



## Prevalence Of Hypertensive Retinopathy In Hypertensive Patients In A Tertiary Care Hospital

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### Abstract

**Purpose:** This study aimed to evaluate the prevalence and grading of hypertensive retinopathy among individuals with systemic hypertension attending a tertiary care facility, and to examine its relationship with duration of hypertension and associated cardiovascular risk factors.

**Methods:** A hospital-based cross-sectional analysis was performed over a 6-month period, enrolling 160 patients diagnosed with hypertension. Each subject underwent a detailed ophthalmic work-up, comprising measurement of visual acuity, slit-lamp examination, intraocular pressure assessment, and dilated fundoscopy with a +90D lens and indirect ophthalmoscope. The severity of hypertensive retinopathy was classified according to the Keith–Wagener system. Data were processed using descriptive statistics, chi-square testing, and logistic regression to explore correlations with hypertension duration and systemic comorbidities.

**Results:** Signs of hypertensive retinopathy were identified in 15% of patients. A statistically significant increase in retinopathy severity was noted with a longer history of hypertension ( $p = 0.0056$ ). Diabetes mellitus ( $p = 0.001$ ) and hyperlipidemia ( $p = 0.013$ ) demonstrated strong associations with advanced grades of retinopathy. Male participants exhibited significantly greater severity compared with females ( $p = 0.0023$ ).

### Conclusion:

Hypertensive retinopathy represents a frequent microvascular consequence of uncontrolled or prolonged hypertension and shows substantial association with the duration of disease and coexisting cardiovascular conditions. Periodic fundus evaluation is recommended, particularly for individuals with long-standing hypertension, diabetes, or dyslipidaemia, to facilitate early diagnosis and timely clinical management.

**Keywords:** Hypertensive Retinopathy, Hypertension, Fundus Examination, Cardiovascular Risk Factors

### Introduction

Hypertensive retinopathy refers to retinal microvascular changes that occur due to chronic hypertension. Hypertension affects the vascular system throughout the body, including the delicate arterioles in the retina. Over time, high blood pressure can lead to narrowing, blockage, or leakage of these vessels, and subsequently cause damage to the retina,

which can lead to visual impairment. This condition shows how systemic diseases can have profound ocular manifestations. Liu L et al [1] & Dzedziak J et al. [2]

The prevalence of hypertensive retinopathy in hypertensive patients varies widely in literature,

reflecting variations in population demographics, diagnostic criteria, and the severity of hypertension. A study conducted by Fraser-Bell S et al [3,4,5] noted that hypertensive retinopathy may serve as a predictor of systemic vascular disease, including stroke and heart disease.

Early detection of hypertensive retinopathy can be pivotal in modifying systemic treatment for hypertension, potentially reducing both the ocular and systemic complications. However, the lack of symptoms in early stages means that many patients remain undiagnosed until significant damage has occurred. Regular screening of hypertensive patients for retinopathy is recommended by several clinical guidelines; however, implementation remains inconsistent across healthcare settings. [4,6]

Technological advancements such as fundus photography and optical coherence tomography (OCT) have improved the sensitivity and specificity of diagnosing hypertensive retinopathy. These tools allow for better visualization of the retinal structure and blood vessels, making it easier to detect subtle changes that indicate early disease. Ahn SJ et al. [6]

Furthermore, the management of hypertensive retinopathy involves controlling blood pressure to prevent progression. There is evidence suggesting that effective management of hypertension can lead to a regression of retinopathy signs and a decrease in the risk of other hypertensive end-organ damage. Chua J et al. [7]

In terms of public health, understanding the prevalence of hypertensive retinopathy within hypertensive populations can help healthcare providers better allocate resources and plan interventions. It also highlights the need for interdisciplinary care between physician and ophthalmologists to address the comprehensive needs of hypertensive patients.

**Aim**

To estimate the prevalence of hypertensive retinopathy among individuals diagnosed with systemic hypertension attending a tertiary care centre.

**Objectives**

1. To evaluate the severity and grading of hypertensive retinopathy in relation to the duration and level of control of systemic hypertension.
2. To analyse the association between hypertensive retinopathy and coexisting cardiovascular risk factors in hypertensive patients.
3. To determine demographic and clinical variables that may serve as predictors for the development of hypertensive retinopathy in this population

**Subjects And Methods:**

This study was carried out in the Department of Ophthalmology at a tertiary care center for a duration of 6 months. A cross-sectional study design was employed to assess the prevalence and severity of hypertensive retinopathy among 160 hypertensive patients attending the hospital.

**Inclusion Criteria:** Hypertensive patients who were willing to participate in the study.

**Exclusion Criteria:** Ocular diseases causing media haze such as corneal and lens opacities, and those with pregnancy-induced hypertension.

Participants underwent a structured clinical evaluation including a detailed ophthalmic examination. Data was collected on standardized proformas, which included sections for demographic details, medical history, and specific findings from ocular examinations. Detailed history was taken and complete ophthalmic examination including visual acuity testing, slit-lamp biomicroscopy examination, refraction, dilated fundus examination using an indirect ophthalmoscope and +90D lens and tonometry.

Hypertensive retinopathy was assessed and graded based on the Keith-Wagener classification during dilated fundus examinations using a +90D lens and indirect ophthalmoscopy.

Grade	Classification	Symptoms
Grade 1	Mild generalized retinal arteriolar narrowing.	No symptoms

Grade 2	Focal arteriolar narrowing and arteriovenous nicking. A 'copper wiring' opacified appearance of arteriolar walls may be seen.	Asymptomatic
Grade 3	Grade 2 plus retinal haemorrhages (dot, blot, flame), hard and soft exudated, macular star.	Symptomatic
Grade 4	Severe grade 3 plus optic disc swelling (malignant hypertension)	Reduced survival

**Statistical Methods**

Data analysis was performed using statistical software. Descriptive statistics such as means, standard deviations, and proportions were calculated for demographic and clinical variables. Chi-square tests were used to analyze the association between categorical variables, and logistic regression was used to adjust for potential confounders and to assess the risk factors associated with hypertensive retinopathy.

**Observations And Results**

Hypertension Classification (ACC/AHA 2017)

Patients were categorized as follows:

- Elevated BP: 120–129/<80 mmHg

- Stage 1 Hypertension: 130–139/80–89 mmHg
- Stage 2 Hypertension:  $\geq 140/\geq 90$  mmHg”

A progressive increase in mean grades of retinopathy was observed from elevated blood pressure, indicating worsening microvascular damage with increasing BP.

Prevalence of Hypertensive Retinopathy shows the overall prevalence of hypertensive retinopathy among 160 hypertensive patients.

A total prevalence of 15% was observed, which was statistically significant ( $p = 0.0123$ ). This indicates that a notable proportion of hypertensive patients already exhibit measurable retinal microvascular damage. The 95% CI (10%–20%) further supports the reliability of this prevalence estimate.

Table 2: Severity of Hypertensive Retinopathy in Relation to Duration of Hypertension

Duration of Hypertension	Mean Grade of Retinopathy (SD)	95% CI	P Value
1–5 years	0.5 (0.8)	0.1 to 0.9	0.0456
5–10 years	1.2 (1.0)	0.9 to 1.5	0.0334
10–15 years	2.0 (1.5)	1.4 to 2.6	0.0125
15–20 years	2.8 (1.3)	2.1 to 3.5	0.0056

Table 2 There is a clear progressive increase in mean retinopathy grade with longer duration of hypertension. Patients with 1–5 years of hypertension showed only mild changes, whereas those with 15–20 years had significantly higher grades (mean 2.8). All comparisons were statistically significant, indicating that prolonged hypertension strongly contributes to microvascular retinal damage.

**Association Between Hypertensive Retinopathy and Any Cardiovascular Risk Factor**

*(Significant association with presence of cardiovascular risk factors.)*

Patients without additional risk factors had a very low mean grade (0.3), while those with at least one risk factor had a significantly higher mean grade (1.8,  $p = 0.0013$ ).

This highlights the additive impact of cardiovascular co-morbidities on the severity of retinal involvement.

**Table 4: Association of Hypertensive Retinopathy with Diabetes Mellitus and Hyperlipidemia**

Co-Morbidity	Mean Grade of Retinopathy (SD)	P Value	Significance
Diabetes Mellitus – Present	2.1 (1.4)	0.001	Significant
Diabetes Mellitus – Absent	0.7 (0.8)	—	—
Hyperlipidemia – Present	1.9 (1.2)	0.013	Significant
Hyperlipidemia – Absent	0.8 (0.9)	—	—

Table 4 assesses the specific influence of Diabetes Mellitus and Hyperlipidemia on hypertensive retinopathy severity.

Both risk factors were found to be significantly associated with higher grades of retinopathy.

1. Diabetic patients showed the highest mean grade (2.1,  $p = 0.001$ ), suggesting a synergistic effect of hyperglycaemia and hypertension on retinal microvascular damage.
2. Hyperlipidaemic patients also had significantly higher mean grades (1.9,  $p = 0.013$ ), indicating that dyslipidaemia further accelerates vascular injury.

**Demographic and Clinical Predictors of Hypertensive Retinopathy**

Male patients had a higher severity (mean grade 2.0) compared to females (1.5), and this difference was statistically significant ( $p = 0.0023$  in males,  $p = 0.0256$  in females).

This suggests that male gender may be an independent risk factor for more advanced hypertensive retinopathy.

**Table 6: Grading of Hypertensive Retinopathy Among Affected Patients**

Grade of Hypertensive Retinopathy	Number of Patients	Percentage (%)	95% CI
Grade 1	12	50%	35% to 65%
Grade 2	8	33.3%	20% to 46.6%
Grade 3	3	12.5%	4% to 21%
Grade 4	1	4.2%	0% to 12%

Table 6 presents the distribution of hypertensive retinopathy grades among affected patients.

Half of the patients had Grade 1, representing mild disease, while Grade 2 accounted for 33.3%. Higher grades (Grade 3 and Grade 4) were less common but clinically significant, with 12.5% and 4.2% respectively. This distribution suggests that most patients presented with early-stage retinopathy, reinforcing the importance of routine screening for early detection.

## Discussion

This study provides a comprehensive assessment of the prevalence, severity, and determinants of hypertensive retinopathy among hypertensive patients, using the ACC/AHA 2017 hypertension classification system, which allows earlier identification of target-organ damage.<sup>[1,2]</sup> The overall prevalence of hypertensive retinopathy in this study was 15%, consistent with previous studies.<sup>[3,4,5]</sup> This finding indicates that nearly one in six hypertensive individuals already exhibits measurable microvascular retinal involvement, often before visual symptoms arise. The observed statistical significance ( $p = 0.0123$ ) reinforces the clinical relevance of this frequency. Comparable results have been reported by Fraser-Bell *et al.* and Dzedziak *et al.*, highlighting that early retinal changes remain a common but frequently under-recognized manifestation of systemic hypertension.<sup>[2,6]</sup>

A clear association was found between the severity of hypertensive retinopathy and the duration of hypertension. Patients with more than 15 years of hypertension demonstrated markedly higher retinopathy grades, with mean levels approaching Grade 3. This aligns with previous studies<sup>[10,15]</sup> suggesting that chronic exposure to elevated blood pressure results in cumulative endothelial dysfunction, arteriolar sclerosis, and progressive microvascular compromise.<sup>[7,8]</sup> Similar conclusions were drawn by Triantafyllou *et al.* and Mulè *et al.*, who reported escalating microvascular target-organ damage with increasing chronicity of hypertension.<sup>[9,10]</sup> These observations highlight the importance of both early diagnosis and consistent long-term blood pressure control to prevent irreversible retinal injury.

Cardiovascular risk factors were also shown to have a significant influence on retinopathy severity. Patient

comorbidities such as diabetes mellitus or hyperlipidemia exhibited substantially higher mean grades of retinopathy compared with those without risk factors. This supports the well-recognized concept that hypertensive retinopathy reflects generalized microvascular stress, and that additional systemic risk factors further amplify vascular injury.<sup>[11]</sup> Prior studies by Cheung *et al.* and Cremer *et al.* have similarly demonstrated that retinal microvascular signs correlate with a heightened risk of stroke, heart failure, and renal impairment, confirming the systemic implications of these fundus findings.<sup>[12,13]</sup>

Among the comorbidities evaluated, diabetes mellitus showed the strongest association with advanced retinopathy grades, supporting the dual-hit hypothesis wherein chronic hyperglycaemia and hypertension synergistically accelerate microvascular damage.<sup>[1,3]</sup> Hyperlipidemia also demonstrated a significant association with increased severity, consistent with evidence that dyslipidaemia enhances arteriosclerotic changes, promotes endothelial dysfunction, and contributes to lipid exudation within the retina.<sup>[10,15]</sup> Meta-analytic studies have confirmed that patients with both hypertension and hyperlipidemia experience earlier onset and faster progression of hypertensive retinopathy.<sup>[11]</sup> These findings emphasize the need for integrated management of both hypertension and metabolic disorders to mitigate ocular and systemic vascular complications.

Gender also emerged as an important determinant, with male patients exhibiting significantly higher grades of retinopathy compared to females. This finding is supported by earlier studies indicating that males generally show greater vulnerability to microvascular and metabolic vascular injury due to a combination of hormonal influences, behavioural factors, and inherent vascular differences.<sup>[14,15]</sup> Consequently, male hypertensive patients may require closer ophthalmic surveillance to detect early microvascular changes.

Although higher grades such as Grade 3 and Grade 4 retinopathy were less common in this study, their presence remains clinically significant because they reflect severe end-organ damage requiring urgent intervention. Most affected patients presented with early-stage retinopathy (Grades 1 and 2); a pattern consistent with other studies reporting that hypertensive retinopathy is frequently mild but

nonetheless predictive of systemic vascular morbidity.<sup>[11,12]</sup> The predominance of early changes reinforces the value of routine screening in enabling early intervention before progression to advanced disease.

Increasing blood pressure, longer duration of hypertension, presence of metabolic comorbidities, and male gender all contribute to more severe hypertensive retinopathy. Routine fundus screening should be especially emphasized for long-standing hypertensives, diabetics, hyperlipidemia, male gender and individuals with Stage 2 hypertension. Early identification of retinal microvascular injury offers an opportunity for timely systemic and ocular intervention, potentially preventing both visual impairment and major cardiovascular events.

### Conclusion

Hypertensive retinopathy is a well-recognized microvascular complication of systemic hypertension and is known to be associated with longer disease duration and metabolic comorbidities such as diabetes mellitus and dyslipidaemia. The present study adds data from a tertiary care centre, demonstrating a prevalence of 15% and a significant increase in retinopathy severity with longer duration of hypertension using the ACC/AHA 2017 classification. The study further highlights the combined influence of diabetes mellitus, hyperlipidemia, and male gender as significant predictors of more advanced retinopathy. The predominance of early-stage disease at presentation emphasizes the importance of routine fundus screening for timely detection. These findings support the need for integrated systemic and ophthalmic management to prevent progression and reduce the risk of visual and systemic complications.

### Limitations Of The Study

1. Single-center study: The study was conducted in a single tertiary care hospital, which may limit generalizability to broader or more diverse populations.
2. Potential confounding factors: Although the study assessed major metabolic risk factors (diabetes, hyperlipidemia), other contributors such as renal dysfunction, obesity, smoking, and antihypertensive medication type were not analysed in detail and may have influenced outcomes.

3. No assessment of treatment impact: Variations in blood pressure control strategies, medication adherence, or lifestyle modifications were not accounted for, limiting interpretation of how management patterns affect retinal findings.

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