



Correlation between Dry Eye Disease and Allergic Conjunctivitis: A Cross-Sectional Study

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Submitted: 25-11-2024

Accepted: 05-12-2024

ABSTRACT:

Objective: Allergic conjunctivitis (AC) often coexists with dry eye disease (DED), creating significant discomfort for affected individuals. This study aimed to investigate the prevalence of DED across different AC subtypes.

Methods: In this observational cross-sectional study conducted at a tertiary ophthalmology center in eastern India, 132 AC patients were examined. DED was diagnosed using the Ocular Surface Disease Index (OSDI), Schirmer's test, and tear film break-up time (TFBUT).

Findings: DED was observed in 31%-36% of AC patients. Breakdown by severity revealed mild (20.45%), moderate (18.18%), and severe (31.81%) cases. PAC showed the highest OSDI scores (mean 29.82), followed by SAC (25.35), and VKC (13.60). TFBUT values below 10 seconds were noted in 45.45% of PAC patients, 30.43% of SAC patients, and 20% of VKC patients, though these differences were not statistically significant. Schirmer's test identified DED in 45.45% of PAC, 43.47% of SAC, and 10% of VKC cases.

Conclusion: The study highlights a significant prevalence of DED among AC patients, with PAC being most affected. These findings underscore the importance of screening for DED in AC cases to optimize treatment and enhance quality of life.

I. INTRODUCTION:

The eyes are among the most common sites for allergic inflammatory conditions, affecting 20–30% of the general population. Allergic conjunctivitis (AC) and dry eye disease (DED) are variable ocular surface disorders, both significantly impacting quality of life. These conditions often present with overlapping symptoms, making it challenging to differentiate between them. Ocular allergies can destabilize the tear film, worsening symptoms, which may lead to increased use of antihistamines that further impair the ocular surface. The mechanisms driving DED in AC patients include lipid layer thickening, changes in tear proteins, and inflammation. This study aims to assess the prevalence of DED in AC patients and explore its distribution across different AC

subtypes, with a focus on the common age and gender of those affected.

II. METHODS:

This study, designed as an observational, cross-sectional analysis, was conducted at a tertiary ophthalmology center in eastern India from April 2023 to October 2024. The study included 132 patients, aged between 6 and 65 years, who were clinically diagnosed with allergic conjunctivitis (AC) and reported eye itchiness as their primary symptom. All participants provided written informed consent, with consent from guardians for pediatric patients. Patients with a history of contact lens use, refractive surgery, recent ocular surgeries within the last 6 months, ocular trauma, or any corneal diseases were excluded from the study. Additionally, individuals with conditions such as trachoma, those who smoked, patients on topical antiglaucoma medications, or those with systemic diseases like diabetes, hypertension, or collagen vascular disease, as well as individuals using immunosuppressants, were also excluded to maintain the study's focus on the relationship between AC and dry eye disease (DED).

The patients with AC were classified according to the Documento de Consenso sobre Conjuntivitis Alérgica criteria into three severity categories: mild, moderate, or severe. A comprehensive patient history was gathered, including demographic details, onset, duration, and progression of symptoms, past and personal medical history, treatment history, and clinical findings. Based on these factors, the participants were further categorized into three subtypes of AC: Seasonal Allergic Conjunctivitis (SAC), Perennial Allergic Conjunctivitis (PAC), and Vernal Keratoconjunctivitis (VKC).

For the diagnosis of DED, a combination of diagnostic tools was used. The Ocular Surface Disease Index (OSDI) questionnaire was administered to all 132 AC patients. The OSDI is a validated instrument consisting of 12 questions related to ocular symptoms, vision-related function, and environmental triggers experienced over the past week. Each question was scored from 0 (none



of the time) to 4 (all of the time), with the total score ranging from 0 to 100. Scores were categorized as follows: ≤ 12 as normal, 13–22 as mild, 23–32 as moderate, and ≥ 33 as severe DED. Patients with OSDI scores greater than 12 were also subjected to additional tests.

Schirmer's test was performed using a standard 5×35 mm filter paper strip (Whatman-41) at normal room temperature to measure tear production. A result of less than 10 mm of wetting was considered abnormal, indicating DED. The Tear Film Break-Up Time (TFBUT) test, which measures the stability of the tear film, was also conducted. The test was repeated three times, and the average value was used for analysis. A TFBUT of less than 10 seconds was classified as abnormal, with values between 5 and 10 seconds being marginal, and values below 5 seconds indicating low tear film stability.

This multi-faceted approach ensured a thorough assessment of the relationship between allergic conjunctivitis and dry eye disease, providing valuable insights into the prevalence and severity of DED in AC patients.

III. STATISTICAL ANALYSIS

Data were presented as percentages and mean \pm standard deviation (S.D.). To assess the normality of the data, Kolmogorov-Smirnov tests were conducted. For comparisons involving more than two parameters, one-way analysis of variance (ANOVA) followed by Tukey's HSD test was applied. To evaluate differences in frequency distribution, Fisher's exact test or the Chi-square test was used. A p-value of less than 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 17 (IBM Corp, NY) and Microsoft Excel 2016 (Microsoft® Inc., USA).

IV. RESULTS:

Characteristics	Number of subjects (n=132)	Percentage
Age (Years) (mean \pm S.D.)		
Gender		
Male	48	36
Female	84	64
Types of allergic conjunctivitis		
Perennial allergic conjunctivitis (PAC)	33	25
Seasonal allergic conjunctivitis (SAC)	69	52.27
Vernal keratoconjunctivitis (VKC)	30	22
Severity of symptoms of AC		
Mild	69	52.27
Moderate	53	40.15
Severe	10	7.57

The demographic characteristics of the study participants are summarized in **Table 1**. In this cohort of AC patients, females represented 64% while males accounted for 36%. The average age of female participants (31.75 years) was

notably higher than that of males (19.44 years). The most prevalent form of AC was seasonal allergic conjunctivitis (SAC) at 52.27%, followed by perennial allergic conjunctivitis (PAC) at 25%, and vernal keratoconjunctivitis (VKC) at 22%.



OSDI	PAC						SAC						VKC					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
>32	3	50	18	66.7	21	63.6	6	33.3	15	29.4	21	30.4	0	0	0	0	0	0
23-32	0	0	3	11.1	3	9.1	6	16.7	12	23.5	15	21.7	6	25	0	0	6	20
13-22	3	50	0	0	3	9.1	6	33.3	9	17.6	15	21.7	9	37.5	0	0	9	30
0-12	0	0	6	22.2	6	18.2	3	16.7	15	29.4	18	26.1	9	37.5	6	100	15	50
Total	6	100	27	100	33	100	18	100	51	100	69	100	24	100	6	100	30	100

Table 2 presents the distribution of OSDI scores across the AC subtypes. Among all participants, 29.54% had a normal OSDI score, while 20.45% had mild, 18.18% had moderate, and 31.81% had severe DED. The mean OSDI score was significantly higher in PAC patients (29.82 ± 12.41), followed by SAC (25.35 ± 12.88), with the lowest scores in VKC patients (13.60 ± 8.63) (p <

0.0001). According to the OSDI scores, 9.1%, 9.1%, and 63.6% of PAC patients had mild, moderate, and severe dry eye, respectively, while 21.7%, 21.7%, and 30.4% of SAC patients had mild, moderate, and severe dry eye. Among VKC patients, 30% had mild and 20% had moderate dry eye, with none presenting with severe dry eye.

TBUT	PAC						SAC						VKC					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
>10 mm	3	50	15	55.56	18	54.55	15	83.33	33	64.71	48	69.57	18	75	6	100	24	80
5-10 mm	3	50	12	44.44	15	45.45	3	16.67	12	23.53	15	21.74	6	25	0	0	6	20
<5 mm	0	0	0	0	0	0	0	0	6	11.76	6	8.7	0	0	0	0	0	0
Total	6	100	27	100	33	100	18	100	51	100	69	100	24	100	6	100	30	100

Table 3 outlines the distribution of DED in relation to Tear Film Break-Up Time (TFBUT). A total of 31.81% of AC patients exhibited signs of dry eyes. TFBUT values under 10 seconds were found in 45.45% of PAC patients, all of whom had marginal TFBUT results. Among SAC patients,

30.43% had TFBUT values under 10 seconds, with 21.74% exhibiting marginal and 8.70% showing low TFBUT. In VKC patients, 20% had TFBUT under 10 seconds, all falling under the marginal category.

Schirmer's	PAC						SAC						VKC					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
>10 mm	6	100	12	44.4	18	54.5	12	66.7	27	52.9	39	56.5	21	87.5	6	100	27	90
6-10 mm	0	0	12	44.4	12	36.4	6	33.3	21	41.2	27	39.1	3	12.5	0	0	3	10
0-5 mm	0	0	3	11.1	3	9.1	0	0	3	5.9	3	4.3	0	0	0	0	0	0
Total	6	100	27	100	33	100	18	100	51	100	69	100	24	100	6	100	30	100

Table 4 shows the distribution of dry eye disease (DED) among various types of allergic conjunctivitis (AC) based on Schirmer's test. Overall, 36% of AC patients had dry eyes. In patients with perennial allergic conjunctivitis (PAC), 45.45% showed Schirmer's test values below 10 mm, with 36.4% having mild to moderate

dry eye and 9.1% experiencing severe dry eye. For seasonal allergic conjunctivitis (SAC) patients, 43.47% had values under 10 mm, with 39.1% showing mild to moderate dry eye and 4.3% with severe dry eye. In contrast, only 10% of vernal keratoconjunctivitis (VKC) patients had values below 10 mm.



Score	PAC (n=33)	SAC (n=69)	VKC (n=30)	f	P
TFBUT	13.45+6.13	14.09+6.18	14.7+3.5	0.382	0.683
Schirmer's score	16.18+10.15	13.26+5.89	26.20+10.48	25.724	<0.0001
OSDI score	29.82+12.41	25.35+12.88	13.60+-8.63	15.741	<0.0001

Table 5 presents a comparison of various test scores among AC subtypes. Post-hoc analysis revealed significant differences in both Schirmer's and OSDI scores among the three groups ($p < 0.0001$). OSDI scores were notably higher in PAC and SAC patients compared to those with VKC. However, no significant differences were observed regarding the mean Tear Film Break-Up Time (TFBUT) across the groups. Additionally, Schirmer's scores were significantly lower in PAC and SAC patients than in those with VKC.

V. DISCUSSION:

This study investigated the prevalence of dry eye disease (DED) in patients with allergic conjunctivitis (AC), finding that 31% to 36% of AC patients were affected by DED. The mean age of participants was 27.54 years, which aligns with findings from studies in Japan and Italy, where similar age ranges were observed among AC patients. In our study, females made up 64% of the sample, and seasonal allergic conjunctivitis (SAC) was the most common type, which aligns with global studies, including those conducted in Japan and Italy.

The prevalence of DED, as measured by the Ocular Surface Disease Index (OSDI), revealed that 31.81% of patients exhibited severe symptoms. Notably, the prevalence of ocular discomfort, based on OSDI scoring, was found to be highest in patients with perennial allergic conjunctivitis (PAC), with a mean score of 29.82 ± 12.41 . This was statistically significant compared to seasonal allergic conjunctivitis (SAC) and vernal keratoconjunctivitis (VKC). A study in Southern California highlighted that a significant portion of AC patients also suffer from DED, with 57.7% of patients experiencing clinically significant dry eye, further emphasizing the comorbidity of these conditions.

A comparison with a study conducted in Turkey, where only 12% of AC patients had DED, suggests that differences in findings could be attributed to sample size, age range (6-18 years), and regional factors. Our findings were also contrasted with a study in Southern India, where 64% of patients had severe dry eye symptoms according to OSDI scores, highlighting how

environmental and climatic differences can influence the prevalence of DED.

TFBUT, an important diagnostic test for tear film stability, revealed that patients with PAC had the shortest mean break-up time at 13.45 ± 6.13 seconds. However, the differences in TFBUT among AC subtypes were not statistically significant. This is in line with other studies, such as one conducted in Southern California, which associated SAC with advanced tear instability, although our study had a higher mean TFBUT compared to others, where TFBUT was as low as 3.4 ± 1.5 seconds.

Schirmer's test, used to measure tear production, showed that 45.45% of PAC patients had values less than 10 mm, indicating significant dry eye symptoms. In SAC patients, 43.47% had Schirmer's scores under 10 mm, and only 10% of VKC patients exhibited such values. Post-hoc analysis of Schirmer's and OSDI scores revealed significant differences across AC subtypes ($p < 0.0001$), with PAC and SAC patients showing higher OSDI scores than those with VKC. These findings are consistent with previous studies, which have suggested a strong association between allergic conjunctivitis and dry eye disease.

In a recent systematic review, it was noted that 47.2% of AC patients also had dry eye disease, supporting the conclusions of this study. However, the results of this research are particularly noteworthy for its focus on the northern Indian population, as no prior studies have specifically addressed the prevalence of DED in AC patients in this region. In contrast to other studies that have grouped SAC and PAC together, we examined them separately, revealing that SAC was the most common form of AC in our study population.

Despite the valuable insights, this study does have limitations, including a relatively small sample size, and the lack of more advanced diagnostic techniques like brush cytology or meibomian gland evaluation. Additionally, skin prick tests to assess for specific allergens were not conducted. Nevertheless, the clinical diagnostic approach employed in this study provides reliable data on the association between AC and DED.

In conclusion, the study demonstrates a significant link between DED and AC, with PAC patients showing the highest prevalence of severe dry eye



symptoms. These findings underscore the importance of thorough diagnostic evaluations for patients presenting with AC to identify and manage potential comorbidities such as dry eye disease. Future research with larger sample sizes and more advanced diagnostic tools would be beneficial in further exploring this association and developing targeted treatment strategies.

VI. CONCLUSION:

This study found that among the different subtypes of allergic conjunctivitis (AC), perennial allergic conjunctivitis (PAC) was more strongly associated with dry eye disease (DED) compared to seasonal allergic conjunctivitis (SAC) and vernal keratoconjunctivitis (VKC). Based on these findings, it is essential for healthcare providers to thoroughly examine all AC patients for dry eye to prevent further damage to the ocular surface and ensure optimal patient care. Comprehensive screening and early intervention can help manage both conditions more effectively, improving the overall quality of care for AC patients.

Financial Support and Sponsorship: Nil

Conflicts of Interest: There are no conflicts of interest

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