International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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A cross-sectional study of dry eye and allergic conjunctivitis from southern India

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International Journal of Science and Research Archive, 2025, 14(03), 748-754

Publication history: Received on 27 January 2025; revised on 04 March 2025; accepted on 06 March 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.14.3.0623

Abstract

Background: Allergic conjunctivitis is frequently linked to dry eye conditions. This investigation aimed to evaluate the relationship between dry eye and various subsets of AC (Allergic conjunctivitis) patients.

Material and Methods: This observational, hospital-based cross-sectional study was carried out in the Department of Ophthalmology at a tertiary center in southern India, involving 110 patients with AC aged between 6 and 18 years. The identification of dry eye disease (DED) was established through the utilization of the Ocular Surface Disease Index (OSDI), Schirmer's test, and tear film break-up time (TFBUT).

Result: Findings indicate that the occurrence of moderate dry eye cases was most significant among AC patients, recorded at 63.63%. In the assessment of OSDI scores, it was found that 15% of patients exhibited severe symptoms, while 25% presented with a mild grade of dry eye disease. The TFBUT score was significantly elevated in individuals diagnosed with mixed conjunctivitis ($n = 12$, $p < 0.00001$). The results indicated a significant association between the severe Schirmer test and mixed allergic conjunctivitis ($n = 4$, $p = 0.0168$).

Conclusion: This investigation demonstrated a significant occurrence of patients experiencing both mixed allergic conjunctivitis and dry eye disease. Among the various categories of AC patients, mixed allergic conjunctivitis showed a notably stronger correlation with dry eye when compared to the palpebral and bulbar forms.

Keywords: Allergic Conjunctivitis; Dry Eye Disease; Palpebral; Bulbar

1. Introduction

Allergic conjunctivitis and dry eye syndrome represent two prevalent anterior inflammatory conditions affecting the eye. These disorders are considered the epidemics of the 21st century.1 The reported prevalence of dry eyes varies significantly across different studies, with estimates ranging from 5% to 35% of the population. [1,2] The manifestations encompass ocular discomfort, redness, pruritus, a burning sensation, irritation, sensitivity to light, dryness, a sensation of a foreign body, and visual disturbances, particularly fluctuating or blurred vision. [3] These symptoms can disrupt daily activities and impact the quality of life related to vision. [4, 5]

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The core pathophysiology of DE and AC is based on the immunological changes that lead to inflammation of the ocular surface, and their common pathogenesis creates negative synergies that worsen the other conditions. [6–8] Prior studies have indicated that diminished tear volume resulting from dry eye conditions impairs the clearance of allergenic antigens from the ocular surface in individuals suffering from hay fever, thereby worsening allergic conjunctivitis linked to hay fever. [9,10] In a similar vein, AC has demonstrated an ability to compromise the stability of the tear film, leading to poorer outcomes in individuals suffering from DE. [9,10]

The occurrence of allergic conditions among children between the ages of 6 and 14 shows considerable variation, ranging from 0.3% to 20.5%, and is on a gradual upward trend. This rise could be attributed to genetic factors, urban air pollution, the presence of pets, and exposure during early childhood. [11]

The manifestations and indicators of AC frequently coincide with those of DED, making it challenging at times to differentiate between the two conditions. [12,13]

The predominant focus of existing studies on SDE has been on adults ranging from 20 to 96 years, rather than on adolescents. [14-16]

The primary objective of this investigation was to determine the occurrence of DED among patients with AC in the adolescent demographic. The secondary objectives involved determining the subtype of AC in which dry eyes are more frequently observed, as well as examining the tear function parameters in cases of allergic conjunctivitis.

2. Material and methods

An observational, hospital-based, cross-sectional study was carried out at our tertiary care ophthalmic institution. Individuals visiting the outpatient department during a 6-month timeframe (June 2024–May 2024) were assessed for eligibility for the study. Before initiating the study, approval for ethical considerations was secured from the Institutional Review Board. Consent was secured from all participants, and the study followed the principles outlined in the Declaration of Helsinki. A non-probability purposive sampling method was utilized to recruit patients aged 6 to 18 years who exhibited symptoms of allergic conjunctivitis and tear film instability, carried out consecutively through this sampling technique. In all cases, written informed consent was secured from each individual who participated. For participants who were in the paediatric age group, consent was secured from the guardian. Individuals with a history of dry eye, keratoconjunctivitis sicca, meibomitis, vitamin A deficiency, and history of atopic conditions were excluded from the study. A total of 110 patients who met the criteria for the study were identified and enrolled within the designated time frame for the study.

According to the criteria outlined in the Documento dE Consenso sobre Conjuntivitis Alérgica, patients with AC were classified as mild, moderate, or severe. [17] Following a comprehensive assessment of demographic characteristics, the onset, duration, and progression of ocular symptoms, along with past and personal medical history, treatment history, and clinical findings, the patients with AC were categorized into SAC (seasonal allergic conjunctivitis), PAC (perennial allergic conjunctivitis), and VKC (vernal keratoconjunctivitis). Following a standard evaluation, the identification of dry eye disease in all confirmed cases of allergic conjunctivitis was established using the Ocular Surface Disease Index questionnaire [17], tear film break-up time (TFBUT) [18], and Schirmer's test. [19]

The OSDI questionnaire was administered to all 110 patients of AC. This is a prevalidated questionnaire in English comprising 12 questions that assess the respondent's experiences over the past week concerning ocular symptoms, vision-related function, and environmental triggers. Each question is scored on a scale from 0 (none of the time) to 4 (all of the time). The overall score for the OSDI varies between 0 and 100. A score of ≤12 indicates a normal classification, while scores ranging from 13 to 22 are considered mild, 23 to 32 moderate, and scores of ≥33 are categorized as severe DED, respectively. A standard 5 × 35 mm strip of Whatman-41 filter paper was utilized for Schirmer's test at normal room temperature on all individuals with an OSDI score exceeding 12. The TFBUT test was conducted to evaluate the stability of the tear film. The experiment was conducted three times, and the average value was determined. A TBUT value of less than 10 seconds was deemed abnormal, with values between 5 and 10 seconds classified as marginal, and those below 5 seconds regarded as low. The objective assessments were conducted exclusively in individuals diagnosed with DED, as determined by the OSDI questionnaire, who provided their consent for additional evaluations. The subjects in this study were assessed using tear film break up time (TBUT) and the Schirmer test. The assessments were conducted in a consistent environment by one examiner, ensuring uniform temperature and humidity levels for all participants. The ambient temperature was controlled within the range of 25°C to 26.5°C, accompanied by a humidity level of 60% to 65% throughout the assessment period.

The data were presented as a percentage and mean ± Standard deviation. The significance of the difference between the frequency distribution of the data was analyzed using Fischer's exact test or the Chi-square test as applicable. A P value of less than 0.05 was deemed to be statistically significant. The data entry was performed utilizing Microsoft Excel Office Version 2021, while the statistical analysis was conducted with SPSS version 27.

3. Result

Table 1 Demographic characteristics of the patients with Dry Eye Disease in the Study Population (N = 110)

Age group (in years)	**Frequency**	**Percentage**
6-9	39	35.45
10-12	23	20.90
13-15	17	15.45
16-18	31	28.18
Sex	Frequency	Percentage
Female	33	30
Male	77	70
Types of Allergic Conjunctivitis	Frequency	Percentage
Mixed	65	22.72
Bulbar	25	63.63
Palpebral	20	13.65

A total of 110 patients diagnosed with Dry Eye Disease were included in the study. The analysis of age distribution indicated that the largest segment of patients (35.45%) fell within the 6 to 9-year range, with the next highest group being 28.18% in the 16–18-year category. The study population included 20.90% of patients aged 10–12 years, whereas 15.45% were in the 13–15-year age group. In terms of sex distribution, a significant portion of the patients (70%) were male, while females made up 30% of the study population. Among the various forms of allergic conjunctivitis identified, the mixed form was observed in 22.72% of the patients. Bulbar allergic conjunctivitis was the most common type, affecting 63.63% of the patients, whereas palpebral allergic conjunctivitis was the least frequent, occurring in 13.65% of cases.

Table 2 Distribution of the patients with Dry Eye Disease according to severity of the disease with regard to Dry eye, TFBUT test, and Schirmer test findings in the Study Population (N = 110)

Severity of Dry eye according to OSDI scoring	**Frequency**	**Percentage**
Mild	25	22.72
Moderate	70	63.63
Severe	15	13.65
Severity According to TFBUT result		
Mild	74	67.27
Moderate	22	20
Severe	14	12.73
Severity According to Schirmer test result		
Mild	72	65.45
Moderate	30	27.27
Severe	8	7.28

The investigation evaluated the intensity of Dry Eye Disease, results from the Tear Film Break-Up Time (TFBUT) test, and findings from the Schirmer test. The study evaluated the severity of Dry Eye Disease among 110 patients. The majority of the patients (63.63%) were classified as having a moderate form of the disease. Mild Dry Eye was observed in 22.72% of the patients, while the severe form was the least common, affecting 13.65% of the study population. According to the TFBUT test results, a significant majority of patients (67.27%) displayed mild severity, whereas 20% were categorized with a moderate condition. Only 12.73% of the patients were found to have severe cases, as indicated by TFBUT findings. In a similar manner, the outcomes of the Schirmer test indicated that 65.45% of the patients were classified as experiencing mild Dry Eye severity, whereas 27.27% demonstrated a moderate condition. Severe instances were the least common, accounting for merely 7.28% of the study cohort.

Table 3 Distribution of the patients with Dry Eye Disease according to severity of the disease with regard to Dry eye, TFBUT test, and Schirmer test findings in the Study Population (N = 110)

TFBUT test result	**Palpebral**	**Bulbar**	**Mixed**	**$\chi 2$**	**P value**
Mild	9 (45%)	14 (56%)	51 (78.46%)	30.578	<0.00001
Moderate	10 (5%)	10 (40%)	2 (3.08%)		
Severe	1 (5%)	1 (4%)	12 (18.46%)		
Schirmer test	Palpebral	Bulbar	Mixed	$\chi 2$	P value
Mild	7 (35%)	20 (80%)	45 (69.23%)	12.062	0.0168
Moderate	11 (55%)	3 (12%)	16 (24.61%)		
Severe	2 (10%)	2 (8%)	4 (6.16%)		

The severity of Dry Eye Disease among the study population (N = 110) was assessed based on TFBUT and Schirmer test findings. In the TFBUT test, the majority of patients (51) with mild dry eye had a mixed pattern of involvement, while 9 and 14 patients had palpebral and bulbar involvement, respectively. Moderate dry eye was observed in 10 patients each with palpebral and bulbar involvement, whereas only 2 patients exhibited a mixed pattern. Severe TFBUT test was most commonly associated with a mixed pattern (12 patients), while palpebral and bulbar involvement were seen in just 1 patient each. A statistically significant association was found ($\chi^2 = 30.578$, $P < 0.00001$). In the Schirmer test, mild dry eye was most frequently associated with a mixed pattern, affecting 45 patients, followed by bulbar involvement in 20 patients and palpebral involvement in 7 patients. Moderate dry eye was observed in 16 patients with a mixed pattern, 11 with palpebral involvement, and 3 with bulbar involvement. Severe findings from Schirmer test were most commonly associated with 4 patients exhibiting a mixed pattern, 2 with palpebral involvement, and 2 with bulbar involvement. A statistically significant association was also observed ($\chi^2 = 12.062$, $P = 0.0168$).

4. Discussion

The examination of age distribution revealed that the most significant portion of patients (35.45%) was located within the 6 to 9-years of age. In a similar study carried out by Chen X et al. [20] the mean age was 14.68±1.70 years, with a range of 12 to 18 years, as reported. The study carried out by Verma S et al. [21] in their study sample found that, the age group most frequently impacted was 5–10 years, accounting for 42%, followed by the 11–15 years group at 32%. The majority of study group consisted of these two age groups.

The current investigation reveals that a notable majority of the participants (70%) were male. In the study carried out by Verma S et al. [21] the male-to-female ratio was 2.1:1 (68% males and 32% females). Comparable findings were reported by Shetty et al. who conducted a study on refractive errors in VKC, leading to the conclusion that the male to female ratio is 3.5:1. A separate investigation carried out by Ahmed et al. [23] determined the male to female ratio to be 1.1:1, with 52.7% males and 47.3% females. Our findings indicate a notably increased prevalence of DED among males. Given that our study was conducted in a hospital setting, this trend may be linked to the insufficient treatment-seeking behaviour observed among females in developing nations. The Salisbury Eye Evaluation study indicated a higher prevalence among males compared to females; however, it focused exclusively on patients aged 65 and older. [24]

A decrease in tear break-up times serves as a crucial objective indicator of dry eye syndrome. [25] In a particular investigation, both seasonal and perennial varieties of AC demonstrated a significant reduction in tear break-up time (3.4 vs. 12.4 seconds; P<.05) and an enhancement in the tear film lipid layer. A total of 78% exhibited grade 3 or higher

alterations in tear film lipid layer interferometry, aligning with the diagnosis of dry eye syndrome. In summary, seasonal air conditioning seems to correlate with increased tear instability and a thickening of the lipid layer in the tear film. [26]

Numerous examples in the literature link tear film dysfunction with AC. A study proposes that dysfunction of the tear film may be a potential complication associated with ocular allergic disease. [27] In individuals experiencing persistent types of AC, including those with atopic keratoconjunctivitis and vernal conjunctivitis, [27] observations in animal models have revealed reduced tear film break-up times, [28] diminished conjunctival mucins in the tear fluid layer, and a decrease in conjunctival goblet cell density. [29-30] Shortened tear break-up times are recognized to correlate with a notable decrease in the number of goblet cells. A particular investigation indicates a process whereby AC diminishes the density of goblet cells, thereby predisposing the patient to dryness. [30] In a separate investigation, the severity of allergic inflammation on the ocular surface was linked to the impact of the tear film (dry eye) phenomenon. [31] The analysis revealed that a severe TFBUT test was predominantly linked to a mixed pattern, and this observation was found to be statistically significant.

In the significant portion of the patients, specifically 63.63%, were categorized as experiencing a moderate form of the disease. Severe findings from the Schirmer test were predominantly linked to individuals displaying a mixed pattern of conjunctivitis. The study conducted by Mazumdar S et al. [32] identified Seasonal Allergic Conjunctivitis (SAC) as the most prevalent type of Allergic Conjunctivitis. Miyazaki et al. [33] in their review article have presented comparable findings, indicating that SAC is the predominant AC in central Japan and Italy. La Rosa M et al. [34] in their investigation have also demonstrated that SAC and PAC (Perennial allergic conjunctivitis) are the most prevalent AC. In a study conducted by Mazumdar S et al. [32] 42 out of 132 AC patients (31.81%) exhibited a severe OSDI score (>32). The analysis conducted by Mazumdar S et al. [32]. revealed a significant difference in Schirmer's score and OSDI score among the three groups ($p < 0.0001$) during post hoc evaluation.

5. Conclusion

This investigation revealed that within various subgroups of Allergic Conjunctivitis, mixed allergic conjunctivitis exhibited a significantly higher association with dry eye in comparison to palpebral and bulbar types. This investigation determines that all patients with AC must undergo a comprehensive examination for dry eye to avert further ocular surface harm and enhance patient care.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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