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"Awareness of Ocular Signs of Systemic Diseases Among Non-Ophthalmic Physicians in Tertiary Care"

Dr. Monika [1],Prof.(Maj) Dr.Premnath.G [2],Dr.Poovendan[3]*,Dr.Sara Aju Thomas[4]*, Dr. Lahari Padma[5]*

1 – Investigator, Postgraduate, Department of Ophthalmology, Chettinad Hospital & Research Institute, Chettinad Academy of Research and Education, Kelambakkam – 603103, Tamil Nadu, India.

2 – Guide, Professor and HOD, Department of Ophthalmology, Chettinad Hospital & Research Institute, Chettinad Academy of Research and Education, Kelambakkam – 603103, Tamil Nadu, India.

3 - Corresponding Author,Senior Resident ,Department of Ophthalmology, Chettinad Hospital & Research Institute, Chettinad Academy of Research and Education, Kelambakkam – 603103, Tamil Nadu, India.

4-Corresponding Author,Postgraduate, Department of Ophthalmology, Chettinad Hospital & Research Institute, Chettinad Academy of Research and Education, Kelambakkam – 603103, Tamil Nadu, India

5-Corresponding Author,Postgraduate, Department of Ophthalmology, Chettinad Hospital & Research Institute, Chettinad Academy of Research and Education, Kelambakkam – 603103, Tamil Nadu, India

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KEYWORDS

Ocular manifestations of systemic illnesses need good communication between physicians and ophthalmologists. Enhancing referral and consultation can be achieved through medical education and awareness.

ABSTRACT:

Background

Ocular signs often appear before systemic symptoms are evident, offering an early window for detection. In tertiary care settings, non-ophthalmic physicians are often the first to encounter these patients. Limited awareness and inconsistent referral practices may cause a delay in diagnosis and increase the risk of irreversible visual impairment.

Objectives

To assess the level of awareness, knowledge, and referral practices of non-ophthalmic physicians regarding ocular manifestations of systemic diseases in a tertiary care centre in South India, and to identify barriers and training needs.

Methods

A descriptive cross-sectional study was carried out at a tertiary care centre among 208 non-ophthalmic doctors. A structured pre-validated study questionnaire was used as a study instrument. In addition to the level of awareness, the questionnaire included demographic details, questions about ocular signs in systemic disease, the referral practices of physicians, confidence in identifying ocular signs, and the training preferred by physicians. Awareness was categorized as adequate (≥75%), moderate (50–74%), or inadequate (<50%). Descriptive and inferential statistical analyses were performed using SPSS version 25.0, with a significance threshold of $p<0.05$.

Results

Almost all participants recognized diabetic retinopathy as a common ocular complication (95.67%) and advised screening at diagnosis of type 2 diabetes mellitus (100%), whereas 76.44% advised earlier screening in type 1 diabetes mellitus. The ability to recognize manifestations of diabetic retinopathy, such as retinal haemorrhages (75.96%), ocular tuberculosis (68.75%), and drug toxicity, was moderate.

Poorly recognized autoimmune ocular manifestations are uveitis (38%). Almost all the physicians (95.67%) carry out basic eye examination, while 85.58% have found a systemic disease based on ocular signs. Nonetheless, at diagnosis, only 25% of the hypertensive patients were referred to an ophthalmologist.

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Conclusion

Though the knowledge of common ocular-systemic associations was good, the deficiencies identified in knowledge about autoimmune and drug-induced manifestations were noteworthy. In the same way, the practice pattern was acknowledged only as moderate with low confidence levels and an unsatisfactory referral pattern. Therefore, it is to be noted that, at the undergraduate level, there is insufficient ophthalmology training. There is also a need for interventions at both the individual and interdisciplinary levels to help close the gaps that still exist in diagnosing these conditions.

Introduction

The human eye is a visual and diagnostic organ. Several systemic diseases like diabetes, hypertension, leprosy and thyroid diseases manifest signs or symptoms in the eye before spreading to vital organs.

This is partly due to transparent eye anatomy and partly due to shared vasculature with other organs. In Diabetes mellitus, hypertension, thyroid and autoimmune diseases, as mentioned by Jr MJK et al., often present with ocular abnormalities that are one of the earliest indicators of these diseases. If these systemic diseases are diagnosed early in the course of the disease, coordination of care and early referral to an ophthalmologist would hasten the diagnosis and management of both ocular and systemic conditions. [1]

Ocular signs in systemic disease have a clinical value that is recognized outside the field of ophthalmology. In most cases, the initial assessment of patients with systemic disease is carried out by a general physician, paediatrician, general surgeon, or pulmonologist who is not an ophthalmologist. While they provide very good care, Deutsch et al. note that these early ocular complaints, like diplopia, blurring of vision or more subtle fundus changes, are overlooked. A lot of systemic diseases like leukaemia, syphilis or multiple sclerosis have atypical ocular presentations. In these diseases, the ocular presentation often precedes the systemic features. [2]

Multiple diagnostic imaging and systemic therapeutic modalities were introduced. However, the ophthalmic examination in non-ophthalmology / non-ophthalmic practices is still underutilized. Understanding systemic causes of ocular pathology requires knowledge across the spectrum of medical and surgical specialities as described by Aroch et al. There is a similar call for greater curricular integration of such knowledge in undergraduate and postgraduate medical education. [3]

Ocular manifestations often seen are retinal vasculitis in systemic lupus erythematosus, keratoconjunctivitis sicca in Sjogren's syndrome, and optic neuritis in demyelinating disorders.

Delays in recognition can lead to irreversible vision loss, and they might miss a diagnosis of a disease. Roszkowska et al. proposed collaborative approaches that are useful in tertiary care settings due to the high complexity of multi-systemic illness. [4]

Abu-Amara et al. evaluated non-ophthalmic healthcare professionals who manage patients with diabetes in the Middle East and found that these professionals had inadequate knowledge of the ocular complications of diabetes. This is despite the heavy load of patients with diabetes. [5] Even though many are aware that diabetic retinopathy is one of the main causes of preventable blindness. Many physicians at the primary and secondary care level rely on overt visual complaints and do not use structured screening or timely ophthalmology referrals for all patients. [5]

The African state is experiencing similar concerns. According to Regassa et al., Ethiopian paediatricians were not very familiar with common paediatric ocular disorders, and they rarely asked for an ophthalmic opinion in systemic diseases, which are well-known to affect the eye, such as congenital infections, nutritional deficiencies, and juvenile arthritis. Due to these types of ignorance, there is a late presentation with poor visual prognosis in this age group. [6]

According to a study by Sp W et al. Among paediatricians in Kenya, [7] low knowledge and an indifferent attitude towards children's eye disorders have negatively affected their clinical practice. Even in a tertiary teaching hospital, assessment of systemic diseases is often done without a thorough ophthalmic evaluation. This effectively highlights the difference

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between having ophthalmology services available and actually utilizing them.

In the South Asian country of Nepal, Subedi et al.[8] studied the awareness of pulmonologists. The lack of knowledge concerning ocular TB and sarcoidosis, though systemic TB and sarcoidosis are common, which results in serious ocular sequelae. [8] Doctors often were oblivious to ocular presentations like choroiditis, vitritis or retinal granulomas. Therefore, either the diagnosis was delayed, or the systemic correlations were missed.

A similar trend was illustrated by Bonsaana et al.[9] regarding awareness of common childhood eye conditions and their systemic associations among paediatricians in Ghana. While there is a child health policy document in the country, it is massively underused, with an over-reliance on symptombased diagnosis without any routine ophthalmic examination. The text points to a larger issue at hand.

When systemic symptoms overlap with ocular disorders, clinicians who are unaware may treat the patient symptomatically without considering the underlying systemic illness. So, decades later, Bistner et al.'s analysis remains relevant, where there was a disconnection between the two (general medicine and ophthalmology) regarding systemic disease management.

This study rests on the important clinical fact that complex systemic diseases that mainly affect the eye are treated in tertiary care centres. However, non-ophthalmologists are not properly equipped to either recognize or manage it. In India, the increasing global burden of non-communicable diseases, infectious and auto-immune disorders warrants a collective clinical interdisciplinary model.

Nonetheless, the evidence given above shows that non-ophthalmic physicians are lagging due to a

lack of structured training, on-ground awareness, and confidence and skill sets in managing systemic diseases with ocular involvement.

This investigation is the first in our subcontinent to assess awareness about eye care practices and prevention of blindness among non-ophthalmic physicians of multiple disciplines in a tertiary-level centre. It assesses their knowledge, referral patterns and clinical practices, and their knowledge and practice gaps. Through conducting this study on our population, we will not only generate local data, but our study will also add to a handful of studies conducted at similar settings in other parts of the world. The study's findings will assist in creating targeted educational initiatives, including CME programs, departmental training, and clinical decision support systems.

In light of the present epidemiological transition scenario of our healthcare system, with rising chronic non-communicable diseases and a growing ageing patient population, the early recognition of ocular signs by non-ophthalmic doctors is critical for early diagnosis and management. Thus, this study is a timely and important step in this direction.

Materials and Methods

Study Design

This study was a descriptive cross-sectional questionnaire-based observational survey, as it will allow assessment of the knowledge level and practice in an already defined population of physicians at one point in time, and is an attempt to identify the existing knowledge gap in them. No manipulation of study variables is involved in this design.

Study Duration

Data collection was conducted from May to June 2025. This data collection period was considered sufficient for obtaining data from qualified respondents from different departments.

Study Population

This targeted study population consisted of any medical professional except for an ophthalmologist engaged in patient care. The postgraduate residents, junior and senior medical officers, and teaching faculty of the non-ophthalmology departments were the study participants. Only those who have at least six months of clinical experience were included in this study. This was an important consideration for the validity of the study, as these participants would have a baseline exposure to the varied presentations of systemic diseases. The research study excluded personnel from the department of ophthalmology, house surgeons, interns or students from the study.

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Sample Size Calculation

The required sample size formula that was used to estimate prevalence is given by $n=Z^2\times p(1-p)/d^2$.

Assuming a confidence interval of 95% (Z =1.96), the expected prevalence of awareness as 50% (P = 0.5) and the absolute precision of 7% (d=0.07), the calculated sample size was 196. The final sample size was rounded off to 200.

Sampling Methodology

Due to constraints of operational feasibility of the availability of the department and rotation programme of the physician; purposive non-probability sampling was used. Questionnaires were administered by handing them out during departmental meetings, conducting ward rounds, and communicating via official e-mails within the institution.

Study Instrument

For this study, a pre-structured self-administered questionnaire was prepared. Following an extensive literature review of the peer-reviewed literature, the questionnaire was devised in English and verified by a panel of experts in ophthalmology and general medicine. An expert panel looked at the validity of the instrument. It consists of four sections. The opening section consists of demographic and professional data such as age, sex, clinical designation, department and years of experience. The second part consisted of 15 knowledge questions which were related to the signs in diseases such as diabetes mellitus, hypertension and autoimmune diseases and infectious diseases like tuberculosis, etc. In the third section, information was gathered about the confidence of participants in recognizing the eye-related symptoms and the current referral practice. The last part asked if they felt their previous training was adequate, and if they have interest in learning more with another ophthalmology-related continuing medical education.

Scoring Criteria and Awareness Classification

One mark was awarded for a correct answer on the knowledge and clinical recognition section, with a maximum possible score of 30. Based on total scores, awareness was classified into three categories. An adequate awareness participant scored at least 23 marks (at least 75 percent). A participant who scored 15 to 22 marks (50–74 percent) was characterised as moderately aware. Any scores below 15 are considered inadequate awareness.

Ethical Approval and Participant Consent

Before the conduction of the study, Institutional human ethical clearance of the study protocol was obtained. Participation was entirely voluntary, and written informed consent was obtained from all. The researcher thoroughly explained the purpose of the study and confidentiality. User must not enter his details. Data was made anonymous at the point of entry. No patients had contact with this study.

No damage to the people involved in the research was expected.

Data Collection Procedure

The eligible participants were approached in their respective departments and either administered a printed copy of the questionnaire or a link for secure access to a similar questionnaire hosted via Google forms. Each participant was provided with sufficient time to complete the questionnaire, with reminders being given from time to time in the data collection period to enhance the response rates. The finished responses were checked for completion, while any found with incomplete critical data were eliminated from the analysis.

Data Entry and Statistical Analysis

All valid responses were entered into MS Excel and analysed using IBM SPSS Statistics for Windows, Version 25.0, was used for the analysis. The participants' and respondents' allocation key details were summarized using descriptive statistics. The categorical variables department and the awareness categories' distribution were measured using frequencies and percentages. To accomplish this, means and standard deviations were used.

Statistical analyses were carried out by using inferential statistics to find any association between level of awareness and study variables. The association between the category of awareness and their study variables such as department and designation was calculated by the chi-square test. To examine the difference in average awareness scores among various physician groups, researchers employed an independent sample t-test and a one-way analysis of

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variance. Pearson's or Spearman's correlation analyses was applied on years of experience and total score of awareness based on the normal distribution of data. A P-value below 0.05 was deemed statistically significant.

Results

Demographics and Clinical Background

Participation in this survey was from a wide range of age groups. 59.13% of the respondents belonged to the <30 years' age group, followed by the 30–40 years group, 28.85%, and a smaller proportion of respondents was in the >50 years group, 10.1%. The 41 to 50 years age group had the lowest representation at 1.92%. Most of our participants were females (60.1%). In terms of specialities, General Medicine (29.81%) was the most preferred speciality, followed by pulmonology (17.79%), Paediatrics (13.94%) and General Surgery (12.02%). Remaining 26.44% were from other departments. With regards to clinical experience, most participants had less than 5 years of practice (59.13%), while 27.88% reported 5-10 years of practice. Only 12.02% of the respondents had practised for more than 20 years, making them a minority.

Referral Frequency

When asked about referral practices for ocular assessment in patients with systemic ailments, a majority responded positively and said often. However, about 27.04% said they refer sometimes, and 16.83% admitted to referring rarely. In the same way, 0.96% stated they refer only when visual symptoms are present.

Knowledge and Beliefs of Systemic Diseases with Eye Symptoms

Table 1: Knowledge and Beliefs of Systemic Diseases with Eye Symptoms

Variables	Frequency (n)	Percentage (%)
Diabetic retinopathy		
Yes	199	95.67
No	9	4.33
Ocular Tuberculosis Part		
Lens	2	0.96
Retina	63	30.29
Uvea	143	68.75
Hypertensive Manifestations		
Retinal hemorrhages	158	75.96
Optic atrophy	7	3.36
Papilledema	43	20.67
Thyroid Disorder		
Hyperthyroidism (Graves' disease)	167	80.29
Hypothyroidism	41	19.71
Type 1 Diabetes Evaluation		
Before 5 years	159	76.44
At diagnosis	49	23.56
Type 2 Diabetes Evaluation		
At diagnosis	208	100
Hydroxychloroquine Toxicity		
Retina	165	79.33
Uvea	43	20.67
Hypertensive Retinopathy Grading		
ETDRS	7	3.36
Keith-Wagener-Barker Classification	201	96.63
Dry Eye in Rheumatoid Arthritis		
Increased intraocular pressure	3	1.44

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Lacrimal gland dysfunction	205	98.56
Diabetic Eye Exam Frequency		
Every 2 years	0	0
Every 6 months	47	22.6
Once a year	161	77.4
Antitubercular Drug Toxicity		
Ethambutol	208	100
Amaurosis Fugax		
Carotid Artery Disease	181	87.02
Hypertension	25	12.02
Rheumatoid Arthritis	2	0.96
Atherosclerosis Sign		
Choroidal Neovascularization	5	2.4
Hollenhorst Plaque	171	82.21
Pigmentary Retinopathy	32	15.38
Rheumatoid arthritis (uveitis or scleritis)		
Yes (**uveitis or scleritis)**	79	38
No	129	62
Thyroid Manifestation		
Proptosis	208	100

Most physicians had a good knowledge of systemic disease affecting the eye. Moreover, a significant majority of the participants (95.67%) agree that diabetic retinopathy is a common ocular complication of diabetes. The majority of the respondents recognized the need for an ophthalmologic evaluation at the time of diagnosis in case of a diabetic type 2. While 76.44% of the participants recognized the need for early screening. Further, recommended ophthalmic evaluation within 5 years of diagnosis of type-1 diabetes. During the follow-up period, 78% recommended yearly eye examination and every two years (Table 1)

A total of 73.95% and 83.90% participants correctly identified retinal haemorrhages as afeature of hypertensive retinopathy. Other signs, such as papilledema (21.85%) and optic atrophy (3.36%) were less frequently recognized. The majority of respondents believed that the uvea is most commonly involved in ocular tuberculosis, followed by the retina, which is next involved. Awareness of **ocular drug toxicity** was strong: all respondents (100%) correctly linked **ethambutol** to potential ocular toxicity, and 79.33% associated **hydroxychloroquine toxicity** with **retinal damage** (Table 1)

The study found that only 38% were aware of ocular sign autoimmune diseases (rheumatoid arthritis, lupus, etc.) (uveitis, scleritis, etc.). However, for rheumatoid arthritis, 98.56% were correct as they identified lacrimal gland dysfunction (dry eye), and only 1.44% mistakenly linked it with raised intraocular pressure. Among all the thyroid disorders, 80.29% chose hyperthyroidism (Graves' disease) to be the most common cause of ocular involvement. 100% of the patients selected proptosis as a prominent feature of thyroid eye disease (Table 1)

Regarding vascular complications, the study found that 87.02 was correct in linking Amaurosis fugax with carotid artery disease, while 12.02 Incorrectly linked it with hypertension and 0.96 linked rheumatoid arthritis with it. Hollenhorst plaques were recognized as the retinal sign of vascular disease (Table 1)

The knowledge of some common conditions like diabetes and hypertension was strong, but on the contrary, the autoimmune-related ocular signs and early signs in the eye were not recognized as much.

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Practice Patterns and Clinical Confidence

Table 2: Practice Patterns and Clinical Confidence

Variables	Frequency (n)	Percentage (%)
Diabetic Eye Exam Frequency		
Every 2 years	0	0
Every 6 months	47	22.6
Once a year	161	77.4
Hypertensive Referral		
At the time of diagnosis	52	25
When BP is persistently >160/100 mmHg	156	75
Basic Eye Exam		
No	9	4.32
Yes	199	95.67
Diagnosed Systemic Disease via Ocular Finding		
No	30	14.42
Yes	178	85.58

As per Table 2, Nearly three-quarters of respondents refer a patient to an ophthalmologist when the blood pressure is greater than 160/100 mmHg, and just one-quarter refer the patient at the time of diagnosis. In addition, 95.67% of doctors who perform basic eye examinations show confidence in using the eye test. Almost 86% of those studied had a diagnosed systemic disease. The study demonstrated that though clinicians are largely competent in the clinical domain related to this condition, certain recommendations, like early referral for hypertension, general versus specific findings, useful differences between vascular and autoimmune signs, etc., would enhance and also form a part of clinical practice guidelines (Table 2)

Training, Awareness & Improvement Strategies

The results indicate a significant lack of training and subsequent awareness of the ophthalmic complications of systemic diseases. 42.40% of healthcare professionals are aware of the correct screening procedure, while >56% answered unsure, and 3.36% of physicians admitted they do not know. In conclusion, there is a need for education on ocular screening among patients on long-term immunomodulatory therapy. Although a large proportion of the participants are competent in ocular screening, and a higher percentage said they would incorporate screening into care for patients with systemic disease, a large proportion (28.85%) of the respondents stated that they do not do this routinely. This may be due to the lack of resources or knowledge.

According to 52.88% of respondents, patient reluctance was the most common barrier to referral. According to 36.54% of respondents, lack of physician awareness was the next most common barrier. 11.06% of respondents were hindered by limited access to ophthalmologists. In relation to the strategies for improving awareness, 80.29% study subjects said that ocular screening should be included in the medical school curriculum alongside systemic disease teaching. 17.79% desired it for CME citation, and 1.92% made it for interdisciplinary seminar citation.

To conclude, this study shows the need for a substantial strengthening of ophthalmology education during the undergraduate medical course and emphasizes practical barriers to implementing shared care in clinical practice.

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Attitudes Toward Training & Collaboration

Responses powerfully indicated a strong interest among physicians for more training on ophthalmic manifestations of systemic diseases. Also, 98.56% of the physicians were interested in further training, while 100% of all the participants agreed that identification of ocular signs early on can help prevent complications. The importance of eye examination in systemic diseases has been acknowledged unanimously.

Even with this enthusiasm for learning, doctors gave more modest evaluations of their existing knowledge. Around 45% gave themselves a rating of two out of five, while another

34.13 % rated themselves three. Merely 3.85% believed their knowledge was excellent. There is always a demand for up-skilling and capacity building.

In regard to this survey response, 100% of respondents agreed that the medical curriculum or professional development requires further ophthalmology training. 97.6% of the respondents were positive about collaborating with Ophthalmologists for better patient outcomes. Only 2.4% respondents showed reluctance. This perspective is optimistic, as it helps to cultivate a healthy relationship between the departments. Further, it helps in smoothing the institutional workflow for referrals.

The data indicate that collaborative care is increasingly recognized as valuable. Although there is a desire to learn, it also signals a need for systemic changes to enable the integration across the specialities.

DISCUSSION

The current cross-sectional study evaluated the knowledge, awareness and referral practices of the non-ophthalmic physicians regarding ocular manifestations of systemic diseases. The results obtained show nearly a high general awareness about common conditions like diabetes, hypertension, etc.

Awareness of Ocular Manifestations in Systemic Diseases

Nearly all physicians (95.67%) recognized diabetic retinopathy as an important complication of diabetes. All respondents correctly recommended eye screening for type 2 diabetes at the time of diagnosis, and 76.44 % of early screening for type 1 within 5 years of diagnosis. These results show that the guideline is partially adhered to, and the information may not have reached all the clinicians. In 1973, Bistner warned that systemic disease often has ocular manifestations and that overlooking these manifestations could delay the final diagnosis or treatment, particularly in primary care where contacts are frequently first made. [10]

As per the study, the physicians were aware of the common ocular manifestations, which are seen in hypertension, tuberculosis and thyroid disease. To illustrate, 75.96% of doctors were aware of retinal haemorrhages in hypertensive retinopathy, 68.75% recognized uvea as the common site for ocular tuberculosis. Similar findings were repeated by Nowinska et al. [11]

A 100% of participants correctly identified that ethambutol had ocular toxicity, which shows good recognition of the risk; however, only 40.38% patients knew the correct hydroxychloroquine follow-up. Both Scheie and Grayson have hinted that spotting early changes can prevent complications from becoming established or irreversible. Yet, this remains a challenge in practice. [12]

Gaps in Recognition of Rare Ocular Conditions

Only 38% of physicians noticed uveitis or scleritis as a feature of rheumatoid arthritis. This just means ocular inflammatory markers are not recognized as much as they should be. According to Cho, systemic inflammation and immune dysregulation are directly reflected in the eye. Thus, this emphasizes the necessity of the physician being clinically on guard. [13]

Knowledge, Confidence, Practice Patterns, and Self-Perception

A considerable number (95.67%) of physicians report carrying out basic ocular examination, while (85.58%) internists diagnosed systemic diseases from ocular signs. However, most rated their confidence in their knowledge as 2 and 3 on a scale of 5. Despite having good clinical exposure, focused training is essential to develop good diagnostic skills as described by Morris and McDonnell et al. [14,15]

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Interdisciplinary Awareness and Barriers

According to the study conducted by Hersi et al, most of the physicians are willing to learn, although they acknowledged gaps in their ophthalmology knowledge. Our findings are consistent with the results of their research. [16]

Additionally, it was described in a regional study on Ababneh et al. that although the physicians may know the importance of ocular systemic associations, they still face institutional barriers like time constraints and a lack of collaborative protocols that limit referrals. The present study revealed patient unwillingness (52.88%) and lack of awareness (36.54%) to be the most significant obstacles to appropriate and timely referral. [17]

The results show that a whopping 97.6% of the responders are willing to work in

collaboration with ophthalmologists, which reflects a good inter-speciality camaraderie. The collaboration of general physicians and ophthalmologists has benefited a large number of systemic diseases, as highlighted by Sheldrick et al. [18]

Implications for Training and Curriculum Development

The foundation of effective training lies in the capacity to enhance skill and increase expertise. Thus, students (or) practitioners who already possess the requisite knowledge, but may lack hands-on experience, can benefit from targeted, practical instruction.[19]

Wiggins and colleagues found that the front-line primary care physicians had a limited understanding of the ocular complications of diabetes. In their study, they found that their knowledge and practice were not aligned in the early detection of vision-threatening

Conditions.[20]

In addition, this study did not directly analyze the steroid-induced ocular complications, especially glaucoma and cataract. Roberts, decades ago, stated that primary care providers mismanaged steroid eye drops owing to a lack of training – perhaps still an issue today. [21]

Similarly, Wilson et al. ultimately defined the inappropriate treatment of red eye and eye diseases in children by non-ophthalmic physicians. This caused there to be an empirical treatment overdose. [22, 23]

CONCLUSION

The findings of this study indicate that general physicians, paediatricians, obstetricians, geriatricians, and surgeons were aware of the ocular manifestations of common systemic diseases. However, they did not recognize the ocular manifestations of less common systemic diseases, and ocular toxicities of drugs as well.

Even though 95.67% of the respondents are performing basic eye examination routinely and 85.58% have diagnosed systemic disease through its ocular manifestation, the self-perceived confidence level was mild. It was observed that neither practical exposure nor clinical competence can be ensured unless there is an administrative and academic thrust, and the departments work in tandem. The unwillingness of one-third of our study subjects to engage in active ophthalmology referral or a simultaneous interdepartmental model was suggestive of institutional inertia, which can compromise patient care.

The results of the study show that all the doctors (100%) agree on the early identification of ocular signs. Another remarkable outcome was that 98.56% of the physicians included in the study expressed a willingness to further train in ophthalmology. There is necessarily a strong desire for change. Hence, it is possible to effect positive change using curricular changes as one of the options. 80.29% of the respondents accept the following integration of ophthalmology teaching in the undergraduate curriculum as a sustainable intervention.

In conclusion, the goal is not to alter the current physical knowledge, but to improve the system through which knowledge is acquired and applied with better training, updated curricula, and teamwork, so that knowledge can more effectively lead to better care for patients.

Data availability statement

The data supporting the findings of the study are available from the corresponding author up on reasonable request

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