol/L	20	44	64 (25.2)	2.83	1.55	5.17	0.001
≥ 11.1 mmol/L	107	83	190 (74.8)				

Table 4. Distribution of Diabetic Retinopathy status of the respondents

Diabetic Retinopathy (DR) Status	Frequency	Percentage
No Retinopathy	**190**	**74.8**
Any type of DR	**64**	**25.2**
Non -proliferative Diabetic Retinopathy (NPDR)	**53**	**20.9**
Mild NPDR	33	13.0
Moderate NPDR	16	6.3
Severe NPDR	4	1.6
Proliferative Diabetic Retinopathy (PDR)	**11**	**4.3**
Clinically significant macular edema (CSME)	**7**	**2.7**
Vision-threatening Diabetic Retinopathy (Severe NPDR+PDR+CSME)	**22**	**8.7**

Figure 2. Pie chart showing percentage of different stages of Diabetic Retinopathy (n=64)

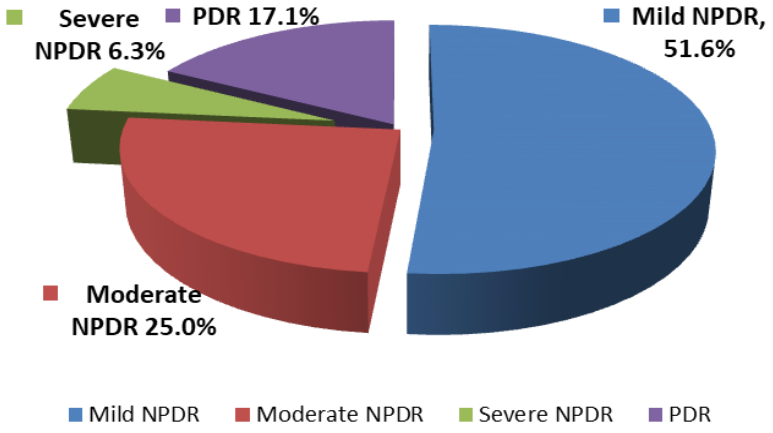

Table 5. Awareness Status on diabetic retinopathy

Factors	Status	Frequency	Percent
Awareness on DR	Yes	12	4.7%
	No	242	95.3%
Dilated Fundus Examination or Fundus Photography	Yes	57	22.4%

	No (First time)	197	77.6%
Awareness on treatment options for DR	Yes	7	2.8%
	No	247	97.2%

DISCUSSION

Overall prevalence of any DR among the diabetic subjects was 25.2% in our study. So far available a population based study of Bangladesh published in 2013 showed that the prevalence of retinopathy among the diabetic, pre diabetic and non-diabetic subjects were 21.6%, 13% and 3.5% respectively.[19] We found slightly higher prevalence of DR among diabetic subjects. As the consequences of increasing number of diabetic subjects, the number of DM with its associated complications like retinopathy would also rise in Bangladesh.

The prevalence of DR in our study was similar to other studies from South Asian countries (Chennai urban rural epidemiology study, the DR Southern India Study, the Gaddap study Pakistan, the Sri Lanka diabetes and Cardiovascular Study, Sri Lankan diabetes clinic study).[20-24] Some studies from China, Thailand, Australia also reported similar findings of DR among their population (The Beijing Eye Study, Thailand diabetes registry project the Lifeline Express Diabetic Retinopathy Screening Program study China, The National Eye Health Survey in Australia).[25-28]

However, the prevalence of DR was high in some Asian countries reported by several studies. Pokharel *et al* reported that the prevalence of DR was 38.8% among the patients with diabetes mellitus in Dharan municipality, Nepal.[29] Another investigation in rural China, the population-based Handan Eye Study found a prevalence of DR of 43.1%.[30] The prevalence of diabetic retinopathy in Malaysia has been reported to range from 44.1% to 48.6%.[31] These differences may be due to variations in study setting, study design, sample size, grading standards, limitation in compensation of confounders and the diagnostic method.[32]

The present study showed that there was no association of retinopathy with gender. Most of the other studies have not reported the association of retinopathy and gender.[33-34] Prevalence of DR was highest (34.4%) in the age group 50 to 59 years and lowest (11.1%) in the age group less than 30 years in our study population, age was not associated with prevalence of DR.

Risk factors for DR previously identified in other studies—longer diabetes duration, higher blood glucose level and higher systolic blood pressure were also identified in our study.[25,33,35] Duration of diabetes and occurrence of diabetic retinopathy are closely associated in our study and this has been proved in a number of previous studies. Type 2 DM patients would have got some degree of DR after a long period of years with diabetes.[5,36]

In the current study, poor control of diabetes as indicated by hyperglycemic status was a significant risk factor for diabetic retinopathy. Patients with a good diabetic control had a lower prevalence of diabetic retinopathy than those with poor glycemic control. A comprehensive systematic review revealed that tight glycemic control reduces the incidence and progression of DR.[37]

The presence of hypertension has been reported to aggravate the prevalence of diabetic retinopathy. Numerous previous studies supported the association between hypertension and the development and progression of retinopathy.[5,7,38,39] A similar observation was also noted in our study.

The patients taking insulin or oral hypoglycemic medicines were having diabetic retinopathy higher compared to those not on any medication. Similar findings have been found in the study of Iranian patients,[40] Pima Indians [41] and in the Beaver Dam study.[42] Our study showed a strong relation between visual acuity of the patient and the prevalence of diabetic retinopathy. The prevalence of any type of visual impairment in patients with DR was remarkably higher than that in patients without DR.

This study was based on retinal photography and standard grading techniques, and it was also the first study from Bangladesh to report on the prevalence of DR using stereo retinal color photography. There are several limitations also. Though it is a community based study, it was done in a diabetic hospital setting. The sample taken was also by convenient sampling technique. The sample size is also limited. We could not include dietary habit (salt, fruits and vegetables), physical activities and anthropometric measurements of the respondents. We could not afford two important and relevant investigations like HbA1c and lipid profile.

More than three-fourth of the respondents in our study never had fundus evaluation before. A great number of diabetic patients may be under risk of DR because of no self-awareness. The lack of awareness of DR

reflects the gravity of this public health concern that needs immediate attention. Therefore, early detection of retinopathy in diabetic patients is very essential general practitioners and physicians, in order to refer them for further evaluation of fundus or treatment by ophthalmologists.

CONCLUSION

Both diabetic retinopathy with proliferative retinopathy were prevalent among the diabetics. It has been shown that the duration of diabetes, poor glycemic control and systemic hypertension are the significant risk factors for diabetic retinopathy. Awareness and knowledge about diabetic retinopathy were also very poor among the respondents. The study findings recommend that collaboration between ophthalmologists and physicians has to be strengthened for the early detection of sight-threatening retinopathy. Hence it is extremely need of spread knowledge and increase public awareness regarding diabetic eye diseases through mass media so that this can help to prevent blindness from diabetes mellitus.

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