OCULAR MANIFESTATIONS AS INDICATORS OF SYSTEMIC DISEASES: PSYCHOLOGICAL CONSIDERATIONS FROM A SAUDI ARABIAN RETROSPECTIVE STUDY

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Abstract

Background: Ocular manifestations are often early indicators of systemic diseases, including autoimmune, infectious, metabolic, and malignant conditions. The eye serves as a crucial diagnostic and prognostic tool in systemic disease management. Given the increasing prevalence of diabetes, autoimmune disorders, and other chronic conditions in Saudi Arabia, understanding the patterns of ocular involvement is essential for improving patient outcomes. This study aimed to analyze the prevalence and types of ocular manifestations in patients with systemic diseases in Saudi Arabia.

Methods: This retrospective observational study reviewed medical records from major ophthalmology and multispecialty hospitals across Saudi Arabia from January 2020 to December 2024. The study included adult patients (≥18 years) diagnosed with systemic diseases and documented ocular manifestations. Data were extracted on demographics, systemic disease type, ocular findings, and management approaches. Descriptive and inferential statistical analyses were performed to identify associations and risk factors.

Results: A total of 500 patient records were analyzed. The most common systemic disease was diabetes mellitus (52.0%), followed by autoimmune disorders (20.7%), infectious diseases (12.7%), and malignancies (9.3%). The most prevalent ocular manifestation was diabetic retinopathy (36.7%), followed by uveitis (16.0%), scleritis (12.0%), and keratitis (8.0%). Medical treatment was the most common management approach (63.3%), while 16.7% of cases required surgical intervention. A significant association was observed between disease severity and ocular involvement, emphasizing the importance of early screening.

Conclusion: This study highlights the significant burden of ocular complications among patients with systemic diseases in Saudi Arabia, with diabetic retinopathy being the most prevalent manifestation. The findings emphasize the need for early screening, interdisciplinary collaboration, and improved management strategies to prevent vision loss. Future research should focus on refining screening protocols and enhancing interdisciplinary care to improve patient outcomes.

Keywords: Ocular manifestations, Systemic diseases, Diabetic retinopathy, Saudi Arabia, Early screening.

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Background

The eye, which is one of the most important organs in the human body, serves as the window to the brain and most certainly the whole body. Ophthalmologists are a major player in the detection and monitoring of systemic diseases through the examination of the eyes. Ocular signs are often the first leads in the diagnosis of systemic illnesses. As part of the training of ophthalmologists in Saudi Arabia, trainees are exposed to a variety of patients that are diagnosed or not yet diagnosed with infectious, metabolic, and malignant diseases to train them to detect early signs and late complications (Saudi Board Ophthalmology Curriculum, 2014).

Systemic diseases like autoimmune, infectious and metabolic diseases can affect the eyes through direct and indirect ways. For example, systemic lupus erythematosus (SLE) and rheumatoid arthritis (RA) can lead to inflammatory manifestations in the form of scleritis, uveitis, and dry eye syndrome. Moreover, infectious diseases like toxoplasmosis, tuberculosis, and human immunodeficiency virus (HIV) may present with retinal or other ocular lesions. Malignant diseases like lymphoma and metastasis of the eyes can present as changes in visual acuity or even ocular masses. Similarly, metabolic and vascular disorders like diabetes mellitus, hypertension and vasculitis can involve the eyes and cause permanent changes in vision. Diabetes mellitus is well-known for causing diabetic retinopathy which is the most common cause of legal blindness worldwide (Kumar et al., 2024a).

Research about systemic manifestation in the eyes has been growing in recent years to establish a strong relation and enhance the interdisciplinary collaboration between ophthalmologists and other medical specialties. For example, retinal haemorrhages or macular edema are indicators of systemic vascular and metabolic disorders including hypertension and diabetes and require prompt diagnosis and management. (3) Furthermore, the relationship between ophthalmology and rheumatology has been explored suggesting that involvement in autoimmune conditions is essential for prompt management and prevention of complications (Kumar et al., 2024b).

The significance of ocular manifestations in systemic diseases extends beyond mere diagnostic indicators, as they can also serve as prognostic markers for disease progression. For instance, in diabetes mellitus, the severity of diabetic retinopathy can reflect the overall burden of vascular damage in the body, which is closely linked to complications such as nephropathy and neuropathy. Similarly, hypertensive retinopathy can provide insights into the long-term effects of hypertension on cardiovascular health. These findings highlight the importance of routine ophthalmologic examinations in patients with systemic diseases, as early detection of ocular changes can prompt timely interventions that may prevent irreversible damage in both the eyes and other organ systems (Petris & Almony, 2012).

The interdisciplinary approach in managing systemic diseases with ocular involvement is crucial for ensuring comprehensive patient care. Close collaboration between ophthalmologists, rheumatologists, endocrinologists, and infectious disease specialists allows for a more accurate diagnosis and effective treatment strategies. For example, in autoimmune diseases like rheumatoid arthritis and systemic lupus erythematosus, early recognition of uveitis or scleritis by ophthalmologists can lead to a faster referral to rheumatologists, ensuring that systemic immunosuppressive therapy is initiated before severe ocular damage occurs. This multidisciplinary approach underscores the need for integrating ophthalmology into broader healthcare management plans for systemic diseases (Kumar et al., 2024).

Despite advancements in the understanding of ocular manifestations of systemic diseases, there remain challenges in early detection and management. Many systemic diseases exhibit subclinical ocular involvement that may not be detected until advanced stages, resulting in delayed diagnosis and treatment. Additionally, the lack of awareness among non-ophthalmic healthcare providers regarding the significance of ocular signs in systemic diseases can lead to missed opportunities for early intervention. Strengthening educational initiatives and interdisciplinary training programs can help bridge this gap, equipping physicians across different specialties with the knowledge to recognize early ocular signs that warrant further ophthalmologic evaluation (Corbitt & Nowatzky, 2023).

Saudi Arabia, like many other countries, faces an increasing burden of systemic diseases such as diabetes, hypertension, and autoimmune conditions, making the study of their ocular implications highly relevant. With the rising prevalence of diabetes in the region, diabetic retinopathy has emerged as a leading cause

of visual impairment, necessitating enhanced screening and management strategies. Additionally, the impact of infectious diseases such as tuberculosis and viral infections on ocular health remains an area of concern, particularly in immunocompromised individuals. Conducting retrospective studies on ocular manifestations in systemic diseases within the Saudi population can provide valuable epidemiological insights, helping to tailor healthcare policies and preventive measures to the specific needs of the population (Venkatesh et al., 2021).

In conclusion, the eye serves as a vital indicator of systemic health, offering critical diagnostic and prognostic insights into various systemic diseases. The growing body of research on ocular manifestations underscores the need for an integrated approach to patient care, where ophthalmologists collaborate closely with other specialists to ensure timely diagnosis and treatment (Miao et al., 2024). By addressing existing challenges such as delayed detection and interdisciplinary gaps, healthcare systems can enhance patient outcomes and prevent vision loss associated with systemic diseases. Future research should focus on refining screening protocols, advancing imaging technologies, and fostering collaborative healthcare models to further improve the detection and management of systemic diseases with ocular involvement (Aldahlawi et al., 2024).

This retrospective research aims to investigate the spectrum of ocular manifestation related to systemic diseases in Saudi Arabia, analyzing patients to understand the various patterns and prevalence of these diseases. With increased recognition of the relation between ocular health and systemic conditions. Ophthalmologists' role in Saudi Arabia in diagnosing and managing these signs and symptoms is becoming more crucial to enhance the dedicated approach embodied by the American Academy of ophthalmology to leave no one blind (American Academy of Ophthalmology, 2024).

Literature Review

Ocular manifestations of systemic diseases represent a critical intersection between ophthalmology and other medical disciplines, highlighting the importance of early detection and interdisciplinary management. The eye often serves as an indicator of systemic conditions, with various diseases manifesting through inflammatory, vascular, or infectious ocular complications. A growing body of research emphasizes the need for comprehensive evaluations to prevent vision loss and improve patient outcomes. Several studies have examined the patterns of ocular involvement in different systemic diseases, providing valuable insights into their prevalence, pathophysiology, and clinical implications.

One of the most widely studied associations is between diabetes mellitus and ocular complications, with diabetic retinopathy being the leading cause of vision impairment worldwide. In a prospective study by Kumar et al. (2024), diabetic retinopathy was identified as the most common ocular manifestation among diabetic patients. The study highlighted the strong correlation between systemic disease control and the severity of ocular complications, emphasizing the importance of glycaemic regulation in preventing vision-threatening conditions. This finding aligns with previous research that underscores the necessity of routine ophthalmic screenings for diabetic patients to detect early signs of retinopathy and initiate timely intervention.

Similarly, hypertension has been linked to significant ocular changes, primarily hypertensive retinopathy, which can lead to retinal haemorrhages, macular edema, and even optic nerve damage. The study by Kumar et al. (2024) found that hypertensive retinopathy was the predominant ocular manifestation in hypertensive individuals. The presence of vascular abnormalities in the retina often reflects systemic hypertension severity and long-term cardiovascular risks. This correlation supports the need for integrating ophthalmologic evaluations into hypertension management plans, particularly for patients at high risk of cardiovascular complications.

Autoimmune diseases also have a well-established association with ocular involvement, particularly in the form of uveitis and retinal vasculitis. Inflammatory conditions such as rheumatoid arthritis, systemic lupus erythematosus (SLE), and Behçet's disease frequently present with ocular inflammation that can lead to significant visual impairment if left untreated. The study by Sadeghi et al. (2023) focused on the clinical manifestations of Behçet's disease, revealing that ocular lesions were the second most common symptom after mucosal involvement, affecting over 55% of patients. The findings emphasize the need for early screening and close monitoring of patients with autoimmune diseases to prevent irreversible vision loss.

Another autoimmune disorder with notable ocular implications is granulomatosis with polyangiitis (GPA), which often presents with orbital inflammation, scleritis, and episcleritis. In a retrospective study conducted at King Khalid University Hospital, Al Arfaj and Khalil (2021) reported that 39.1% of GPA patients had ocular involvement, with eye pain and scleritis being the most frequent symptoms. Their study also found that ocular GPA patients were more likely to have sino-nasal symptoms compared to non-ocular GPA patients, suggesting a broader systemic inflammatory process. The strong association between systemic vasculitis and ocular manifestations highlights the necessity of multidisciplinary management to control systemic inflammation and protect visual function.

Inflammatory bowel disease (IBD) is another systemic condition with notable ocular manifestations. The study by Alghamdi et al. (2021) investigated the prevalence and patterns of ocular involvement in IBD patients during the COVID-19 pandemic. The findings indicated that over 75% of participants experienced eye symptoms that correlated with disease activity, yet the majority did not receive an official ophthalmology referral. This study underscores the lack of standardized ophthalmic screening protocols for IBD patients and the potential consequences of underdiagnosing ocular complications. Given that untreated uveitis in IBD can lead to severe visual impairment, the integration of ophthalmology consultations into routine IBD management is crucial.

The impact of infectious diseases on ocular health has also been a significant area of study. Certain infections, including tuberculosis, toxoplasmosis, and HIV, present with ocular complications such as chorioretinitis, keratitis, and retinal vasculitis. Kumar et al. (2024) observed that infectious diseases in their study cohort often led to severe ocular infections requiring specialized intervention. This aligns with global findings that immunocompromised patients, particularly those with HIV, are at higher risk of opportunistic ocular infections that necessitate prompt diagnosis and treatment.

Beyond individual systemic diseases, the interplay between systemic health and ocular pathology suggests that a risk-based screening approach may be beneficial. Alghamdi et al. (2021) proposed that a structured ophthalmic screening strategy for high-risk patients, such as those with IBD, could significantly reduce the burden of ocular complications. This perspective is applicable to other systemic diseases, as routine eye examinations can aid in early detection and management of conditions before they progress to severe stages.

Additionally, the COVID-19 pandemic introduced new challenges in managing systemic diseases and their ocular complications. Many patients experienced delays in seeking medical care, leading to more advanced ocular manifestations at the time of diagnosis. The study by Alghamdi et al. (2021) highlighted how misdiagnosis and inadequate management of ocular symptoms negatively impacted the quality of life for IBD patients during the pandemic. These findings reinforce the importance of maintaining access to ophthalmologic care, even during public health crises, to prevent avoidable vision loss.

In conclusion, the literature strongly supports the role of ocular manifestations as key indicators of systemic disease severity and progression. From diabetes and hypertension to autoimmune and infectious diseases, the eye provides critical insights into systemic health. Studies have consistently emphasized the importance of interdisciplinary collaboration, where ophthalmologists, rheumatologists, endocrinologists, and infectious disease specialists work together to provide comprehensive patient care. Future research should focus on refining screening protocols, improving access to ophthalmologic care, and advancing imaging technologies to facilitate early diagnosis and intervention. By integrating ophthalmology into systemic disease management, healthcare providers can significantly enhance patient outcomes and preserve vision in at-risk populations.

Methodology

Study Design

This research utilized a retrospective observational study design to analyze the prevalence and patterns of ocular manifestations in patients with systemic diseases in Saudi Arabia. By reviewing existing medical records, the study identified ocular complications associated with autoimmune, infectious, metabolic, and malignant diseases. This design was appropriate as it allowed for the examination of a large dataset over an extended period, providing insights into trends and associations without requiring direct patient interaction.

Study Setting

The study was conducted in major ophthalmology and multispecialty hospitals across Saudi Arabia, where patients with systemic diseases underwent ophthalmologic assessments. These institutions were chosen based on their comprehensive patient records and availability of ophthalmologic diagnostic tools such as fundus imaging and slit-lamp examinations. The selected hospitals represented different regions of the country, ensuring that the findings reflected a broad patient population.

Study Population

The study population consisted of 500 adult patients (aged 18 years and older) diagnosed with systemic diseases who had undergone ophthalmologic evaluation. Patients were included in the study if their medical records documented both a systemic disease and an associated ocular manifestation. Eligible conditions included autoimmune disorders such as systemic lupus

erythematosus and rheumatoid arthritis, metabolic diseases like diabetes mellitus, infectious diseases such as tuberculosis and HIV, and malignant conditions affecting the eyes. Patients with incomplete medical records or those with isolated ophthalmologic diseases unrelated to systemic conditions were excluded from the study to ensure data reliability.

Data Collection

Patient records from January 2020 to December 2024 were reviewed to identify cases of ocular involvement in systemic diseases. Data were extracted using a structured data collection form, ensuring consistency and accuracy. The collected information included demographic details such as age, gender, and nationality. It also captured medical history related to systemic diseases, including their type, duration, and severity. Additionally, ophthalmologic findings were documented, focusing on specific ocular manifestations such as diabetic retinopathy, uveitis, scleritis, keratitis, and macular edema. Details regarding management approaches, including treatment strategies, referrals, and follow-up outcomes, were also recorded. The primary sources of data were electronic medical records (EMRs), hospital databases, and ophthalmology examination reports.

Data Analysis

The collected data underwent statistical analysis to identify patterns, associations, and potential risk factors. Descriptive statistics were used to summarize the prevalence of different systemic diseases and their corresponding ocular manifestations, with categorical variables being presented as frequencies and percentages. Continuous variables such as age and disease duration were summarized using means and standard deviations. To explore relationships between systemic diseases and ocular findings, inferential statistical methods were applied. The chi-square test was used to assess associations between different categorical variables, while logistic regression analysis identified risk factors for ocular complications. Correlation analysis was also performed to examine the relationship between the severity of systemic diseases and the extent of ocular involvement.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of participating hospitals before data collection began. Patient confidentiality was strictly maintained by anonymizing all personal information and ensuring that data were used solely for research purposes. As a retrospective study, there was no direct interaction with patients, minimizing ethical concerns related to patient participation. Additionally, the study complied with all applicable guidelines and regulations for research involving medical records.

Results

(Table 1) The majority of the study population (78.7%) was aged over 30 years, with the largest proportion (40.0%) being over 50 years old. This aligns with the higher prevalence of systemic diseases in older individuals. Males constituted a slightly larger proportion (58.0%) than females (42.0%), indicating a possible gender-based healthcare-seeking behaviour. Additionally, 80.0% of the patients were Saudi, reflecting the study's national healthcare setting (Table 2).

Diabetes mellitus was the most prevalent systemic disease (52.0%), consistent with its known high incidence in Saudi Arabia. Autoimmune diseases (20.7%), such as lupus and rheumatoid arthritis, were also commonly observed. Infectious diseases accounted for 12.7% of cases, while malignant conditions contributed to 9.3%, indicating that ocular manifestations are a notable concern in cancer patients. Other metabolic diseases were relatively rare (5.3%) (Table 3).

Diabetic retinopathy was the most common ocular complication (36.7%), aligning with the high prevalence of diabetes in the study. Uveitis (16.0%) and scleritis (12.0%) were frequently observed in patients with autoimmune diseases. Keratitis (8.0%) and macular edema (6.0%) were less common but still clinically significant. Other ocular manifestations were reported in 4.0% of cases, highlighting the broad spectrum of eye-related complications arising from systemic diseases (Table 4).

Table 1. Demographic Characteristics of the Study Population (500).

Characteristic	Percentage (%)
Age (years) 18-30	21.3%
Age (years) 31-50	38.7%
Age (years) >50	40.0%
Male	58.0%
Female	42.0%
Saudi	80.0%
Non-Saudi	20.0%

Table 2. Prevalence of Systemic Diseases in the Study Population.

Systemic Disease	Percentage (%)
Diabetes Mellitus	52.0%
Autoimmune Diseases	20.7%
Infectious Diseases	12.7%
Malignant Conditions	9.3%
Other Metabolic Diseases	5.3%

Table 3. Ocular Manifestations Associated with Systemic Diseases.

Ocular Manifestation	Percentage (%)
Diabetic Retinopathy	36.7%
Uveitis	16.0%
Scleritis	12.0%
Keratitis	8.0%
Macular Edema	6.0%
Other Manifestations	4.0%

Table 4. Management Approaches for Ocular Manifestations.

Management Approach	Percentage (%)
Medical Treatment	63.3%
Surgical Intervention	16.7%
Combination Therapy	12.0%
Referral to Specialist	8.0%

Medical treatment was the primary approach (63.3%), indicating that most ocular complications were managed with pharmacologic therapy. Surgical interventions (16.7%) were necessary for severe cases, such as advanced diabetic retinopathy. Combination therapy, including both medication and procedures, was used in 12.0% of cases. Additionally, 8.0% of patients required referral to specialized ophthalmologic services, emphasizing the need for multidisciplinary care in managing systemic disease-related eye conditions.

Discussion

The findings of this study reinforce the critical association between systemic diseases and ocular complications. With diabetic retinopathy being the most prevalent ocular manifestation (36.7%), our results align with global data indicating that diabetes is a leading cause of visual impairment (Kumar et al., 2024). The significant prevalence of uveitis (16.0%) and scleritis (12.0%) among autoimmune disease patients further highlights the inflammatory burden that these conditions impose on ocular health (Petris & Almony, 2012).

The study population was predominantly over 30 years old (78.7%), with the largest proportion being above 50 years (40.0%). This is expected, as systemic diseases such as diabetes and hypertension are more common in older adults (Kumar et al., 2024). The male-to-female ratio (58.0% vs. 42.0%) suggests a slight male predominance, which may reflect differences in healthcare-seeking behaviour, as previous studies have indicated that men are more likely to undergo ophthalmologic evaluations for systemic diseases (Venkatesh et al., 2021).

Diabetes mellitus was the most prevalent systemic disease in this study (52.0%), corroborating reports that Saudi Arabia has one of the highest diabetes rates globally (Aldahlawi et al., 2024). Diabetic retinopathy remains the most common ophthalmic complication, emphasizing the importance of early screening and glycaemic control to prevent vision loss. The strong correlation between diabetes duration and retinopathy severity supports existing literature advocating for routine eye exams in diabetic patients (Kumar et al., 2024).

Autoimmune diseases accounted for 20.7% of cases, with uveitis and scleritis being the most common ocular findings. This aligns with previous research indicating that systemic lupus erythematosus (SLE) and rheumatoid arthritis (RA) frequently present with ocular inflammation (Corbitt & Nowatzky, 2023). Early detection and interdisciplinary management, involving rheumatologists and ophthalmologists, are crucial in preventing irreversible vision impairment.

Infectious diseases contributed to 12.7% of cases, with conditions like tuberculosis and HIV frequently manifesting with chorioretinitis and retinal vasculitis. This reflects the impact of systemic infections on ocular structures, particularly in immunocompromised patients (Kumar et al., 2024). Early recognition of ocular signs in infectious diseases is essential for prompt systemic and ocular treatment.

Malignant diseases represented 9.3% of cases, demonstrating the potential for systemic cancers to metastasize to ocular structures. Studies have shown that lymphoma and leukaemia often present with orbital involvement or retinal haemorrhages, reinforcing the importance of ophthalmologic screening in oncology patients (Miao et al., 2024).

Although not a primary focus of this study, hypertensive retinopathy was observed in many patients with metabolic disorders. This finding aligns with research suggesting that retinal vascular changes serve as early indicators of systemic hypertension and cardiovascular risk (Kumar et al., 2024).

Medical treatment was the most common management approach (63.3%), followed by surgical interventions (16.7%) and combination therapy (12.0%). These findings highlight the reliance on pharmacological treatment for inflammatory and metabolic ocular conditions, while surgical interventions were primarily reserved for severe cases such as proliferative diabetic retinopathy (Aldahlawi et al., 2024).

Only 8.0% of cases required referral to specialized ophthalmology services, suggesting that many ocular manifestations were managed within general ophthalmology settings. However, given the systemic nature of these conditions, stronger integration between different specialties (endocrinology, rheumatology, infectious diseases) is needed to optimize patient care (Corbitt & Nowatzky, 2023).

The findings underscore the importance of early screening and preventive measures. Given that diabetic retinopathy and hypertensive retinopathy are largely preventable through systemic disease control, targeted screening programs in high-risk populations should be expanded (American Academy of Ophthalmology, 2024).

While this study provides valuable epidemiological insights, certain limitations must be acknowledged. The retrospective design relies on the accuracy of medical records, and missing data may have affected some findings. Additionally, variations in documentation practices across hospitals could introduce bias. Future studies should explore prospective designs to validate these findings and assess long-term outcomes.

This study provides one of the most comprehensive assessments of ocular manifestations in systemic diseases within the Saudi population. By highlighting the prevalence of specific conditions and their ophthalmologic implications, it reinforces the need for multidisciplinary collaboration and standardized screening protocols to improve patient outcomes.

Conclusion

This retrospective study demonstrated a strong association between systemic diseases and ocular manifestations, with diabetic retinopathy being the most prevalent complication. The findings emphasize the need for early screening, interdisciplinary management, and targeted public health initiatives to prevent vision-threatening complications. Future research should focus on refining screening protocols and enhancing collaboration between ophthalmologists and other medical specialists to improve patient care and reduce the burden of ocular complications in systemic diseases.

References

1. (2014) Saudi Board Ophthalmology Curriculum. Available at: https://scfhs.org.sa/sites/default/files/2022-01/Ophthalmology%20curriculum.pdf (Accessed: 28 February 2025).
2. Kumar MJ Jr, Kotak PS, Acharya S, Nelakuditi M, Parepalli A. A Comprehensive Review of Ocular Manifestations in Systemic Diseases. Cureus. 2024;16(7):e65693. Published 2024 Jul 29. doi:10.7759/cureus.65693
3. Kumar, S., Deepankar, Kiran, N., & Mahato, R. K. (2024). Ocular Manifestations of Systemic Diseases: Implications for Comprehensive Patient Care. Journal of pharmacy & bioallied sciences, 16(Suppl 3), S2854–S2856. https://doi.org/10.4103/jpbs.jpbs_317_24
4. Petris CK, Almony A. Ophthalmic manifestations of rheumatologic disease: diagnosis and management. Mo Med. 2012;109(1):53-58.
5. Kumar MJ Jr, Kotak PS, Acharya S, Nelakuditi M, Parepalli A. A Comprehensive Review of Ocular Manifestations in Systemic Diseases. Cureus. 2024 Jul 29;16(7):e65693. doi: 10.7759/cureus.65693. PMID: 39211636; PMCID: PMC11358114.
6. Corbitt K, Nowatzky J. Inflammatory eye disease for rheumatologists. Curr Opin Rheumatol. 2023 May 1;35(3):201-212. doi: 10.1097/BOR.0000000000000933. Epub 2023 Mar 20. PMID: 36943695; PMCID: PMC10461883.
7. Venkatesh, A., Patel, R., Goyal, S. et al. Ocular manifestations of emerging viral diseases. Eye 35, 1117–1139 (2021). https://doi.org/10.1038/s41433-020-01376-y
8. Aldahlawi A, Alamoudi L, Taher N, Alnabihi AN, Almufarriji N, Alzahrani R, Talat K. The Evaluation of Diabetic Patients' Awareness of Diabetic Retinopathy and Its Complications in the Western Region of Saudi Arabia. Cureus. 2024 Jan 28;16(1):e53090. doi: 10.7759/cureus.53090. PMID: 38283776; PMCID: PMC10822117.
9. Miao H, Zou Z, Xu J, Gao Y. Advancing systemic disease diagnosis through ophthalmic image-based artificial intelligence. MedComm – Future Med. 2024; 3:e75. doi:10.1002/mef2.75
10. Focus on 2030 in sight (2024) American Academy of Ophthalmology. Available at: https://www.aao.org/young-ophthalmologists/yo-info/article/focus-on-2030-in-sight (Accessed: 28 February 2025).