



RESEARCH ARTICLE

Correlation Between Systemic Risk Factors (Blood Pressure, HbA1c, Lipid Profile) and Severity of Diabetic Retinopathy

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ABSTRACT

Introduction: Systemic metabolic management has a significant impact on diabetic retinopathy (DR), which continues to be one of the major causes of avoidable blindness globally. The purpose of this study was to assess the relationship between the severity of diabetic retinopathy in 150 patients over a one-year period (April 2025 to March 2026) and systemic risk variables, including blood pressure, glycemic control (HbA1c), and lipid profile.

Methods: In a tertiary care facility, a cross-sectional observational study was carried out. Based on a routine fundus examination, patients with diabetes mellitus were categorized into various phases of DR after undergoing a thorough ophthalmological evaluation. Systolic and diastolic blood pressure, HbA1c levels, and the lipid profile (total cholesterol, LDL, HDL, and triglycerides) were among the systemic indicators that were noted.

Results: The severity of diabetic retinopathy was found to be statistically significantly correlated with poor glycemic control (HbA1c > 8%), raised systolic blood pressure (>140 mmHg), and dyslipidemia ($p < 0.05$). The greatest mean HbA1c and LDL levels were seen in patients with proliferative diabetic retinopathy (PDR). Advanced stages of DR were also linked to reduced HDL and elevated triglycerides.

Conclusion: The study comes to the conclusion that systemic factors are crucial in the development of diabetic retinopathy, highlighting the significance of thorough metabolic management in averting complications that could endanger vision.

Keywords: diabetic retinopathy, metabolic management, glycemic control, HbA1c, LDL levels

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INTRODUCTION

Persistent hyperglycemia brought on by deficiencies in insulin secretion, action, or both is a hallmark of diabetes mellitus, a chronic metabolic disease. Diabetic retinopathy (DR) is the most prevalent of its many microvascular consequences and continues to be a major cause of blindness and visual impairment in working-age individuals worldwide. Diabetic retinopathy is a complex etiology that includes long-term exposure to hyperglycemia, which causes retinal ischemia, capillary basement membrane thickening, and microvascular damage. However, the diversity in the course of the disease cannot be entirely explained by glycemic management alone. There is growing evidence that systemic risk factors including dyslipidemia and hypertension have a major impact on the development and severity of DR[1].

By raising hydrostatic pressure, which causes endothelial dysfunction and the disintegration of the blood-retinal barrier, hypertension exacerbates retinal vascular injury. Similarly, hard exudates and increasing retinal disease have been linked to dyslipidemia, especially high LDL cholesterol and triglycerides. Glycated

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hemoglobin (HbA1c) has been repeatedly demonstrated to correspond with the severity of diabetic retinopathy (DR) and is a trustworthy measure of long-term glycemic management[2].

Diabetic retinopathy is still underdiagnosed in many populations, especially in developing nations, despite advancements in screening and treatment. It is essential for early intervention and prevention measures to comprehend the connection between systemic risk factors and the severity of DR. In a cohort of 150 patients over the course of a year, this study attempts to assess the relationship between systemic risk factors blood pressure, HbA1c levels, and lipid profile and the degree of diabetic retinopathy. This study aims to improve therapeutic care and lower vision-related morbidity by identifying modifiable risk variables linked to illness development[3].

METHODS

- Study Design: Cross-sectional observational study.
- Study Duration: April 2025 – March 2026
- Sample Size: 150 patients with diagnosed diabetes mellitus.

Inclusion Criteria

- Patients aged ≥ 18 years
- Diagnosed with Type 1 or Type 2 diabetes
- Willing to participate

Exclusion Criteria

- Patients with other retinal diseases
- History of ocular surgery within 6 months
- Severe systemic illness

Data Collection

- Detailed ophthalmic examination including fundus evaluation
- Classification of DR:
 - No DR
 - Mild NPDR
 - Moderate NPDR
 - Severe NPDR
 - PDR

Systemic Parameters

- Blood Pressure (Systolic & Diastolic)
- HbA1c
- Lipid Profile:
 - Total Cholesterol
 - LDL
 - HDL
 - Triglycerides

Statistical Analysis

- Chi-square test
- ANOVA
- p-value < 0.05 considered significant

RESULTS

Table 1: HbA1c and DR Severity

DR Severity	Mean HbA1c (%)	p-value
No DR	6.8 ± 0.5	
Mild NPDR	7.5 ± 0.6	
Moderate NPDR	8.3 ± 0.7	
Severe NPDR	9.1 ± 0.8	
PDR	9.8 ± 0.9	<0.001

Table 2: Blood Pressure and DR Severity

DR Severity	Mean SBP (mmHg)	Mean DBP	p-value
No DR	122	78	
Mild NPDR	130	82	
Moderate NPDR	138	86	
Severe NPDR	145	90	
PDR	152	94	0.002

Table 3: Lipid Profile (LDL)

DR Severity	Mean LDL (mg/dL)	p-value
No DR	95	
Mild NPDR	110	
Moderate NPDR	125	
Severe NPDR	140	
PDR	155	0.004

Table 4: Triglycerides and HDL

DR Severity	TG (mg/dL)	HDL (mg/dL)	p-value
No DR	140	48	
Mild NPDR	160	45	
Moderate NPDR	180	42	
Severe NPDR	200	38	
PDR	220	35	0.006

DISCUSSION

In a cohort of 150 patients, this study assessed the relationship between systemic risk factors and the degree of diabetic retinopathy. The results unequivocally show that poor glycemic control, hypertension, dyslipidemia, and the advancement of diabetic retinopathy are strongly and statistically significantly correlated. The steady rise in HbA1c levels with increasing DR stages was one of the study's most significant findings(4). HbA1c values were considerably greater in patients with proliferative

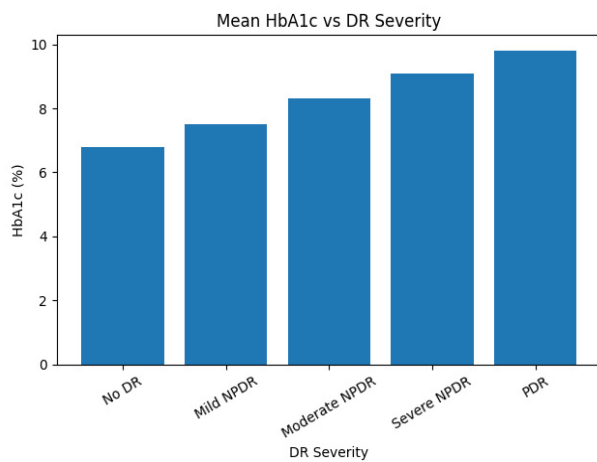


Figure 1: Mean HbA1c Vs DR severity

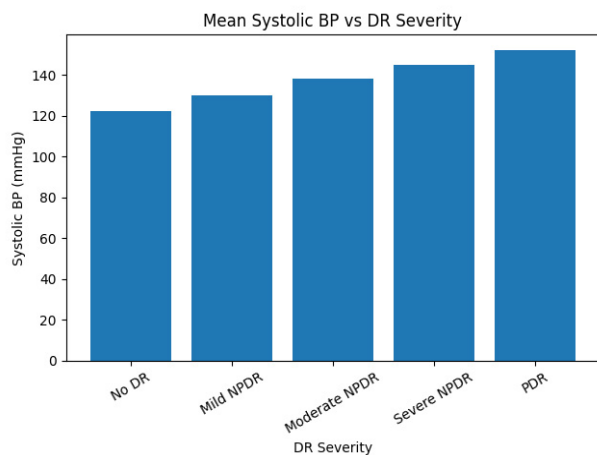


Figure 2: Mean systolic BP Vs DR severity

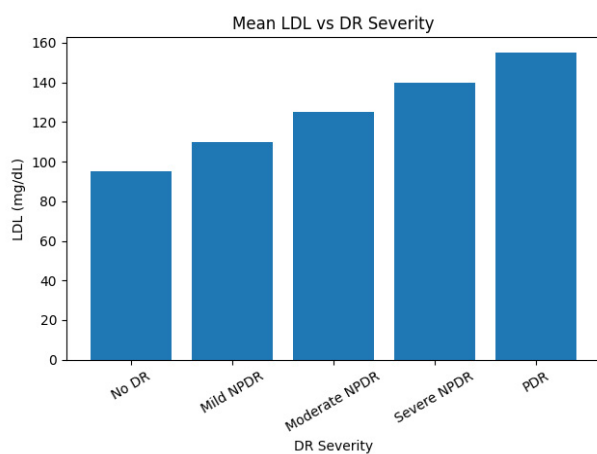


Figure 3: Mean LDL Vs DR severity

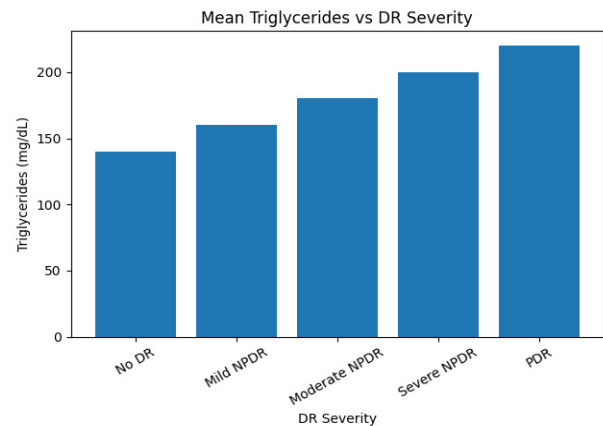


Figure 4: Mean triglyceride Vs DR severity

diabetic retinopathy (PDR) than in patients without the condition. This is consistent with research showing that long-term hyperglycemia causes microvascular damage via mechanisms such as the production of advanced glycation end products, oxidative stress, and protein kinase C activation. The results highlight how crucial careful glycemic control is to stopping or slowing the course of DR[5].

The severity of DR was also strongly correlated with hypertension. Throughout the DR phases, both the diastolic and systolic blood pressure gradually rose. High blood pressure accelerates the progression of retinopathy by aggravating ischemia, increasing vascular permeability, and causing damage to retinal capillaries[6]. The findings of this investigation are in line with earlier extensive studies that found hypertension to be a significant modifiable risk factor.

Advanced stages of DR were substantially correlated with dyslipidemia, especially increased LDL and triglycerides. In addition to having lower HDL levels, patients with severe NPDR and PDR had higher LDL and triglyceride levels. Lipid abnormalities can exacerbate retinal edema and lead to the production of hard exudates. These results emphasize how crucial cholesterol control is to all-encompassing diabetic therapy[7].

It's interesting to note that these systemic elements seem to have a synergistic influence on the severity of DR. Compared to patients with isolated abnormalities, those with poor glycemic control, hypertension, and dyslipidemia were more likely to exhibit progressive retinopathy. This implies that for the best results, multifaceted intervention is necessary[8]. This study's well-defined sample size and thorough assessment of systemic factors are among its strong points. However, it cannot prove causation because it is a cross-sectional study. To confirm these results, longitudinal studies would be helpful[9].

Overall, this study emphasizes how important it is to manage systemic risk factors in order to avoid vision-threatening diabetic retinopathy. The burden of disease can be considerably decreased and quality of life can be enhanced by early detection and treatment of certain risk factors[10].

CONCLUSION

The severity of diabetic retinopathy is significantly correlated with systemic risk factors, specifically dyslipidemia, hypertension, and poor glycemic management. Advanced stages of retinopathy, such as proliferative diabetic retinopathy, were more common in patients with higher HbA1c levels, increased blood pressure, and aberrant lipid profiles. The results highlight the fact that diabetic retinopathy is a sign of systemic metabolic dysregulation rather than just an eye disorder. A multidisciplinary strategy emphasizing strict glucose control, blood pressure reduction, and lipid optimization is necessary for effective therapy.

Vision-threatening consequences can be considerably decreased by aggressively managing systemic risk factors and routinely screening for diabetic retinopathy. To increase treatment adherence and lifestyle changes, clinicians should place a high priority on early intervention and patient education. It is advised that future research with longitudinal follow-up be conducted in order to determine causal linkages and assess the efficacy of certain therapies. Overall, this study highlights how crucial comprehensive diabetes care is for avoiding blindness and enhancing patient outcomes.

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