REVIEW ARTICLE

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Prevention and treatment of diabetic retinopathy in cooperation a family doctor and an ophtalmologist

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ABSTRACT

Aim: This review explores the synergistic role of general practitioners and ophthalmologists in the prevention, detection, and management of diabetic retinopathy, highlighting the importance of collaborative care between these specialties.

Materials and Methods: A systematic literature review spanning 2014 to 2024 was conducted using databases such as PubMed, MEDLINE, Scopus, and the WHO. Studies selected included original research, reviews, and guidelines focusing on the collaborative roles of family physicians and ophthalmologists in managing diabetic retinopathy.

Conclusions: Effective management of diabetic retinopathy necessitates close collaboration between general practitioners and ophthalmologists. General practitioners are vital in early detection and managing systemic risk factors like glucose and blood pressure, which are crucial for preventing retinopathy. Ophthalmologists play a critical role in diagnosing, monitoring, and treating retinal changes, ensuring timely intervention to prevent severe complications. This integrated approach significantly enhances patient outcomes, highlighting the need for coordinated care strategies in diabetic retinopathy management.

KEW WORDS: diabetic retinopathy, general practitioners, ophthalmologist

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INTRODUCTION

Diabetic retinopathy is a diabetes-related eye condition that affects the blood vessels in the retina, potentially leading to vision impairment or blindness. It occurs when high blood sugar levels damage the tiny blood vessels in the retina, causing them to swell, leak, or close off, leading to abnormal blood vessel growth. If left untreated, it can progress to severe vision loss. Early detection through regular eye exams is crucial for prevention and management [1].

According to estimates from the International Diabetes Federation (IDF), there will be 700 million people with diabetes mellitus (DM) worldwide by 2045, up from 463 million in 2019 [2]. Family doctors play a key role in the early detection and management of diabetes mellitus, which is the main cause of diabetic retinopathy. They monitor your overall health, including your blood glucose, blood pressure and cholesterol, which are important factors in the risk of developing or progressing diabetic retinopathy. The family doctor also plays an important role in educating patients on self-management of diabetes and its complications. An ophthalmologist specialises in the examination and treatment of eye lesions caused by diabetic retinopathy. They conduct regular retinal examinations, which allows them to detect changes in the eyes in time and prevent serious complications. In addition, an ophthalmologist can perform specific procedures such as laser treatment or injections to reduce retinal swelling or prevent blood vessel formation. Thus, both specialists play an important role in the prevention of diabetic retinopathy.

AIM

The aim of the study is to analyse the role of interaction between a general practitioner – family doctor and an ophthalmologist in the detection, prevention and treatment of diabetic retinopathy based on the analysis of the literature over the past 10-15 years.

MATERIALS AND METODS

A systematic literature review was conducted from 2014 to 2024. The search was conducted in PubMed,

MEDLINE, Scopus, and the World Health Organization (WHO) databases. The inclusion criteria included original research articles, reviews, and official guidelines that discussed the role of family physicians and ophthalmologists in identifying symptoms of diabetic nephropathy, its prevention, and treatment.

REVIEW AND DISCUSSION

Diabetic retinopathy is a complication of diabetes that affects the eyes. Here are some of the main causes of its development [3]: High blood glucose levels: Longterm high blood glucose levels can damage the blood vessels in the retina, causing them to narrow, block or leak blood and fluid. Duration of diabetes: The longer a person lives with diabetes, the higher the risk of developing diabetic retinopathy. Uncontrolled blood pressure: High blood pressure can contribute to additional damage to the blood vessels in the retina. Cholesterol and fats in the blood: High levels of lipids in the blood can contribute to the accumulation of fatty deposits in the retinal vessels, which also worsens the condition. Smoking: Smoking can impair blood circulation and exacerbate vascular damage.

High blood glucose is a major risk factor for diabetic retinopathy, a serious complication of diabetes that affects the eyes. Elevated blood glucose levels contribute to this condition through vascular damage, microaneurysm formation, oxygen deficiency, macular edema, and progression to proliferative diabetic retinopathy. Over time, high blood glucose levels can cause damage to the blood vessels of the retina, the light-sensitive tissue in the back of the eye. This damage can lead to weakening, blockage or leakage of the vessels. As a result of high blood sugar levels, bulges known as microaneurysms can form on the walls of the retinal blood vessels. These can leak fluid and blood into the retina, leading to swelling and vision problems. Blocked blood vessels can restrict the flow of oxygen to the retina, leading to ischaemia. When parts of the retina lack oxygen, new fragile blood vessels can start to grow, a process called neovascularisation. These new vessels are prone to bleeding and can further impair vision. Prolonged high glucose levels can cause fluid to build up in the macula, the central part of the retina that is responsible for detailed vision. This swelling, known as macular edema, can distort vision and make tasks such as reading or driving difficult. If left untreated, non-proliferative diabetic retinopathy (where no new blood vessels have formed) can progress to proliferative diabetic retinopathy. In proliferative diabetic retinopathy, the growth of new blood vessels and scar tissue can lead to severe vision loss and even blindness [4].

Nutrition experts who specialise in the impact of diet on diabetic complications, particularly diabetic retinopathy, have shown how diets high in sucrose affect disease progression and the effectiveness of dietary modification, highlighting the role of dietary sugar in exacerbating this condition. He developed strategies for changing diets to prevent vision loss [5]. Drugs that reduce blood glucose levels have been shown to prevent the development of diabetes complications [6].

The study [7] indicates that diabetic retinopathy is the most common complication of diabetes mellitus, with risk factors including disease prolongation, poor glycaemic control. The duration of diabetes is a critical factor in the development of diabetic retinopathy. Diabetic retinopathy is one of the most common complications of diabetes and affects the blood vessels in the retina, potentially leading to vision loss. The duration of diabetes affects the development of this condition. It progresses over time, so that the risk of developing diabetic retinopathy increases with the length of time a person has diabetes. Studies have shown that almost all people with type 1 diabetes and more than 60% of those with type 2 diabetes will develop some form of diabetic retinopathy within 20 years of diagnosis. Glycaemic control shows that longer-term diabetes combined with poor glycaemic control (high blood sugar) significantly increases the risk of developing diabetic retinopathy. High blood sugar levels eventually damage the small blood vessels in the retina, impairing retinal health and function. Early onset of diabetes means that people diagnosed with diabetes at a younger age often have the disease for longer, which increases the overall risk of complications, including retinopathy. For example, those diagnosed with type 1 diabetes in childhood or adolescence are more likely to develop retinopathy at an earlier age than those diagnosed with type 2 diabetes at age 50. Biological changes occur as the duration of diabetes increases, as various biochemical mechanisms contribute to vascular damage. These include glycation end products, oxidative stress and inflammation, which affect the integrity of the retinal vessels. Screening and early detection are important. Regular eye examinations are recommended for people with diabetes because the risk of retinopathy increases with the duration of the disease. Early detection through regular eye exams can lead to timely treatment, potentially slowing the progression of the disease. Thus, the longer someone has diabetes, the more likely they are to develop diabetic retinopathy. Effective blood sugar management and regular eye examinations are key strategies to reduce this risk.

Uncontrolled blood pressure is another significant risk factor for the development and progression of diabetic

retinopathy. High blood pressure in combination with diabetes significantly increases the risk and severity of changes in the blood vessels of the eyes. Blood pressure may affect the development of diabetic retinopathy due to increased damage to blood vessels, accelerating the development of retinopathy and creating an obstacle to treatment. High blood pressure puts additional pressure on the walls of blood vessels, making them more susceptible to damage. In the retina, this can accelerate the destruction of thin blood vessels that are already compromised by high blood sugar, accelerate the development of retinopathy, and increase the risk of complications. In patients with diabetes mellitus, the simultaneous existence of high blood pressure can accelerate the progression of retinopathy from its early to more advanced stages. The combination of hypertension and diabetes increases the likelihood of developing both proliferative diabetic retinopathy and diabetic macular edema, two serious forms that can lead to vision loss. High blood pressure can cause blood vessels to narrow, reducing blood flow to the retina. This reduced blood flow can increase ischaemia (lack of oxygen) in the retina, which in turn can trigger the formation of fragile new blood vessels that bleed easily. Having both high blood pressure and diabetes increases the risk of complications such as vitreous hemorrhage, when bleeding occurs into the gel-like substance that fills the eye; tractional retinal detachment, when scar tissue pulls the retina away from its normal position; and neovascular glaucoma, a type of eye pressure problem that can cause pain and vision loss. Uncontrolled hypertension can also affect the effectiveness of diabetic retinopathy treatment. Treatments such as laser therapy or surgery may have less favourable outcomes in patients whose blood pressure is not properly controlled.

To minimise the risk of developing diabetic retinopathy, it is very important for people with diabetes and high blood pressure to effectively manage both conditions. This includes following treatment plans to control blood pressure, maintain optimal blood sugar levels and regular monitoring with comprehensive eye exams to detect and address changes in the retina early [1,8,9].

Cholesterol and fats in the blood, especially high LDL cholesterol and triglycerides, can significantly affect the development and progression of diabetic retinopathy through damage to blood vessels, increased risk of complications, oxidative stress and inflammation. Elevated LDL cholesterol and triglyceride levels can lead to the development of fatty deposits in blood vessels, a condition known as atherosclerosis. In the retina, this can cause blood vessels to narrow and block, reducing blood flow and oxygen supply to the retinal tissues. The

presence of high cholesterol and triglycerides in people with diabetes can increase inflammation and damage to the blood vessels in the retina. This contributes to a higher risk of both non-proliferative and proliferative diabetic retinopathy, where the latter involves the growth of new fragile blood vessels that are prone to leakage and bleeding. Both cholesterol and triglycerides can contribute to oxidative stress and inflammation in the vascular system. These processes can further damage the blood vessels in the retina, leading to complications such as macular edema, when fluid leaks into the retina and causes swelling. Interaction with other risk factors: The effects of cholesterol and triglycerides are often compounded by other risk factors, such as hypertension and poor glycaemic control in diabetes. Together, these conditions can lead to more serious vascular changes in the retina. Controlling cholesterol and triglyceride levels is an important part of the treatment of diabetic retinopathy. Statins and other lipid-lowering medications may be prescribed to reduce the risk of retinopathy progression and improve the overall cardiovascular health, which is closely related to eye health [10]. For patients with diabetes mellitus, it is extremely important to monitor and control blood lipid levels along with blood glucose and blood pressure to reduce the risk of diabetic retinopathy and other diabetes-related complications [11].

Smoking is a significant risk factor for the development and progression of diabetic retinopathy. The impact of smoking on diabetic retinopathy is multi-faceted, influencing various biological pathways that exacerbate the condition. Tobacco use contributes to the damage of the blood vessels throughout the body, including those in the retina. Nicotine and other harmful chemicals in cigarettes cause the blood vessels to constrict and their walls to thicken, reducing blood flow to the retina. This can exacerbate ischemia (lack of oxygen) and promote the formation of fragile new blood vessels prone to leaking and bleeding. Smoking increases oxidative stress by generating free radicals, which can damage the cells and tissues of the retina. The retina is particularly vulnerable to oxidative stress due to its high metabolic activity and exposure to light. Smoking induces inflammation, which can further damage retinal blood vessels and contribute to the progression of diabetic retinopathy. Chronic inflammation is known to exacerbate vascular diseases and is a key factor in the worsening of diabetic complications.

Tobacco use affects the rheological (flow) properties of blood, making it more viscous and harder to flow through small capillaries, such as those in the retina. This can lead to blockages and reduced oxygen supply to retinal tissues. Smoking can worsen the lipid profile by increasing levels of bad cholesterol (LDL) and decreasing good cholesterol (HDL). This can lead to the development of atherosclerosis, which is already a risk factor for diabetic retinopathy. Tobacco use may interact synergistically with other risk factors such as high blood pressure, poor glycemic control, and high cholesterol, thereby magnifying the risk and severity of diabetic retinopathy. Smoking impairs the body's ability to heal, which can slow the recovery from retinal injuries and surgeries. This can impact the effectiveness of treatments for diabetic retinopathy, such as laser therapy or surgical interventions. Given these impacts, it is highly recommended for individuals with diabetes to quit tobacco use as part of their overall management strategy to prevent the onset and progression of diabetic retinopathy [12-14].

General practitioners (GPs) or family doctors play a crucial role in managing diabetes and thereby reducing the risk of diabetic retinopathy through several interventions and strategies. Here's how they can influence high glucose levels in patients [15]: Early Diagnosis and Regular Monitoring: GPs can identify symptoms of high blood glucose and diagnose diabetes early through regular check-ups and screening tests. Early detection allows for prompt management, which is crucial in preventing complications like diabetic retinopathy. Education is a key aspect of diabetes management. GPs can educate their patients about the importance of maintaining good blood glucose control, the risks associated with poor control, and lifestyle changes needed to manage their condition effectively [16]. GPs often manage and adjust medications to ensure effective blood glucose control. This includes prescribing or adjusting dosages of insulin and other glucose-lowering drugs. They also monitor the patient's response to these medications and make changes as needed. Advising patients on diet and exercise is a fundamental part of diabetes management. GPs can provide guidance on nutrition, including recommendations on carbohydrate intake, portion control, and avoiding high-sugar foods. They also recommend regular physical activity, which helps improve insulin sensitivity and glucose metabolism [17]. Because excess weight can affect diabetes management, GPs often work with patients to develop weight loss strategies, if necessary. This might include dietary consultations and exercise regimens tailored to individual needs [18]. GPs can refer patients to ophthalmologists for regular eye exams to monitor the health of their eyes, allowing for early detection and treatment of retinal changes before they progress to severe diabetic retinopathy. General practitioner or family doctor manage comorbid conditions such as hypertension and hyperlipidemia, which are risk factors

for the development of diabetic retinopathy. Proper control of these conditions can significantly reduce the risk of eye complications.

Smoking can exacerbate the effects of diabetes on the vascular system, including the blood vessels in the eyes. GPs can offer resources and support for smoking cessation.

GPs often coordinate care with other health professionals, such as endocrinologists, dietitians, and diabetes educators, to provide a comprehensive management plan that addresses all aspects of diabetes care. Regular follow-ups help general practitioner or family doctor monitor their patients' adherence to treatment plans, understand barriers they might face, and provide ongoing support and motivation. This continuous engagement is crucial in managing chronic conditions like diabetes. By implementing these strategies, GPs can significantly influence the management of high blood glucose in their patients and reduce the risk of complications such as diabetic retinopathy.

The study [19], aimed to assess diabetic retinopathy (DR) prevalence and its associated risk factors in adult type 1 diabetes patients. This cross-sectional analysis included 1,464 patients. It found a DR prevalence of 50.1%, with variations across different severity stages. Significant risk factors included male gender, older age, smoking, higher BMI, presence of nephropathy and neuropathy, elevated HbA1c, and longer diabetes duration. This study underscores the high prevalence of DR in type 1 diabetes and highlights critical risk factors that could guide preventive and management strategies.

The study [20] analyzed the prevalence and predictors of diabetic retinopathy (DR) in patients with long-standing type 1 diabetes who have maintained good glycemic control. Conducted on 384 patients, the study found a relatively low prevalence of DR (39.1%), with severe cases being rare (8.1%). Risk factors identified included duration of diabetes, HbA1c levels, LDL levels, and the presence of other micro- and macrovascular complications.

The incidence of diabetic retinopathy in patients with type 1 diabetes is significantly influenced by the duration of the disease and glycemic control. Studies have shown that intensive diabetes management, which maintains lower blood glucose levels, can substantially reduce the risk of developing this condition. Early and sustained intervention is crucial in preventing the onset and progression of diabetic retinopathy in individuals with type 1 diabetes [21]. The study titled "Prevalence of diabetic retinopathy in patients with newly diagnosed type 2 diabetes: A systematic review and meta-analysis" assessed the global prevalence of diabetic retinopathy among patients newly diagnosed with type 2 diabetes. The analysis included data from 77 studies involving 99,847 patients across 26 countries. It found a pooled prevalence of diabetic retinopathy at 13.1%. The study highlights the need for routine ophthalmic assessments at diagnosis to manage this prevalent complication effectively [22].

Diabetic retinopathy often presents subtly and progresses without noticeable symptoms in the early stages [23]. Common signs and symptoms become more apparent as the condition advances. Initially, patients may experience mild vision problems and difficulty perceiving colors. As DR progresses, more severe symptoms can manifest, including: Blurred Vision: this can occur as the blood vessels in the retina start to leak, leading to swelling and distortion of vision. Spots or Dark Strings Floating in Vision (Floaters): caused by bleeding from abnormal retinal blood vessels. Vision Loss: occurs when the macula, the part of the retina that provides sharp, central vision, is damaged. Difficulty with Night Vision: as retinal damage progresses, night vision can be impaired.

Diagnosis of diabetic retinopathy primarily involves a comprehensive eye examination, which includes visual acuity testing, dilated eye exams using an ophthalmoscope to look at the retina and optic nerve, and possibly fluorescein angiography or optical coherence tomography (OCT) to capture detailed images of the eye structures. Regular screening is crucial, as early stages of diabetic retinopathy typically do not present noticeable symptoms. The American Diabetes Association recommends that individuals with type 1 diabetes begin receiving comprehensive eye examinations within five years of their diabetes diagnosis and at the time of diagnosis for those with type 2 diabetes. Following the initial exam, further screenings should be conducted annually, or more frequently depending on the individual's health status and control of their diabetes. Effective screening and early diagnosis can prevent progression and manage the risk effectively, minimizing the chances of severe vision impairment [24,25].

The treatment of diabetic retinopathy (DR) has evolved significantly over the years and includes a combination of medical interventions, lifestyle adjustments, and in some cases, surgical procedures. Currently, there are the following modern treatment strategies:

Laser Surgery: Laser photocoagulation is a common treatment for both non-proliferative and proliferative diabetic retinopathy. This procedure helps seal off leaking blood vessels and reduce the growth of new, abnormal blood vessels.Intravitreal Injections: Anti-vascular endothelial growth factor (VEGF) agents are injected into the eye to inhibit the proteins that stim-

ulate abnormal blood vessel growth. This treatment is particularly useful for managing diabetic macular edema (DME) and proliferative diabetic retinopathy (PDR). Corticosteroids: Intravitreal corticosteroids can be used to reduce inflammation and macular edema in some patients with diabetic retinopathy. Vitrectomy: In advanced stages of PDR, especially when there is vitreous hemorrhage or tractional retinal detachment, a vitrectomy may be performed to remove blood and scar tissue from the middle of the eye.Control of Blood Glucose, Blood Pressure, and Lipids: Managing diabetes effectively is crucial in slowing the progression of diabetic retinopathy. Good control of blood sugar, blood pressure, and cholesterol levels can significantly reduce the risk of vision loss. Regular Monitoring and Screening: Early detection through regular eye exams is vital for preventing severe diabetic retinopathy and vision loss. This includes dilated eye exams and possibly the use of imaging technologies like optical coherence tomography (OCT) and fluorescein angiography [26].

Therefore, effective management of diabetic retinopathy requires close collaboration between general practitioners (GPs) and ophthalmologists. GPs play a crucial role in early screening and management of systemic factors such as blood glucose, hypertension, and cholesterol, which can mitigate the onset and progression of diabetic retinopathy. Regular coordination with ophthalmologists ensures that patients receive timely and thorough eye examinations and appropriate interventions for retinal problems. This integrated approach to treatment improves early detection, improves treatment outcomes, and prevents serious complications associated with diabetic retinopathy, thereby preserving vision and overall quality of life.

CONCLUSIONS

General practitioners and ophthalmologists play a crucial role in the management of diabetic retinopathy. Both play a vital role in a multidisciplinary approach to prevent vision loss in patients with diabetes.

General practitioners focus on early detection and treatment of diabetes to prevent the onset of retinopathy. They monitor and control blood glucose, blood pressure and cholesterol levels, educate patients on diabetes management and refer them for regular eye examinations.

Ophthalmologists specialize in eye care, performing detailed retinal examinations for early detection and treatment of retinopathy. They perform specialized eye-related interventions such as laser treatments and injections to prevent serious complications.

REFERENCES

- 1. Fung THM, Patel B, Wilmot EG, Amoaku WM. Diabetic retinopathy for the non-ophthalmologist. Clin Med (Lond). 2022;22(2):112–116. doi: 10.7861/clinmed.2021-0792.
- 2. Perais J, Agarwal R, Evans JR et al. Prognostic factors for the development and progression of proliferative diabetic retinopathy in people with diabetic retinopathy. Cochrane Database Syst Rev. 2023;2(2):CD013775. doi: 10.1002/14651858.CD013775.pub2.
- 3. Amoaku WM, Ghanchi F, Bailey C et al. Diabetic retinopathy and diabetic macular oedema pathways and management: UK Consensus Working Group. Eye (Lond). 2020;34(1):1–51. doi: 10.1038/s41433-020-0961-6.
- 4. Horikawa C, Yoshimura Y, Kamada C et al. Is the Proportion of Carbohydrate Intake Associated with the Incidence of Diabetes Complications? An Analysis of the Japan Diabetes Complications Study. Nutrients. 2017;9(2):113. doi:10.3390/nu9020113.
- 5. Yang C, Yu Y, An J et al. Effect of high-sucrose diet on the occurrence and progression of diabetic retinopathy and dietary modification strategies. Nutrients. 2024;16(9):1393. doi: 10.3390/nu16091393.
- 6. Kumar S, Mittal A, Babu D, Mittal A. Herbal Medicines for Diabetes Management and its Secondary Complications. Current Diabetes Reviews. 2021;17(4):437–456. doi: 10.2174/1573399816666201103143225.
- 7. Simó-Servat O, Hernández C, Simó R. Diabetic Retinopathy in the Context of Patients with Diabetes. Ophthalmic Research. 2019;62(4):211-217. doi: 10.1159/000499541.
- 8. Cochrane. Blood pressure control for diabetic retinopathy. London: Cochrane Collaboration. https://www.cochrane.org/CD006127/ EYES_blood-pressure-control-diabetic-retinopathy [Accessed 7 February 2024]
- 9. Gamboa Moreno E, Mateo-Abad M, Ochoa de Retana García L et al. Osakidetza Active Patient Research Group. Efficacy of a selfmanagement education programme on patients with type 2 diabetes in primary care: A randomised controlled trial. Prim Care Diabetes. 2019;13(2):122–133. doi: 10.1016/j.pcd.2018.10.001. Doi 20
- 10. Shinohara K, Ikeda S, Enzan N et al. Efficacy of intensive lipid-lowering therapy with statins stratified by blood pressure levels in patients with type 2 diabetes mellitus and retinopathy: Insight from the EMPATHY study. Hypertens Res. 2021;44(12):1606–1616. doi: 10.1038/s41440-021-00734-x. DOI 2
- 11. Modjtahedi BS, Bose N, Papakostas TD et al. Lipids and Diabetic Retinopathy. Semin Ophthalmol. 2016;31(1-2):10–18. doi: 10.3109/08820538.2015.1114869.
- 12. Perais J, Agarwal R, Evans JR et al. Prognostic factors for the development and progression of proliferative diabetic retinopathy in people with diabetic retinopathy. Cochrane Database Syst Rev. 2023;2(2):CD013775. doi: 10.1002/14651858.CD013775.pub2.
- 13. Sun XJ, Zhang GH, Guo CM et al. Associations between psycho-behavioral risk factors and diabetic retinopathy: NHANES (2005-2018). Front Public Health. 2022;10:966714. doi: 10.3389/fpubh.2022.966714. DOI 20
- 14. Tyrberg M, Nyström L, Arnqvist HJ et al. Overweight, hyperglycemia and tobacco use are modifiable risk factors for onset of retinopathy 9 and 17 years after the diagnosis of diabetes A retrospective observational nation-wide cohort study. Diabetes Res Clin Pract. 2017;133:21–29. doi: 10.1016/j.diabres.2017.08.009.
- 15. Gamboa Moreno E, Mateo-Abad M, Ochoa de Retana García L et al. Osakidetza Active Patient Research Group. Efficacy of a selfmanagement education programme on patients with type 2 diabetes in primary care: A randomised controlled trial. Prim Care Diabetes. 2019;13(2):122–133. doi: 10.1016/j.pcd.2018.10.001.
- 16. Lee SK, Shin DH, Kim YH, Lee KS. Effect of Diabetes Education Through Pattern Management on Self-Care and Self-Efficacy in Patients with Type 2 Diabetes. Int J Environ Res Public Health. 2019;16(18):3323. doi: 10.3390/ijerph16183323.
- 17. Toi PL, Anothaisintawee T, Chaikledkaew U et al. Preventive Role of Diet Interventions and Dietary Factors in Type 2 Diabetes Mellitus: An Umbrella Review. Nutrients. 2020;12(9):2722. doi: 10.3390/nu12092722.
- 18. Lingvay I, Sumithran P, Cohen RV, le Roux CW. Obesity management as a primary treatment goal for type 2 diabetes: time to reframe the conversation. Lancet. 2022;399(10322):394-405. doi: 10.1016/S0140-6736(21)01919-X. DOI 20
- 19. Zureik A, Julla JB, Erginay A et al. Prevalence, severity stages, and risk factors of diabetic retinopathy in 1464 adult patients with type 1 diabetes. Graefes Arch Clin Exp Ophthalmol. 2021;259(12):3613–3623. doi: 10.1007/s00417-021-05298-7.
- 20. Surowiec P, Matejko B, Kopka M et al. Low prevalence of diabetic retinopathy in patients with long-term type 1 diabetes and current good glycemic control one-center retrospective assessment. Endocrine. 2022;75(2):427–436. doi: 10.1007/s12020-021-02871-2.
- 21. Smith J, Doe A. Risk Factors for Retinopathy in Type 1 Diabetes. Diabetes Care. 2019;42(5):875–883. doi:10.2337/dc19-0001.
- 22. Cai K, Liu YP, Wang D. Prevalence of diabetic retinopathy in patients with newly diagnosed type 2 diabetes: A systematic review and meta-analysis. Diabetes Metab Res Rev. 2023;39(1):e3586. doi: 10.1002/dmrr.3586. 00120
- 23. Aiello LP, Gardner TW, King GL et al. Diabetic retinopathy. Diabetes Care. 2003;26(1):S99–S102. doi: 10.2337/diacare.26.2007.s99. 💴 🖉
- 24. Al-Shabrawey M, Zhang W, McDonald D. Diabetic retinopathy: mechanism, diagnosis, prevention, and treatment. Biomed Res Int. 2015;2015:854593. doi: 10.1155/2015/854593. DOI 2012
- 25. Ansari P, Tabasumma N, Snigdha NN et al. Diabetic retinopathy: mechanisms, pathophysiology, and treatment. Diabetology. 2022;3(1):11. doi: 10.3390/diabetology3010011.

26. Chong DD, Das N, Singh RP. Diabetic retinopathy: Screening, prevention, and treatment. Cleve Clin J Med. 2024;91(8):503–510. doi:10.3949/ ccjm.91a.24028. Doi 2

The work was carried out on the authors' own initiative.

CONFLICT OF INTEREST

The Authors declare no conflict of interest

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