

ORIGINAL ARTICLE

Frequency of Retinopathy in Diagnosed Patients of Hypertension

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ABSTRACT

Background: By definition, systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, measured on at least 2 separate occasions in a seated position during outpatient visits, irrespective of antihypertensive therapy, constitute hypertension. Persistent hypertension is associated with microvascular complications, including hypertensive retinopathy.

Objective: To determine the frequency of hypertensive retinopathy among diagnosed hypertensive patients presenting to a tertiary care hospital in Lahore.

Methods: We conducted a cross-sectional descriptive study in the Medical Outpatient Department (OPD) of Fatima Memorial Hospital, Lahore. A total of 260 diagnosed hypertensive patients were included. All participants underwent clinical evaluation, including fundoscopic examination, to assess for hypertensive retinopathy.

Results: Out of 260 patients, hypertensive retinopathy was identified in 189 (72.7%) patients, while 71 (27.3%) showed no evidence of retinal changes.

Conclusion: A high frequency of hypertensive retinopathy was observed among patients with hypertension. Routine dilated fundoscopic examination is recommended to detect early retinal changes, which may reduce morbidity and prevent systemic complications.

Keywords: Hypertension, Retinopathy, Fundoscopy

INTRODUCTION: Hypertension is defined as a systolic blood pressure greater than 140 mmHg and/or a diastolic blood pressure greater than 90 mmHg, measured on at least two separate occasions, with or without antihypertensive therapy. Persistent hypertension increases the risk of microvascular complications, including hypertensive retinopathy, making early detection essential. Pre-hypertension is characterized by a systolic blood pressure of 130–139 mmHg or a diastolic blood pressure of 80–89 mmHg. Hypertensive retinopathy refers to retinal and fundoscopic changes that occur in patients with hypertension and is commonly classified using the Keith–Wagener classification system. Uncontrolled hypertension can lead to vascular damage in multiple organs, including the eyes, where it manifests as hypertensive retinopathy. Early identification of retinal changes through fundoscopic examination, along with appropriate management strategies such as blood pressure control and dietary interventions like the DASH diet, may help reduce complications. [1-4] Hypertensive retinopathy was first described by Marcus Gunn in 1859, and the Keith–Wagener grading system was subsequently developed to classify the severity of retinal changes.[5] In a prospective study conducted by Shah et al. at Chandka Medical College Hospital, Larkana, from January to December 2010, 495 patients with primary hypertension were evaluated. Hypertensive retinopathy was detected in 45.1% of patients, while 54.9% showed no retinal changes. Among those affected, grade 1 retinopathy was observed in 48.4%, grade 2 in 31.8%, grade 3 in 16.1%, and grade 4 in 3.6% of cases.[6] The prevalence of hypertensive retinopathy varies among different populations; African Americans have approximately twice the prevalence compared with Whites. Reported prevalence rates are around 12% in European populations and 18% in Afro-Caribbean

populations, highlighting the importance of blood pressure control in high-risk groups.[7] Fundoscopy remains a simple, convenient, and noninvasive method for detecting hypertensive retinal changes, and clinical guidelines recommend regular dilated fundoscopic examinations for all hypertensive patients to facilitate early detection of retinal damage. The identification of hypertensive retinopathy is clinically significant because it reflects not only ocular involvement but also systemic target organ damage. [8-9] Several factors influence the progression of hypertensive retinopathy, including the duration of hypertension. One study reported an overall prevalence of 66.3%, with grade 1 and grade 2 retinopathy present in 33.6% and 32.7% of patients, respectively.[10] Given the high global burden of diabetes and the frequent coexistence of hypertension and diabetes, strict blood pressure control is necessary to minimize the progression of target organ damage. The present study was conducted to determine the frequency of hypertensive retinopathy among patients with hypertension presenting to a tertiary care hospital in Lahore. Patients were considered hypertensive if they had a previous diagnosis of hypertension, were taking regular antihypertensive medications, and had been attending outpatient follow-up for 3–5 years. Hypertensive retinopathy was diagnosed when fundoscopic examination revealed retinal changes corresponding to any grade of hypertensive retinopathy according to the Keith–Wagener classification. In this classification, grade 1 is characterized by tortuosity and increased reflectiveness of retinal arteries (silver wiring), grade 2 includes grade 1 changes along with arteriovenous nicking, grade 3 consists of grade 2 changes with flame-shaped haemorrhages and cotton wool spots, and grade 4 includes grade 3 changes with papilledema manifested by blurring of the optic disc margins. Grades 3 and 4 are indicative of malignant hypertension, a severe condition associated with a rapid rise in blood pressure, typically with a diastolic blood pressure exceeding 120 mmHg.

METHODS: This cross-sectional descriptive study was conducted in the Medical Outpatient Department (OPD) of Fatima Memorial Hospital, Lahore. The study commenced on October 23, 2023, and data collection was completed on April 22, 2024. Previously diagnosed hypertensive patients presenting to the Medical OPD and fulfilling the eligibility criteria were enrolled in the study. A total of 260 patients were included using a continuous sampling technique. Duration of hypertension was defined as the time interval, in completed years, from the first diagnosis of hypertension to the date of enrolment in the study. This information was obtained from the patient's clinical history and available outpatient records. Only patients with a duration of hypertension between 3 and 5 completed years were included. For analysis and presentation, the duration of hypertension was categorized into three groups: 3 years, 4 years, and 5 years.

Patients aged 30–65 years of either gender with a prior diagnosis of hypertension, as defined by the study's operational criteria, were eligible for inclusion. Age was recorded in completed years and initially analyzed as a continuous variable. For stratified descriptive analysis, participants were further categorized into relatively younger and older age groups using a cut-off value of 48 years. This cut-off was selected specifically for descriptive comparison of retinopathy frequency within the study population and was not intended to represent an established clinical or diagnostic threshold. Patients already diagnosed with hypertensive retinopathy, those with diabetic retinopathy, ocular conditions preventing adequate fundus examination such as corneal opacity or cataract, and hypertensive patients who were non-compliant with medication were excluded from the study. Following approval from the hospital's Ethics Committee (FMH-12-2013-IRB-833-M dated 26-09-2024) eligible patients were enrolled after obtaining written informed consent. Personal information, including name, age, sex, and address, was recorded, and a detailed history of hypertension was obtained. Fundoscopic examination was performed by the researcher and associates using a direct ophthalmoscope (HEINE BETA 200) after the instillation of mydriatic eye drops (Mydriacyl, tropicamide 1.0%; Alcon). To minimize diagnostic bias, all findings were subsequently confirmed by a consultant ophthalmologist. Data were collected using a structured proforma, and all study-related expenses were borne by the researcher.

Data analysis was performed using SPSS version 24.0. Quantitative variables, such as age, were summarized using mean and standard deviation, whereas qualitative variables, including sex and retinopathy status, were presented as frequencies and percentages. Stratification by age and sex was carried out to control for potential effect modifiers. Age was categorized using the 48-year cut-off solely for descriptive comparison and table presentation. The association between duration of hypertension and severity of hypertensive retinopathy was assessed using the Pearson chi-square test. Since both duration of hypertension and retinopathy grade were

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ordinal variables, a linear-by-linear association test and Spearman rank correlation were additionally applied to evaluate trends across increasing duration of hypertension and severity of retinopathy.

RESULTS: A total of 260 patients were included in this study. Among them, 85 (32.7%) were male, and 175 (67.3%) were female. The mean age was 51.38 ± 9.17 years (range, 30–65 years). The mean duration of hypertension was 4.12 ± 0.86 . Among the participants, 82 (31.5%) had hypertension for 3 years, 66 (25.4%) for 4 years, and 112 (43.1%) for 5 years. Hypertensive retinopathy was present in 189 (72.7%) patients, whereas 71 (27.3%) showed no retinal changes.

Distribution of retinopathy grades

- Grade 1: 96 (36.9%)
- Grade 2: 78 (30.0%)
- Grade 3: 15 (5.8%)

Categorical variables were presented as frequency and percentage. The association between categorical variables and presence of hypertensive retinopathy was assessed using the Pearson chi-square test. Fisher's exact test was used where expected cell counts were less than 5. A p-value <0.05 was considered statistically significant. Hypertensive retinopathy was significantly more frequent among patients aged >48 years compared with those aged <48 years (80.0% vs 58.9%, $p<0.001$). Although retinopathy was more frequent among males than females, this difference was not statistically significant (78.8% vs 69.7%, $p=0.122$).

Among male patients ($n=85$), 67 (78.8%) had hypertensive retinopathy, and 18 (21.2%) had no retinopathy. Among female patients ($n=175$), 122 (69.7%) had retinopathy, whereas 53 (30.3%) had no retinal changes.

Table I: Frequency of hypertensive retinopathy grades, along with duration of hypertension, age, and gender

Variable	Total patients n	Retinopathy present n (%)	Retinopathy absent n (%)	Statistical test	p-value
Age group				Pearson chi-square test	<0.001
<48 years	90	53 (58.9)	37 (41.1)		
>48 years	170	136 (80.0)	34 (20.0)		
Sex				Pearson chi-square test	0.122
Male	85	67 (78.8)	18 (21.2)		
Female	175	122 (69.7)	53 (30.3)		

Values are presented as frequency and percentage. Percentages were calculated row-wise. The Pearson chi-square test was used to assess the association between categorical variables and the presence of hypertensive retinopathy. One p-value is reported for each overall comparison, rather than separately for each category row. A p-value <0.05 was considered statistically significant.

Table II: Grades of hypertensive retinopathy along with duration of hypertension in males and females

Grade of hypertensive retinopathy	Duration of hypertension	Male n (%)	Female n (%)	Total n (%)
	3 years	7 (24.1)	22 (75.9)	29 (11.2)
	4 years	6 (26.1)	17 (73.9)	23 (8.8)
	5 years	5 (26.3)	14 (73.7)	19 (7.3)
	Total	18 (25.4)	53 (74.6)	71 (27.3)

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Grade of hypertensive retinopathy	Duration of hypertension	Male n (%)	Female n (%)	Total n (%)
Grade I	3 years	9 (32.1)	19 (67.9)	28 (10.8)
	4 years	10 (41.7)	14 (58.3)	24 (9.2)
	5 years	11 (25.0)	33 (75.0)	44 (16.9)
	Total	30 (31.2)	66 (68.8)	96 (36.9)
Grade II	3 years	9 (42.9)	12 (57.1)	21 (8.1)
	4 years	4 (22.2)	14 (77.8)	18 (6.9)
	5 years	14 (35.9)	25 (64.1)	39 (15.0)
	Total	27 (34.6)	51 (65.4)	78 (30.0)
Grade III	3 years	2 (50.0)	2 (50.0)	4 (1.5)
	4 years	0 (0.0)	1 (100.0)	1 (0.4)
	5 years	8 (80.0)	2 (20.0)	10 (3.8)
	Total	10 (66.7)	5 (33.3)	15 (5.8)
Overall	3 years	27 (32.9)	55 (67.1)	82 (31.5)
	4 years	20 (30.3)	46 (69.7)	66 (25.4)
	5 years	38 (33.9)	74 (66.1)	112 (43.1)
	Total	85 (32.7)	175 (67.3)	260 (100.0)

Values are presented as frequency and percentage. Male and female percentages were calculated row-wise within each grade-duration category. Total percentages were calculated using the overall study population as the denominator, n=260. Percentages were rounded to one decimal place; therefore, minor differences in totals may occur due to rounding. A statistically significant association was observed between duration of hypertension and severity of hypertensive retinopathy. Patients with a longer duration of hypertension showed a greater frequency of higher-grade retinopathy. Using the Pearson chi-square test, this association was statistically significant, $\chi^2 = 13.74$, $p = 0.033$. A weak but significant positive ordinal association was also observed between duration of hypertension and retinopathy grade using Spearman rank correlation, $\rho = 0.186$, $p = 0.003$.

DISCUSSION: This study aimed to determine the frequency of retinopathy among patients with diagnosed hypertension. Early-stage hypertensive retinopathy serves as a marker of target-organ damage. Early detection of retinopathy can assist physicians in identifying end-organ damage and preventing hypertension-related complications, such as ischemic heart disease and stroke. All patients included in our study were aged between 30 and 65 years, consistent with the age range used in most comparable studies. Age is an important factor impacting outcomes in hypertensive patients with retinopathy; as age increases, the likelihood of developing retinopathy also increases, as demonstrated by Zakria et al [11]. Grade 1 retinopathy was observed in 96 (36.9%) patients, grade 2 in 78 (30.0%), and grade 3 in 15 (5.8%). No cases of grade 4 retinopathy were identified. These findings are comparable to those reported by Zakria et al [11] in which only a small number of patients had grade 4 retinopathy. The absence of grade 4 retinopathy in this study may be attributed to the restricted age range (30–65 years) and limited duration of hypertension (3–5 years). In contrast, Zakria et al. included patients aged 20–85 years, with no restriction on hypertension duration, and included those with irregular antihypertensive medication use. Most patients in this study had grade 1 (36.9%) and grade 2 (30.0%) retinopathy, consistent with findings reported by Zakria et al [11]. Additionally, Gupta et al [12] reported a prevalence of hypertensive retinopathy of 69%, which is comparable to the present finding of 72.7%. Increasing age and longer duration of hypertension were associated with a higher likelihood of developing retinopathy. In this study, 80% of patients aged ≥ 48 years had retinopathy. Similarly, Gupta et al [12] observed that retinopathy

was predominantly present in patients in the sixth decade of life. The association between sex and retinopathy was not statistically significant ($p = 0.122$), consistent with findings reported by Gupta et al [12]. Khan A et al [13] reported that most patients had grade 1 (21.1%) and grade 2 (25.8%) hypertensive retinopathy. Similarly, this study showed retinopathy rates of 36.9% (grade 1), 30.0% (grade 2), and 5.8% (grade 3). These differences may be explained by variations in study design: Khan et al. included patients across all age groups and hypertension durations, whereas this study defined specific age and hypertension duration limits. Khan A et al [13] also reported that only 3 (1.5%) patients had grade 4 retinopathy. In contrast, no patients in this study had grade 4 retinopathy. This difference may be due to the inclusion of patients with a longer disease duration in their study. A study conducted in Sweden by Henderson et al [14] on a Caucasian population reported a prevalence of hypertensive retinopathy of 54.83%, compared to 72.7% in the present study. This difference may be attributed to differences in study populations, as their study included patients at high risk of stroke or with an existing stroke, whereas the present study included patients with a defined duration of hypertension. Similarly, Klein et al [9] reported a prevalence of 68.5% in the Beaver Dam population, which is comparable to the present results. A study conducted in Birmingham among patients with malignant hypertension reported grade 4 retinopathy in 47.5% and grade 3 retinopathy in 15.5% of patients. This difference is expected, as that study focused exclusively on patients with malignant hypertension, whereas the present study included patients with varying severities of hypertension. Meenakshisundaram et al [15] reported hypertensive retinopathy in 69% of patients, while Erden et al [16] reported a prevalence of 66.3%, both of which are comparable to our finding of 72.7%. Cuspidi C et al [17] reported that 32% of patients had grade 2 hypertensive retinopathy, a finding similar to that in the present study (30.0%). They also reported that fewer than 2% of patients had grade 4 retinopathy, whereas no cases were observed in this study. This difference may be due to the larger sample size in their study (800 patients) compared to the present study (260 patients). Retinopathy was present in 31.8% of hypertensive patients, which is comparable to our finding of 30.0%. They also observed that patients with less than 10 years of hypertension did not exhibit grade 4 retinopathy, consistent with our findings. When comparing retinopathy grades within similar durations of hypertension, Shah AH et al [6] reported grade 1 retinopathy in 54.4% and grade 2 in 45.6% of patients. In contrast, the present study reported grade 1 in 36.9% and grade 2 in 30.0%. This difference may be attributed to stricter duration criteria (3–5 years) in the present study, whereas Shah AH et al. included patients with a duration of less than 10 years. Multiple studies support that the prevalence and severity of hypertensive retinopathy increase with longer duration of hypertension [11,12]. Retinopathy in patients with hypertension reflects widespread vascular damage and is associated with increased risk of cardiovascular and cerebrovascular morbidity and mortality. Therefore, a comprehensive evaluation of hypertensive patients is essential. Increased awareness among physicians and the general public regarding blood pressure control and its complications is necessary. Early detection of hypertensive retinopathy through routine fundoscopy can help identify end-organ damage and reduce the risk of adverse outcomes. Our study is a single-center study with a relatively small sample size, which is its main limitation. Given the high prevalence of hypertension in the general population, these findings may not be generalizable to the wider population. Regional variations may also exist.

Recommendations: Multicenter studies with larger sample sizes can better estimate the burden of hypertensive retinopathy. Additionally, increased awareness among physicians is necessary to facilitate early detection of retinal changes in collaboration with ophthalmologists.

CONCLUSION: This study demonstrated a high frequency of hypertensive retinopathy among diagnosed hypertensive patients attending a tertiary care hospital in Lahore, with most cases showing early-grade retinal changes. Retinopathy was significantly more common in older patients and showed a significant positive association with longer duration of hypertension and increasing severity of retinal involvement. These findings emphasize the importance of routine fundoscopic screening in hypertensive patients for early detection of target-organ damage and timely intervention to reduce ocular, cardiovascular, and cerebrovascular complications.

Multicenter studies with larger sample sizes can better estimate the burden of hypertensive retinopathy. Additionally, increased awareness among physicians is necessary to facilitate early detection of retinal changes in collaboration with ophthalmologists.

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