



Association of hypertension and dyslipidemia with progression of DR (Diabetic Retinopathy).

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Abstract

Background

Diabetic Retinopathy (DR) is a major microvascular complication of Diabetes Mellitus (DM) and a leading cause of vision loss. Hypertension and dyslipidemia have been identified as modifiable risk factors that may accelerate DR progression.

Methodology

A hospital-based cross-sectional study was conducted among 200 diabetic patients at G.M.C.H., Purnea, from January to December 2024. Participants underwent clinical, ophthalmic, and laboratory evaluations. DR was graded using the ETDRS classification. Lipid abnormalities and hypertension were assessed as per standard guidelines. Data were analyzed using SPSS version 25

Results

The prevalence of DR was 43%. Hypertension (61%) and dyslipidemia (54%) were significantly associated with DR ($p < 0.05$). Patients with both conditions showed a higher frequency of moderate-to-severe DR. Logistic regression revealed hypertension (OR 2.41, $p = 0.006$) and dyslipidemia (OR 1.97, $p = 0.032$) as independent predictors, with combined presence increasing risk more than threefold (OR 3.64, $p = 0.002$).

Conclusion

Hypertension and dyslipidemia are significant risk factors for the progression of diabetic retinopathy. Comprehensive management of blood pressure, lipid profile, and glycemic control is essential to reduce vision-threatening complications in diabetic patients.

Recommendation

Regular screening for lipid and blood pressure abnormalities should be integrated into diabetes care programs to prevent or slow DR progression.

Keywords: Diabetic Retinopathy, Hypertension, Dyslipidemia, Diabetes Mellitus, Risk Factors.

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Background of the study

Diabetes Mellitus (DM) is a metabolic disorder with hyperglycemia as a major distinctive characteristic. There is also a complication of DM called "Diabetic Retinopathy" (DR), which is classified as one of the most common microvascular complications of DM and listed as a major cause of irreversible blindness among working aged population [1,2]. Diabetic Retinopathy, however, progresses as damages are inflicted to the microvasculature of the retina, which is then manifested as microaneurysms and

hemorrhages, exudates, neovascularization, and even macular edema, where the proliferative stage of DR is developed [3]. The approximate prevalence of Diabetic Retinopathy in the world is about 35%, with 7% of the population having macular edema and 7% fitted with proliferative DR [2]. The DR of an individual is not just determined by the duration of diabetes and hyperglycemia. The Setheim comorbidities (systemic vascular) diabetes, for instance, hypertension, and dyslipidemia, also contribute to the onset and progress of the complications [4,5]. Diabetic



hypertension also causes DR through endothelial malfunction, shear stress, and poor autoregulation damage to the retinal capillaries [6]. In type 2 diabetes, the UKPDS showed that strict management of hypertension led to reduced vision loss and DR [7]. In addition, it was shown that elevated systolic hypertension was directly proportional to the rate of DR, including the rate of progression [8,9].

Another significant metabolic condition associated with diabetes that contributes to the etiology of diabetic retinopathy (DR) is dyslipidemia. The development of retinal hard exudates, the disruption of the blood-retinal barrier, and oxidative endothelium degradation are linked to elevated levels of total cholesterol and triglycerides, LDL cholesterol, and low levels of HDL cholesterol [10]. Abnormal lipid levels have been linked in numerous studies to the severity of DR [11,12]. Furthermore, lipid-lowering drugs such as fibrates and statins seem to decrease the progression of DR and lessen the requirement for laser photocoagulation [13,14]. The prevalence of diabetes is rising quickly in India, as are the vascular problems linked to the disease, particularly when hypertension and dyslipidemia are combined, which exacerbates DR [15]. Hence, the need to target these modifiable risk factors in the decline of DR is more important than ever. The present study seeks to determine the relationship between hypertension, dyslipidemia, and the progression of diabetic retinopathy. The results of this study will help understand the effect of these systemic vascular factors in the progression of DR and help to plan early and integrated approaches to prevent vision loss in diabetic patients in this area.

Methodology

Study Design and Setting

From January 2024 to December 2024, a hospital-based observational cross-sectional study will be conducted at the Ophthalmology and Medicine Departments of G.M.C.H., Purnea, Bihar, to evaluate the impact of hypertension and dyslipidemia on the development of diabetic retinopathy (DR) in diabetic patients. If they meet the inclusion criteria and grant their agreement, people with type 1 and type 2 diabetes will be the study's primary focus.

Study Population

The study population will consist of patients aged 30 years and above with a confirmed diagnosis of diabetes mellitus. Only patients with a clear, gradable DR assessment will be enrolled. Those with other retinal vascular diseases, ocular

conditions causing fundus obscuration, systemic diseases that target lipid metabolism, and hypertension regulation will be excluded. Patients who recently started lipid-lowering or antihypertensive therapy (within three months) will also be excluded.

Sample Size and Sampling Technique

Sample size will be calculated with 35% of the population having DR, within 95% confidence interval, and a margin of error of 5% to get a minimum sample size of 200 to get statistically unbiased results. The study population will be identified from the outpatient department during the study period.

Ethical Considerations

Data collection will begin only after the study protocol passes the review process of the Institutional Ethics Committee of G.M.C.H., Purnea. Every participant will be informed of the study's objectives and scope, and the study will gain informed written consent from them. Documentation will ensure the participant's information remains confidential, and the study will follow the ethical guidelines of the Declaration of Helsinki.

Clinical and Ophthalmic Evaluation

Interviews and clinical examinations of the individuals will form the basis of the study. Age, sex, and length of diabetes are examples of axial demographic data. In accordance with JNC 8 recommendations, systolic and diastolic blood pressure will be measured and categorized as hypertensive. Following five minutes of relaxation and comfortable sitting, the participant's blood pressure will be taken using a suitable cuff. Every study participant will undergo a thorough ophthalmic evaluation, which will include determining their best-corrected visual acuity, performing a slit-lamp examination, measuring their intraocular pressure, and performing a dilated fundus examination using both direct and indirect ophthalmoscopy. Fundus photography will also be necessary. The ETDRS classification system will be used to evaluate diabetic retinopathy. A less severe classification of diabetic retinopathy will be devoid of or no diabetic retinopathy. The more severe classification is proliferative diabetic retinopathy.

Laboratory Investigations

A blood sample must be fasted for 8 to 12 hours overnight in order to perform a lipid profile. Total cholesterol, triglycerides, low-density lipoprotein cholesterol (LDL-C),



and high-density lipoprotein cholesterol (HDL-C) are among the biochemical components that will be evaluated. The National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) guidelines state that overall dyslipidemia is defined as having triglycerides of at least 150 mg/dL, cholesterol of at least 200 mg/dL, LDL-C of at least 130 mg/dL, and HDL-C of less than 40 mg/dL in men and less than 50 mg/dL in women.

Data Analysis

Data collected will be entered into Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS) 25.0 version. Demographic and clinical factors will be summarized using descriptive statistics, where continuous values will be represented as mean $\pm$ standard deviation and categorical data as frequencies and percentages. Continuous variables will be compared using the independent t-test or one-way ANOVA, while categorical variables will be compared using the chi-square test. By controlling for confounding variables such as age, sex, length of diabetes, and glycemic management,

multivariate logistic regression will be used to examine the association between hypertension, dyslipidemia, and the severity of DR. A p-value of less than 0.05 will be considered statistically significant.

Results

Demographic and Clinical Profile

The study, which was carried out at G.M.C.H., Purnea, between January 2024 and December 2024, involved 200 individuals with diabetes mellitus. Participants ranged in age from 32 to 78 years old, with a mean age of 56.2 ± 9.4 years. The male-to-female ratio was 1.2:1, with 108 (54%) of the total being male and 92 (46%) being female.

The average duration of diabetes was 10.3 ± 5.6 years, and there was a strong correlation ($p < 0.001$) between the existence of diabetic retinopathy and longer duration. Participants' average fasting blood glucose level was 166.7 ± 44.3 mg/dL.

Table 1. Baseline characteristics of study participants (n = 200)

Parameter	Total (n=200)	With DR (n=86)	Without DR (n=114)	p-value
Age (years)	56.2 ± 9.4	59.8 ± 8.6	53.5 ± 9.7	0.012*
Gender (M: F)	1.2: 1	1.3: 1	1.1: 1	0.274
Duration of diabetes (years)	10.3 ± 5.6	13.6 ± 6.2	8.1 ± 4.8	<0.001*
Fasting blood glucose (mg/dL)	166.7 ± 44.3	178.9 ± 46.5	157.2 ± 41.1	0.016*
HbA1c (%)	8.2 ± 1.4	8.9 ± 1.6	7.7 ± 1.2	0.002*

*Statistically significant ($p < 0.05$)

Prevalence of Hypertension, Dyslipidemia, and Diabetic Retinopathy

Out of 200 patients, 122 (61%) had hypertension and 108 (54%) had dyslipidemia. The overall prevalence of diabetic

retinopathy (DR) was 43% ($n = 86$). Patients with hypertension and dyslipidemia showed a significantly higher occurrence of DR compared to those without these conditions ($p < 0.05$).

Table 2. Distribution of hypertension and dyslipidemia among participants

Risk Factor	Total (n=200)	With DR (n=86)	Without DR (n=114)	p-value
Hypertension present	122 (61%)	64 (74%)	58 (51%)	0.003*
Dyslipidemia present	108 (54%)	58 (67%)	50 (44%)	0.008*
Both hypertension and dyslipidemia	78 (39%)	49 (57%)	29 (25%)	0.001*

*Statistically significant ($p < 0.05$)



The prevalence of DR was notably higher among patients with both hypertension and dyslipidemia (57%) than in those without either condition (25%), indicating a possible synergistic effect on disease progression.

Among the 86 patients diagnosed with DR, 25 (28.9%) had mild non-proliferative DR (NPDR), 32 (37.2%) had moderate NPDR, 18 (20.9%) had severe NPDR, and 11 (13%) had proliferative DR (PDR). The majority of patients with moderate-to-severe DR had a history of both hypertension and dyslipidemia.

Severity of Diabetic Retinopathy

Table 3. Severity of DR among hypertensive and dyslipidemic patients

Stage of DR	Total (n=86)	Hypertensive (n=64)	Non-hypertensive (n=22)	Dyslipidemic (n=58)	Normal lipid (n=28)
Mild NPDR	25 (28.9%)	14 (21.9%)	11 (50.0%)	14 (24.1%)	11 (39.3%)
Moderate NPDR	32 (37.2%)	27 (42.2%)	5 (22.7%)	25 (43.1%)	7 (25.0%)
Severe NPDR	18 (20.9%)	15 (23.4%)	3 (13.6%)	13 (22.4%)	5 (17.9%)
Proliferative DR	11 (13.0%)	8 (12.5%)	3 (13.6%)	6 (10.4%)	5 (17.9%)

The trend demonstrated that hypertensive and dyslipidemic patients were more likely to develop moderate-to-severe forms of DR compared to their normotensive and normolipidemic counterparts.

Lipid Profile in Relation to Diabetic Retinopathy

Patients with DR had significantly higher mean total cholesterol, LDL, and triglyceride levels compared to those without DR, while HDL levels were lower in the DR group.

Table 4. Comparison of lipid profile among patients with and without DR

Lipid Parameter (mg/dL)	With DR (n=86)	Without DR (n=114)	p-value
Total Cholesterol	211.3 ± 32.7	186.2 ± 28.9	0.001*
LDL Cholesterol	132.8 ± 27.5	115.6 ± 23.8	0.004*
HDL Cholesterol	38.9 ± 6.7	45.3 ± 7.2	0.002*
Triglycerides	182.4 ± 44.5	157.8 ± 36.1	0.006*

**Statistically significant (p < 0.05)*

These findings support the hypothesis that lipid abnormalities contribute to retinal vascular damage and DR progression.

Multivariate logistic regression analysis was performed to identify independent predictors of DR. After adjusting for age, sex, and duration of diabetes, both hypertension and dyslipidemia remained significant independent risk factors.

Association of Risk Factors with DR Progression (Multivariate Analysis)

Table 5. Logistic regression analysis showing association with DR

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Duration of diabetes (>10 years)	3.12	1.68–5.81	0.001*
HbA1c (>8%)	2.54	1.35–4.76	0.004*
Hypertension	2.41	1.28–4.52	0.006*



Dyslipidemia	1.97	1.05–3.68	0.032*
Both hypertension and dyslipidemia	3.64	1.72–7.13	0.002*

**Statistically significant (p < 0.05)*

The presence of both hypertension and dyslipidemia increased the risk of DR progression by more than threefold, indicating that simultaneous control of these modifiable risk factors may reduce DR progression rates significantly.

Discussion

This hospital-based study at G.M.C.H., Pune, showed a strong correlation between the development of diabetic retinopathy (DR), hypertension, and dyslipidemia. DR was more common and more severe in patients with high blood pressure and abnormal cholesterol levels than in those with regulated systemic parameters. The results show that retinal microvascular degeneration is accelerated by a longer duration of diabetes, inadequate glycemic control, and related vascular risk factors. Thus, systemic comorbidities and chronic hyperglycemia both have an impact on the development of DR. Through appropriate control of blood pressure, blood sugar, and cholesterol, diabetics can significantly lower their risk of developing vision-threatening issues.

Both dyslipidemia and hypertension were revealed to be substantially linked to DR in the current investigation. Patients with hypertension had a 74% prevalence of DR, while those with dyslipidemia had a 67% prevalence. This pattern is consistent with prior research that found elevated systolic and diastolic blood pressure to be a powerful predictor of the progression of DR [16,8]. According to data from the UK Prospective Diabetes Study (UKPDS), strict blood pressure management reduced the requirement for laser therapy by 47% and the rate of DR progression by 34% [7]. Through elevated capillary pressure, endothelial dysfunction, and oxidative stress, hypertension exacerbates retinal microvascular damage, which ultimately leads to ischemia and vascular leakage [17].

The **combined effect** of hypertension and dyslipidemia in this study increased the odds of developing advanced DR by over threefold. This agrees with previous research suggesting that multiple metabolic abnormalities act synergistically to accelerate retinal vascular damage [9,3]. The combination of high blood pressure and abnormal lipid levels amplifies endothelial damage, promotes inflammation, and impairs retinal autoregulation, thereby increasing the severity of DR.

In the current investigation, dyslipidemia by itself was also found to be independently linked to the advancement of DR. Triglycerides, LDL cholesterol, and total cholesterol were all noticeably higher in DR patients, but HDL cholesterol was decreased. These findings are in line with past research that connected lipid abnormalities to the development of retinal hard exudate and macular edema [18]. Fenofibrate-based lipid-lowering therapy has been shown in clinical trials like the FIELD and ACCORD Eye studies to decrease the requirement for laser treatment and postpone the progression of DR [19,20].

Patients with DR exhibited higher HbA1c levels and a longer period of diabetes (mean 13.6 years), indicating that glycemic control and diabetes duration were important factors of DR. The cumulative impact of long-term hyperglycemia on the retinal microvasculature, which results in capillary nonperfusion, thicker basement membrane, and pericyte loss, is supported by this connection [21–23].

Comparison with other Indian studies revealed similar prevalence rates and patterns of DR. Studies from South India and Western India also reported prevalence between 28–45% [24,25]. The slightly higher rate in this study could be attributed to regional lifestyle, poor control of systemic risk factors, and limited awareness.

The results reinforce the importance of **multifactorial intervention** in diabetic patients. Along with optimal glycemic control, management of hypertension and dyslipidemia should be prioritized to reduce DR progression. Integrated management strategies, regular retinal screening, and patient education can substantially reduce visual complications. These findings align with recommendations from the American Diabetes Association, which advocates comprehensive care to prevent both microvascular and macrovascular complications [26].

Although the present study provides valuable insight, it is limited by its hospital-based and cross-sectional design, which restricts the ability to establish causal relationships. Nevertheless, the strong statistical association supports the role of hypertension and dyslipidemia as key modifiable risk factors influencing the course of diabetic retinopathy.



Conclusion

This hospital-based study at G.M.C.H., Pune, showed a strong correlation between the development of diabetic retinopathy (DR), hypertension, and dyslipidemia. DR was more common and severe in patients with high blood pressure and aberrant cholesterol levels than in those with regulated systemic parameters. The results show that coexisting vascular risk factors, poor glycemic control, and longer diabetes duration all contribute to an acceleration of retinal microvascular damage. As a result, systemic comorbidities and chronic hyperglycemia both affect how DR develops. Patients with diabetes can significantly lower their risk of vision-threatening complications by effectively controlling their blood pressure, blood sugar, and cholesterol levels.

Recommendation

Strict blood glucose, blood pressure, and lipid profile control are essential components of comprehensive diabetes therapy because they can stop or slow the development of diabetic retinopathy. For early identification and prompt treatment, all diabetic patients should have routine eye exams, ideally once a year. It is important to promote lifestyle changes like eating a balanced diet, exercising frequently, controlling one's weight, and quitting smoking. For high-risk people, pharmacological therapies utilizing lipid-lowering and antihypertensive medications should be used judiciously. Furthermore, to improve early diagnosis, increase patient compliance, and lessen the overall burden of diabetes blindness, community-based screening programs and awareness campaigns are crucial.

List of Abbreviations

DR: Diabetic Retinopathy
DM: Diabetes Mellitus
UKPDS: United Kingdom Prospective Diabetes Study
LDL: Low-Density Lipoprotein
HDL: High-Density Lipoprotein
NPDR: Non-Proliferative Diabetic Retinopathy
PDR: Proliferative Diabetic Retinopathy
ETDRS: Early Treatment Diabetic Retinopathy Study
NCEP-ATP III: National Cholesterol Education Program – Adult Treatment Panel III
JNC 8: Eighth Joint National Committee (Guidelines for Hypertension)
SPSS: Statistical Package for the Social Sciences
HbA1c: Glycated Hemoglobin
OR: Odds Ratio

CI: Confidence Interval

FIELD: Fenofibrate Intervention and Event Lowering in Diabetes

ACCORD: Action to Control Cardiovascular Risk in Diabetes

ADA: American Diabetes Association

G.M.C.H: Government Medical College and Hospital

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

All authors equally contributed to the manuscript.

References

1. World Health Organization. World Report on Vision. Geneva: WHO; 2023.
2. Yau JWY, Rogers SL, Kawasaki R, et al. Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care*. 2012;35(3):556-564. <https://doi.org/10.2337/dc11-1909>
3. Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. *Lancet*. 2010;376(9735):124-136. [https://doi.org/10.1016/S0140-6736\(09\)62124-3](https://doi.org/10.1016/S0140-6736(09)62124-3)
4. Zhang X, Saaddine JB, Chou CF, et al. Prevalence of diabetic retinopathy in the United States, 2005-2008. *BMJ Open Diabetes Res Care*. 2017;5(1):e000437.
5. Raman R, Rani PK, Gnanamoorthy P, et al. Risk factors for diabetic retinopathy in self-reported type 2 diabetes: Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetic Study (SN-DREAMS, report 2). *Indian J Ophthalmol*. 2020;68(Suppl 1): S36-S41.
6. Wong TY, Klein R, Klein BEK, et al. Retinal vessel diameters and their associations with age and blood pressure. *N Engl J Med*. 2008;359:221-232.
7. UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. *BMJ*. 1998;317:703-713. <https://doi.org/10.1136/bmj.317.7160.703>
8. van Hecke MV, Dekker JM, Nijpels G, et al. Inflammation and endothelial dysfunction are



- associated with retinopathy: the Hoom Study. *Diabetologia*. 2009;52(7):1199-1209.
9. Stratton IM, Kohner EM, Aldington SJ, et al. UKPDS 50: risk factors for incidence and progression of retinopathy in type 2 diabetes over 6 years. *Diabetologia*. 2001;44(2):156-163. <https://doi.org/10.1007/s001250051594>
10. Miller RG, Anderson SJ, Costacou T, et al. Risk factors for proliferative diabetic retinopathy in the Pittsburgh Epidemiology of Diabetes Complications Study. *Diabetes Care*. 2013;36(9):2610-2617.
11. Chew EY, Davis MD, Danis RP, et al. The effects of medical management on the progression of diabetic retinopathy in persons with type 2 diabetes: The ACCORD Eye Study. *Ophthalmology*. 2014;121(12):2443-2451. <https://doi.org/10.1016/j.ophtha.2014.07.019>
12. Sasongko MB, Wong TY, Nguyen TT, et al. Serum apolipoproteins are associated with systemic and retinal microvascular function in type 2 diabetes. *Ophthalmology*. 2011;118(5):1033-1039.
13. Keech AC, Mitchell P, Summanen PA, et al. Effect of fenofibrate on the need for laser treatment for diabetic retinopathy (FIELD study). *Lancet*. 2007;370:1687-1697. [https://doi.org/10.1016/S0140-6736\(07\)61607-9](https://doi.org/10.1016/S0140-6736(07)61607-9)
14. ACCORD Eye Study Group. Effects of medical therapies on retinopathy progression in type 2 diabetes. *N Engl J Med*. 2010;363(3):233-244. <https://doi.org/10.1056/NEJMoa1001288>
15. Rema M, Premkumar S, Anitha B, et al. Prevalence of diabetic retinopathy in urban India: The Chennai Urban Rural Epidemiology Study (CURES) Eye Study, I. *Diabet Med*. 2005;22(8):1141-1148. <https://doi.org/10.1167/iov.05-0019>
16. Klein R, Klein BE, Moss SE, Davis MD, DeMets DL. The Wisconsin Epidemiologic Study of Diabetic Retinopathy: IV. Diabetic retinopathy in type 1 diabetes. *Arch Ophthalmol*. 1984;102(4):520-526. <https://doi.org/10.1001/archophth.1984.01040030398010>
17. Wong TY, Klein R, Klein BE, Tielsch JM, Hubbard LD, Nieto FJ. Retinal microvascular abnormalities and their relationship with hypertension. *N Engl J Med*. 2004;351(8):710-720.
18. Miller RG, Anderson SJ, Costacou T, Sekikawa A, Orchard TJ. Lipids and the progression of diabetic retinopathy in type 1 diabetes: The Pittsburgh Epidemiology of Diabetes Complications Study. *Diabetes Care*. 2013;36(9):2610-2617.
19. Keech AC, Mitchell P, Summanen PA, O'Day J, Davis TM, Moffitt MS, et al. Effect of fenofibrate on the need for laser treatment for diabetic retinopathy (FIELD study): A randomised controlled trial. *Lancet*. 2007;370(9600):1687-1697. [https://doi.org/10.1016/S0140-6736\(07\)61607-9](https://doi.org/10.1016/S0140-6736(07)61607-9)
20. ACCORD Eye Study Group; Chew EY, Ambrosius WT, Davis MD, Danis RP, Gangaputra S, et al. Effects of medical therapies on retinopathy progression in type 2 diabetes. *N Engl J Med*. 2010;363(3):233-244. <https://doi.org/10.1056/NEJMoa1001288>
21. Mohamed Q, Gillies MC, Wong TY. Management of diabetic retinopathy: A systematic review. *JAMA*. 2007;298(8):902-916. <https://doi.org/10.1001/jama.298.8.902>
22. Klein R, Klein BEK, Moss SE. The Wisconsin Epidemiologic Study of Diabetic Retinopathy: XV. The 15-year incidence and progression of diabetic retinopathy and associated risk factors. *Ophthalmology*. 1998;105(10):1801-1815. [https://doi.org/10.1016/S0161-6420\(98\)91020-X](https://doi.org/10.1016/S0161-6420(98)91020-X)
23. Kowluru RA, Chan PS. Oxidative stress and diabetic retinopathy. *Exp Diabetes Res*. 2007;2007:43603. <https://doi.org/10.1155/2007/43603>
24. Raman R, Rani PK, Reddi Rachepalle S, Gnanamoorthy P, Uthra S, Kumaramanickavel G, et al. Prevalence of diabetic retinopathy in India: Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetic Study (SN-DREAMS). *Ophthalmology*. 2009;116(2):311-318. <https://doi.org/10.1016/j.ophtha.2008.09.010>
25. Gadkari SS, Maskati QB, Nayak BK. Prevalence of diabetic retinopathy in India: The All India Ophthalmological Society diabetic retinopathy eye screening study 2014. *Indian J Ophthalmol*. 2016;64(1):38-44. <https://doi.org/10.4103/0301-4738.178144>
26. American Diabetes Association. Standards of Medical Care in Diabetes-2024. *Diabetes Care*. 2024;47(Suppl 1):S1-S170.



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