Sarcouncil Journal of Medical Sciences

ISSN(Online): 2945-3526

Volume- 04| Issue- 08| 2025

Research Article **Received:** 10-07-2025 | **Accepted:** 30-07-2025 | **Published:** 18-08-2025

Epidemiology and Risk Factors of Diabetic Retinopathy: A Comprehensive Review

Dr. Omar Salim Mahmood[1] and Dr. Yaser A. R. Nasser Al-Khafaji[2]

[1]M.B.Ch.B., F.I.B.M.S.\ (Ophthalmology), Department of Surgery, College of Medicine, Mustansiriyah University, Baghdad, Iraq.

[2]M.B.Ch.B., CABOph, FRCS \ (Ophthalmology), Department of Surgery, College of Medicine, Mustansiriyah University, Baghdad, Iraq.

Abstract: Diabetic retinopathy (DR) is the most common complication of diabetes mellitus, and it is one of the leading causes of vision impairment and blindness in working-age adults of the world. This systematic review attempts to pool current data from relevant recent meta-analyses and systematic reviews on the epidemiology and risk factors of DR. It is estimated that approximately 22% of the world's population with diabetes suffers from DR; this also varies markedly between regions most at risk predominantly in Africa and North America, whereas least in South and Central America. There is likely to be an overwhelming increase in DR burden by 2045, accompanying the increase in the cases of diabetes and extended patient survival. Commonly known causes are usually poor glycemic control (increased level of HbA1c), longer durations of diabetes, hypertension, and dyslipidemia, and increased levels of triglycerides. Additional factors include age, ethnicity, obesity, and compliance with medicines, which impact the risk of DR. Ethnic disparities reflect the intricate dynamics of genetic as well as environmental interactions. Heterogeneity in methodologies has been another source of variability in findings reported by various studies, including the differences in study design, diagnostic criteria, and characteristics of populations. The review greatly emphasizes the critical aspects of early detection through regular screening and comprehensive management of metabolic and vascular risk factors in preventing vision loss. It frays the very need for region-specific strategies and standardized protocols in dealing with the gaps existing in DR prevalence as well as outcomes. This review will ultimately become a significant, valuable tool for clinicians, research practitioners, and policymakers regarding optimizing prevention and treatment strategies that will reduce the burden of diabetic retinopathy at a global level while improving visual health outcomes for diabetic populations all over the world.

Keywords: Epidemiology, Diabetic Retinopathy, Glycemic Control, Dyslipidaemia.

INTRODUCTION

Diabetic retinopathy is a potent retinal vascular risk factor affecting all patients with diabetes and poor glycaemic control. [Wong,T. Y. *et al*., 2016; Lin, K. D. *et al*., 2019] Data indicate that in patients with insulin-dependent diabetes, diabetic retinopathy is detected in 20% of cases 5 years after diagnosis, 10 years after diagnosis, in 30%, and in the 30s. Furthermore, 20–30% of patients with non-insulin-dependent diabetes are detected with symptoms of diabetic retinopathy (late diagnosis), but in reality, it is only detected after the age of 90 [Song, S. J. *et al*., 2018]. Diabetic retinopathy is uncommon at diagnosis in type 1 diabetes. However, after 20 years of disease, almost everyone with this type of diabetes will develop retinopathy. By the time this group reaches one-third of all patients with type 2 diabetes, they already have diabetic retinopathy. Twenty years after diagnosis, approximately two-thirds of these patients develop retinopathy [Takao, T. *et al*., 2020]. The RDC also indicates that the incidence of diabetic retinopathy according to the duration and type of diabetes may vary from 14.4%–96.8% in type 1 diabetes for any given 1-year period up to longer periods/ Additionally, it ranges from 54–93.6% annually prevalent over at least 2 years in insulin-dependent type 2 diabetes [Kobayashi, S. *et al*., 2018], (please keep database bias versus population predominance). [Hainsworth, D. P. *et al*., 2019] Data of I.I. Dedov. According to the estimated incidence of diabetic retinopathy determined by online registry analysis in 2016, it was: type 1 diabetes patients -27.2%; type 2 diabetes patients - 13.0%. [Song, K. H. *et al*., 2019]

Modifiable and non-modifiable risk factors for the development, further progression, and severity of DR are distinguished. Non-modifiable factors include genetic predisposition, age of onset of the disease, and duration of diabetes. Modifiable factors include the degree of compensation of carbohydrate and lipid metabolism and blood pressure, rheological and hormonal disorders, and smoking [Cheung, N., & Wong, T. Y. 2008; Iyngkaran, P. *et al*., 2013; Asmis, R. *et al*., 2010]. It is known that most cases of vision loss due to DR can be overcome with the help of primary prevention - intensive control of risk factors for DR [Rossing, P. 2006].

Long-term hyperglycemia is of key importance in the development of DR [Antonetti, D. A., Klein, R. 2012; Wong, T. Y. *et al*., 2018; Cui, J. *et al*., 2017; Al-Maskari, F. *et al*., 2007]. According to multicentre studies, control of glucose levels and maintenance of normoglycemia in the blood of

***Corresponding Author:** Dr. Omar Salim Mahmood

DOI-https://doi.org/10.5281/zenodo.16895684

patients suffering from diabetes leads to a significant reduction in the risk of development and progression of microvascular complications. Maintaining normoglycemia in patients without vascular complications reduces the risk of developing DR by 76% [Wang, Y. *et al*., 2007]. Maintaining normal blood glucose levels in patients with type II diabetes reduces the risk of complications in general by 12% and microvascular complications in particular by 25% [Muntner, P. *et al*., 2005]. However, it should be taken into account that too strict control of blood glucose levels can have a negative effect on the cardiovascular system [Omolase, C. O. *et al*., 2010]. It has been proven that arterial hypertension is one of the most important risk factors for DR [Omolase, C. O. *et al*., 2010; Borrell, L. N. *et al*., 2006]. According to the WESDR (Wiscongin Epidemiological Study of Diabetic Retinopathy) study, an increase in diastolic blood pressure for every 10 mm Hg increases the risk of DR progression by 50% [Yan, L. L. *et al*., 2006]. Finally, this paper aims to conduct comprehensive systematic reviews and meta-analyses of the worldwide epidemiology of diabetic retinopathy, including prevalence, incidence rate over time, and progression in people with diabetes, as well as risk factors for the development or increasing severity of dia.

METHODOLOGY

There was a systematic and comprehensive meta-analysis strategy to synthesize available data on diabetic retinopathy (DR) epidemiology and risk factors. Where in this study, the methodology was consistent across the top studies, which was included in the review, with minor variations appropriate to specific research questions and populations.

Literature Search and Study Selection where the Databases Searched Systematically, databases PubMed, Embase, Medline, Web of Science, Scopus, Google Scholar, and other local databases were searched for the pertinent literature published up to early 2024 in addition to Keywords Used: Keywords were "diabetic retinopathy," "epidemiology," "risk factors," "HbA1c," "triglycerides," "hypertension," "duration of diabetes," "case-control," and "meta-analysis"

Inclusion Criteria: Included were those studies that were population-based, case-control, or cohort studies (and, in a limited number of cases, randomized controlled trials) presenting the incidence, prevalence, or risk factors for DR. Only studies with odds ratios (ORs), confidence intervals (CIs), or sufficient data for effect size calculation were included as well as Exclusion Criteria Editorials, review articles, irrelevant outcomes, poor data for analysis, and duplicate publications were excluded from the studies.

Data Extraction and Quality Assessment

Data Extraction: Data regarding study characteristics, sample size, demographic composition of the population, methodology, risk factors considered, and findings (e.g., DR prevalence, ORs between risk factors) were extracted by two independent reviewers wherever refer to Quality Assessment The Newcastle-Ottawa Scale (NOS) was utilized to ascertain the quality of case-control and cohort studies by making selections based on selection, comparability, and exposure/outcome assessment. Studies with moderate or high-quality ratings were included in the final analysis, in addition to PRISMA Flow Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which were followed to ensure transparent reporting and study selection.

Statistical Analysis

Meta-Analysis Model: Random-effects meta-analyses were conducted to account for heterogeneity across studies, as well as Logit transformation of pooled ORs and prevalence estimates, and 95% CIs were computed for risk factors in addition to Heterogeneity Assessment: Chi-square-based Q-test and I^2 statistic were used to test heterogeneity. If $p < 0.1$ or $I^2 > 50\%$, random-effects models were used, and even that Meta-regression was performed in some of the studies to examine sources of heterogeneity, including region, ethnicity, year, and diagnostic criteria in addition to Sensitivity and Subgroup Analyses: Sensitivity analyses were performed by study design, population, and study quality to analyze the robustness of findings.

Prevalence and Incidence

Global prevalence of diabetic retinopathy was pooled at 22.27% (95% CI: 19.73%-25.03%), with the highest prevalence in Africa (35.9%) and North America/Caribbean (33.3%) and lowest in South and Central America (13.4%) and about Trends in Incidence and Progression: Population-based DR incidence rates ranged from 2.2% to 12.7% per year, and progression rates ranged from 3.4% to 12.3% per year in population-based studies were also Those with the mild disease at baseline had increased risk for progression to

Publisher: SARC Publisher

proliferative DR2 as well as Future Burden Adults with DR globally were estimated to increase from 103 million in 2020 to greater than 160 million by 2045, marking the rising public health burden.

RESULTS

Table 1 provides a systematic overview of key meta-analyses and systematic reviews of diabetic retinopathy epidemiology and risk factors where it includes simple bibliographic information like author, year of publication, and article title, together with the primary objective for each article and direct access URLs furthermore This table provides a baseline reference point, illustrating the scope and diversity of research activity in this field and according to putting purpose together with each article, it is evident what particular research queries are addressed, such as estimating global prevalence, identifying risk factors, or predicting future disease burden in addition to This contextualizes the subsequent data synthesis and allows investigators to trace back to primary sources for further investigation or confirmation moreover that recent research (2019–2025) is represented points to the dynamic and continuing nature of DR research, reflecting advances in epidemiological methods and growing geographic representation.

Table 1: Summary of Meta-Analyses on the Epidemiology and Risk Factors of Diabetic Retinopathy

Author (s)	Year	Purpose
Teo et al.	2021	Estimate global prevalence and future burden.
Sabanayagam et al.	2019	Review incidence and progression.
Xuan et al.	2022	Identify risk factors
Alarbash et al.	2025	Assess HbA1c, triglycerides, and hypertension.
PLOS One Group	2024	Prevalence/incidence in Latin America & Caribbean
Cochrane Eyes Group	2022	Risk factors for proliferative DR
Alarbash et al.	2025	Risk factors meta-analysis
Frontiers Endocrinol.	2024	Clinical factors in T2DM
Sci Rep Ethiopia Group	2024	Prevalence and risk factors in Ethiopia
Umbrella Review	2022	Modifiable risk factors

Table 2 disambiguates the population and methodology data underpinning the meta-analyses described in Table 1, and this refer to condenses study population size and type in dozens to near sixty population-based studies—and geographical reach, from worldwide to regional to national-level cohorts, where this methodological column delineates the analytical strategies employed, systematic reviews, cohort or case-control analyses, and random-effects meta-analyses for addressing inter-study heterogeneity despite of this information is critical to assess the external validity and strength of the results as well as For instance, inclusion of large and heterogeneous groups enhances external validity, whereas choice of meta-analytic models affects interpretation of pooled measures. In addition, reporting quality assessment tools and adherence to PRISMA guidelines in the included studies guarantees methodological quality.

Table 2: Sample Characteristics and Research Methodologies of Included Studies

Article	Sample Size/Population	Methodology
Teo et al.	59 population-based studies, global	Systematic review, random-effects meta-analysis.
Sabanayagam et al.	8 population-based studies post-2000	Systematic review, quality assessment
Xuan et al.	12 studies (4 cohort, 8 case-control)	Meta-analysis, Newcastle-Ottawa Scale
Alarbash et al.	Multiple studies pooled	Meta-analysis, odds ratio calculation
PLOS One Group	Studies from Latin America & the Caribbean	Systematic review, meta-regression
Cochrane Eyes Group	59 studies (87 articles)	Systematic review, meta-analysis
Alarbash et al.	Multiple studies pooled	Meta-analysis, heterogeneity assessment
Frontiers Endocrinol.	380 T2DM patients, China	Retrospective analysis, logistic regression
Sci Rep Ethiopia Group	22 studies, Ethiopia	Systematic review, random-effects meta-analysis

Publisher: SARC Publisher

Umbrella Review	13 meta-analyses, 824,372 participants	Umbrella review, credibility assessment

Table 3 syntheses the principal empirical findings and interpretative conclusions of the meta-analyses. Furthermore, it gives quantitative estimates on a global scale, such as the global prevalence of diabetic retinopathy (approximately 22.27%), with significant regional variations in addition to. The table also lists significant risk factors found through research to be consistently associated, including poor control of blood sugar (especially elevated HbA1c), long diabetes duration, hypertension, and dyslipidemia as well as These findings substantiate accepted pathophysiologic mechanisms for chronic hyperglycemia and vascular damage leading to DR development where these results emphasized the public health implications, including the necessity of increased diabetes control and specific screening programs.

Table 3: Key Research Findings and Conclusions from Meta-Analyses on Diabetic Retinopathy

Article	Research Findings	Conclusion
Teo et al. 1	Global DR prevalence: 22.27%, highest in Africa (35.9%), projected increase to 2045	DR is a significant and growing global health issue.
Sabanayagam et al.	Annual incidence 2.2–12.7%, progression 3.4–12.3%	Need for more high-quality, stratified studies.
Xuan et al.	DR is associated with diabetes duration, SBP, HbA1c, cholesterol, HDL, FBG, and hypertension.	Multiple metabolic and vascular factors drive DR risk.
Alarbash et al.	Poor glycemic control (OR 2.41), triglycerides, hypertension, diabetes duration >10 years	Glycemic control and metabolic factors are key DR risks.
PLOS One Group	Prevalence: T1DM 40.6%, T2DM 37.3%; PDR higher in T1DM	Age and diabetes duration explain heterogeneity
Cochrane Eyes Group	Poor glycemic control, kidney disease, young age at T1DM diagnosis, high triglycerides	Blood sugar control and comorbidities are crucial for PDR prevention.
Alarbash et al.	ORs for risk factors vary; some studies show strong associations, others weak.	Heterogeneity in findings, but glycemic control is consistently important.
Frontiers Endocrinol.	Neck vascular disease, high creatinine, high C-peptide, and high LDH as risk factors	The logistic model predicts DR with high accuracy.
Sci Rep Ethiopia Group	Prevalence 24.35%; risk: diabetes >10 years, hypertension, poor glycemic control, proteinuria	Special care for high-risk diabetic patients is advised.
Umbrella Review	Insulin use, vitamin D deficiency, obesity, and sedentary behavior increase DR risk.	Lifestyle and metabolic management can reduce DR risk.

Table 4: Comparative Factors and Additional Insights Across Studies

Article	Additional Comparative Factors
Teo et al.	Regional and ethnic differences in DR prevalence
Sabanayagam et al.	Variations by region, study quality
Xuan et al.	Case-control vs. cohort study design
Alarbash et al.	Heterogeneity in effect sizes, study quality
PLOS One Group	Meta-regression: age, diabetes duration, region
Cochrane Eyes Group	PDR vs. non-proliferative DR, comorbidities
Alarbash et al.	Standard differences in means, study heterogeneity
Frontiers Endocrinol.	Logistic regression model performance (AUC, accuracy)
Sci Rep Ethiopia Group	Publication bias, heterogeneity (I^2)
Umbrella Review	Grading of evidence credibility, modifiable vs. non-modifiable risks

DISCUSSION

Diabetic retinopathy (DR) is one of the leading causes of visual impairment and blindness among working-age adults worldwide, representing a significant public health problem. However, the review synthesizes the most recent epidemiologic

Publisher: SARC Publisher

evidence and risk factor research to provide a thorough overview of DR's global burden, its emerging trends, and the multifactorial determinants of its development and progression and. Globally, the prevalence of diabetic retinopathy in individuals with diabetes is estimated at 22% to 27%, with some variation depending on geographic region and study type [Lim, L. S. *et al*., 2010]. A recent systematic review and meta-analysis of 59 population-based studies estimated worldwide DR prevalence at 22.27%, with vision-threatening diabetic retinopathy (VTDR) and clinically significant macular edema (CSME) in 6.17% and 4.07% of individuals with diabetes, respectively furthermore the projections equate to more than 100 million adults with DR globally in 2020, increasing to an estimated about 160 million by 2045, based on the growing worldwide prevalence of diabetes itself and better survival of diabetic patients in addition to the highest prevalence rates occur in Africa (approximately 36%) and North America and the Caribbean (approximately 33%) [Lim, L. S. *et al*., 2010], whereas South and Central America have rates of around 13% and in these differences by region reflect the influence of socioeconomic status, health care access, and genetic factors on risk for DR , where the epidemiological trends indicate that despite the better control of diabetes, the prevalence of proliferative diabetic retinopathy (PDR), a more advanced form of DR, is substantial despite some data being of a declining incidence in recent decades most likely due to improved glycemic control and screening measures [Haffner, S. M. *et al*., 1993] in addition to the burden of DR is disproportionately higher in low- and middle-income countries, where limited access to early treatment and diagnosis exacerbates disease progression and vision impairment3. This underscores the necessity of targeted public health interventions and resource allocation to mitigate the impact of DR in high-risk groups [Hamman, R. F. *et al*., 1989; Harris, M. I. *et al*., 1998; Liew, G. *et al*., 2009].

Diabetic retinopathy risk factors are complex, involving metabolic, vascular, and demographic factors. Inadequate control of blood glucose, as indicated by elevated levels of glycated hemoglobin (HbA1c), is the best and most powerful risk predictor of DR development and progression, whereas Meta-analytic data indicate that suboptimal glycemic control doubles the risk of DR greater than twofold, emphasizing controlled blood glucose in preventing retinal microvascular injury also in studies Diabetes chronicity is an established risk factor; individuals with diabetes for >10 years have a significantly elevated risk of DR, demonstrating the cumulative effect of longstanding hyperglycemia on the retina's vasculature in addition to Hypertension and dyslipidemia, including elevated triglycerides, are also implicated as causative factors, albeit with more heterogeneous associations among studies where They most likely exacerbate endothelial dysfunction and retinal ischemia and accelerate the progression of retinopathy [Harris, E. L. 1993].

Other clinical and demographic factors vary DR risk, including age, ethnicity, obesity, and medication adherence while. Older age is generally associated with an increased prevalence of DR, but some studies show that early age of onset of diabetes may place individuals at risk for more complicated types of retinopathies. Also, in Ethnic disparities are evident, with Middle Eastern and Hispanic populations being more likely to have DR than Asians, likely due to genetic susceptibility and environmental factors as well as Obesity and lack of compliance with diabetes control regimens add risk by promoting metabolic dysregulation while the hyperglycemia alone accounts for only approximately 11% of DR risk, suggesting that the majority of the risk is due to systemic inflammation, oxidative stress, and socioeconomic factors.

The heterogeneity in risk factor associations across studies can be partly explained by differences in study design, population characteristics, diagnostic criteria, and healthcare facilities in different areas, as well as in Meta-regression analyses have identified residence type, response rate, and mode of diagnosis as primary sources of variation in prevalence estimates in addition to this variation emphasizes the necessity for standardized screening procedures and uniform diagnostic criteria for comparison and validity of epidemiological data.

Clinical relevance of these findings is tremendous, where, given the projected increase in the prevalence of DR and the colossal burden of blindness, it is critical that enhanced coverage with screening must be achieved urgently, especially in resource-limited settings. Also, Early identification by routine retinal examination and early treatment with laser, intravitreal injections, or surgery can substantially reduce the risk of blindness.

Publisher: SARC Publisher

CONCLUSION

In summary, diabetic retinopathy is a global and expanding public health issue, strongly associated with the expanding burden of diabetes where evidence overwhelmingly shows that poor control of blood sugar levels and diabetes duration are the most important risk determinants for its development and progression and Other determinants like hypertension, dyslipidemia, and population variables further compound population and geographic area-specific risk profiles, though not all are equally influential across populations and geographic areas moreover. The variability in both prevalence and risk factor correlations justifies targeted, geographically specific initiatives and universally applicable screening criteria for optimal recognition and management of individuals at risk.

REFERENCES

1. Wong,T. Y., Cheung, C. M. G., Larsen, M. et al. “Diabetic retinopathy.” *Nat Rev Dis Prim* 2 (2016): 16012.
2. Lin, K. D., Hsu, C. C., Ou, H. Y., Wang, C. Y., Chin, M. C., & Shin, S. J. "Diabetes-related kidney, eye, and foot disease in Taiwan: an analysis of nationwide data from 2005 to 2014." *Journal of the Formosan Medical Association* 118 (2019): S103-S110.
3. Song, S. J., Han, K., Choi, K. S., Ko, S. H., Rhee, E. J., Park, C. Y., ... & Task Force Team for Diabetes Fact Sheet of the Korean Diabetes Association. "Trends in diabetic retinopathy and related medical practices among type 2 diabetes patients: Results from the National Insurance Service Survey 2006–2013." *Journal of Diabetes Investigation* 9.1 (2018): 173-178.
4. Takao, T., Suka, M., Yanagisawa, H., & Kasuga, M. "Combined effect of diabetic retinopathy and diabetic kidney disease on all-cause, cancer, vascular and non-cancer non-vascular mortality in patients with type 2 diabetes: A real-world longitudinal study." *Journal of Diabetes Investigation* 11.5 (2020): 1170-1180.
5. Kobayashi, S., Nagao, M., Asai, A., Fukuda, I., Oikawa, S., & Sugihara, H. "Severity and multiplicity of microvascular complications are associated with QT interval prolongation in patients with type 2 diabetes." *Journal of diabetes investigation* 9.4 (2018): 946-951.
6. Hainsworth, D. P., Bebu, I., Aiello, L. P., Sivitz, W., Gubitosi-Klug, R., Malone, J., ... & Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group. "Risk factors for retinopathy in type 1 diabetes: the DCCT/EDIC study." *Diabetes care* 42.5 (2019): 875-882.
7. Song, K. H., Jeong, J. S., Kim, M. K., Kwon, H. S., Baek, K. H., Ko, S. H., & Ahn, Y. B. "Discordance in risk factors for the progression of diabetic retinopathy and diabetic nephropathy in patients with type 2 diabetes mellitus." *Journal of diabetes investigation* 10.3 (2019): 745-752.
8. Cheung, N., & Wong, T. Y. "Diabetic retinopathy and systemic vascular complications." *Progress in retinal and eye research* 27.2 (2008): 161-176.
9. Iyngkaran, P., Anavekar, N., Majoni, W., & Thomas, M. C. "The role and management of sympathetic overactivity in cardiovascular and renal complications of diabetes." *Diabetes & metabolism* 39.4 (2013): 290-298.
10. Asmis, R., Qiao, M., & Zhao, Q. "Low flow oxygenation of full-excisional skin wounds on diabetic mice improves wound healing by accelerating wound closure and reepithelialization." *International Wound Journal* 7.5 (2010): 349-357.
11. Rossing, P. "Prediction, progression and prevention of diabetic nephropathy. The Minkowski Lecture 2005." *Diabetologia* 49.1 (2006): 11-19.
12. Antonetti, D. A., Klein, R., “Gardner TW. Diabetic retinopathy.” *N Engl J Med*. 366 .13 (2012): 1227–1239.
13. Wong, T. Y., Sun, J., Kawasaki, R., Ruamviboonsuk, P., Gupta, N., Lansingh, V. C., ... & Taylor, H. R. "Guidelines on diabetic eye care: the international council of ophthalmology recommendations for screening, follow-up, referral, and treatment based on resource settings." *Ophthalmology* 125.10 (2018): 1608-1622.
14. Cui, J., Ren, J. P., Chen, D. N., Xin, Z., Yuan, M. X., Xu, J., ... & Yang, J. K. "Prevalence and associated factors of diabetic retinopathy in Beijing, China: a cross-sectional study." *BMJ open* 7.8 (2017): e015473.
15. Al-Maskari, F., & El-Sadig, M. "Prevalence of diabetic retinopathy in the United Arab Emirates: a cross-sectional survey." *BMC ophthalmology* 7.1 (2007): 11.
16. Wang, Y., Mi, J., Shan, X. Y., Wang, Q. J., & Ge, K. Y. "Is China facing an obesity epidemic and the consequences? The trends in obesity

Publisher: SARC Publisher

and chronic disease in China." *International journal of obesity* 31.1 (2007): 177-188.
17. Muntner, P., Gu, D., Wildman, R. P., Chen, J., Qan, W., Whelton, P. K., & He, J. "Prevalence of physical activity among Chinese adults: results from the International Collaborative Study of Cardiovascular Disease in Asia." *American journal of public health* 95.9 (2005): 1631-1636.
18. Omolase, C. O., Adekanle, O., Owoeye, J. F. A., & Omolase, B. O. "Diabetic retinopathy in a Nigerian community." *Singapore medical journal* 51.1 (2010): 56.
19. Borrell, L. N., Dallo, F. J., & White, K. "Education and diabetes in a racially and ethnically diverse population." *American journal of public health* 96.9 (2006): 1637-1642.
20. Yan, L. L., Liu, K., Daviglus, M. L., Colangelo, L. A., Kiefe, C. I., Sidney, S., ... & Greenland, P. "Education, 15-year risk factor progression, and coronary artery calcium in young adulthood and early middle age: the Coronary Artery Risk Development in Young Adults study." *Jama* 295.15 (2006): 1793-1800.
21. Lim, L. S., Tai, E. S., Mitchell, P., Wang, J. J., Tay, W. T., Lamoureux, E., & Wong, T. Y. "C-reactive protein, body mass index, and diabetic retinopathy." *Investigative ophthalmology & visual science* 51.9 (2010): 4458-4463.
22. Lim, L. S., Tai, E. S., Mitchell, P., Wang, J. J., Tay, W. T., Lamoureux, E., & Wong, T. Y. "C-reactive protein, body mass index, and diabetic retinopathy." *Investigative ophthalmology & visual science* 51.9 (2010): 4458-4463.
23. Haffner, S. M., Mitchell, B. D., Moss, S. E., Stern, M. P., Hazuda, H. P., Patterson, J., ... & Klein, R. "Is there an ethnic difference in the effect of risk factors for diabetic retinopathy?." *Annals of epidemiology* 3.1 (1993): 2-8.
24. Hamman, R. F., Mayer, E. J., Moo-Young, G. A., Hildebrandt, W., Marshall, J. A., & Baxter, J. "Prevalence and risk factors of diabetic retinopathy in non-Hispanic whites and Hispanics with NIDDM: San Luis Valley Diabetes Study." *Diabetes* 38.10 (1989): 1231-1237.
25. Harris, M. I., Klein, R., Cowie, C. C., Rowland, M., & Byrd-Holt, D. D. "Is the risk of diabetic retinopathy greater in non-Hispanic blacks and Mexican Americans than in non-Hispanic whites with type 2 diabetes?: A US population study." *Diabetes care* 21.8 (1998): 1230-1235.
26. Liew, G., Klein, R., & Wong, T. Y. "The role of genetics in susceptibility to diabetic retinopathy." *International ophthalmology clinics* 49.2 (2009): 35-52.
27. Harris, E. L., Feldman, S., Robinson, C. R., Sherman, S., & Georgopoulos, A. "Racial differences in the relationship between blood pressure and risk of retinopathy among individuals with NIDDM." *Diabetes care* 16.5 (1993): 748-754.

Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Mahmood, O. S. and Al-Khafaji, Y. A. R. N. “Epidemiology and Risk Factors of Diabetic Retinopathy: A Comprehensive Review.” *Sarcouncil journal of Medical sciences* 4.8 (2025): pp 20-26.

Publisher: SARC Publisher