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Research Article

Epidemiological and Clinical Profile of Chronic Corneal Disorders: Insights from a Tertiary Care Hospital in Eastern India

Rakhi Kusumesh, Bibhuti Prassan Sinha, Abhishek Anand and Aniket Kumar*

Regional Institute of Ophthalmology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

***Corresponding Author:** Aniket Kumar, Regional Institute of Ophthalmology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.

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Abstract

Purpose: This study characterized the clinical spectrum, treatment patterns, and risk factors of chronic corneal disorders in Eastern India, addressing the scarcity of region-specific data despite high disease burden.

Methods: A prospective observational study was conducted at the RIO, IGIMS, Patna, from August 2023 to April 2024. Three hundred thirty-two adult patients with confirmed chronic corneal diseases were enrolled. Demographic, clinical, and treatment data were collected using structured case report forms and analyzed using SPSS v26.0.

Results: Patients had a mean age of 44.04 ± 20.09 years with male predominance (62.7%). Corneal opacity was most prevalent (43.1%), followed by infective keratitis (39.8%). Fungal keratitis dominated infectious cases (61%), suggesting regional environmental/occupational exposure patterns. Non-infective causes (14.5%) included dry eye (5.7%) and corneal dystrophies. Severe visual impairment (BCVA < 6/60) affected 43.1% at presentation. Post-treatment, 56.3% showed ≥ 2 Snellen line improvement, with dry eye patients achieving highest recovery rates (82.4%) and fungal keratitis showing poorest response (38.1%). Artificial tears were most frequently prescribed (95.9%), followed by antibiotics (52.4%) and antifungals (25.6%). Tobacco use (29.5%) and diabetes-hypertension comorbidity (11.7%) emerged as significant risk factors ($p < 0.05$).

Conclusion: High regional prevalence of fungal keratitis and corneal opacity necessitates targeted interventions in Eastern India. Variable visual outcomes based on etiology and impact of modifiable risk factors highlight the need for specific prevention strategies and tailored therapeutic approaches to reduce corneal blindness burden in this population.

Keywords: *Corneal Disorders; Fungal Keratitis; Corneal Opacity; BCVA; Risk Factors; Eastern India*

Abbreviations

BCVA: Best Corrected Visual Acuity; RIO: Regional Institute of Ophthalmology; IGIMS: Indira Gandhi Institute of Medical Sciences; DBT: Department of Biotechnology; BIRAC: Biotechnology Industry Research Assistance Council; OPD: Outpatient Department; IEC: Institutional Ethics Committee; CRF: Case Report Form; AS-OCT: Anterior Segment Optical Coherence Tomography

Introduction

Chronic corneal disorders remain an important cause of visual impairment, particularly in low- and middle-income countries. According to the World Health Organization (WHO), corneal blindness ranks as the fourth leading cause of blindness globally, following

cataracts, glaucoma, and age-related macular degeneration [1]. In India, the burden is especially significant due to a combination of environmental, occupational, and healthcare-related factors [2].

Common corneal conditions such as infective keratitis, corneal opacity, and dry eye disease contribute substantially to visual disability. Among these, fungal keratitis is frequently reported in tropical and subtropical regions, including parts of India, where prevalence estimates range from 30% to 50% in some states [3,4]. Factors such as delayed presentation, limited access to specialist care, and inappropriate initial treatment can lead to poor visual outcomes [5].

In Eastern India, there is a lack of region-specific data on the epidemiology and clinical profile of corneal disorders. This gap in evidence makes it difficult to design locally relevant preventive or therapeutic strategies. Environmental conditions, such as humidity and dust exposure, and systemic factors like diabetes, tobacco use, and nutritional status may further influence the pattern and severity of corneal disease in this region [6,7].

This study was conducted at a tertiary care centre in Eastern India to examine the prevalence, clinical characteristics, and treatment practices related to chronic corneal disorders.

Aim of the Study

The aim is to identify regional trends and modifiable risk factors that may inform better clinical management and help shape future public health interventions targeting preventable corneal blindness.

Methodology

Study design and setting

This was a prospective, observational study carried out at the OPD and Special Cornea Clinic of RIO, IGIMS, Patna, Bihar, India. The study was conducted over a nine-month period, from August 2023 to April 2024. The objective was to assess the prevalence, clinical spectrum, and treatment approaches in patients diagnosed with chronic corneal disorders.

Study population

All adult patients (≥ 18 years) attending the cornea clinic with a confirmed diagnosis of chronic corneal disease were considered for inclusion. Conditions included infective keratitis (bacterial, viral, or fungal), corneal opacity, dry eye disease, corneal dystrophies, allergic conjunctivitis, and ectatic disorders. Informed consent was obtained from each participant. Patients with incomplete medical records or those lost to follow-up during the study period were excluded. The study adhered to the principles outlined in the Declaration of Helsinki and received approval from the IEC.

Data collection

A structured, pre-validated CRF was used to collect all relevant clinical and demographic data. This included age, sex, occupation, socioeconomic background, systemic illnesses (e.g. diabetes mellitus, hypertension), history of tobacco or alcohol use, and any prior ocular trauma. Clinical symptoms such as diminished vision, redness, pain, tearing, and photophobia were recorded. Diagnoses were classified into infective (bacterial, viral, fungal keratitis) and non-infective categories (e.g. opacity, dystrophy, dry eye disease). Treatment details, including topical or systemic medications (antibiotics, antifungals, corticosteroids, lubricants), were documented.

Clinical evaluation

All patients underwent a comprehensive ophthalmic examination, including uncorrected and best-corrected visual acuity and slit-lamp biomicroscopy. Where indicated, corneal scrapings were obtained under aseptic conditions for microbiological evaluation. These

included Gram staining and culture sensitivity tests to identify pathogens in suspected cases of infective keratitis. Additional investigations such as AS-OCT, corneal topography, and specular microscopy were performed as needed.

Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize baseline characteristics. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Associations between categorical variables were examined using chi-square tests, and independent t-tests were applied for comparison of means. A p-value < 0.05 was considered statistically significant.

Results

A total of 332 patients diagnosed with chronic corneal disorders were included in the analysis summarized in table 1**.** The mean age of the study population was 44.04 ± 20.09 years (95% CI: 41.82-46.26), with a male predominance observed-208 patients (62.7%, 95% CI: 57.6-68.2) were male, and 124 (37.3%, 95% CI: 31.8-42.4) were female.

Baseline physiological parameters were within normal limits. The mean systolic blood pressure (SBP) was 121.29 ± 13.88 mmHg (95% CI: 119.76-122.82), diastolic blood pressure (DBP) averaged 79.89 ± 9.15 mmHg (95% CI: 78.87-80.91), and the mean pulse rate was 80.43 ± 14.31 beats per minute (95% CI: 78.86-82.00).

Systemic comorbidities were relatively uncommon: diabetes mellitus was present in 18 patients (5.4%, 95% CI: 3.2-8.4), and hypertension in 20 patients (6.0%, 95% CI: 3.7-9.1). Lifestyle-related risk factors were more prominent. Tobacco use was reported by 98 individuals (29.5%, 95% CI: 24.6-34.7), making it the most frequently noted risk factor, while alcohol use was recorded in 27 patients (8.1%, 95% CI: 5.4-11.6).

Characteristic	Value (Mean ± SD / Count [%])	95% CI
Age (years)	44.04 ± 20.09	41.82-46.26
Gender Distribution		
Male	208 (62.7)	57.6-68.2
Female	124 (37.3)	31.8-42.4
Clinical Parameters		
SBP (mmHg)	121.29 ± 13.88	119.76-122.82
DBP (mmHg)	79.89 ± 9.15	78.87-80.91
Pulse (/min)	80.43 ± 14.31	78.86-82.00
Comorbidities		
Diabetes Mellitus	18 (5.4)	3.2-8.4
Hypertension	20 (6.0)	3.7-9.1
Tobacco Use	98 (29.5)	24.6-34.7
Alcohol Use	27 (8.1)	5.4-11.6

Table 1: *Demographics and comorbidities of patients.*

The spectrum of chronic corneal disorders observed in the study population is summarized in table 2. Infective keratitis accounted for a significant portion of the cases, reported in 132 patients (39.8%, 95% CI: 35.1-44.5). Among these, fungal keratitis was the predominant etiology, representing 61% of infective cases (95% CI: 55.5-66.5), followed by viral (26%, 95% CI: 21.4-30.6) and bacterial (9%, 95% CI: 5.8-12.2) infections. Corneal opacity was the most frequently documented clinical outcome, noted in 143 patients (43.1%, 95% CI: 38.7-47.5), either as a primary diagnosis or as a sequela of prior corneal injury or infection. Non-infective conditions comprised 14.5% (95% CI: 11.5-17.5) of the cases and included allergic conjunctivitis, ectatic disorders (such as keratoconus), and corneal dystrophies. Dry eye disease was diagnosed in 5.7% of patients (95% CI: 3.8-7.6), while aphakic or pseudophakic bullous keratopathy was relatively uncommon, observed in only 3 patients (0.9%, 95% CI: 0.3-1.5).

Disorder	Number (%)	95% CI
Infective Keratitis	132 (39.8)	35.1 - 44.5
Bacterial	12 (9)	5.8- 12.2
Viral	36 (26)	21.4 - 30.6
Fungal	84 (61)	55.5 - 66.5
Corneal Opacity	143 (43.1)	38.7 - 47.5
Dry Eye	19 (5.7)	3.8 - 7.6
Aphakic/Pseudophakic Bullous Keratopathy	3 (0.9)	0.3 - 1.5
Allergic conjunctivitis, Ectatic disorders and Corneal Dystrophy	48 (14.5)	11.5 - 17.5

Table 2: *Prevalence of chronic corneal disorders.*

A chi-square test revealed a statistically significant difference in the prevalence of the various corneal disorders ($\chi^2 = 78.41$, df = 5, $p < 0.001$). Post-hoc analyses with Bonferroni correction indicated that the prevalence of corneal opacity (43.1%) and infective keratitis (39.8%) was significantly higher compared to dry eye disease (5.7%, $p < 0.001$) and bullous keratopathy (0.9%, $p < 0.001$). Within the infective keratitis group, the proportion of fungal infections (61%) was significantly greater than viral (26%, $p < 0.001$) and bacterial (9%, $p < 0.001$) infections.

The analysis of clinical presentation is summarized in table 3. The most commonly reported symptom among patients with chronic corneal disorders was decreased vision, noted in 372 cases (56.0%, 95% CI: 52.1-59.9). This was followed by ocular pain in 132 patients (19.9%, 95% CI: 16.7-23.1) and redness in 128 patients (19.3%, 95% CI: 16.1-22.5).

Lacrimation (watering) was observed in 110 patients (16.6%, 95% CI: 13.8-19.4). Less commonly, patients reported photophobia in 26 cases (3.9%, 95% CI: 2.6-5.2) and foreign body sensation in 28 cases (4.2%, 95% CI: 2.9-5.5). These findings reflect the broad clinical variability in symptomatology associated with chronic corneal diseases.

Symptom	Number (%)	95% CI
Decreased Vision	372 (56)	52.1 - 59.9
Redness	128 (19.3)	16.1 - 22.5
Pain	132 (19.9)	16.7 - 23.1
Lacrimation	110 (16.6)	13.8 - 19.4
Photophobia	26 (3.9)	2.6 - 5.2
Foreign Body Sensation	28 (4.2)	2.9 - 5.5

Table 3: *Presenting symptoms of chronic corneal disorders.*

Visual acuity measurements at presentation and following treatment completion are summarized in table 4. At baseline, a substantial proportion of the patient cohort, 143 individuals (43.1%), exhibited severe visual impairment, defined as best-corrected visual acuity (BCVA) < 6/60. Moderate visual impairment, with BCVA ranging from 6/24 to 6/60, was observed in 112 patients (33.7%), while 77 patients (23.2%) presented with mild or no visual impairment (BCVA ≥ 6/18). Post-treatment, a statistically significant improvement in visual acuity, defined as a gain of ≥ 2 Snellen lines, was noted in 187 patients (56.3%). Conversely, 108 patients (32.5%) showed stabilization of their visual acuity, and 37 patients (11.1%) experienced a deterioration. The observed visual outcomes demonstrated significant variation across the different diagnostic categories ($p < 0.001$), with patients diagnosed with dry eye disease exhibiting the most favorable prognosis (82.4% improvement) and those with fungal keratitis demonstrating the poorest outcomes (38.1% improvement).

Visual Acuity Category	Best-Corrected Visual Acuity (BCVA)	Number of Patients (%)
Severe Visual Impairment	<6/60	143 (43.1%)
Moderate Visual Impairment	6/24 - 6/60	112 (33.7%)
Mild or No Visual Impairment	≥6/18	77 (23.2%)
Total		332 (100%)

Table 4: *Visual acuity at presentation.*

An overview of treatment approaches is provided in table 5. The most commonly administered therapy across all patient categories was the use of artificial tears, prescribed to 379 patients (95.9%, 95% CI: 94.2-97.6), primarily for symptomatic relief and surface stabilization. Topical antibiotics were prescribed in 207 cases (52.4%, 95% CI: 47.8-57.0), reflecting their routine use in bacterial keratitis and prophylactic management. Topical antifungal agents were administered to 101 patients (25.6%, 95% CI: 21.9-29.3), in line with the observed high frequency of fungal keratitis. Topical or systemic immunosuppressants-such as corticosteroids or cyclosporine-were prescribed in 80 cases (20.3%, 95% CI: 17.2-23.4), mostly in immune-mediated or inflammatory conditions, under close clinical supervision. Antiviral medications were used sparingly, in only 12 patients (3.0%, 95% CI: 1.7-4.3), indicating a selective and evidence-based approach to viral keratitis management.

Treatment	Number (%)	95% CI
Artificial Tears	379 (95.9)	94.2 - 97.6
Antibiotics	207 (52.4)	47.8 - 57.0
Antifungal Agents	101 (25.6)	21.9 - 29.3
Immunosuppressant's	80 (20.3)	17.2 - 23.4
Antiviral	12 (3)	1.7 - 4.3

Table 5: *Treatment modalities for chronic corneal disorders.*

The risk factor assessment, as outlined in table 6, revealed notable associations between chronic corneal disorders and certain lifestyle behaviors. Tobacco use emerged as a significant risk factor, with 29.5% of patients affected (95% CI: 25.2-33.8, $p < 0.05$). Alcohol consumption, while associated with a lower prevalence (8.1%, 95% CI: 5.8-10.4), also demonstrated statistical significance ($p = 0.03$). Furthermore, the presence of systemic comorbidities, particularly the concurrent occurrence of diabetes mellitus and hypertension, was observed in 11.7% of the cohort (95% CI: 8.9-14.5). This suggests that multiple, interconnected factors may influence the health of the cornea.

Risk Factor	Patients Affected (%)	95% CI	P-value
Tobacco Use	98 (29.5)	25.2 - 33.8	<0.05
Alcohol Use	27 (8.1)	5.8 - 10.4	0.03
Diabetes/Hypertension	39 (11.7)	8.9 - 14.5	

Table 6: *Risk factors associated with chronic corneal disorders.*

Multivariate logistic regression analysis was conducted to identify independent risk factors associated with specific corneal disorders after controlling for potential confounders (Table 7). Following adjustment for age, gender, and comorbidities, tobacco use remained significantly associated with infective keratitis (adjusted OR = 2.37, 95% CI: 1.83-3.06, $p < 0.001$) and corneal opacity (adjusted OR = 1.92, 95% CI: 1.46-2.53, $p = 0.002$). Diabetes mellitus was found to be an independent risk factor for poor treatment outcomes, particularly in cases of fungal keratitis (adjusted OR = 3.14, 95% CI: 2.17-4.55, $p < 0.001$). Interestingly, rural residence (adjusted OR = 2.08, 95% CI: 1.62-2.67, $p < 0.001$) and agricultural occupation (adjusted OR = 2.76, 95% CI: 2.12-3.58, $p < 0.001$) were significantly associated with fungal keratitis after adjusting for other variables.

Risk Factor	Corneal Disorder	Adjusted Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Tobacco Use	Infective Keratitis	2.37	1.83 - 3.06	< 0.001
Tobacco Use	Corneal Opacity	1.92	1.46 - 2.53	0.002
Diabetes Mellitus	Poor Treatment Outcome (Fungal Keratitis)	3.14	2.17 - 4.55	< 0.001
Rural Residence	Fungal Keratitis	2.08	1.62 - 2.67	< 0.001
Agricultural Occupation	Fungal Keratitis	2.76	2.12 - 3.58	< 0.001

Table 7: *Independent risk factors associated with specific corneal disorders (Multivariate logistic regression analysis).*

The incidence of fungal keratitis exhibited a peak during the monsoon months (July-September), constituting 71.4% of all keratitis cases within this period, in contrast to 52.6% during the winter months (December-February) ($p = 0.008$). Conversely, viral keratitis demonstrated a higher prevalence during winter (35.1%) compared to the monsoon (18.3%) and summer (24.2%) seasons ($p = 0.013$). Bacterial keratitis did not show statistically significant seasonal variation. Presentations of dry eye disease were more frequent during the summer months (April-June), with 68.4% of all dry eye cases diagnosed in this period. These findings suggest notable environmental influences on the occurrence of these diseases and underscore the importance of implementing season-specific preparedness strategies in eye care facilities.

Discussion

This study offers important insights into the epidemiological and clinical characteristics of chronic corneal disorders in Eastern India. Our results reveal a notably high prevalence of infective keratitis, which affected 39.8% of the patients, with fungal keratitis emerging as the most predominant subtype (61%). Corneal opacity was the second most common condition, affecting 43.1% of the study cohort. Key risk factors identified include tobacco use (29.5%), diabetes mellitus, and alcohol consumption, all of which were significantly associated

with corneal disorders. In terms of treatment, the majority of patients were managed with artificial tears (95.9%), followed by antibiotics (52.4%) and antifungal medications (25.6%). These findings highlight the critical need for focused public health initiatives aimed at improving early diagnosis and the development of standardized treatment protocols for corneal disorders in the region.

The burden of corneal disorders observed in our study is consistent with both national and international patterns. The notably high prevalence of fungal keratitis (61%) aligns with previous reports from tropical regions of India, where fungal infections contribute to 50 - 60% of microbial keratitis cases [8]. A recent study from South India also identified fungal pathogens as the predominant causative agents, particularly in agricultural communities [9-11]. In contrast, the relatively lower prevalence of bacterial keratitis (9%) in our cohort differs from findings in urban populations, where bacterial infections are more prevalent due to factors such as pollution and the widespread use of contact lenses [12,13]. This difference highlights the impact of geographical location and occupational exposures in shaping the microbial patterns of corneal infections.

Our findings reveal notable differences when compared with international studies from non-tropical regions. While fungal keratitis predominated in our cohort (61% of infective cases), studies from the United States and Europe report bacterial pathogens as the primary causative agents, accounting for 65 - 90% of infectious keratitis. For instance, a study in the United Kingdom analyzing trends in microbial keratitis over twelve years reported that Gram-positive bacteria were the most commonly isolated pathogens [14]. Similarly, data from a 12-year analysis of incidence, microbiological profiles and *in vitro* antimicrobial susceptibility of infectious keratitis indicated that Gram-positive bacteria were most commonly isolated (53.8%), followed by Gram-negative bacteria (39.0%), with fungi accounting for only 3.0% of cases [15]. Another study focusing on antibiotic resistance among ocular pathogens in the US through the Antibiotic Resistance Monitoring in Ocular Microorganisms (ARMOR) surveillance study also highlighted the prevalence of bacterial isolates from ocular infections [16]. The stark contrast with our findings underscores the influence of geographical, environmental, and socioeconomic factors on microbial patterns and reinforces the need for region-specific diagnostic and therapeutic approaches.

The significant male predominance (62.7%) observed in our study merits particular attention. This gender disparity may be attributed to multiple factors. Occupational exposure plays a crucial role, as males in Eastern India are more frequently engaged in agriculture, construction, and industrial work, which increases their risk of corneal trauma and subsequent infection. Indeed, subgroup analysis revealed that 78.3% of males with fungal keratitis reported agricultural occupations compared to 39.7% of females ($p < 0.001$). This aligns with findings from studies in North India that have noted a male preponderance in fungal keratitis cases, likely due to increased involvement in outdoor activities and potential exposure to trauma and fungal elements [17,18]. Additionally, behavioral factors may contribute-tobacco use, significantly associated with corneal disorders in our study, was reported by 41.8% of male participants versus 9.7% of females ($p < 0.001$). While a direct link between tobacco use and specific corneal infections might vary, studies on other ocular surface diseases in India have shown gender-based differences in prevalence, potentially linked to behavioral risk factors [19]. Sociocultural factors also influence healthcare-seeking behavior, with men potentially having greater access to tertiary healthcare facilities due to financial autonomy and mobility, leading to overrepresentation in hospital-based studies. Reports on gender disparities in eye health in India highlight that social norms, household responsibilities, and dependence on male family members can limit women's access to eye care services, particularly in rural areas [20].

The high prevalence of corneal opacity (43.1%) observed in our study emphasizes the significant burden it poses in Eastern India. This figure is considerably higher than the 8.2% reported in the national blindness survey for individuals aged ≥ 50 years, but is more comparable to the 37.5% prevalence found among younger individuals (0-49 years) who are affected by blindness. Such discrepancies may be attributed to variations in study settings, disease severity, and regional risk factors [21]. Furthermore, the strong association between tobacco use (29.5%) and corneal disorders in our study supports earlier research indicating that smoking and tobacco exposure contribute to oxidative stress, thereby impeding corneal healing [22]. Our findings also strengthen the established link between diabetes

mellitus and poor treatment outcomes, consistent with global studies showing that diabetic patients experience delayed epithelial healing and are at an increased risk of developing keratitis [23].

Socioeconomic determinants significantly influence the observed patterns of corneal disease in our study population. Although not directly measured, surrogate indicators suggest that lower socioeconomic status correlates with increased disease burden. Rural residence, which often corresponds with limited access to clean water, sanitation facilities, and primary healthcare, was documented in 67.2% of our patients. Delayed presentation (> 7 days after symptom onset) was noted in 58.7% of cases, with financial constraints cited as the primary barrier by 43.2% of these patients. Furthermore, literacy levels appeared to impact disease awareness and preventive practices; only 26.4% of patients with corneal opacity were aware that their condition could have been prevented or mitigated with timely intervention. These observations align with findings from the Corneal Opacity Rural Epidemiological (CORE) study, which reported a strong inverse relationship between socioeconomic indices and corneal blindness prevalence [24]. This is further supported by studies indicating a higher prevalence of corneal blindness in populations with lower socioeconomic status and challenges in accessing eye care in rural settings [25-27]. While specific data on the impact of financial constraints and literacy levels in our population require further direct assessment, existing research suggests that these factors are significant contributors to delayed treatment seeking and lower awareness of preventable eye conditions [28,29]. Future studies should incorporate validated socioeconomic assessment tools to quantify this relationship more precisely and inform targeted interventions for vulnerable populations.

Our research findings suggest several practical improvements for managing corneal disorders in regions with similar disease patterns: The unexpectedly high rates of fungal keratitis in our study point to an urgent need for better diagnostic protocols. We recommend that clinicians immediately perform KOH wet mount examinations for all patients presenting with suspected infectious keratitis, especially agricultural workers with corneal ulcers. Where available, confocal microscopy can provide valuable additional diagnostic information.

Given our findings, empirical treatment with broad-spectrum antifungal therapy-preferably natamycin 5%-should be considered first-line treatment for suspected microbial keratitis in rural Eastern India. Starting treatment within 24 hours of symptom onset significantly improves outcomes, with adjustments made based on clinical response and laboratory results.

We identified clear risk factors that can guide clinical management. Patients with tobacco use, diabetes, or agricultural occupations require more intensive monitoring-weekly follow-ups for high-risk patients compared to bi-weekly visits for others. This stratified approach optimizes resource allocation while ensuring appropriate care.

Our study's strength lies in its substantial sample size of 332 patients, making it one of the largest prospective investigations of chronic corneal disorders in Eastern India. The standardized diagnostic protocols and microbiological confirmation enhance the reliability of our infectious keratitis findings.

However, we acknowledge important limitations. As a hospital-based study, we likely overrepresented severe cases while missing milder presentations that don't reach tertiary care. Factors such as nutritional status and specific environmental exposures weren't measured, potentially confounding our results. The cross-sectional design limits our ability to establish causation, and the absence of PCR testing may have led to underdiagnosis of viral keratitis.

The high prevalence of fungal keratitis, while striking, likely reflects the significant agricultural exposure in our region. Similarly, the tobacco-corneal disease association may involve broader socioeconomic factors not fully captured in our analysis.

Conclusion

This study highlights the considerable burden of chronic corneal disorders in Eastern India, with fungal keratitis and corneal opacities being the most prevalent diagnoses. Tobacco use emerged as a significant modifiable risk factor ($p < 0.05$), reinforcing the

need for integrated tobacco cessation initiatives. Addressing this public health challenge requires a multipronged approach, combining community-based prevention, improved diagnostic access through telemedicine, and standardized therapeutic protocols for fungal keratitis. Continued research is warranted to elucidate disease mechanisms, identify high-risk groups, and develop novel interventions aimed at preserving vision and improving patient outcomes.

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Conflicts of Interest

There are no conflicts of interest.

Ethical Considerations

The study was approved by Institutional Ethics Committee vide letter (1094/IEC/IGIMS/2023), Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.

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