OCULAR FINDINGS IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Abstract

Chronic obstructive pulmonary disease (COPD) is a common respiratory condition known for its systemic impact and wide range of comorbidities. While its pulmonary effects are well documented, emerging evidence points to possible ocular involvement that has received less clinical and research attention. Visual impairments due to cataract, age-related macular degeneration (ARMD), and glaucoma are among the leading causes of blindness worldwide, yet their prevalence in individuals with COPD remains underexplored and poorly characterized in existing literature.

In a cross-sectional study, 150 COPD patients were recruited from respiratory clinics and primary care settings. Each participant underwent a thorough ophthalmic evaluation, including visual acuity testing, slit-lamp examination, intraocular pressure measurement, dilated fundus examination, and optical coherence tomography. Simultaneously, detailed clinical data regarding COPD—such as disease severity, exacerbation frequency, smoking history, duration of illness, and medication use—were collected to identify possible associations between respiratory and ocular health.

The findings revealed cataract as the most prevalent ocular condition among participants, followed by ARMD and glaucoma. Notably, a strong correlation was observed between ocular pathology and COPD-related factors, particularly smoking and disease severity. These associations suggest shared pathophysiological mechanisms, such as oxidative stress and chronic inflammation, linking lung dysfunction with ocular degeneration.

These results underscore the importance of integrating regular ophthalmic screening into the routine care of COPD patients. Early detection and timely management of ocular comorbidities can significantly improve overall quality of life in this vulnerable population. The study highlights the need for further research to better understand the underlying biological connections and to develop comprehensive, multidisciplinary strategies for care.

Keywords: Age-Related Macular Degeneration (ARMD), Cataract, COPD (Chronic Obstructive Pulmonary Disease), Glaucoma, Ocular manifestations

INTRODUCTION

Chronic inflammation of the airways and ongoing restriction of airflow are hallmarks of Chronic Obstructive Pulmonary Disease (COPD), a progressive respiratory condition. A major source of mortality and morbidity globally, it primarily impacts the lungs but can also have systemic manifestations.COPD is often accompanied

by systemic inflammation, oxidative stress, and hypoxia, which collectively contribute to the disease's multisystem involvement. [1,2]

While the pulmonary aspects of COPD are well recognized, accumulating evidence indicates that COPD can have significant implications for ocular health. The eye, being highly vascularized and sensitive to systemic changes, is susceptible to the chronic inflammatory and hypoxic environment characteristic of COPD. Consequently, patients with COPD exhibit a spectrum of ophthalmic manifestations and complications, which may adversely impact their quality of life. [2,3]

The ocular manifestations observed in COPD patients are multifactorial in origin. They may arise from direct effects of systemic inflammation, chronic hypoxia, oxidative damage, and side effects of medications used to manage COPD, particularly corticosteroids. Moreover, comorbid conditions common in COPD patients, such as cardiovascular diseases and diabetes mellitus, further compound the risk of ocular complications. [4,5]

One of the most frequently reported ocular abnormalities in COPD patients is dry eye syndrome. This condition results from instability of tear film and damage to the ocular surface epithelium, leading to symptoms such as ocular discomfort, irritation, visual disturbances, and increased risk for corneal abrasions and infections. The pathogenesis of dry eye in COPD is complex, involving inflammatory pathways, meibomian gland dysfunction, and tear film disruption due to the chronic systemic inflammation and hypoxia associated with COPD. [2,6]

Beyond dry eye syndrome, COPD patients are predisposed to developing other significant ocular conditions, such as cataracts, Age-Related Macular Degeneration (ARMD) and glaucoma. The development of these conditions is influenced by risk factors like advanced age, smoking and systemic inflammation—all of which are frequently encountered in COPD populations. [7,8] Cataracts, characterized by lens opacification, may be exacerbated by the systemic use of corticosteroids prescribed during COPD exacerbations. Such corticosteroid use can accelerate cataract formation and increase intraocular pressure (IOP), thereby predisposing patients to glaucoma and progressive visual field loss. [1,7,8]

Emerging research also highlights a potential association between COPD and retinal microvascular abnormalities. Chronic hypoxia and systemic inflammation may induce endothelial dysfunction and microvascular damage, leading to retinal vascular changes such as retinal vein occlusion and other microangiopathies. These retinal alterations can result in visual impairment and may reflect the broader systemic vascular pathology observed in COPD. [3,9]

Given the broad range of ocular manifestations in COPD and their potential to significantly affect patient outcomes, it is critical to conduct comprehensive studies to elucidate the prevalence, clinical characteristics, and underlying mechanisms of these ocular complications. Such studies would provide valuable insights to facilitate early diagnosis, intervention, and holistic management of COPD patients, thereby improving their overall quality of life. [4,7]

Therefore, our observational study aims at systematically evaluating the prevalence of cataract, ARMD and glaucoma among patients diagnosed with COPD. Utilizing thorough ophthalmic evaluations and robust statistical analyses, this study seeks to clarify the intricate relationship between COPD and ocular health. Ultimately, a better understanding of these ocular manifestations may encourage interdisciplinary collaboration between pulmonologists and ophthalmologists, promoting integrated care for patients suffering from this debilitating respiratory condition.

Objectives

Our study aims at investigating the prevalence of cataract, glaucoma, and Age-Related Macular Degeneration (ARMD) in patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD). Additionally, it seeks to identify potential opportunities for early detection, intervention, and management of ocular comorbidities in the COPD population. COPD is a systemic inflammatory disease often accompanied by ocular complications that significantly impact patients' quality of life. [1,4,6] Understanding the prevalence and clinical features of these ocular disorders in COPD patients could guide improved interdisciplinary care. [7,8]

MATERIALS AND METHODOLOGY

Design of Study:
To investigate the prevalence and clinical features of cataract, ARMD, and glaucoma in COPD patients, our observational study employs a cross-sectional design. This design is suitable for estimating the frequency of ocular comorbidities and identifying associated risk factors at a single time point. [2,3]

Participant Recruitment:
Patients diagnosed with COPD will be recruited from theOphthalmologyOutpatientDepartment of Saveetha Medical College and Hospital. Inclusion criteria include a confirmed diagnosis of COPD based on spirometry and clinical evaluation, age between 40 and 75 years, and provision of informed consent. [5,6] Exclusion criteria include the presence of significant ocular comorbidities affecting visual function, such as diabetic retinopathy or advanced macular degeneration unrelated to ARMD, as well as any condition preventing a thorough ophthalmic examination. [12,13]

Ophthalmic Evaluation:
All eligible participants will undergo comprehensive ophthalmic evaluation, which includes visual acuity assessment, intraocular pressure (IOP) measurement, slit-lamp examination, dilated fundus examination and Optical Coherence Tomography (OCT) imaging. The use of OCT enhances the detection of subtle retinal changes characteristic of ARMD and optic nerve damage indicative of glaucoma. [8,9] Classification of ARMD will be based on the presence of pigmentary changes, drusen, geographic atrophy, or choroidal neovascularization identified through fundus examination and OCT imaging. [14-16] Glaucoma diagnosis will be established based on characteristic optic disc cupping, corresponding visual field defects, and elevated IOP measurements, corroborated by OCT and optic disc photography. [10,11]

Data Collection:
Demographic information, medical history including smoking status and COPD severity, ocular findings, visual function parameters, and healthcare utilization data will be collected using standardized data forms. Additionally, spirometry results, history of COPD exacerbations, and current medication use will be documented to explore associations between COPD clinical status and ocular manifestations. [6,7,24]

Statistical Analysis:
Descriptive statistics will summarize demographic characteristics, clinical parameters, and ocular findings. The prevalence of cataract, ARMD, and glaucoma in COPD patients will be calculated along with 95% confidence intervals. Inferential statistics, including Chi-square tests, regression analysis and t-tests, will be applied to evaluate associations between COPD-related factors and ocular findings. Subgroup analyses will explore the influence of COPD severity and smoking history on ocular comorbidities. A p-value of less than 0.05 will be considered statistically significant. [1,4,5]

Ethical Considerations:
The study has obtained ethical approval from the Institutional Review Board (IRB) and Institutional Ethics Committee (IEC). Prior to enrollment, Informed Consent was obtained from all participants. Confidentiality and data protection protocols were strictly maintained throughout the study. [7,8]

Employing a rigorous cross-sectional design combined with comprehensive ophthalmic evaluation, this study aims to shed light on the incidence, clinical characteristics, and potential associations of cataract, ARMD, and glaucoma in the COPD population. The findings may contribute to early identification, risk stratification and focused management of ocular comorbidities, ultimately improving quality of life and the clinical outcome for COPD patients. [1,6,7]

RESULTS

A cross-sectional observational study was carried out on 150 patients who visited Saveetha Medical College's out-patient department of Ophthalmology between March 2024 and September 2024, with a special emphasis on detailed history.

In this study our participants were aged between 40-75 years and majority of them were of 60-69(40%) years.

Table 1: Age distribution of the participants

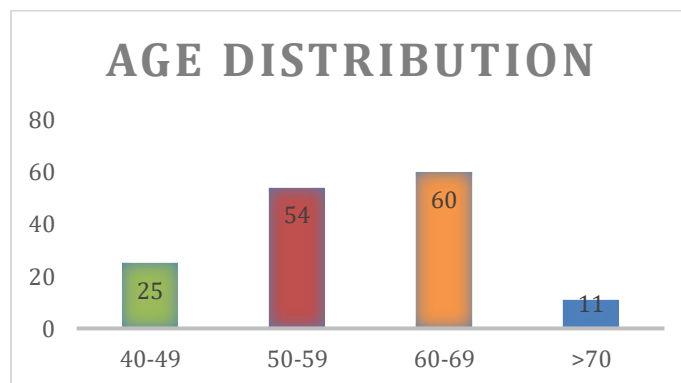| Age	Frequency	Percentage
40-49	25	16.7
50-59	54	36
60-69	60	40
>70	11	7.3

Figure 1: Age distribution

In our study male subjects (60%) outnumbered their female counterparts (40%).

Table 2: Gender distribution of the participants

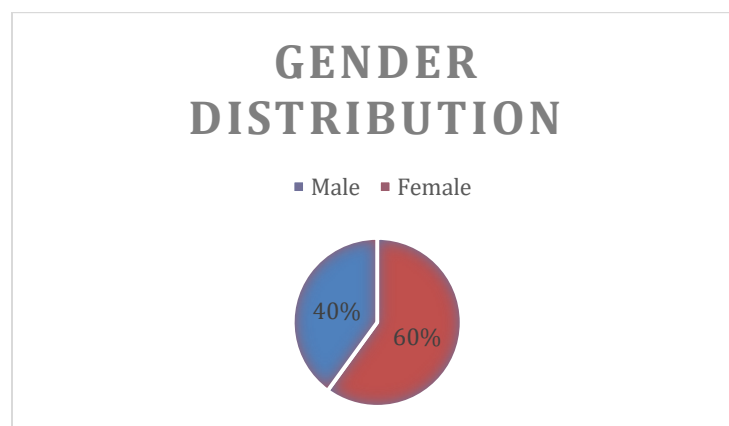| Sex	Frequency	Percentage
Male	90	60
Female	60	40

Figure 2: Gender distribution

Cataract (88.6%), glaucoma (6.8%), and ARMD (4.6%) were the most common ocular manifestations in COPD cases.

Table 3: Frequency distribution of Ocular manifestations

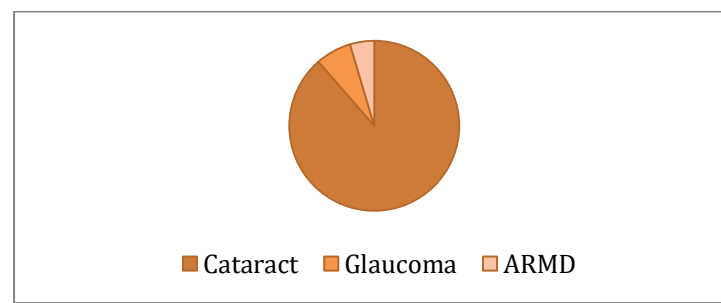| Ocular manifestations	Frequency	Percentage
Cataract	117	88.6
Glaucoma	9	6.8
ARMD	6	4.6

Figure 3: Ocular Manifestations

Compared to patients who did not use steroid inhalers (71.95%), the cataract incidence was higher in users of steroid inhalers (85.29%).

Table 4: Incidence of cataract in subjects using steroid inhalers vs. non-users

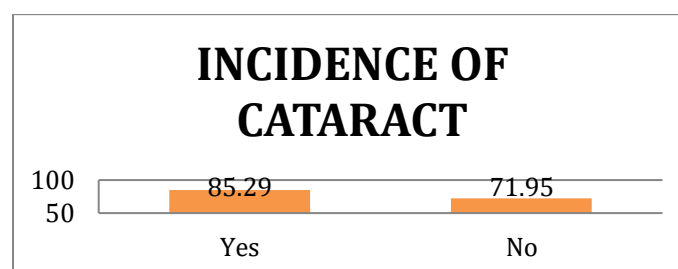| Inhalational steroid users	No. of subjects	No. of subjects with Cataract	Percentage
Yes	68	58	85.29
No	82	59	71.95

Figure 4: Incidence of cataract in participants using steroid inhalers vs. non-users

In the case of glaucoma and ARMD, the difference between both the groups is insignificant.

Table 5: Incidence of glaucoma in patients using steroid inhalers vs. non-users

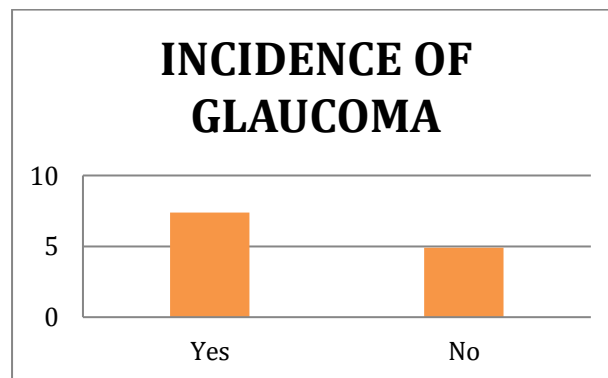| Inhalational steroid users	No. of patients	No. of patients with glaucoma	Percentage
Yes	68	5	7.4
No	82	4	4.9

Figure 5: Incidence of glaucoma in participants using steroid inhalers vs. non-users

Table 6: Incidence of ARMD in subjects using steroid inhalers vs. non-users

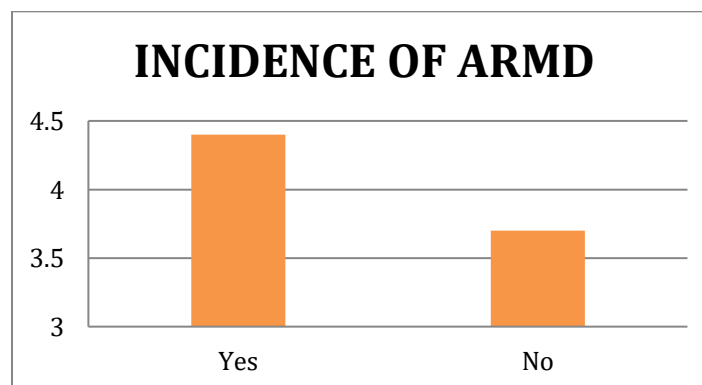| Inhalational steroid users	No. of patients	No. of patients with ARMD	Percentage
Yes	68	3	4.4
No	82	3	3.7

Figure 6: Incidence of ARMD in participants using steroid inhalers vs. non-users

DISCUSSION

This observational study aimed to investigate the prevalence, clinical characteristics, and potential associations of cataract, ARMD and glaucoma in patients diagnosed with chronic obstructive pulmonary disease (COPD). The findings shed light on the growing recognition of ocular complications as significant comorbidities in COPD and provide a foundation for improved multidisciplinary clinical care.

Understanding these associations is crucial, as visual impairment may further compromise the functional status and quality of life in an already vulnerable patient population. [1]

Our results demonstrated a notably high prevalence of cataract among COPD patients, followed by ARMD and glaucoma. This observation is consistent with existing literature, where cataract emerges as the most common ocular manifestation in patients with chronic systemic conditions, particularly those involving long-term oxidative stress and systemic inflammation. [4] The elevated risk of cataract in COPD is likely multifactorial, involving advanced age, tobacco exposure, corticosteroid use, and chronic systemic inflammation. [5,6] Inhaled or systemic corticosteroids—commonly prescribed for COPD management—have been independently associated with posterior subcapsular cataract formation. [8]

The presence of ARMD and glaucoma in the COPD population further underscores the systemic impact of chronic respiratory disease. Several mechanisms may explain these associations. Systemic inflammation and oxidative stress—hallmarks of COPD—are also implicated in the pathogenesis of ARMD and glaucomatous optic neuropathy. [2,3] Microvascular dysfunction and impaired oxygenation, often present in advanced COPD, may contribute to retinal ischemia and progressive optic nerve damage. [10,11]

Furthermore, the study highlights that the severity of COPD, frequency of exacerbations, and cumulative steroid exposure are potential modifiers of ocular disease risk. This finding supports the hypothesis that disease burden and treatment intensity in COPD may directly influence ocular outcomes. It also emphasizes the need for tailored ophthalmic surveillance, especially in patients with severe or poorly controlled COPD. [6,24]

Beyond clinical pathophysiology, the implications of visual dysfunction in COPD extend into functional and psychological domains. Visual impairment can impair medication adherence, hinder mobility, and increase the risk of falls and hospitalizations. [17] In the context of COPD, where patients are already compromised in terms of respiratory function, the additional burden of vision loss can severely impact overall quality of life. [7]

Visual impairment remains a significant global health concern, with estimates suggesting over 285 million people affected worldwide, underscoring the public health importance of managing ocular complications in chronic diseases such as COPD. [18] The complexity of ocular manifestations in COPD requires a multidisciplinary clinical approach supported by thorough ophthalmic assessment and evidence-based guidelines. Standard ophthalmologic texts highlight that systemic diseases and their treatments can influence ocular health significantly, necessitating heightened vigilance for early signs of vision-threatening conditions. [19] Among risk factors for age-related macular degeneration (ARMD), systemic factors including body mass index and cardiovascular comorbidities commonly seen in COPD patients have been associated with disease progression, suggesting overlapping pathogenetic mechanisms. [20]

National and international guidelines emphasize the importance of integrated care pathways for chronic diseases, recommending routine screening for systemic complications, which should extend to ocular health in COPD patients to optimize clinical outcomes. [21] The global burden of glaucoma continues to rise, with projections estimating millions affected worldwide, emphasizing the need for proactive identification and management of glaucoma risk in populations with COPD who are predisposed due to corticosteroid use and systemic inflammation. [23] Incorporating these considerations can enhance holistic patient care, reduce the burden of preventable visual disability, and ultimately improve quality of life in COPD patients.

From a healthcare systems perspective, early ophthalmic screening in COPD could potentially reduce long-term morbidity. Implementing routine ophthalmic evaluations in pulmonology clinics or integrating vision screening into COPD management protocols may lead to earlier identification of treatable ocular conditions, especially ARMD in its early stages or steroid-induced ocular hypertension. [9,24] This reinforces the importance of interdisciplinary collaboration between pulmonologists and ophthalmologists.

However, our study possesses limitations. The cross-sectional design precludes causal inference and temporal sequencing of COPD and ocular disease onset. The absence of a control group also restricts the ability to establish comparative prevalence. Furthermore, ocular findings may be underreported in milder COPD cases not referred for tertiary care, potentially introducing selection bias. [25] Future longitudinal studies are needed to better establish causality, assess the progression of ocular disease, and determine whether COPD control influences ocular outcomes over time.

Looking ahead, there is a critical need for mechanistic studies exploring the shared molecular pathways between COPD and ocular pathologies. Understanding the role of chronic systemic inflammation, oxidative stress, and vascular dysfunction at the cellular level may identify novel therapeutic targets that can address both pulmonary and ocular complications. Additionally, clinical trials investigating the impact of COPD treatments on ocular outcomes could provide guidance on optimizing therapy to minimize adverse ocular effects without compromising respiratory care. [6,22]

Finally, integrating patient education regarding potential ocular risks into COPD management programs is essential. Awareness should be created in patients, about the importance of regular eye examinations, especially if they have advanced disease or are on long-term corticosteroid therapy. Health systems should also explore cost-effectiveness analyses of routine ophthalmic screening within COPD clinics to inform policy decisions. By fostering stronger collaboration between respiratory and eye care specialists, we can work towards comprehensive care models that improve both respiratory and visual health outcomes. [7]

CONCLUSION

This study offers comprehensive insights into the ocular comorbidities prevalent among patients with chronic obstructive pulmonary disease (COPD), focusing on cataract, Age-Related Macular Degeneration (ARMD), and glaucoma. Our findings contribute to an expanding understanding of COPD as a systemic illness with significant extrapulmonary manifestations, particularly in ocular health. These insights highlight the critical need for integrated clinical approaches that extend beyond pulmonary care to include vigilant ophthalmologic assessment and multidisciplinary management strategies.

The notably high prevalence of cataract in COPD patients identified in this study aligns with previous literature, confirming cataract as the most frequent ocular complication within this population. [1,4] The multifactorial etiology of cataract development in COPD likely involves synergistic effects of aging, chronic tobacco exposure, sustained systemic inflammation, and notably, prolonged corticosteroid therapy commonly used for COPD management. [5,6,8] Corticosteroid-induced posterior subcapsular cataracts have been well documented, emphasizing the importance of balancing therapeutic benefits and ocular side effects in COPD treatment regimens. [8,24] These findings underscore the necessity for clinicians to monitor ocular health proactively in patients receiving long-term corticosteroids.

Age-related macular degeneration and glaucoma also presented with considerable prevalence in our COPD cohort, illustrating the systemic nature of COPD and its impact on ocular vascular and neurodegenerative processes. [2,3,10] Both conditions share pathogenic mechanisms, including chronic systemic inflammation, oxidative stress, microvascular dysfunction, and hypoxia-induced tissue damage, which are exacerbated in advanced COPD. [10,11] Our study also identified that COPD severity, frequency of exacerbations, and cumulative corticosteroid exposure serve as important modifiers of ocular disease risk and severity, thereby reinforcing the need for personalized ophthalmic surveillance strategies tailored to individual disease burden. [6,24]

The clinical implications of these ocular comorbidities are profound. Visual impairment in COPD patients can further limit functional independence, exacerbate psychological distress, and impair adherence to complex medical regimens essential for respiratory health. [7,17] The compounded disability resulting from respiratory and visual dysfunction may increase fall risk, hospitalizations, and overall healthcare utilization, emphasizing the vital importance of early detection and management of ocular complications to preserve quality of life. [7,17]

From a global health perspective, the significance of visual impairment is well recognized, with over 285 million people affected worldwide. [18] The overlap of ocular disease risk factors—such as cardiovascular

comorbidities and metabolic disturbances common in COPD—with those implicated in ARMD progression highlights shared pathogenetic pathways warranting further investigation. [20] These epidemiological links call for routine ocular screening in COPD populations, as recommended by national and international guidelines advocating integrated care pathways for chronic diseases. [21,22] Furthermore, the increasing global burden of glaucoma necessitates proactive risk assessment in COPD patients, especially those exposed to corticosteroids and systemic inflammation, to prevent irreversible vision loss. [23]

Implementing routine ophthalmic screening within COPD management protocols could yield significant benefits in early detection and treatment of vision-threatening conditions, including early-stage ARMD and steroid-induced ocular hypertension. [9,24] Such integration demands strengthened interdisciplinary collaboration among pulmonologists, ophthalmologists, and primary care providers to develop standardized clinical guidelines ensuring comprehensive care. [7] The potential cost-effectiveness of such models also merits exploration, given the economic burden associated with visual impairment and COPD-related healthcare costs. [7]

Despite these compelling findings, we would like to acknowledge several study limitations. The study design limits causal inference and temporal sequencing of COPD and ocular disease onset, while the absence of a control group restricts comparative prevalence analysis. [25] Selection bias may exist due to recruitment from tertiary care centers, potentially overestimating ocular disease prevalence in the broader COPD population. Addressing these limitations requires prospective longitudinal studies with appropriate control groups to clarify causal relationships and assess ocular disease progression relative to COPD severity and management. [25]

Moving forward, mechanistic research exploring shared molecular and cellular pathways between COPD and ocular diseases is urgently needed. Investigating the roles of systemic inflammatory mediators, oxidative stress markers, and microvascular changes in ocular tissues could identify novel therapeutic targets capable of addressing both pulmonary and ocular complications simultaneously. [6] Clinical trials assessing the ocular safety profiles of COPD treatments, especially corticosteroids, alongside interventions aimed at minimizing ocular morbidity will be critical in guiding evidence-based practice. [6,22]

Educating patients is crucial to comprehensive COPD management. Informing patients about potential ocular risks, the importance of regular eye examinations, and symptoms warranting prompt ophthalmic evaluation may improve early detection and intervention, ultimately preserving vision and quality of life. [7] Healthcare systems should consider incorporating ocular health education into COPD care programs, thereby enhancing patient empowerment and adherence to screening recommendations.

In addition, the neurological and neuro-ophthalmic manifestations of COPD, such as optic neuropathies and other neuro-ophthalmic complications, though less common, deserve attention due to their potential impact on visual function and quality of life. [25] Recognizing these less frequent but significant complications can facilitate timely diagnosis and management, contributing to holistic care.

Standard ophthalmologic references emphasize that systemic diseases and their treatments profoundly influence ocular health, necessitating heightened clinical vigilance in populations with chronic systemic illnesses such as COPD. [19] Integrating these insights into COPD management aligns with current precision medicine trends that emphasize individualized, comprehensive care addressing all aspects of disease burden.

In summary, this study highlights a significant burden of ocular comorbidities—including cataract, ARMD, and glaucoma—among COPD patients, emphasizing the necessity of incorporating ocular health assessment into routine COPD care. Recognizing and managing these ocular complications can prevent vision loss, improve functional status, and enhance overall quality of life for this vulnerable patient group. Strengthening interdisciplinary collaboration between respiratory and ophthalmologic specialists, advancing mechanistic research, and implementing patient-centered education and screening programs will be vital to achieving these goals.

With the evolution of healthcare systems to meet the demands of chronic diseases, recognizing and proactively managing the full spectrum of COPD-associated manifestations turn crucial to optimizing patient well-being. This aligns with the requirement for inclusive healthcare policies that guarantee underprivileged populations full medical coverage, supporting early identification and intervention techniques. [26]

Chronic inflammation and oxidative stress in COPD may contribute to neuropsychiatric disturbances as well, mandating a comprehensive approach beyond just ophthalmic screening. [27]

Considering AI's expanding importance in biomedical research, subsequent studies may use AI-driven analytical methods to further understand the complex relationships between ocular diseases and COPD. This could improve early identification and streamline therapeutic approaches.[28]

Scientific Review Board:
SRB approval has been granted at the institutional level with number **711/03/2024/PG/SRB/SMCH**

Conflicts Of Interest:
We wish to disclose that there are no conflicts of interest related to this manuscript. All authors have read and approved the final version of the manuscript and agree with its submission to Texila International Journal of Public Health.

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