# Prevalence of Dry Eye Disease in Children and Adult with Chronic Ocular Allergy in Upper Egyptian Population

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**Abstract**

**Background:** Dry eye disease (DED) is a multifactorial ocular disorder defined by the chronic loss of tear film homeostasis and instability, resulting in a self-closed cycle of ocular surface damage and inflammation.

**Objectives:** To assess the occurrence of dry eye disease in long-term children and adult ocular allergies within the southern Egyptian community.

**Patients and methods:** This cross-sectional, observational, hospital-based research has been performed on one hundred patients' eyes presented by various ophthalmic complaints such as irritation, discomfort, dryness, presence of foreign body sensation, gritty sensation, burning sensation, and light sensitivity, divided into Group A: 50 eyes in childhood chronic allergy and Group B: 50 eyes in adult chronic allergy at the Ophthalmology Department, Qena University Hospital, South Valley University.

**Results:** A highly statistically significant variance was detected among the pediatric and adult groups regarding the duration of allergic conjunctivitis (AC), dry eye score system (DESS) score, tear film break-up time test (TFBUT), fluorescein corneal staining (FCS) scores, and tear film breakup time. A statistically insignificant variance was observed among the pediatric and adult groups regarding tearing and foreign body sensations.

**Conclusion:** We conclude that a highly statistically significant variance was observed among pediatric and adult groups regarding the duration of AC, DESS score, TFBUT, and FCS scores. Also, a statistically significant variance was observed among pediatric and adult groups regarding K1, K2, Schirmer, TMH-R, severity of OSDI, total OSDI score, and ocular-symptom RQLQ score.

**Keywords:** DED; Ocular allergy; Allergic conjunctivitis.

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## Introduction

Dry eye disease (DED) is a multifactorial ocular disorder defined by the chronic loss of tear film homeostasis and instability, resulting in a self-closed cycle of ocular surface damage and inflammation **(Zaky et al., 2020)**.

Dry eye disease can also be treated by environmental factors, like raised airflow over the ocular surface, low humidity, tobacco smoke, dust, and air pollutants, in addition to lifestyle conditions like poor eyelid hygiene practices, frequent utilization of digital devices, and contact lens wearing. This results in chronic inflammation and injury to the ocular surface, which might ultimately impair the vision of those who are impacted **(Sheppard et al., 2023)**.

Work activities of daily living have been reported to be adversely affected by dry eye disease, suggesting that the condition has significant socioeconomic consequences. Ocular allergy and dry eye disease are both prevalent, pertinent, and symptomatic conditions that impact the ocular surface. A few clinical and biochemical characteristics are shared between them **(Vega-Estrada et al., 2016)**

Few studies try to assess the prevalence of dry eye in areas of hot weather in cases of ocular allergies **(Cavas-Martínez et al., 2016).**

The research aimed to Is to evaluate the prevalence, complaint and calculate the clinical score of dry eye disease in chronic children and adult ocular allergy in south Egyptian population

## Patients and methods

This cross-sectional, observational, hospital-based research has been performed on one hundred patients' eyes presented by various ophthalmic complaints such as irritation, discomfort, dryness, presence of foreign body sensation, gritty sensation, burning sensation, and light sensitivity, divided into Group A: 50 eyes in childhood chronic allergy and Group B: 50 eyes in adult chronic allergy at the Ophthalmology Department, Qena University Hospital, South Valley University.

**Inclusion criteria:** Patients (children and adults) with chronic ocular allergies include those presenting with various ophthalmic complaints such as irritation, discomfort, dryness, the presence of foreign body sensations, gritty sensations, burning sensations, and light sensitivity.

**Exclusion criteria:** Corneal scars, a history of keratorefractive surgery, a history of ocular infections, patients diagnosed with and on treatment for dry eye disease, abnormal lid movement disorder or lid defect, a history of autoimmune disorders, herpetic disease, recent pregnancy, otherwise lactation, irregular nasolacrimal drainage, and the placement of plugs throughout thirty days of punctual testing

**Ethical Consideration:** The research protocol had been submitted for acceptance by the Institutional Review Board at the Department of Ophthalmology at Qena University Hospital, South Valley University. Every subject who participated in the research provided verbal informed consent. Confidentiality and personal privacy were respected at every stage of the research. Ethical approval code: SVU-MED-OPH026-1-23-8-707.

### *Methods*

**Visual acuity test using landolt c chart and converting logMAR uncorrected distance visual acuity (UDVA) and logMAR corrected distance visual acuity (CDVA):** According to the manufacturer's instructions, a Landolt C chart has been shown at a distance of five meters, with each line including 4 directions (right, left, up, and down). A remote controller has been utilized to project black optotypes on a white background box with retro-illumination, one following the other. On the chart, the twelve rows showed the

decimal values of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.5, and 2.0. The ring sizes were arranged in descending order from the largest (top row) to the smallest. In the situation where cases were unable to detect the top optotypes, they continued at a half-meter interval until they were able to accurately determine the direction of the ring. The lowest line, where at least half of the rings were correctly determined by our routine recording method, was utilized to score visual acuity. If half of the rings were correctly determined, an additional 0.05 was added to the score. E.g., a patient's score would be 0.3+1 if they were able to read 4 rings of 0.3 and 1 ring of 0.4, 0.35 if they could read two rings of 0.4, and 0.4-1 if they could read three rings of 0.4. Acuities were determined in logMAR units (logarithm of the minimal angle of resolution) for statistical analysis. Prior to being converted to logMAR, Landolt C's score was corrected by 0.025 for +1 and -1. For example, 0.3+1 and 0.4-1 are equivalent to 0.325 and 0.375.

**Refractive status:** Sphere, refractive cylinder, and spherical equivalent (SE). Pentacam was used to assess patients' keratometry. The value of K1 and K2 were determined.

**Evaluation:** The tear film and corneal filaments were observed to contain mucus strands. The irregularity, or thickening, of the lid margins was assessed. **Baab et al. (2022)** evaluated the integrity of meibomian gland function in all cases, utilizing the Foulks-Bron scoring system. Pouting, secretion, plugging, and foam presence were all assessed in meibomian orifices. In the tarsal conjunctiva, the existence of papillae was assessed.

**Objective testing included the following:** Ocular surface staining by fluorescein dye was carried out. The Oxford schema (Bron) **(Bischoff 2014)** was used to estimate the surface damage (conjunctival and corneal staining). A tear film breakup time (TBUT) test was carried out: 1% fluorescein dye was applied to the eye, and the average of three consecutive breakup times (utilizing a stopwatch) was calculated. A breakup time of less than 10 seconds was considered abnormal. Finally, Schirmer's test with a local anesthetic (benoxinate hydrochloride, 0.4%) was performed. After 2 minutes, Whatman's filter paper (5 mm ×35 mm, no. 41) has been applied to the inferior conjunctival sac located at the junction of the medial two-thirds and lateral one-third. The case has been instructed to look straight and is permitted to blink. The test strips were removed after five minutes. We recorded the amount of wetting. Values < 10 mm were abnormal. The sequence of these tests was maintained so that each test did not affect the next. (**Fig. 1).**


**Fig.1.** Schirmer's test with a local anesthetic

The Ocular Surface Disease index (OSDI) was used to assess symptoms and how they affect vision-related tasks. The questionnaire was divided into three sections: the first evaluates the frequency of symptoms; the second evaluates the effect of symptoms on daily tasks; and the third evaluates the effect of environmental factors, such as windy conditions and air conditioning. The scores on the three sections were summed to arrive at a final ocular surface disease score, which ranged from 0 to 100, with higher values indicating greater symptom severity [normal (<12), mild (13-22) moderate (23-32) or severe (33-100)]. The ocular surface disease index has a high degree of sensitivity (80%) and specificity (79%) for discriminating patients with and without dry eye disease **(Prokopich et al., 2014).**

The diagnosis of dry eye disease was confirmed by the presence of chirmer's test measurement of ten millimeters or less with the presence of dry eye symptoms evaluated with the ocular surface disease index questionnaire (OSDI ≥ 13) **(Emam et al., 2021).** The diagnosis of allergic eye disease was further confirmed by Skin prick testing (SPT) which is the gold standard method for allergy testing. It is the most widely used diagnostic test in allergy as it has advantages of high sensitivity and specificity, rapid results, flexibility, low cost, good tolerability, and clear demonstration to patients of their allergies **(Haggag et al., 2017).**

The Dry eye scoring system (DESS) was used to assess the symptoms related to dry eye disease, this questionnaire was used. The dry eye scoring system asked about the presence of 6 items: eye fatigue, ocular itching/burning, local redness, gritty/sandy sensation, blurred vision, and abnormal excessive blinking. Every item is represented with an answer of zero (absent), one (sometimes), two (frequent), and 3 (always found). The score of DESS ranged from zero (minimal score) to 18 (maximal severe score) **(Ismail et al., 2023).**

The corneal fluorescein staining score ranged from 0 to 3 points (Grade 0 = no staining, Grade 1 = minimal staining, Grade 2 = mild/moderate staining, Grade 3 = severe staining) **(Ogawa et al., 2013). (Fig. 2).**

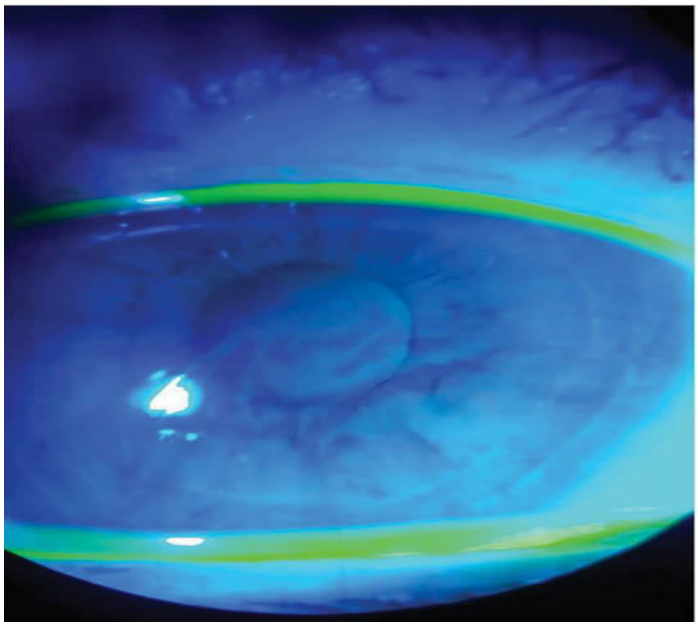

**Fig.2.** Fluorescein staining test

The Rhino-conjunctivitis Quality of Life Questionnaire (RQLQ) was used to measures the functional impairments due to eye disease. In this study, we used the sleep problems (3 items) and the eye symptoms (4 items) domains. Each domain had a 7-point scale (0 = not impaired at all - 6 = severely impaired). Higher scores reflect lower quality of life **(Park et al., 2002).**

***Research outcome measures***

**Primary (main):** Study of the prevalence of dry eye disease in allergy disease in south Egypt on a large sample population

**Secondary (subsidiary):** Dry eye disease in allergy disease in children and adults in south Egypt.

**Statistical analysis**

Microsoft Excel software was utilized to code, enter, and analyze data obtained throughout the history, basic clinical examination, laboratory examinations, and outcome measures. Data were subsequently entered into the Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. The following tests were utilizing to evaluate the significance of variances: Pearson's correlation or Spearman's correlation, depending on the type of data. Qualitative data is represented as a number and percentage, while quantitative data is represented as a mean ± standard deviation. The P value was established at <0.05 for significant findings and <0.001 for high-level significant findings. The data was gathered and subjected to statistical analysis. The mean and standard deviation (SD) were used as statistical tests and parameters.

**Results**

(**Table.1**) demonstrates that a statistically insignificant variance was observed among pediatric and adult groups with regard to sex, while a statistically significant variance was observed among pediatric and adult groups regarding age.

**Table 1. Distribution of demographic data between the studied groups.**

| Variables | Pediatric group N=50 | Adult group N=50 | P-value |
|---|---|---|---|
| **Age** (year) | | | |
| Mean± SD | 4.62±0.87 | 36.74±10.7 | <0.001 |
| **Sex** | | | |
| Male | 25(50%) | 22(44%) | 0.54 |
| Female | 25(50%) | 28(56%) | |

P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is greatly significant., SD: standard deviation

(**Table.2**) shows that a highly statistically significant variance was observed among pediatric and adult groups regarding the duration of allergic conjunctivitis, dry eye score system, tear film break-up time test, and fluorescein corneal staining scores.

**Table 2. Distribution of Clinical findings between the examined groups.**

| Variables | Pediatric group N=50 | Adult group N=50 | P-value |
|---|---|---|---|
| **Duration of AC (months)** | | | |
| Mean± SD | 5.74±1.20 | 6.88±2.27 | **<0.001** |
| **DESS** | | | |
| Mean± SD | 5.2±1.73 | 7.98±4.74 | **<0.001** |
| **TFBUT (seconds)** | | | |
| Mean± SD | 6.66±1.61 | 3.54±1.11 | **<0.001** |

| | | | |
|---|---|---|---|
| **FCS scores** | | | |
| Mean± SD | 1.42±0.97 | 2.32±1.30 | **<0.001** |

AC: allergic conjunctivitis, DESS: dry eye score system, TFBUT: tear film break-up time test, FCS: fluorescein corneal staining. P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is highly significant., SD: standard deviation.

(**Table.3**) shows that a highly statistically significant variance was observed among pediatric and adult groups regarding tear film breakup time.

**Table 3. Distribution of TFBUT between the examined groups.**

| Variables | Pediatric group N=50 | Adult group N=50 | P-value |
|---|---|---|---|
| **Tear film breakup time** | | | |
| ≥10 seconds (eyes %) | 0 (0%) | 0 (0%) | **<0.001** |
| ≥5 to <10 seconds (eyes %) | 38(76%) | 9(18%) | |
| <5 seconds (eyes %) | 12 (24%) | 41(82%) | |

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**Table.4**) shows that a statistically significant variance was observed among pediatric and adult groups regarding K1, K2, Schirmer, and TMH-R.

**Table 4. Distribution of findings of keratometry, Schirmer test, and tear meniscus height reflex between the studied groups.**

| Variables | Pediatric group N=50 | Adult group N=50 | P-value |
|---|---|---|---|
| **K1 (D)** | | | |
| Mean± SD | 43.73±1.74 | 44.63±1.64 | 0.009 |
| **K2 (D)** | | | |
| Mean± SD | 44.61±1.55 | 45.3±1.61 | 0.03 |
| **Schirmer** (mm) | | | |
| Mean± SD | 11.7±3.88 | 7.46±4.98 | <0.001 |
| **TMH-R** (mm) | | | |
| Mean± SD | 0.096±0.05 | 0.12±0.03 | 0.004 |

K: keratometry, TMH-R: tear meniscus height reflex

(**Table.5**) shows that a statistically significant variance was observed among pediatric and adult groups regarding the severity of OSDI, total OSDI score, and ocular-symptom RQLQ score.

**Table 5. Distribution of OSDI score and ocular-symptom RQLQ score between the examined groups.**

| Variables | Pediatric group N=50 | Adult group N=50 | P-value |
|---|---|---|---|
| **Severity of OSDI** | | | |
| Normal | 16(32%) | 6(12%) | 0.003 |
| Mild | 23(46%) | 16(32%) | |
| Moderate | 9(18%) | 19(38%) | |
| Sever | 2(4%) | 9(18%) | |
| **Total OSDI score** | | | |
| Mean± SD | 15.84±6.75 | 24.64±9.16 | <0.003 |

| **Ocular-symptom RQLQ score** | | | |
|---|---|---|---|
| Mean± SD | 26.16±7.98 | 15.8±2.34 | 0.003 |

OSDI score: Ocular Surface Disease Index, RQLQ: Rhino-conjunctivitis Quality of Life Questionnaire

(**Table.6**) shows that statistically insignificant variance was observed among pediatric and adult groups regarding tearing and foreign body sensation.

**Table 6. Distribution of complaint data among the examined groups.**

| **Variables** | **Pediatric group N=50** | **Adult group N=50** | **P-value** |
|---|---|---|---|
| **Complaints** | | | |
| Tearing | 9(18%) | 11(22%) | 0.61 |
| Foreign body sensation | 20(40%) | 22(44%) | 0.68 |

**Discussion**

The present study showed that according to demographic data in the studied groups, there was a statistically significant results between groups as regards age (p-value < 0.001). The pediatric group showed lower age with a mean (4.62±0.87) than the adult group with a mean (36.74±10.7). There were no statistically significant results between groups as regards gender (p-value = 0.61). In the pediatric group 25 patients (50%) were males, and 25 (50%) were females, and in the adult group 22 patients (44%) were males, and 28 patients (56%) were females.

Our results supported by **Akil et al. (2015),** who aimed to assess the comorbidity of dry eye disease and changes in corneal curvature in children with allergies. They included 49 patients. They reported that in pediatric group, the mean age was 11.18 ± 2.5, twenty-three (46.9%) children were male, and 26 (53.1%) were female.

As well, our results are consistent with **Mazumdar et al.(2023),** who aimed to find out the prevalence of dry eye disease. They revealed that in the adult group, the mean age of patients was 27.54 years. Females outnumbered males (64% vs 36%) in the study population of subjects with dry eye disease. The mean age of females (31.75 years) was much higher as compared to males (19.44 years).

In our study, the pediatric group showed significantly lower duration of dry eye disease with a mean (5.74±1.20) than the adult group with a mean (6.88±2.27). Also, the pediatric group showed significantly lower dry eye score system score with a mean (5.2±1.73) than the adult group with a mean (7.98±4.74). The pediatric group showed higher tear film break-up time test with a mean (6.66±1.61) than the adult group with a mean (3.54±1.11). The pediatric group showed lower fluorescein corneal staining score with a mean (1.42±0.97) than the adult group with a mean (2.32±1.30).

Our results matched with **Chen et al.(2016),** who found that in pediatric group, the mean duration of allergic symptoms was 5.76 ± 1.16 months. Dry eye score system had a mean value of 4.75 ± 2.22. Ten seconds for tear film break-up time test was 6.54 ± 1.48. Fluorescein corneal staining scores (0.79 ±1.34).

Also, our results are consistent with **Bakhritdinova et al.(2020),** who aimed to improve treatment of dry eye patients with allergic conjunctivitis through the use of artificial tears. Fifty-six patients with acute allergic conjunctivitis complicated by secondary dry eye syndrome were included in the study. They found that mean tear film break-up time test value for all 56 patients was 5.9±2.1.

Additionally, our results are consistent with (**Gupta et al. 2023),** who aimed to evaluate dry eyes in children. They reported that the mean tear film break-up time test was 5.9 ± 1.9 s in dry eye groups. The mean duration of allergic symptoms was 27.7±30.8 months.

We found that there was a statistically significant results between groups as regards tear film breakup time (p-value < 0.001). In the pediatric group 38 patients (76%) had ≥5 to <10 seconds, and 12 patients (24%) had <5 seconds, and in the adult group 9 patients (18%) had ≥5 to <10 seconds (eyes %), and 41 patients (82%) had <5 seconds (eyes %).

Our results supported by **Chen et al.(2016),** who found that in pediatric group, regarding tear film break-up time test, 71 patients (88.75%) had ≥5 to <10 seconds, and 7 patients (8.75%) had <5 seconds and 2 (2.50%) had ≥10 seconds.

In the present study, the pediatric group showed lower K1, K2, and tear meniscus height reflex while the adult group showed lower Schirmer test value.

Along with our results, **Akil et al.(2015),** who found that in pediatric group, the mean K1 was 43.33±1.4, mean K2 was 44.06±1.4, the mean Schirmer was 11.74±4.32 and the mean tear meniscus height reflex was 0.1±0.05. There was statistically significant difference between groups for the Schirmer test, and tear meniscus height reflex (P < 0.001 for all comparisons). Also, our results are consistent with **Gupta et al.(2023),** who reported that the mean value of Schirmer's test was 20.8 ± 8.6 mm in the dry eye groups.

In our study, among the pediatric group 16 patients (32%) were normal, 23 patients (46%) were mild, 9 patients (18%) were moderate, and 2 patients (4%) were severe, and in the adult group 6 patients (12%) were normal, 16 patients (32%) were mild, 19 patients (38%) were moderate, and 9 patients (18%) were severe (P = 0.0003). The pediatric group showed lower total score with a mean (15.84±6.75) than the adult group with a mean (24.64±9.16) by showed higher ocular-symptom rhino-conjunctivitis quality of life questionnaire score with a mean (26.16±7.98) than the adult group with a mean (15.8±2.34).

Our results are consistent with **Mazumdar et al.(2023),** who reported that among adult group, 29.54% of patients had a normal ocular surface disease index score, while 20.45%, 18.18%, and 31.81% had mild, moderate, and severe ocular surface disease index score, respectively. With a mean ocular surface disease index score was 25.35 ± 12.88.

Also, our results are consistent with **Akil et al.,(2015)**, who found that most allergic conjunctivitis cases were classified as ocular surface disease index moderate and severe, followed by very severe. In the pediatric group (48%) patients were mild, 9 (48 %) patients were moderate, and 2 (4%) patients were severe.

As well, our results are consistent with **Bakhritdinova et al.(2020),** who revealed that the mean ocular surface disease index and mean ocular-symptom rhino-conjunctivitis quality of life questionnaire scores of study patients were 24.17 ± 8.55 and 15.35 ± 2.15, respectively. Furthermore, **Gupta et al.(2023)** reported that total ocular surface disease index score was 32.7±17.6.

In the present study, there were no statistically significant results between groups as regards tearing (p-value = 0.61) or foreign body sensation (p-value = 0.68).

Our results are consistent with, **Bakhritdinova et al.(2020),** who revealed that regarding distribution of complaints data, mean tear score was 2.2±0.16 and mean foreign body sensation score was 1.8±0.13.

Also, our results are consistent with **Malu et al.(2014),** who found that the subjects who presented with allergic conjunctivitis had various complaints. The most frequent was itching in 516 (20.8%), followed by redness in 432 (17.4%), pains in 324 (13.0%), watery discharge in 288 (11.6%), sticky eyes in 120 (4.8%), mucoid discharge in 114 (4.6%), puffy eyes in 108 (4.3%) and photophobia. Other complaints included headaches, dry eyes, and body itching with seasonal eye problems.

**Conclusion**

Based on our findings, we conclude that a highly statistically significant variance was observed among pediatric and adult groups regarding the duration of allergic conjunctivitis, dry eye score system score, tear meniscus height reflex, and fluorescein corneal staining scores. Also, we observed a statistically significant variance among the pediatric and adult groups according to K1, K2, Schirmer, tear meniscus height reflex, severity of ocular surface disease index, total ocular surface disease index score, and ocular-symptom rhino-conjunctivitis quality of life questionnaire score.

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