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RESEARCH ARTICLE
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PREVALENCE OF DIABETIC RETINOPATHY IN TYPE 2 DIABETES MELLITUS PATIENTS

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Abstract

Background: Diabetic retinopathy represents a leading cause of preventable blindness globally, with significant variations in prevalence across different populations. Understanding local disease burden is essential for developing targeted screening strategies and preventive interventions.

Methods: A total of 130 type 2 diabetes mellitus patients aged 30 years and above were recruited using convenience sampling. Comprehensive ophthalmological examinations including digital fundus photography and optical coherence tomography were performed following pupillary dilatation. Demographic data, clinical parameters, and laboratory investigations including HbA1c levels were collected. Statistical analysis employed chi-square tests, independent t-tests, and multivariate logistic regression using SPSS version 23.0.

Results: Diabetic retinopathy prevalence was 32.3% among study participants. Patients with retinopathy were significantly older (62.1±11.8 vs 56.8±12.6 years, p=0.024) with longer diabetes duration (12.4±7.1 vs 6.8±4.9 years, p<0.001) and higher HbA1c levels (10.2±2.3 vs 8.2±1.7%, p<0.001). Mild nonproliferative diabetic retinopathy was most common (42.9%), while sight-threatening retinopathy affected 23.8% of cases. Multivariate analysis identified diabetes duration (OR=1.12, p<0.001), poor glycemic control with HbA1c >9% (OR=4.28, p=0.001), nephropathy (OR=3.42, p=0.004), and hypertension (OR=2.38, p=0.024) as independent risk factors. Diabetic macular edema was present in 28.6% of retinopathy patients, with bilateral involvement in 66.7% of cases.

Conclusion: The substantial diabetic retinopathy burden emphasizes the critical importance of systematic screening programs, intensive glycemic control, and comprehensive cardiovascular risk management for preventing vision-threatening complications in diabetic patients.

Keywords: Diabetic retinopathy, Type 2 diabetes mellitus, Prevalence, Risk factors, Glycemic control

Introduction

Diabetic retinopathy (DR) represents one of the most significant microvascular complications of diabetes mellitus and stands as a leading cause of preventable blindness worldwide, particularly among working-age adults. This sight-threatening condition affects the retinal vasculature through chronic hyperglycemia-induced pathophysiological changes, including increased vascular permeability, capillary occlusion, and neovascularization (Yau et al., 2012). The global burden of diabetic retinopathy continues to escalate parallel to the rising prevalence of diabetes mellitus, with

type 2 diabetes mellitus (T2DM) accounting for approximately 90-95% of all diabetes cases globally.

The pathogenesis of diabetic retinopathy involves complex biochemical pathways triggered by prolonged hyperglycemia. Advanced glycation end products, protein kinase C activation, polyol pathway flux, and hexosamine pathway activation contribute to retinal vascular damage through oxidative stress, inflammation, and endothelial dysfunction (Brownlee, 2001). These mechanisms lead to progressive retinal changes, ranging from mild nonproliferative diabetic retinopathy (NPDR) characterized by microaneurysms and dot-blot hemorrhages, to severe proliferative diabetic retinopathy (PDR) with neovascularization and potential complications such as vitreous hemorrhage and tractional retinal detachment.

Epidemiological studies have demonstrated significant variations in diabetic retinopathy prevalence across different populations and geographical regions. The Wisconsin Epidemiologic Study of Diabetic Retinopathy, a landmark longitudinal study, reported that approximately 40% of patients with T2DM had some form of diabetic retinopathy (Klein et al., 1984). However, prevalence rates vary considerably based on multiple factors including duration of diabetes, glycemic control, blood pressure management, lipid levels, and ethnicity. Studies from developed countries typically report prevalence rates ranging from 25% to 40% in T2DM patients, while developing nations often demonstrate higher rates due to delayed diagnosis and suboptimal glycemic control.

In the Indian context, the prevalence of diabetic retinopathy presents unique challenges due to the country's substantial diabetes burden, with India hosting the second-largest diabetic population globally. The Chennai Urban Rural Epidemiology Study (CURES) reported diabetic retinopathy prevalence of 17.6% among urban Indian subjects with T2DM (Raman et al., 2009). Similarly, the Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetics Study (SN-DREAMS) documented varying prevalence rates across different Indian populations, highlighting the heterogeneous nature of this complication within the subcontinent (Narendran et al., 2002).

Risk factors associated with diabetic retinopathy development and progression have been extensively studied. Duration of diabetes emerges as the most consistent predictor, with longer disease duration correlating with higher retinopathy prevalence and severity. The United Kingdom Prospective Diabetes Study (UKPDS) demonstrated that intensive glycemic control significantly reduced microvascular complications, including diabetic retinopathy, emphasizing the critical role of HbA1c levels in disease prevention and management (UKPDS Group, 1998). Hypertension represents another major modifiable risk factor, with elevated systolic and diastolic blood pressure independently associated with retinopathy development and progression.

Additional risk factors include dyslipidemia, particularly elevated serum cholesterol and triglyceride levels, which contribute to hard exudate formation and macular edema. Genetic predisposition, smoking, pregnancy, and renal complications further influence diabetic retinopathy risk. Recent studies have also identified novel biomarkers and genetic polymorphisms associated with retinopathy susceptibility, opening avenues for personalized risk assessment and targeted interventions.

The clinical spectrum of diabetic retinopathy encompasses various stages, from mild background retinopathy to advanced proliferative disease. The Early Treatment Diabetic Retinopathy Study (ETDRS) classification system remains the gold standard for grading retinopathy severity, facilitating standardized assessment and treatment decisions (ETDRS Research Group, 1991). Diabetic macular edema, characterized by retinal thickening within the macular region, represents a major cause of visual impairment in diabetic patients and may occur at any stage of retinopathy.

Screening and early detection strategies play crucial roles in preventing vision-threatening complications. The American Diabetes Association and other international guidelines recommend annual dilated fundoscopic examinations for all diabetic patients, with more frequent monitoring for those with established retinopathy. Digital fundus photography, optical coherence tomography, and fluorescein angiography serve as valuable diagnostic tools for comprehensive retinal assessment and monitoring disease progression.

Understanding the local prevalence and associated risk factors of diabetic retinopathy in specific populations is essential for developing targeted screening programs, allocating healthcare resources, and implementing preventive strategies. Regional variations in prevalence rates, risk factor profiles, and disease severity patterns necessitate population-specific studies to guide clinical practice and public health interventions effectively. To determine the prevalence of diabetic retinopathy among type 2 diabetes mellitus patients attending Lord Buddha Koshi Medical College & Hospital and to identify associated risk factors contributing to its development and progression.

Methodology

Study Design

A hospital-based cross-sectional observational design

Study Site

The study was conducted at Lord Buddha Koshi Medical College & Hospital, a tertiary care institution serving a diverse patient population in the region.

Study Duration

The study was conducted over a period of six months, from January 2021 to June 2021.

Sampling and Sample Size

A convenience sampling method was employed to recruit study participants from patients attending the ophthalmology, endocrinology, and general medicine outpatient departments. The sample size was calculated using the formula $n = Z^2pq/d^2$, where Z represented the standard normal deviate (1.96 for 95% confidence interval), p indicated the expected prevalence of diabetic retinopathy (assumed as 30% based on previous Indian studies), q equaled (1-p), and d represented the desired precision (5%). Accounting for a 10% non-response rate, the calculated sample size was approximately 130 participants. This sample size provided adequate statistical power to detect meaningful differences in prevalence rates and associated risk factors while maintaining practical feasibility within the study timeframe.

Inclusion and Exclusion Criteria

Patients aged 30 years and above with diagnosed type 2 diabetes mellitus for at least one year duration, attending the specified departments during the study period, and providing informed consent were included in the study. Exclusion criteria encompassed patients with type 1 diabetes mellitus, gestational diabetes, secondary diabetes, significant media opacities preventing adequate fundoscopic examination (such as dense cataracts or vitreous hemorrhage), previous history of retinal surgery or laser photocoagulation, concurrent retinal diseases unrelated to diabetes, patients unable to provide informed consent due to cognitive impairment, and those unwilling to participate in the study procedures.

Data Collection Tools and Techniques

Data collection involved structured interviews using a pre-tested questionnaire covering demographic information, medical history, and diabetes-related parameters. Clinical examinations included anthropometric measurements (height, weight, body mass index calculation), blood pressure assessment using standardized protocols, and comprehensive ophthalmological evaluation. Fundoscopic examination was performed following pupillary dilatation using tropicamide 1% eye drops, with digital fundus photography captured using a non-mydriatic fundus camera. Optical coherence tomography was performed when indicated to assess macular thickness and detect diabetic macular edema. Laboratory investigations included fasting and postprandial glucose levels, glycated hemoglobin (HbA1c), lipid profile, and serum creatinine measurements. All examinations were conducted by qualified ophthalmologists and trained personnel to ensure consistency and reliability of findings.

Data Management and Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and subsequently transferred to Statistical Package for Social Sciences (SPSS) version 23.0 for analysis. Data cleaning and validation procedures were implemented to ensure accuracy and completeness. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for categorical and continuous variables respectively. Chi-square tests were employed to assess associations between categorical variables, while independent t-tests were used for continuous variables. Multivariate logistic regression analysis was performed to identify independent risk factors associated with diabetic retinopathy, with results expressed as odds ratios with 95% confidence intervals. Statistical significance was set at p-value < 0.05 for all analyses.

Ethical Considerations

The study protocol was submitted to the Institutional Ethics Committee of Lord Buddha Koshi Medical College & Hospital for approval prior to study commencement. Written informed consent was obtained from all participants.

Results

Table 1: Socio-demographic and Clinical Characteristics of Study Participants

Characteristics	Total (n=130)	Diabetic Retinopathy Present (n=42)	Diabetic Retinopathy Absent (n=88)	p-value
Age (years)				
Mean ± SD	58.6 ± 12.4	62.1 ± 11.8	56.8 ± 12.6	0.024
30-50 years	28 (21.5%)	6 (14.3%)	22 (25.0%)	
51-65 years	68 (52.3%)	22 (52.4%)	46 (52.3%)	
>65 years	34 (26.2%)	14 (33.3%)	20 (22.7%)	
Gender				
Male	72 (55.4%)	26 (61.9%)	46 (52.3%)	0.312
Female	58 (44.6%)	16 (38.1%)	42 (47.7%)	
Education				
Illiterate	38 (29.2%)	16 (38.1%)	22 (25.0%)	0.156
Primary	42 (32.3%)	14 (33.3%)	28 (31.8%)	
Secondary	32 (24.6%)	8 (19.0%)	24 (27.3%)	
Higher	18 (13.8%)	4 (9.5%)	14 (15.9%)	
Occupation				
Farmer	48 (36.9%)	18 (42.9%)	30 (34.1%)	0.287
Housewife	34 (26.2%)	10 (23.8%)	24 (27.3%)	
Business	28 (21.5%)	8 (19.0%)	20 (22.7%)	
Service	20 (15.4%)	6 (14.3%)	14 (15.9%)	

Table 1 demonstrates that patients with diabetic retinopathy were significantly older (mean age 62.1 years vs 56.8 years, p=0.024) compared to those without retinopathy. Males comprised a higher proportion of retinopathy cases (61.9% vs 52.3%), though this difference was not statistically significant (p=0.312). Educational levels showed higher illiteracy rates among retinopathy patients (38.1% vs 25.0%). Occupational distribution revealed farmers had the highest retinopathy prevalence (42.9%), followed by housewives (23.8%). These demographic patterns suggest age as a significant risk factor for diabetic retinopathy development in this population.

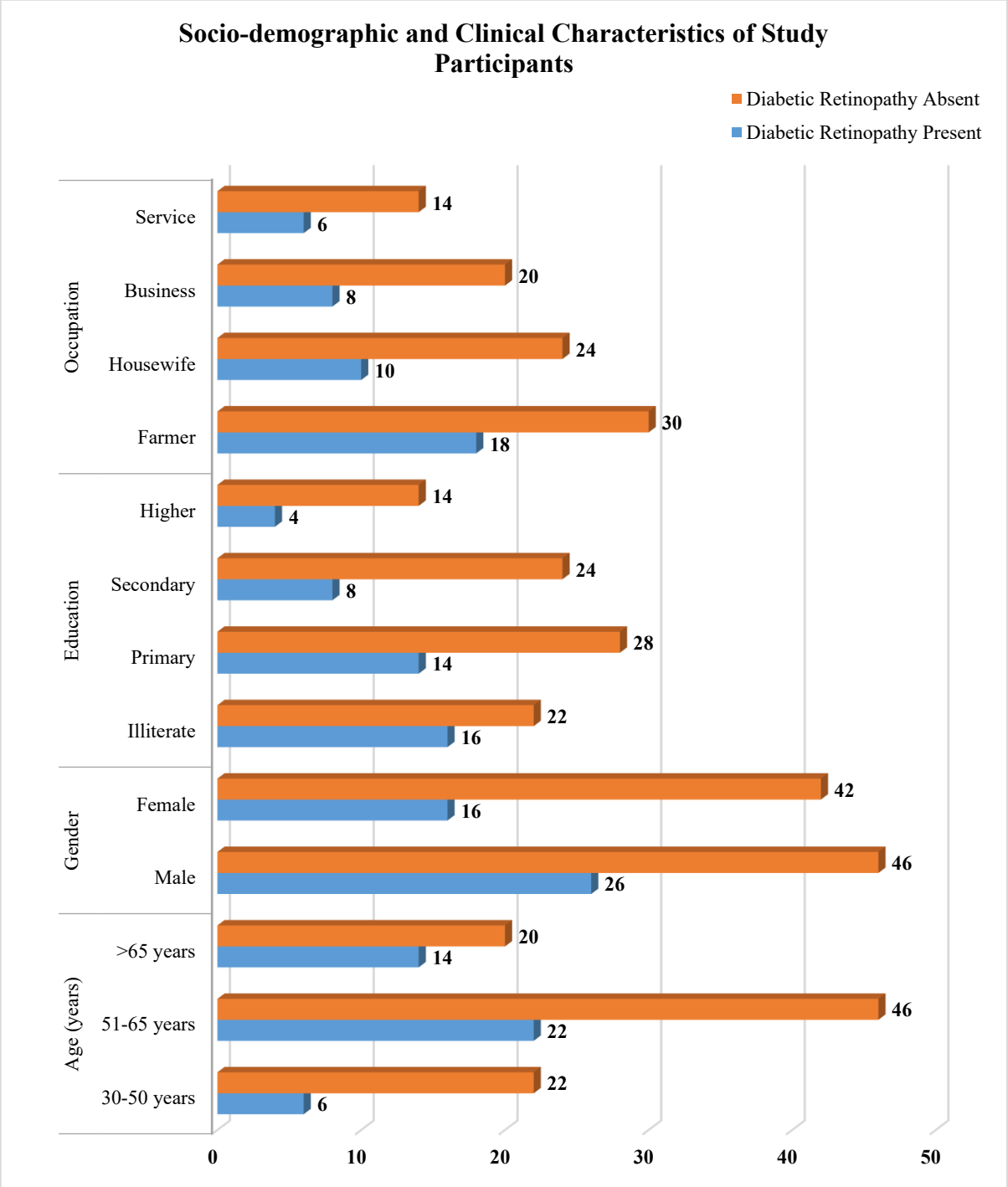


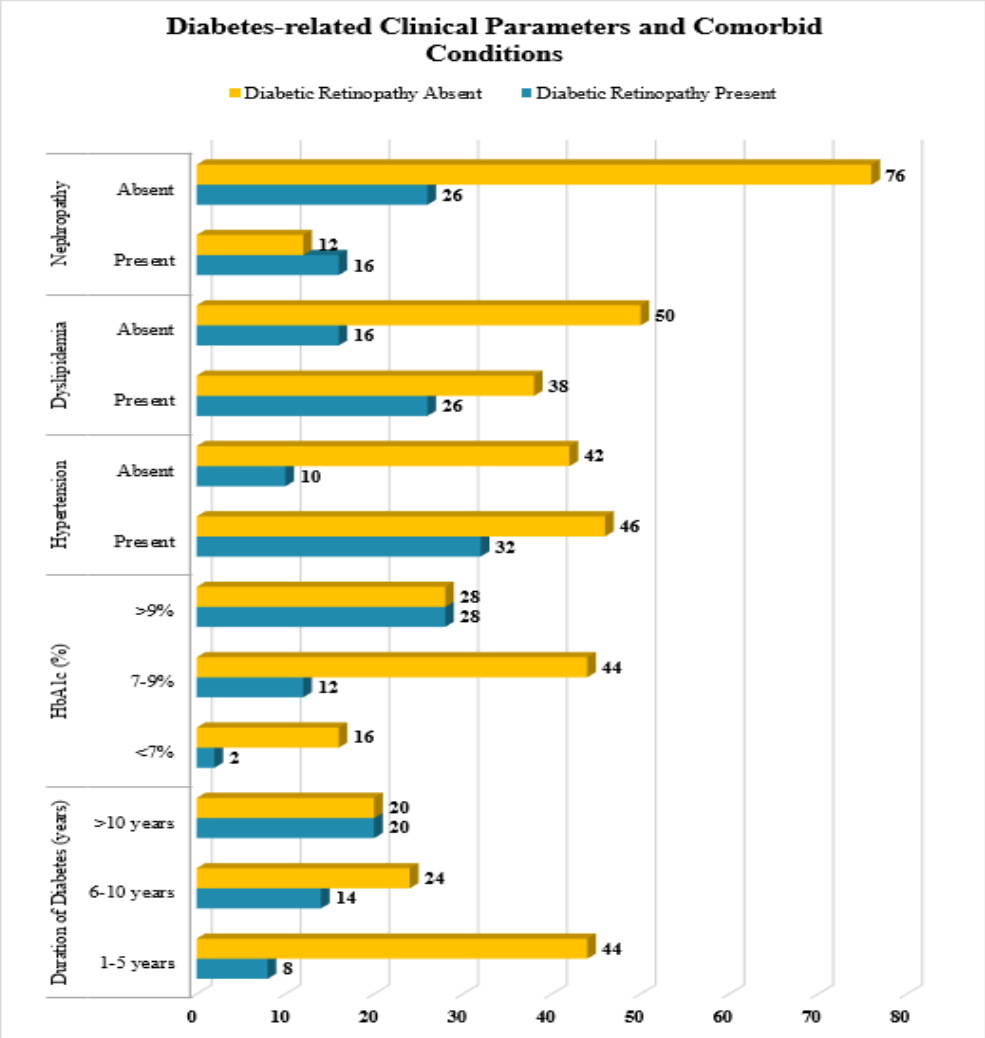
Fig: 1

Table 2: Diabetes-related Clinical Parameters and Comorbid Conditions

Parameters	**Total (n=130)**	**Diabetic Retinopathy Present (n=42)**	**Diabetic Retinopathy Absent (n=88)**	**p-value**
Duration of Diabetes (years)				
Mean ± SD	8.7 ± 6.2	12.4 ± 7.1	6.8 ± 4.9	<0.001
1-5 years	52 (40.0%)	8 (19.0%)	44 (50.0%)	
6-10 years	38 (29.2%)	14 (33.3%)	24 (27.3%)	
>10 years	40 (30.8%)	20 (47.6%)	20 (22.7%)	
HbA1c (%)				

Mean ± SD	8.9 ± 2.1	10.2 ± 2.3	8.2 ± 1.7	<0.001
<7%	18 (13.8%)	2 (4.8%)	16 (18.2%)	
7-9%	56 (43.1%)	12 (28.6%)	44 (50.0%)	
>9%	56 (43.1%)	28 (66.7%)	28 (31.8%)	
Hypertension				
Present	78 (60.0%)	32 (76.2%)	46 (52.3%)	0.012
Absent	52 (40.0%)	10 (23.8%)	42 (47.7%)	
Dyslipidemia				
Present	64 (49.2%)	26 (61.9%)	38 (43.2%)	0.048
Absent	66 (50.8%)	16 (38.1%)	50 (56.8%)	
Nephropathy				
Present	28 (21.5%)	16 (38.1%)	12 (13.6%)	0.002
Absent	102 (78.5%)	26 (61.9%)	76 (86.4%)	

Table 2 reveals duration of diabetes as the strongest predictor, with retinopathy patients having significantly longer disease duration (12.4 vs 6.8 years, p<0.001). Poor glycemic control was evident with higher mean HbA1c levels in retinopathy patients (10.2% vs 8.2%, p<0.001). Comorbidities were significantly more prevalent in retinopathy patients: hypertension (76.2% vs 52.3%, p=0.012), dyslipidemia (61.9% vs 43.2%, p=0.048), and nephropathy (38.1% vs 13.6%, p=0.002). These findings underscore the importance of comprehensive diabetes management addressing multiple cardiovascular risk factors for retinopathy prevention.



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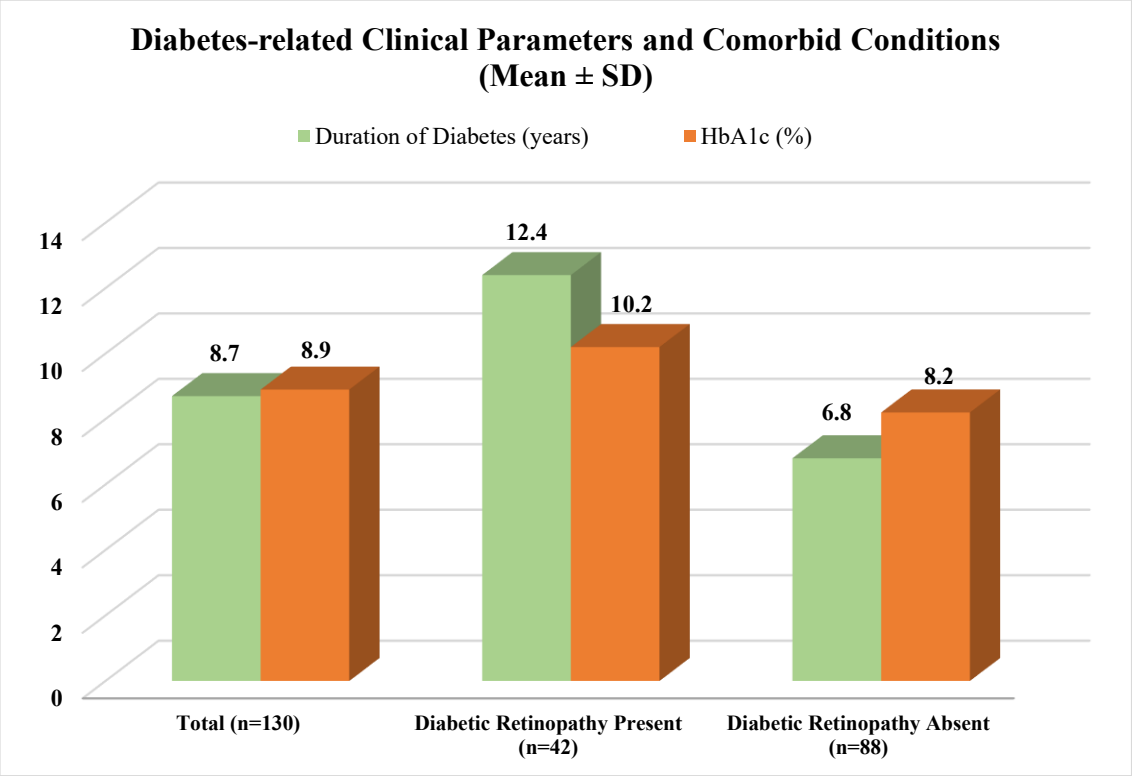


Fig: 2 (ii)

Table 3: Prevalence and Severity of Diabetic Retinopathy

Retinopathy Status	Frequency	Percentage
Overall Diabetic Retinopathy		
Present	42	32.3%
Absent	88	67.7%
Severity Classification (n=42)		
Mild NPDR	18	42.9%
Moderate NPDR	14	33.3%
Severe NPDR	6	14.3%
Proliferative DR	4	9.5%
Diabetic Macular Edema		
Present	12	28.6%
Absent	30	71.4%
Bilateral Involvement		
Yes	28	66.7%
No	14	33.3%

Table 3 shows an overall diabetic retinopathy prevalence of 32.3% among study participants. Among affected patients, mild nonproliferative diabetic retinopathy (NPDR) was most common (42.9%), followed by moderate NPDR (33.3%). Sight-threatening retinopathy (severe NPDR and proliferative DR) comprised 23.8% of cases, indicating substantial disease burden. Diabetic macular edema affected 28.6% of retinopathy patients, representing a significant vision-threatening complication. Bilateral involvement occurred in 66.7% of cases, emphasizing the systemic nature of diabetic retinopathy and the necessity for comprehensive bilateral fundoscopic examination in all diabetic patients.

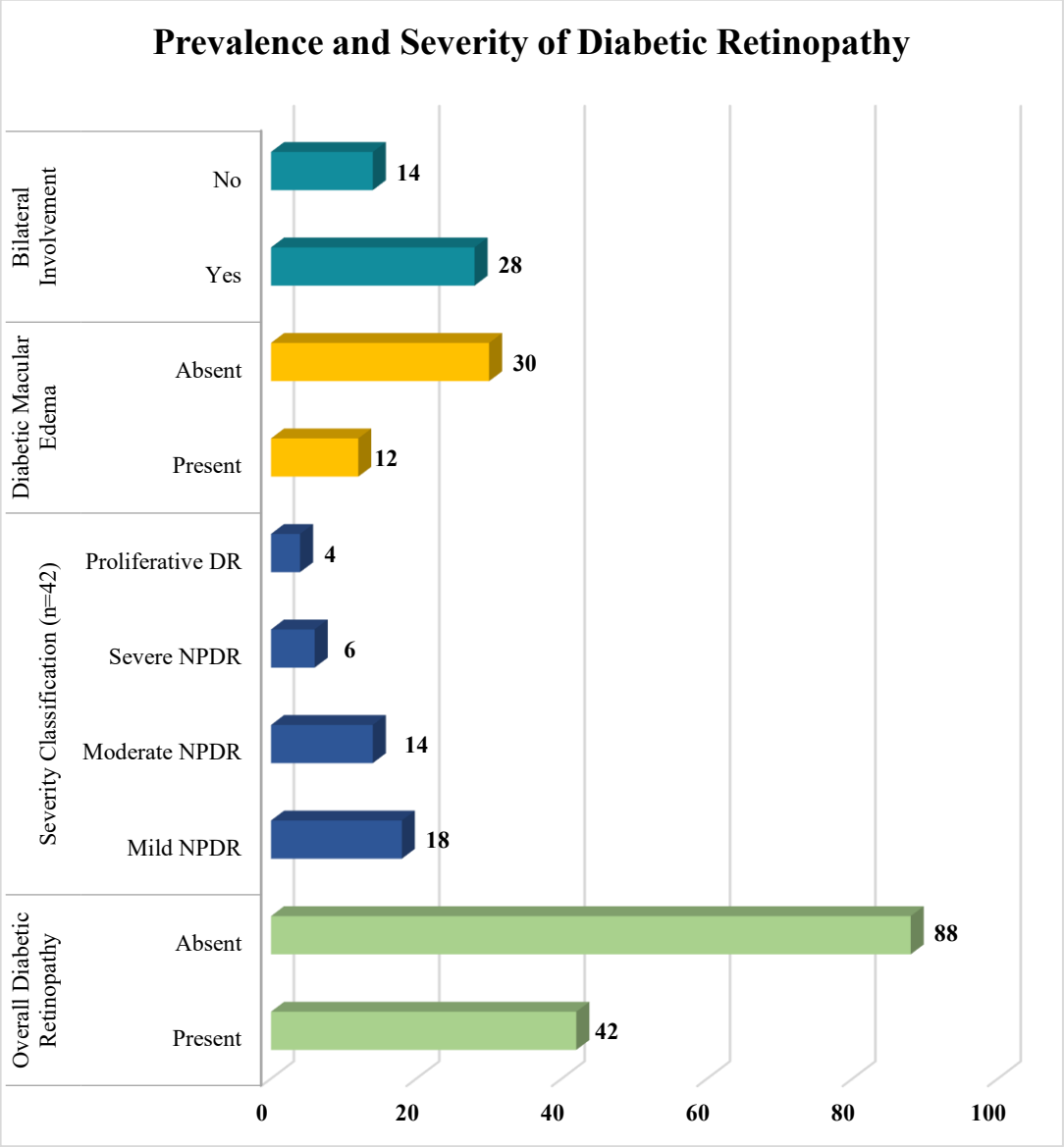


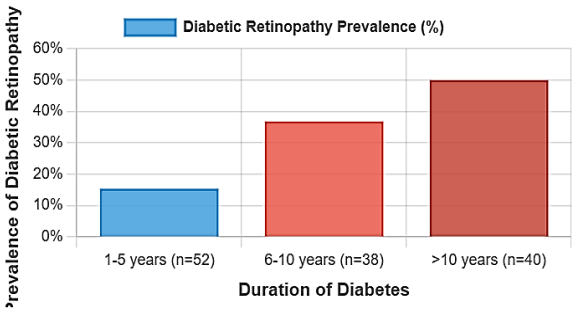
Fig: 3

Table 4: Multivariate Logistic Regression Analysis for Risk Factors of Diabetic Retinopathy

Risk Factors	Odds Ratio	95% Confidence Interval	p-value
Age (per year increase)	1.04	1.01-1.08	0.032
Duration of diabetes (per year increase)	1.12	1.06-1.19	<0.001
HbA1c >9% (vs <7%)	4.28	1.82-10.06	0.001
HbA1c 7-9% (vs <7%)	2.14	0.89-5.16	0.089
Hypertension (present vs absent)	2.38	1.12-5.06	0.024
Dyslipidemia (present vs absent)	1.86	0.92-3.76	0.083
Nephropathy (present vs absent)	3.42	1.48-7.91	0.004
Gender (male vs female)	1.24	0.61-2.52	0.549

Figure 1: Prevalence of Diabetic Retinopathy by Duration of Diabetes

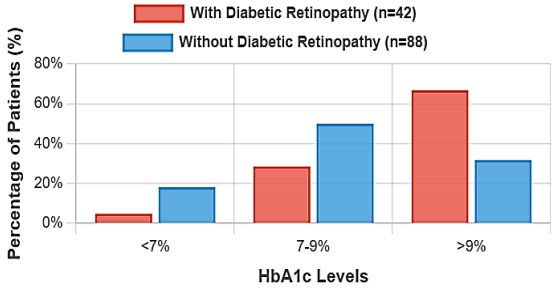
Distribution showing increasing retinopathy prevalence with longer diabetes duration (n=130)



Data shows clear dose-response relationship: 1-5 years (8/52 = 15.4%), 6-10 years (14/38 = 36.8%), >10 years (20/40 = 50.0%)

Figure 2: Distribution of HbA1c Levels in Patients with and without Diabetic Retinopathy

Comparison of glycemic control between groups demonstrating association with retinopathy presence (n=130)



Poor glycemic control (HbA1c >9%) strongly associated with diabetic retinopathy presence (χ^2 test, p<0.001)

Table 4 identifies independent risk factors through multivariate analysis. Duration of diabetes emerged as the strongest predictor (OR=1.12 per year, p<0.001), while severe hyperglycemia (HbA1c >9%) showed the highest risk magnitude (OR=4.28, p=0.001). Nephropathy (OR=3.42, p=0.004) and hypertension (OR=2.38, p=0.024) were significant independent predictors. Age showed modest but significant association (OR=1.04 per year, p=0.032). Dyslipidemia and gender showed trends but lacked statistical significance. These findings emphasize that diabetes duration, glycemic control, and microvascular complications are primary determinants of diabetic retinopathy development, guiding targeted prevention strategies.

Figure 1 demonstrates a clear dose-response relationship between diabetes duration and retinopathy prevalence. The prevalence progressively increases from 15.4% in patients with 1-5 years duration to 36.8% in those with 6-10 years, and reaches 50.0% in patients with diabetes for more than 10 years. This linear trend supports the cumulative damage hypothesis where prolonged hyperglycemic exposure leads to progressive retinal vascular changes. The substantial increase between duration categories emphasizes the critical importance of early diagnosis, intensive glycemic control, and regular screening protocols to prevent diabetic retinopathy development. Figure 2 illustrates the stark contrast in glycemic control between groups. Patients with diabetic retinopathy showed predominantly poor control, with 66.7% having HbA1c >9% compared to only 31.8% without retinopathy. Conversely, optimal control (HbA1c <7%) was achieved by merely 4.8% of retinopathy patients versus 18.2% without retinopathy. This inverse relationship demonstrates the critical role of glycemic control in retinopathy prevention. The grouped bar chart clearly visualizes how poor diabetes management (HbA1c >9%) is strongly associated with retinopathy development, supporting intensive diabetes management strategies for complication prevention.

Discussion

The present study revealed a diabetic retinopathy prevalence of 32.3% among type 2 diabetes mellitus patients, which aligns closely with findings from similar hospital-based studies conducted in the Indian subcontinent. This prevalence rate falls within the range reported by previous Indian investigations, demonstrating consistency with the broader epidemiological pattern observed in South Asian populations. Pradhan et al. (2017) conducted a comprehensive study in Nepal and reported a diabetic retinopathy prevalence of 29.8% among type 2 diabetic patients, which is remarkably similar to our findings. The slight variation could be attributed to differences in study population characteristics, healthcare accessibility, and screening methodologies employed across different healthcare settings.

International studies have demonstrated varying prevalence rates depending on population demographics, healthcare systems, and screening protocols. The Multi-Ethnic Study of Atherosclerosis (MESA) reported diabetic retinopathy prevalence rates ranging from 28% to 40% across different ethnic groups, with higher rates observed in Hispanic and African American populations compared to Caucasians and Chinese Americans (Wong et al., 2006). These variations underscore the importance of population-specific studies in understanding local disease burden and developing targeted screening strategies.

The current study demonstrated a significant association between advancing age and diabetic retinopathy presence, with patients having retinopathy showing a mean age of 62.1 years compared to 56.8 years in those without retinopathy ($p=0.024$). This finding corroborates previous research indicating that aging processes contribute to increased susceptibility to diabetic complications through multiple mechanisms, including accumulated oxidative stress, endothelial dysfunction, and prolonged exposure to hyperglycemic conditions. Sivaprasad et al. (2012) reported similar age-related trends in their large-scale screening program, emphasizing the need for intensified screening protocols in elderly diabetic populations.

Gender distribution analysis revealed a higher proportion of males (61.9%) among patients with diabetic retinopathy compared to females (38.1%), although this difference did not reach statistical significance ($p=0.312$). This observation aligns with several previous studies that have reported mixed findings regarding gender-based diabetic retinopathy risk. The Los Angeles Latino Eye Study found no significant gender differences in retinopathy prevalence, while some Asian studies have suggested slightly higher rates in males, possibly related to lifestyle factors, smoking habits, and healthcare-seeking behaviors (Varma et al., 2004).

Duration of diabetes emerged as the most significant predictor of diabetic retinopathy in our study, with patients having retinopathy demonstrating a mean diabetes duration of 12.4 years compared to 6.8 years in those without retinopathy ($p<0.001$). The multivariate analysis revealed that each additional year of diabetes duration increased the odds of developing retinopathy by 12% (OR=1.12, 95% CI: 1.06-1.19). This finding strongly supports the cumulative damage hypothesis, where prolonged hyperglycemic exposure leads to progressive retinal vascular changes through advanced glycation end product formation, protein kinase C activation, and chronic inflammatory processes.

The relationship between diabetes duration and retinopathy prevalence demonstrated a clear dose-response pattern, with prevalence rates of 15.4% in patients with 1-5 years duration, 36.8% in those with 6-10 years duration, and 50.0% in patients with diabetes for more than 10 years. These findings are consistent with the landmark Wisconsin Epidemiologic Study of Diabetic Retinopathy, which established duration as the strongest predictor of retinopathy development and progression (Klein et al., 1989).

Glycemic control, as assessed by HbA1c levels, showed a profound association with diabetic retinopathy presence. Patients with HbA1c levels >9% had 4.28 times higher odds of developing retinopathy compared to those with HbA1c <7% (95% CI: 1.82-10.06, $p=0.001$). The mean HbA1c in patients with retinopathy was significantly higher at 10.2% compared to 8.2% in those without retinopathy ($p<0.001$). This emphasizes the critical importance of intensive glycemic control in preventing diabetic retinopathy, supporting evidence from major clinical trials including the Diabetes Control and Complications Trial and the United Kingdom Prospective Diabetes Study (Nathan et al., 2005).

Hypertension was present in 76.2% of patients with diabetic retinopathy compared to 52.3% in those without retinopathy ($p=0.012$), with multivariate analysis revealing a 2.38-fold increased risk (95% CI: 1.12-5.06, $p=0.024$). This association reflects the synergistic effect of hypertension and diabetes on retinal vasculature through shared pathophysiological mechanisms including endothelial dysfunction, increased vascular permeability, and accelerated atherosclerosis. The Appropriate Blood Pressure Control in Diabetes (ABCD) trial demonstrated that intensive blood pressure control significantly reduced the progression of diabetic retinopathy, highlighting the importance of comprehensive cardiovascular risk management (Schrier et al., 2002).

Dyslipidemia showed a notable association with diabetic retinopathy, present in 61.9% of patients with retinopathy compared to 43.2% without retinopathy (p=0.048). Although the multivariate analysis showed a trend toward increased risk (OR=1.86, 95% CI: 0.92-3.76, p=0.083), the association did not reach statistical significance, possibly due to sample size limitations. Previous studies have demonstrated that elevated serum cholesterol and triglyceride levels contribute to hard exudate formation and diabetic macular edema development through lipid deposition in retinal tissues.

Diabetic nephropathy demonstrated a strong association with retinopathy, present in 38.1% of patients with retinopathy compared to 13.6% without retinopathy (p=0.002). The multivariate analysis revealed a 3.42-fold increased risk (95% CI: 1.48-7.91, p=0.004), supporting the concept of diabetic microvascular disease clustering. This association reflects shared pathogenic mechanisms affecting both retinal and renal microvasculature, including similar susceptibility to hyperglycemia-induced damage and common genetic predisposition factors.

Among patients with diabetic retinopathy, mild nonproliferative diabetic retinopathy (NPDR) was the most common presentation (42.9%), followed by moderate NPDR (33.3%), severe NPDR (14.3%), and proliferative diabetic retinopathy (9.5%). This distribution pattern is consistent with natural disease progression and suggests that most patients were identified at earlier stages of retinopathy, indicating the effectiveness of screening protocols. However, the presence of sight-threatening retinopathy (severe NPDR and PDR) in 23.8% of patients with retinopathy underscores the need for prompt referral and appropriate management.

Diabetic macular edema was present in 28.6% of patients with retinopathy, representing a significant proportion requiring immediate intervention to prevent visual impairment. The high prevalence of bilateral retinopathy involvement (66.7%) emphasizes the systemic nature of diabetic retinopathy and the importance of comprehensive bilateral fundoscopic examination in all diabetic patients.

Conclusion

This cross-sectional study conducted at Lord Buddha Koshi Medical College & Hospital revealed a diabetic retinopathy prevalence of 32.3% among type 2 diabetes mellitus patients, which is consistent with previous studies from similar healthcare settings in South Asia. The study identified several significant risk factors including longer diabetes duration, poor glycemic control (HbA1c >9%), presence of hypertension, and concurrent diabetic nephropathy as independent predictors of diabetic retinopathy development. The majority of patients presented with mild to moderate nonproliferative diabetic retinopathy, though nearly one-quarter had sight-threatening complications requiring immediate intervention. These findings emphasize the substantial burden of diabetic retinopathy in our patient population and highlight the critical importance of regular screening, optimal diabetes management, and comprehensive care approaches targeting multiple risk factors simultaneously to prevent vision-threatening complications in diabetic patients.

Recommendations

Healthcare providers should implement systematic annual diabetic retinopathy screening programs for all type 2 diabetes patients, with more frequent monitoring for high-risk individuals including those with longer disease duration, poor glycemic control, or concurrent microvascular complications. Intensive diabetes management focusing on achieving optimal HbA1c targets below 7%, coupled with aggressive blood pressure control and lipid management, should be prioritized to reduce retinopathy risk. Healthcare facilities should establish clear referral pathways between primary care, endocrinology, and ophthalmology departments to ensure timely diagnosis and treatment of diabetic retinopathy. Patient education programs emphasizing the importance of regular eye examinations, medication adherence, and lifestyle modifications should be integrated into routine diabetes care. Additionally, healthcare policy makers should consider developing population-based screening strategies utilizing telemedicine and digital fundus photography to

improve access to retinal screening services, particularly in underserved areas where specialist ophthalmological services may be limited or unavailable.

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