

Refractive Error Patterns and Their Demographic and Clinical Associations in Patients with Allergic Conjunctivitis: A Prospective Observational Study

Punam Radhesham Kela¹, Sushila Kaura², Ujwala Desai³

1. Research Scholar, Jayoti Vidyapeeth Women's University, Jaipur, Rajasthan, India Orchid ID 0009-0001-3944-8385 punamkelaphd@gmail.com
2. Associate Professor, Department of Pharmaceutical Sciences, Jayoti Vidyapeeth Women's University, Jaipur Orchid ID 0000-0003-1679-2762 sushilakaura@gmail.com
3. Assistant Professor, PES Modern College of Pharmacy Nigdi Pune 44 Orchid ID 0000-0001-6510-0385 ujudesai@gmail.com

Corresponding author: Punam Radhesham Kela, Research Scholar, Jayoti Vidyapeeth Women's University, Jaipur, Rajasthan, India Orchid ID 0009-0001-3944-8385 punamkelaphd@gmail.com

Abstract

Background: Allergic conjunctivitis (AC) is an ocular inflammatory disorder that may coexist with refractive abnormalities and other ocular-surface complaints. Refractive status is clinically relevant because uncorrected refractive error can affect visual function and may coexist with allergic ocular symptoms. This study characterized the distribution of refractive error among patients with AC and examined its associations with demographic, social, medical and current-symptom variables.

Methods: This prospective observational cohort included 1047 patients diagnosed with eye allergies and recruited from ophthalmology clinics. Demographic characteristics, social history, past medical and allergic history, current symptoms and refractive status were recorded. Associations between refractive-error status and categorical variables were assessed using chi-square testing. Binary logistic regression was used in the broader analysis to evaluate sociodemographic, behavioral, medical and symptom factors associated with refractive error. Continuous age, OSDI and quality-of-life measures were compared using the Mann–Whitney U test where appropriate.

Results: Refractive error was present in 244/1047 participants (23.3%), while 803 (76.7%) had no reported refractive error. Prevalence was similar between females and males (23.5% vs 23.2%; $p = 0.909$) and across age groups ($p = 0.714$). No significant associations were observed with alcohol consumption ($p = 0.889$), smoking ($p = 0.913$) or recreational drug use ($p = 0.948$). Most medical-history variables were also not significantly associated with refractive error. Asthma showed a borderline association ($p = 0.051$). Current symptoms were not significantly associated with refractive error. Participants with and without refractive error had similar OSDI scores (14.89 ± 4.80 vs 14.69 ± 5.07 ; $p = 0.836$) and overall quality-of-life scores (53.85 ± 5.38 vs 53.65 ± 5.57 ; $p = 0.696$).

Conclusion: Refractive error was present in approximately one-quarter of this AC cohort. Its distribution was broadly independent of sex, age, social history and most examined medical and symptom variables. The absence of significant associations should not be interpreted as evidence that allergic conjunctivitis has no relationship with refractive development; rather, the present observational analysis did not identify statistically significant relationships within the recorded variables.

Keywords: Allergic Conjunctivitis; Refractive Error; Myopia; Astigmatism; Ocular Allergy; Visual Function; Observational Study.

How to cite this article: Punam Radhesham Kela¹ Sushila Kaura² Ujwala Desai³. Refractive Error Patterns and Their Demographic and Clinical Associations in Patients with Allergic Conjunctivitis: A Prospective Observational Study. Int J Drug Deliv Technol. 2026;16(85s):1552-1557. DOI: 10.25258/ijddt.16.85s.163.

Introduction

Allergic conjunctivitis is a common ocular hypersensitivity disorder characterized by itching, conjunctival hyperemia, tearing and ocular discomfort. The condition is driven by interactions among environmental allergens, immunoglobulin E, mast cells and inflammatory mediators and may occur as seasonal or perennial allergic conjunctivitis or as more severe keratoconjunctivitis [1–4]. Persistent or recurrent ocular inflammation may affect visual comfort and ocular-surface homeostasis. Refractive error represents an important component of visual health and includes myopia, hypermetropia and astigmatism. In patients with ocular allergy, the relationship between

inflammatory disease and refractive status is of clinical interest because chronic ocular symptoms, rubbing behavior, visual discomfort and associated ocular changes may coexist with refractive abnormalities. Earlier clinical work has reported associations between allergic conjunctivitis, allergen-specific IgE and myopia, although the direction and mechanisms of such relationships remain incompletely defined [6]. The present study cohort was designed to characterize multiple dimensions of ocular allergy, including refractive status. Within this dataset, refractive-error status was recorded as a binary clinical variable and evaluated against demographic characteristics, social

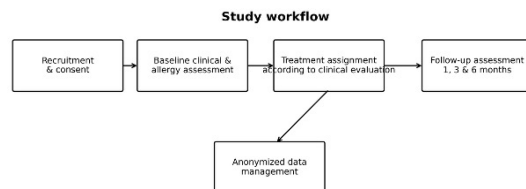
history, medical and allergic conditions and current symptoms. The study also permitted comparison of ocular-surface symptom burden and quality-of-life measures between participants with and without refractive error [7]. A focused analysis of refractive status is useful because it separates the visual/refractive domain from the ocular-surface disease analysis addressed in the companion manuscript. Such separation permits clearer interpretation of the statistical associations and avoids combining distinct clinical outcomes into a single broad analysis. The objective of this study was therefore to determine the prevalence of refractive error among patients with allergic conjunctivitis and to evaluate its association with demographic, behavioral, medical and current clinical characteristics, together with differences in OSDI and quality-of-life measures.

Materials and Methods

Study design and population

This prospective observational cohort study included patients diagnosed with eye allergies who were recruited from ophthalmology clinics. Participants were eligible from 6 years of age. The study cohort comprised 1047 participants. The study workflow included recruitment and consent, baseline clinical and allergy-history assessment, treatment assignment according to clinical evaluation, follow-up assessment and anonymized data management [8].

Figure 1. Flowchart of recruitment, treatment assignment, follow-up and analysis of patients



Data collection

Data collected included demographic characteristics, medical and allergic history, social history, ocular symptoms, current systemic symptoms, treatment history and refractive status. Patient-reported OSDI and health-related quality-of-life measures were also recorded. The analysis reported here focused on refractive-error status and its relationships with the recorded demographic and clinical variables [9].

Primary outcome

The primary outcome was the presence or absence of refractive error as recorded in the study dataset. Participants were categorized as having refractive error or no refractive error. The available results document the overall binary distribution and its associations with demographic, behavioral, medical and symptom variables [10].

Statistical analysis

Categorical variables were summarized as frequencies and percentages. Associations between refractive-error

status and categorical demographic, social, medical and symptom variables were evaluated using the chi-square test. Binary logistic regression was used for selected refractive-error analyses, with refractive error (No/Yes) as the dependent dichotomous variable and adjusted and unadjusted odds ratios reported in the broader dataset. Continuous variables were compared using the Mann–Whitney U test where appropriate. A p value <0.05 was considered statistically significant; p = 0.051 was interpreted as borderline rather than statistically significant [11–13].

Results

Distribution of refractive error

Refractive error was present in 244 of 1047 participants (23.3%), while 803 (76.7%) had no reported refractive error. Thus, approximately one in four participants in the cohort had recorded refractive error (Table 1; Figure 2).

Table 1. Distribution of Study Participants According to Presence of Refractive Error (N = 1047).

Refractive Error	Frequency	Percentage
No	803	76.7
Yes	244	23.3
Total	1047	100.0

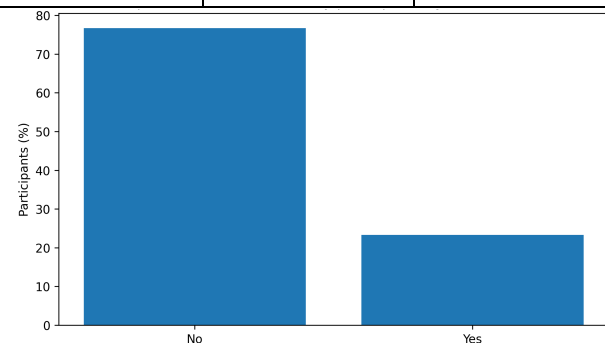


Figure 2. Distribution of study participants by refractive error

Association with demographic variables

Refractive-error prevalence was similar between females and males. Refractive error was present in 118 females (23.5%) and 126 males (23.2%), with no significant association between sex and refractive-error status ($\chi^2 = 0.013$, p = 0.909). Across age groups, refractive error was present in 21.4% of children, 18.6% of adolescents, 24.4% of young adults, 24.4% of middle-aged adults and 24.6% of geriatric participants; the association was not statistically significant ($\chi^2 = 2.12$, p = 0.714). These data are summarized in Table 2 and illustrated in Figure 3 and 4.

Table 2. Association of Refractive Error with Demographic Variables among Study Participants

Demographic variable	No refractive error n	Refractive error n	χ^2	p
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Refractive Error Patterns and Their Demographic and Clinical Associations in Patients with Allergic Conjunctivitis: A Prospective Observational Study

	(%)	(%)		
Female	385 (76.5)	118 (23.5)	0.01 3	0.90 9
Male	418 (76.8)	126 (23.2)		
Children (<12 y)	154 (78.6)	42 (21.4)	2.12	0.71 4
Adolescents (12–18 y)	79 (81.4)	18 (18.6)		
Young adults (19–35 y)	282 (75.6)	91 (24.4)		
Middle-aged adults (36–60 y)	242 (75.6)	78 (24.4)		
Geriatrics (>60 y)	46 (75.4)	15 (24.6)		

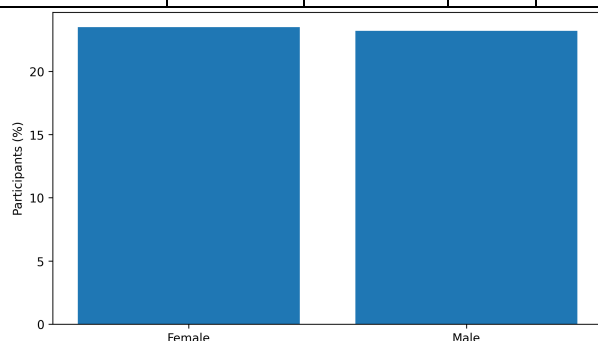


Figure 3. Gender distribution by refractive error

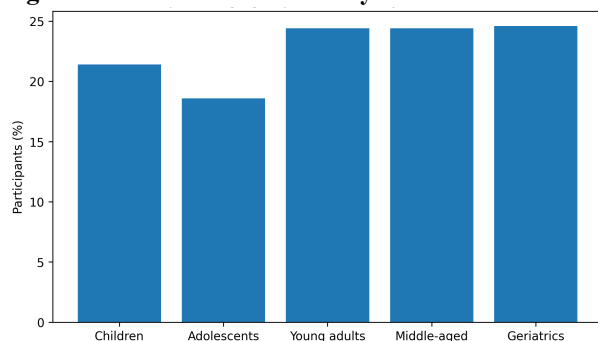


Figure 4. Age group distribution by refractive error

Association with social history

No significant association was observed between refractive-error status and alcohol consumption, smoking or recreational drug use. Refractive error was present in 25.0% of participants reporting alcohol consumption, 22.2% of those reporting smoking and 22.7% of those reporting recreational drug use. The corresponding p values were 0.889, 0.913 and 0.948, respectively (Table 3)

Table 3. Association of Refractive Error with Social History Variables among Study Participants

Social history	No refractive	Refractive error n	χ^2	p
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	error n (%)	(%)		
Alcohol: No	794 (76.7)	241 (23.3)	0.020	0.889
Alcohol: Yes	9 (75.0)	3 (25.0)		
Smoking: No	789 (76.7)	240 (23.3)	0.012	0.913
Smoking: Yes	14 (77.8)	4 (22.2)		
Recreational drugs: No	786 (76.7)	239 (23.3)	0.004	0.948
Recreational drugs: Yes	17 (77.3)	5 (22.7)		

Association with past medical and allergic conditions

Most recorded medical and allergic-history variables were not significantly associated with refractive-error status. The proportions with refractive error were 22.3% among participants with diabetes, 22.7% with hypertension, 23.9% with thyroid disease, 22.3% with cardiovascular disease, 25.0% with gastrointestinal disease, 21.1% with asthma, 22.1% with eczema, 23.0% with rhinitis and 23.1% with bronchitis. Asthma showed a borderline association ($p = 0.051$), but this did not meet the prespecified threshold for statistical significance. Results are summarized in Table 4 and figure 5.

Table 4. Association of Refractive Error with Past History of Non-Allergic and Allergic Conditions among Study Participants

Past condition	No refractive error n (%)	Refractive error n (%)	χ^2	p
Diabetes: No	597 (76.3)	185 (23.7)	0.215	0.643
Diabetes: Yes	206 (77.7)	59 (22.3)		
HTN: No	470 (76.3)	146 (23.7)	0.132	0.717
HTN: Yes	333 (77.3)	98 (22.7)		
Thyroidism: No	501 (77.1)	149 (22.9)	0.140	0.709
Thyroidism: Yes	302 (76.1)	95 (23.9)		
CVD: No	674 (76.5)	207 (23.5)	0.114	0.736
CVD: Yes	129	37 (22.3)		

Refractive Error Patterns and Their Demographic and Clinical Associations in Patients with Allergic Conjunctivitis: A Prospective Observational Study

	(77.7)			
GIT: No	749 (76.8)	226 (23.2)	0.124	0.724
GIT: Yes	54 (75.0)	18 (25.0)		
Asthma: No	322 (73.7)	115 (26.3)	3.805	0.051
Asthma: Yes	481 (78.9)	129 (21.1)		
Eczema: No	465 (75.9)	148 (24.1)	0.582	0.445
Eczema: Yes	338 (77.9)	96 (22.1)		
Rhinitis: No	538 (76.5)	165 (23.5)	0.033	0.856
Rhinitis: Yes	265 (77.0)	79 (23.0)		
Bronchitis: No	176 (76.9)	53 (23.1)	0.004	0.948
Bronchitis: Yes	627 (76.7)	191 (23.3)		

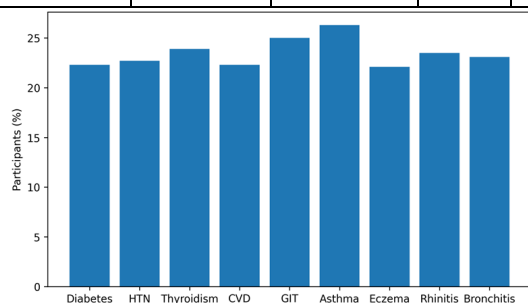


Figure 5. Distribution of past history of allergic and non-allergic conditions by refractive error

Association with current symptoms

No statistically significant association was observed between refractive-error status and the examined current symptom groups. Refractive error was present in 20.1% of participants without respiratory symptoms and 24.6% of those with respiratory symptoms ($p = 0.126$). For dry-eye symptoms, refractive error was present in 25.0% of participants without dry-eye symptoms and 23.1% of those reporting dry-eye symptoms ($p = 0.687$). Skin symptoms ($p = 0.151$), gastrointestinal symptoms ($p = 0.884$) and other symptoms ($p = 1.000$) were likewise not significantly associated with refractive error (Table 5; Figure 6).

Table 5. Association of Refractive Error with Current Symptoms among Study Participants

Current symptom	No refractive error n (%)	Refractive error n (%)	χ^2	p
Respiratory tract: No	298 (79.9)	60 (20.1)	2.343	0.126
Respiratory tract: Yes	749 (75.4)	184 (24.6)		
Dry eyes: No	92 (75.0)	23 (25.0)	0.162	0.687
Dry eyes: Yes	955 (76.9)	221 (23.1)		
Skin: No	473 (74.6)	120 (25.4)	2.059	0.151
Skin: Yes	574 (78.4)	124 (21.6)		
Gastrointestinal: No	704 (76.6)	165 (23.4)	0.021	0.884
Gastrointestinal: Yes	343 (77.0)	79 (23.0)		
Others: No	533 (76.7)	162 (23.3)	0	1.000
Others: Yes	270 (76.7)	82 (23.3)		

Respiratory tract: No	298 (79.9)	60 (20.1)	2.343	0.126
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Others: Yes	270 (76.7)	82 (23.3)		

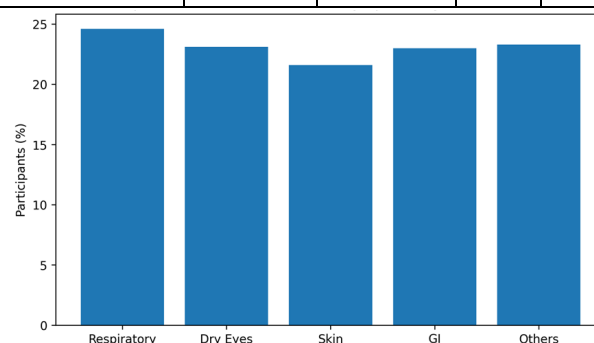


Figure 6. Distribution of current symptoms by refractive error

OSDI and quality-of-life outcomes according to refractive-error status

Participants with and without refractive error had similar mean ages and patient-reported ocular-surface and quality-of-life measures. Mean age was 31.60 ± 17.61 years in participants with refractive error and 30.19 ± 17.45 years in those without ($p = 0.343$). Mean OSDI total score was 14.89 ± 4.80 versus 14.69 ± 5.07 ($p = 0.836$), and OSDI percentage score was 31.01 ± 10.01 versus 30.61 ± 10.55 ($p = 0.836$). QoL total score was 53.85 ± 5.38 versus 53.65 ± 5.57 ($p = 0.696$). None of the reported QoL domains differed significantly between the two groups (Table 6; Graph 18).

Table 6. Comparison of Age, OSDI Scores, and Quality of Life (QoL) Domains between Participants With and Without Refractive Error

Variable	No refractive error	Refractive error Mean $\pm$	p value
Age	30.19 $\pm$ 17.45	31.60 $\pm$ 17.61	0.343
OSDI total score	14.69 $\pm$ 5.07	14.89 $\pm$ 4.80	0.836
OSDI percentage score	30.61 $\pm$ 10.55	31.01 $\pm$ 10.01	0.836
QoL total score	53.65 $\pm$ 5.57	53.85 $\pm$ 5.38	0.696

	Mean $\pm$ SD	SD	
Age in years	30.19 $\pm$ 17.45	31.60 $\pm$ 17.61	0.343
OSDI Total Score	14.69 $\pm$ 5.07	14.89 $\pm$ 4.80	0.836
OSDI (%)	30.61 $\pm$ 10.55	31.01 $\pm$ 10.01	0.836
QoL Total Score	53.65 $\pm$ 5.57	53.85 $\pm$ 5.38	0.696
Overall QoL Average (%)	25.53 $\pm$ 6.89	25.86 $\pm$ 6.60	0.476
D1 Physical Health Score	14.83 $\pm$ 2.49	14.98 $\pm$ 2.36	0.447
D2 Psychological Health Score	12.69 $\pm$ 2.38	12.58 $\pm$ 2.34	0.717
D3 Social Relationship Score	4.90 $\pm$ 2.95	5.17 $\pm$ 2.90	0.213
D4 Environment Score	17.00 $\pm$ 2.74	16.93 $\pm$ 2.74	0.609
D5 General Score	4.23 $\pm$ 1.38	4.19 $\pm$ 1.32	0.727
D1 Physical Health (%)	27.98 $\pm$ 8.89	28.48 $\pm$ 8.44	0.447
D2 Psychological Health (%)	27.88 $\pm$ 9.90	27.42 $\pm$ 9.75	0.717
D3 Social Relationship (%)	15.79 $\pm$ 24.59	18.10 $\pm$ 24.20	0.213
D4 Environment (%)	28.14 $\pm$ 8.55	27.90 $\pm$ 8.55	0.609
D5 General (%)	27.86 $\pm$ 17.31	27.41 $\pm$ 16.47	0.727

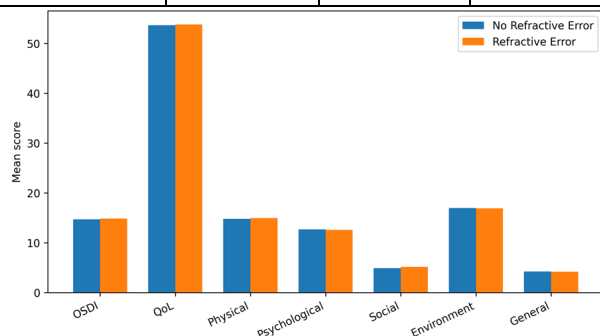


Figure 7. Mean scores by refractive error
Logistic regression findings

The broader refractive-error analysis also included binary logistic regression. The available results indicate that the examined sociodemographic and behavioral variables did not show statistically significant associations with refractive-error status in adjusted or unadjusted models. Asthma remained a borderline finding ($p = 0.051$) in the corresponding categorical analysis. Current symptom models likewise did not identify statistically significant associations. Because the present paper focuses on the clinically interpretable distribution and categorical associations, the regression findings are presented as supportive rather than as evidence of independent causal predictors.

Discussion

The present study identified refractive error in 23.3% of patients with allergic conjunctivitis. This represents a substantial minority of the cohort and supports the relevance of refractive assessment in the broader clinical evaluation of patients with ocular allergy. The most important finding, however, was not a statistically significant association with demographic or clinical variables, but rather the broadly similar refractive-error prevalence across the examined subgroups.

The absence of a significant sex association was notable. Refractive error was present in 23.5% of females and 23.2% of males ($p = 0.909$), indicating almost identical proportions in the two groups. Similarly, the distribution across age categories did not differ significantly ($p = 0.714$). Although young adults and middle-aged adults each had a prevalence of 24.4%, and geriatric participants had 24.6%, these small differences did not establish an age-related pattern within this cohort.

The findings are relevant to earlier literature suggesting a possible relationship between allergic conjunctivitis and refractive status. Mimura and colleagues previously reported an association between allergic conjunctivitis, allergen-specific IgE and myopia. The present data do not reproduce such an association at the level of binary refractive-error status. Differences in age structure, allergen characterization, refractive-error classification, study setting and analytical approach may contribute to this discrepancy. Importantly, the present dataset does not provide sufficient evidence to conclude that allergic inflammation causes refractive error.

Social history also showed no significant relationship with refractive-error status. Alcohol consumption, smoking and recreational drug use were each statistically unrelated to refractive error. These findings suggest that, within the recorded cohort, these behavioral variables did not explain the observed distribution of refractive abnormalities.

Most medical and allergic comorbidities similarly showed no significant association. Diabetes, hypertension, thyroid disease, cardiovascular disease, gastrointestinal disease, eczema, rhinitis and bronchitis

all had *p* values above 0.05. Asthma produced a borderline result (*p* = 0.051), with refractive error somewhat more frequent among participants without asthma than among those with asthma. Because the value narrowly exceeded the predefined significance threshold, it should not be interpreted as a confirmed association.

The absence of significant relationships between refractive error and current symptoms was also consistent across the dataset. In particular, dry-eye symptoms were not associated with refractive-error status (*p* = 0.687). This finding complements the ocular-surface analysis by showing that the presence of reported dry-eye symptoms did not distinguish participants with and without refractive error.

Similarly, OSDI and quality-of-life outcomes were comparable between participants with and without refractive error. The mean OSDI total scores were 14.89 ± 4.80 and 14.69 ± 5.07 , respectively (*p* = 0.836), while QoL total scores were 53.85 ± 5.38 and 53.65 ± 5.57 (*p* = 0.696). None of the reported quality-of-life domains demonstrated statistically significant differences. Therefore, the available data do not support the assumption that refractive-error status necessarily corresponds to greater patient-reported ocular-surface symptom burden or poorer quality of life.

Several methodological considerations are important when interpreting these findings. First, refractive error was analyzed as a binary variable in the reported results. Consequently, the present analysis cannot determine whether specific refractive categories such as myopia, hypermetropia or astigmatism have different relationships with allergic conjunctivitis. Second, the observational design does not establish temporal or causal relationships. Third, detailed objective ophthalmic measurements and longitudinal refractive changes were not available in the reported analysis. These limitations may reduce the ability to detect more specific associations. Clinically, the findings support retaining refractive assessment as part of comprehensive ocular evaluation in patients with allergic conjunctivitis, while avoiding assumptions about causality or subgroup risk based on the present associations. Future studies should prospectively characterize refractive type and magnitude, ocular axial parameters, allergen sensitization, ocular-rubbing behavior and objective measures of allergic and ocular-surface inflammation. Such studies could better determine whether particular allergic phenotypes are associated with specific patterns of refractive development.

Conclusion

Refractive error was present in 23.3% of the 1047 patients with allergic conjunctivitis studied. Its prevalence did not differ significantly according to sex or age group and was not significantly associated with alcohol consumption, smoking, recreational drug use, most recorded medical or allergic conditions, or current symptom categories. Asthma showed a borderline

association but did not meet the prespecified threshold for statistical significance. OSDI and quality-of-life measures were also comparable between participants with and without refractive error. These findings indicate that refractive abnormalities constitute a clinically relevant component of the AC cohort but were not statistically linked to the examined demographic and clinical characteristics in this observational analysis.

Conflict of interest

The authors should declare No conflicts of interest.

Funding: No

References

1. Leonardi A, et al. Management of ocular allergy. *Allergy*. 2019;74(9):1611-1630.
2. Craig JP, et al. TFOS DEWS II definition and classification report. *Ocul Surf*. 2017;15(3):276-283.
3. Villani E, et al. Ocular allergy as a risk factor for dry eye in adults and children. *Curr Opin Allergy Clin Immunol*. 2018;18(5):471-476.
4. Akasaka Y, et al. Prevalence of comorbidity between dry eye and allergic conjunctivitis: a systematic review and meta-analysis. *Ocul Surf*. 2022;25:137-146.
5. Schiffman RM, et al. The Ocular Surface Disease Index (OSDI). *Arch Ophthalmol*. 2000;118(4):615-621.
6. Karlsson J, et al. Sex differences in immune responses. *Front Immunol*. 2021;12:631355.
7. P. Pandey, A. K. Mishra, S. Singh, Increased Long-Term Risks of Gastroesophageal Reflux Disease Phenotypes: A Global Propensity-Matched Cohort Study, *Neurogastroenterology & Motility* 38, no. 8 (2026): e70415, <https://doi.org/10.1111/nmo.70415>
8. Becker WJ, et al. Sex differences in migraine. *Cephalalgia*. 2015;35(5):428-436.
9. Schaumberg DA, et al. Hormone replacement therapy and dry eye syndrome. *JAMA*. 2001;286(17):2114-2119.
10. Ngo ST, et al. Sex differences in autoimmune disease. *Autoimmun Rev*. 2014;13(10):1047-1052.
11. Skevington SM, et al. The World Health Organization's WHOQOL-BREF quality of life assessment. *Qual Life Res*. 2004;13(2):299-310.
12. Sullivan DA, et al. The impact of dry eye on daily life: a qualitative study. *Cornea*. 2014;33(9):931-938.
13. Schaumberg DA, et al. Burden of dry eye disease: incidence, prevalence, and optimal management strategies. *Ocul Surf*. 2013;11(2):126-133.