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Stage Of Diabetic Retinopathy And Its Relation With Duration Of Diabetes Mellitus

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Abstract
Background: *Diabetic retinopathy (DR) is a significant complication of diabetes mellitus (DM), contributing to morbidity and decreased quality of life among patients. This study aims to evaluate the relationship between the duration of diabetes and the stages of diabetic retinopathy in a cohort of diabetic patients.*
Methods: *This cross-sectional descriptive study was conducted over six months, from March 2012 to August 2012, at the outpatient Department of Endocrinology, BSMMU, Shahbagh, Dhaka. A total of 114 diabetic subjects aged 30-64 years with diagnosed diabetic retinopathy were included. Participants were categorized based on age, gender, duration of diabetes, and stages of retinopathy. Data were collected through direct ophthalmoscopic examination and analyzed using SPSS version 22.0, with significance set at $p < 0.05$.*
Results: *The majority of participants were aged 40-49 years (34.21%) and male (57.02%). The mean duration of diabetes was 9.11±6.56 years. Non-proliferative diabetic retinopathy was present in 71.05% of participants, maculopathy in 17.54%, and proliferative retinopathy in 11.41%. Significant correlations were found between the duration of diabetes and the stages of retinopathy: non-proliferative retinopathy ($r=0.275$, $p=0.01$), maculopathy ($r=0.2915$, $p=0.01$), and proliferative retinopathy ($r=0.2895$, $p=0.0255$). Complications such as peripheral vascular disease (4.39%), diabetic neuropathy (7.02%), and diabetic nephropathy (7.89%) were noted. High prevalence rates of dyslipidemia (51.75%) and smoking (49.12%) were also observed.*
Conclusion: *The study underscores the strong association between the duration of diabetes and the severity of diabetic retinopathy. These findings highlight the need for early and continuous management of diabetes to prevent the progression of retinopathy. Comprehensive risk factor management, including stringent glycemic control and lifestyle modifications, is essential to mitigate the impact of diabetic complications.*
Keywords: *Diabetic retinopathy, Diabetes mellitus, Duration of diabetes, Non-Proliferative Retinopathy, Glycemic control, Risk factors.*

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I. Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia due to insulin deficiency or resistance. It is a major global health concern, with the International Diabetes Federation (IDF) reporting that approximately 463 million adults were living with diabetes in 2019, a number expected to rise to 700 million by 2045 (1). The increasing prevalence of diabetes is accompanied by a corresponding rise in diabetes-related complications, among which diabetic retinopathy (DR) is one of the most significant. DR is a leading cause of vision impairment and blindness among working-age adults, resulting from prolonged exposure to high blood glucose levels, which damage the retinal blood vessels. Understanding the relationship between the duration of diabetes and the stages of diabetic retinopathy is crucial for early detection, prevention, and management of this debilitating condition. Numerous studies have consistently demonstrated a positive correlation between the duration of diabetes and the prevalence and severity of diabetic retinopathy. For instance, the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) found that patients with a longer duration of diabetes were more likely to progress to more severe stages of retinopathy (2). Similarly, Yau et al. reported significant increases in diabetic retinopathy prevalence after 10 years of diabetes (3). Jerneld and Algvere's study further supported this, showing that the prevalence of diabetic retinopathy reached 100% after 30 years of diabetes (4). The risk factors for developing diabetic retinopathy are multifaceted. Marshall et al. identified the duration of diabetes, mean longitudinal glycohemoglobin (HbA1c) levels, smoking, and diastolic blood pressure as significant factors influencing the onset and progression of retinopathy (5). Additionally,

Jarrett's research highlighted that higher blood pressure levels are notable risk factors for the development of retinopathy (6). Doft et al. demonstrated a high correlation between the degree of metabolic control, as measured by glycosylated hemoglobin levels, and early retinopathy changes (7). The prevalence of diabetes and diabetic retinopathy varies globally, with significant impacts observed in different regions. In Bangladesh, Wahiduzzaman et al. and Ahmed et al. reported high rates of both diabetes and diabetic retinopathy, emphasizing the need for improved healthcare strategies to manage and mitigate these conditions (8,9). These findings highlight the global burden of diabetic retinopathy and the critical need for effective management and intervention strategies. The impact of diabetic retinopathy extends beyond the physical complications to significantly affect patients' quality of life and the healthcare system. Deswal et al. demonstrated the significant detrimental impact of diabetic retinopathy on the quality of life of Indian patients, which worsens with increasing severity of the disease (10). Granado-Casas et al. found that patients with diabetic retinopathy had a poorer perception of their quality of life, particularly in areas such as work life and dependence (11). Fenwick et al. assessed the impact of diabetic retinopathy and diabetic macular edema on health-related quality of life, finding significant associations between these conditions and worse quality of life scores (12). These studies underscore the profound effects of diabetic retinopathy on individuals' daily lives and the broader implications for public health. Furthermore, diabetic retinopathy's impact on quality of life is not uniform across all patients. Factors such as the stage of retinopathy, presence of macular edema, and additional diabetic complications play crucial roles. Fenwick et al. highlighted that individuals with more severe stages of retinopathy or macular edema experienced greater declines in health-related quality of life (12). Additionally, patients with multiple diabetes-related complications reported worse quality of life outcomes, emphasizing the compounded burden of comorbidities (13). Effective management and early intervention are critical in mitigating the progression of diabetic retinopathy and improving patients' quality of life. Studies suggest that strict glycemic control can significantly reduce the risk and progression of diabetic retinopathy. The Diabetes Control and Complications Trial (DCCT) demonstrated that intensive diabetes management could delay the onset and slow the progression of retinopathy (14). This highlights the importance of early and aggressive intervention in diabetes care to prevent long-term complications. In conclusion, the relationship between the stages of diabetic retinopathy and the duration of diabetes mellitus is well-documented, with longer durations of diabetes associated with higher prevalence and severity of retinopathy. The risk factors for developing retinopathy are multifactorial, and the condition significantly impacts patients' quality of life and healthcare systems. Understanding these dynamics is crucial for developing effective screening, prevention, and management strategies to mitigate the burden of diabetic retinopathy on individuals and society.

II. Methods

This cross-sectional descriptive study was conducted to evaluate 114 diabetic subjects aged 30-64 years suffering from diabetic retinopathy. The study took place in the outpatient Department of Endocrinology at Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbagh, Dhaka, over a six-month period from March 2012 to August 2012. Subjects were enrolled in the study after fulfilling the inclusion criteria, and diabetic retinopathy was diagnosed based on direct ophthalmoscopic findings. Among the total of 114 subjects, 14 were diagnosed with type 1 diabetes and 100 with type 2 diabetes. Prior to the commencement of the study, the research protocol was approved by the Bangladesh College of Physicians and Surgeons (BCPS). Ethical clearance was obtained from the ethical review board of BSMMU. The objectives, risks, and benefits of the study were thoroughly explained to the participants in an easily understandable local language, and informed written consent was obtained from each subject. It was assured that all information and records would be kept confidential, and the procedure would be beneficial for both the physician and the patient in making rational decisions regarding case management. The inclusion criteria for the study were as follows: diabetic subjects (both type 1 and type 2) with retinopathy and adult subjects of either sex. The exclusion criteria were subjects with hypertensive retinopathy, subjects who had undergone any eye surgery for the treatment of retinopathy, subjects with cataracts, and subjects with gestational diabetes mellitus. All relevant data collected during the study were compiled onto a master chart and organized using scientific calculations and standard statistical formulas. Percentages were calculated to determine the proportion of findings. Data entry and analysis were performed using SPSS for Windows version 22.0. The output of data and graphical representations was generated using Microsoft Office Chart and Microsoft Word. A p-value of less than 0.05 was considered statistically significant. The results were presented in tables, figures, and diagrams to provide a clear and comprehensive overview of the findings.

III. Results

Table 1: Distribution of participants by baseline characteristics (N=114)

Baseline characteristics	Number	Percentage
Age		

30-39	33	28.95%
40-49	39	34.21%
50-59	27	23.68%
60 and above	15	13.16%
Mean± SD	51.26 ± 10.14	
Gender		
Male	65	57.02%
Female	49	42.98%
Duration of Diabetes		
≤5	18	15.79%
5-9	24	21.05%
10-14	32	28.07%
≥15	44	38.60%
Mean ± SD	09.11±6.56	

The study evaluated 114 diabetic subjects aged 30-64 years with diagnosed diabetic retinopathy. The distribution of participants by baseline characteristics is presented in Table 1. The age distribution revealed that the majority of participants were in the 40-49 age group (34.21%), followed by those aged 30-39 years (28.95%), 50-59 years (23.68%), and those aged 60 and above (13.16%). The mean age of the participants was 51.26 years with a standard deviation of 10.14 years. Gender distribution showed that 57.02% of the participants were male (n=65) and 42.98% were female (n=49). Regarding the duration of diabetes, 15.79% of the participants had diabetes for 5 years or less, 21.05% had diabetes for 5-9 years, 28.07% had diabetes for 10-14 years, and the largest group, 38.60%, had diabetes for 15 years or more. The mean duration of diabetes among the participants was 9.11 years with a standard deviation of 6.56 years.

Table 2: Distribution of participants by presence of diabetic complications (N=114)

Diabetic Complications	Number	Percentage
Peripheral Vascular disease	5	4.39%
Diabetic Neuropathy	8	7.02%
Diabetic Nephropathy	9	7.89%

The study also assessed the presence of diabetic complications among the participants, as shown in Table 2. Among the 114 subjects, peripheral vascular disease was present in 4.39% (n=5) of the participants. Diabetic neuropathy was observed in 7.02% (n=8) of the participants, and diabetic nephropathy was found in 7.89% (n=9) of the participants.

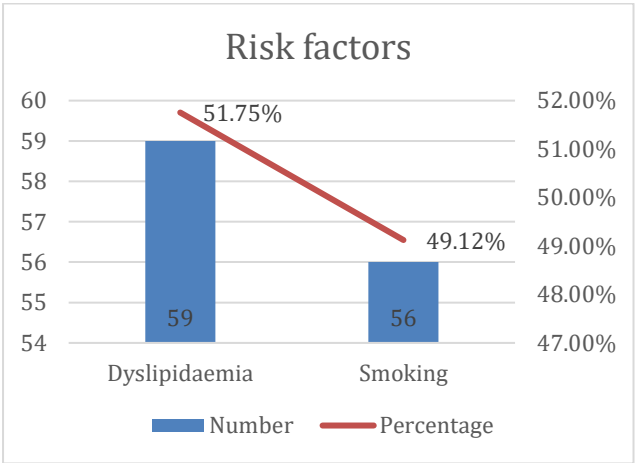

Figure 1: Distribution of participants by pre-existing risk factors (N=114)

The two main risk factors assessed were dyslipidemia and smoking. Dyslipidemia was present in 51.75% of the participants (n=59), making it the most common risk factor among the study population. Smoking was reported by 49.12% of the participants (n=56).

Table 3: Mean±SD Glycemic status of the study subjects (n=114)

Glycemic status	Mean ± SD	Maximum- Minimum
FBG (mmol/l)	10.0±4.9	22.3-5.7

AG (mmol/l)	16.7±7.7	25.43-9.24
Hb A1C%	9.9±2.5	12.2-5.7

The glycemic status of the study subjects is detailed in Table 3. The mean fasting blood glucose (FBG) level was 10.0±4.9 mmol/l, with a range from 5.7 to 22.3 mmol/l. The average glucose (AG) level was 16.7±7.7 mmol/l, ranging from 9.24 to 25.43 mmol/l. The mean HbA1c level, a marker of long-term glycemic control, was 9.9±2.5%, with values ranging from 5.7% to 12.2%.

Table 4: Stages of retinopathy of the study subjects (N=114)

Stages of retinopathy	Number	Percentage
Non-proliferative	81	71.05
Maculopathy	20	17.54
Proliferative	7	11.41

The stages of retinopathy among the study subjects are presented in Table 4. The majority of the participants, 71.05% (n=81), were diagnosed with non-proliferative diabetic retinopathy. Maculopathy was observed in 17.54% (n=20) of the participants. Proliferative diabetic retinopathy, the most severe stage, was present in 11.41% (n=7) of the participants.

Table 5: Stages of retinopathy and its relationship with duration of diabetes (n=114)

Stages of Retinopathy	Correlation coefficient		Regression Coefficient	
	r value	P value	β value	P value
Non-proliferative	0.275	**0.01**	0.5165	**0.0145**
Maculopathy	0.2915	**0.01**	0.6585	**0.0385**
Proliferative	0.2895	**0.0255**	0.189	**0.025**

The correlation and regression coefficients indicate significant relationships between the duration of diabetes and the severity of retinopathy. For non-proliferative diabetic retinopathy, the correlation coefficient (r value) was 0.275 with a p value of 0.01, indicating a moderate positive correlation that is statistically significant. The regression coefficient (β value) was 0.5165 with a p value of 0.0145, suggesting that an increase in the duration of diabetes is associated with an increased likelihood of developing non-proliferative retinopathy. In the case of maculopathy, the correlation coefficient was 0.2915 with a p value of 0.01, also indicating a moderate positive correlation. The regression coefficient was 0.6585 with a p value of 0.0385, showing a significant relationship between longer duration of diabetes and the presence of maculopathy.

IV. Discussion

The findings of this study reveal significant associations between the duration of diabetes and the stages of diabetic retinopathy (DR), providing critical insights into the progression of this condition among diabetic patients. The mean age of our study population was 51.26±10.14 years, with a higher prevalence of DR in the 40-49 age group (34.21%). This aligns with previous studies, such as the one by Henricsson et al. (2003), which reported similar age distributions in diabetic retinopathy patients (15). The gender distribution in our study showed a higher proportion of males (57.02%), which is consistent with findings from Chaturvedi et al. (2001), who also observed a higher incidence of retinopathy among male patients (16). The duration of diabetes emerged as a significant factor in the development of retinopathy, with a substantial proportion of patients (38.60%) having diabetes for 15 years or more. Our study found that longer diabetes duration was significantly correlated with more severe stages of retinopathy. This is corroborated by the work of Jerneld and Algvere (1986), who found that retinopathy prevalence reached 100% after 30 years of diabetes, highlighting the cumulative effect of prolonged hyperglycemia on retinal health (4). Our analysis of diabetic complications revealed that peripheral vascular disease, diabetic neuropathy, and diabetic nephropathy were present in 4.39%, 7.02%, and 7.89% of participants, respectively. These findings are consistent with those reported by Foussard et al. (2020), who demonstrated that the incidence of major lower-extremity arterial disease increased with the severity of retinopathy (17). This underscores the interconnected nature of diabetic complications, where retinopathy serves as a marker for broader systemic involvement. Glycemic control is a pivotal factor in managing diabetes and its complications. The mean fasting blood glucose (FBG) level in our study was 10.0±4.9 mmol/l, the average glucose (AG) level was 16.7±7.7 mmol/l, and the mean HbA1c level was 9.9±2.5%. These values indicate poor glycemic control among the participants, similar to findings by Sakuma et al. (2011), who highlighted the importance of cumulative glucose exposure over time (HbA1c years) in

predicting retinopathy development (18). Effective glycemic management, therefore, remains a cornerstone in preventing the progression of DR. In terms of retinopathy stages, 71.05% of our participants had non-proliferative diabetic retinopathy, 17.54% had maculopathy, and 11.41% had proliferative diabetic retinopathy. These distributions are in line with findings from Henricsson et al. (2003), who observed similar prevalence rates. Moreover, our study found significant correlations between the duration of diabetes and the stages of retinopathy: non-proliferative retinopathy (r=0.275, p=0.01), maculopathy (r=0.2915, p=0.01), and proliferative retinopathy (r=0.2895, p=0.0255). These correlations are supported by Yuan et al. (2021), who found that earlier onset age and longer duration of diabetes were significant risk factors for more severe retinopathy stages (19). Additionally, the presence of pre-existing risk factors like dyslipidemia (51.75%) and smoking (49.12%) among our participants highlights the multifactorial nature of DR. Shahwan et al. (2019) reported similar high prevalence rates of dyslipidemia in diabetic populations, underscoring its role in exacerbating retinal complications (20). Smoking, as identified in the study by Marshall et al. (1993), also significantly contributes to the onset and progression of retinopathy, further complicating disease management (5). In conclusion, our study reinforces the critical relationship between the duration of diabetes and the severity of diabetic retinopathy. The findings underscore the need for stringent glycemic control and regular screening to manage and mitigate the progression of retinopathy. Comparative analysis with previous studies supports our observations and highlights the consistency of these risk factors across different populations. Future research should focus on longitudinal studies to further elucidate the mechanisms underlying these associations and to develop targeted interventions for high-risk diabetic patients.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

V. Conclusion

In conclusion, this study highlights the significant relationship between the duration of diabetes and the severity of diabetic retinopathy among a cohort of patients aged 30-64 years. Our findings indicate that longer diabetes duration is strongly associated with more advanced stages of retinopathy, emphasizing the critical need for early and continuous management of diabetes to prevent retinal complications. The prevalence of diabetic complications such as neuropathy, nephropathy, and peripheral vascular disease further underscores the multifaceted impact of prolonged hyperglycemia on patients' health. Additionally, the high rates of dyslipidemia and smoking among participants point to the necessity of comprehensive risk factor management. Effective glycemic control, as evidenced by the significant correlations with fasting blood glucose, average glucose, and HbA1c levels, remains a cornerstone in mitigating the progression of diabetic retinopathy. This study reinforces the importance of regular screening, early detection, and integrated care approaches to improve outcomes for diabetic patients and reduce the burden of retinopathy on healthcare systems.

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