Original Research Article

A STUDY ON ASSOCIATION OF SYSTEMIC AND ENVIRONMENTAL FACTORS WITH DRY EYES

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ABSTRACT

Background: 'Dry eye' - a common ailment, can be caused by conditions affecting the ocular surface, environmental factors such as low humidity, wind and underlying systemic conditions such as rheumatoid arthritis, Vitamin A deficiency, and postmenopausal women on estrogen therapy.

Material & Methods: 70 patients aged between 18 – 60 years with dry eyes, attending the ophthalmology OPD were included in this study. The visual acuity of the study participants was assessed followed by examination of the anterior segment and posterior segment of the eye using 90D spherical lens. Schirmer's test and Tear Film Breakup Time (TFBT) were done to assess the production of tears and tear film integrity.

Results: The majority of participants were aged 51-60, with a male predominance (61.4%) and middle-class socioeconomic status (42.85%). Common complaints included eye irritation (31.4%) and foreign body sensation (25.7%). Significant ocular findings were arcus senilis (62.86%) and immature cataracts (77.14%). Comorbidities, particularly diabetes (58.57%) and hypertension (22.857%), showed a mild to moderate correlation with tear instability (mean TBUT: 8.8 and 8.6 seconds, respectively). Environmental factors like screen time and hot air exposure were associated with lower TBUT scores. However, p-values for correlations with TBUT and DED severity were non-significant (comorbidities $p = 0.98$, environmental factors $p = 0.52$).

Conclusion: DED is a multifactorial condition with interplay of systemic disorders, aging and environmental factors. Identifying the causative factor and addressing it is the cornerstone of DED management.

Key Words: Dry eye disease, tear break-up time, Schirmer's test, comorbidities, environmental factors.

INTRODUCTION

Keratoconjunctivitis sicca, also known as "Dry eyes disease" is one of the most prevalent ocular conditions. It is a multifactorial condition characterized by loss of tear film integrity, hyperosmolarity and inflammation leading to symptoms such as inflamed eyes, blurring of vision, pruritus, and photophobia.[1]

The tear film is a crucial structure for maintenance of corneal surface and is composed of 3 layers. The innermost mucin layer – anchors the tear film to the corneal surface. The middle layer is the aqueous layer which is responsible for hydration, nutrient supply and removal of debris. The outermost layer is the lipid layer, which prevents evaporation of the aqueous layer. The lacrimal glands, meibomian glands, goblet cells and accessory lacrimal glands synergistically produce the tear film to maintain a clear ocular surface thereby giving a clear vision.[2]

Dry eye disease (DED) is a complex multifactorial condition characterized by symptoms such as blurring of vision, inflamed eyes, photophobia and pruritis. DED could be attributable to intrinsic factors such as autoimmune disorders like rheumatoid arthritis, Sjogren's syndrome which cause dry eyes by autoimmune destruction of the lacrimal gland epithelium; Vitamin A deficiency

(hinders production of mucin by goblet cells), hormonal changes such as post menopause (due to decrease in estrogen levels which affect the meibomian glands).[3,4] Extrinsic environmental factors include low humidity, exposure to wind and prolonged screen time, which increase evaporation of tear film precipitating dry eyes.[5-7]

Evaluation of DED includes a multitude of tests to assess tear film integrity, osmolarity and gland function. Schirmer's test assesses the quantity of tear production by measuring the wetness of a filter paper placed at the eyelid margin. The tear breakup time evaluates the integrity of tear film by staining the ocular surface with fluorescein or lissamine green dye. Any breaks in the integrity will indicate epithelial cell damage.[8,9]

Dry eyes disease poses a significant effect on the quality of life of people by hindering their vision and thereby decreasing their productivity at work. With the increase in prevalence of systemic disease like diabetes and prolonged usage of mobile devices, the incidence of DED is on the rise amongst various age groups. This study was conducted with an aim to evaluate the prevalence of dry eye disease amongst patients presenting to the OPD of this tertiary care centre and to assess the various intrinsic and extrinsic factors causing it.

MATERIALS AND METHODS

This prospective observational study was conducted in the OPD of Department of Ophthalmology, Tagore Medical College, Chennai, over a period of 6 months, i.e. from January 2024 to June 2024. The study included patients aged between 18- 60 years with symptoms of dry eyes and history of systemic conditions predisposing to dry eyes, presenting to the OPD. Patients with ocular infections, or on medications for treating dry eyes, or presence of any ocular pathology or patients wearing contact lens were excluded from the study.

Ethical approval was taken from the Ethical Committee board of the institution before starting the study. A written informed consent was taken from all the patients before enrolling them into the study.

A detailed demographic and clinical history was taken from all the study participants. McMonnies questionnaire is a validated screening tool for diagnosing dry eyes. It comprises of questions on ocular discomfort, foreign body sensation, dryness, pruritis, lacrimation, photophobia and other ocular symptoms and assesses the severity of each symptom.10 History of extrinsic or intrinsic factors causing dry eyes were taken.

A thorough systemic examination was done to find for any signs of systemic diseases. A detailed ocular examination was done which included testing of visual acuity, examination of anterior and posterior segments of eyes using a spherical 90D lens. Following ocular examination, objective tests for diagnosing dry eyes were done – Schirmer's test and tear breakup time (TBUT).

Schirmer's test was done by placing a filter paper strip on the margin of lower eyelid for a period of 5minutes and assessing the level of wetness of the paper strip. A wetting measurement of above 15mm in 5min is considered to be normal and anything below this is suggestive of reduced tear secretion.

The Tear Breakup Time (TBUT) was performed by asking the patient to blink after instilling Fluorescein or Lissamine green dye in the lower conjunctival sac. The interval between last blink and the first sign of tear film breakup was measured by the examiner using a slip lamp under cobalt blue light. An interval of greater than 10 seconds is considered normal and values below this is suggestive of rapid tear film evaporation.

RESULTS

A total of 70 (140 eyes) individuals were enrolled in this study. In the demographic data (Table 1), most participants (38.57%) fell within the 51-60 years age range, and there was a higher male representation (61.4%). Socioeconomically, the middle class made up 42.85% of participants. Predominant complaints included eye irritation (31.4%) and foreign body sensation (25.7%).

Ocular features observed (Table 2) showed a high prevalence of arcus senilis (62.86%) and immature cataracts (77.14%), reflecting age-related changes possibly affecting tear stability and visual acuity. Notably, 78.6% of participants experienced reduced visual acuity, emphasizing the need for targeted intervention in this group. [Table 1]

Comorbid conditions (Figure 1) frequently observed were diabetes mellitus (58.57%) and hypertension (22.857%). The mean TBUT values for these groups were 8.8 seconds and 8.6 seconds, respectively, indicating mild to moderate tear instability. Diabetes showed a broader distribution across DED severities, while rheumatoid arthritis and Sjogren's syndrome presented with lower TBUT values, linking them to severe DED. [Table 2]

In environmental factors (Figure 2), exposure to hot air and prolonged screen time correlated with shorter TBUT scores (7.6 and 7.2 seconds, respectively), suggesting increased risk of tear instability in these conditions. A humid environment was associated with a higher average TBUT (10 seconds), indicating protective effects against DED symptoms. However, statistical testing did not reveal significant correlations between TBUT and DED severity with either comorbidities (p = 0.98) or environmental factors (p = 0.52).
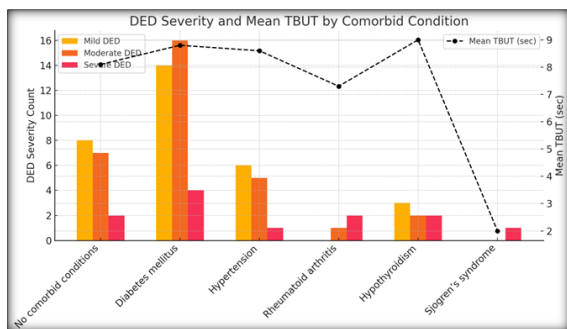
Figure 1: Correlation between comorbidities with DED severity and mean TBUT
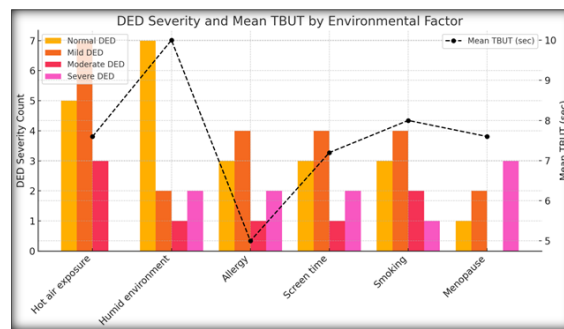
Figure 2: Correlation between environmental factors with DED severity and TBUT

Table 1: Demographic characteristics

Characteristics		Frequency
Age group	< 21 years	1 (1.43%)
	21-30 years	8 (11.43%)
	31-40 years	5 (7.14%)
	41-50 years	18 (25.71%)
	51-60 years	27 (38.57%)
	>60 years	11 (15.71%)
Gender distribution	Males	43 (61.4%)
	Females	37 (52.8%)
Socioeconomic status	Lower class	22 (31.4%)
	Middle class	30 (42.85%)
	Upper class	18 (25.7%)
Complaints	Irritation	22 (31.4%)
	Foreign body sensation	18 (25.7%)
	Watering	17 (24.2%)
	Redness	13 (18.57%)

Table 2: Ocular Features

Ocular condition	Frequency
Reduced visual acuity	55 (78.6%)
Blepharitis	4 (5.7%)
Meibomian gland dysfunction (MGD)	8 (11.43%)
Pterigyium	9 (12.8%)
Pingecula	7 (10%)
Arcus senilis	44 (62.86%)
Immature cataract	54 (77.14%)
pseudophakia	20 (28%)

DISCUSSION

Dry eye disease (DED) is a multifactorial condition characterized by a disrupted tear film, leading to symptoms such as irritation, dryness, and visual disturbances. It affects millions worldwide, particularly among older adults, and is influenced by factors like age, hormonal changes, environmental exposures, and underlying health conditions. This observational study was done to analyze the prevalence and causative intrinsic and extrinsic factors of DED in patients presenting to our tertiary care center.

The present study included 70 participants, with most (38.57%) aged between 51-60 years, which is similar to study by Jones et al,[11] supporting previous studies that highlight DED prevalence among middle-aged and older populations.

The male predominance (61.4%) in present study differs slightly from study by Smith et al,[12] and Zhou et al,[13] had observed a higher prevalence in females, particularly postmenopausal women.

Ocular complaints in the current study centered on irritation (31.4%) and foreign body sensation (25.7%), paralleling findings from study by Li et al,[14] who also reported high rates of discomfort and visual symptoms in older adults with DED. The high prevalence of age-related ocular changes, including Arcus Senilis (62.86%) and immature cataracts (77.14%) is consistent with age-related changes that influence tear film stability and visual acuity. Reduced visual acuity was found in 78.6% of participants, which is similar to the study findings of Chen et al,[15] highlighting the need for targeted DED interventions, especially among older adults with significant comorbid conditions.

Comorbid conditions like diabetes mellitus (58.57%) and hypertension (22.857%) were frequent in this cohort, with TBUT averaging 8.8 and 8.6 seconds, respectively, indicating mild to moderate tear instability. These values mirror results from study by Lee et al,[16] who noted similar TBUT averages in DED patients with diabetes.

Rheumatoid arthritis and Sjogren's syndrome, both linked to more severe DED presentations, similar to the findings of study by Wu et al,[17] also displayed lower TBUT values in this study, reaffirming the role of autoimmune conditions in severe DED.

In present study, it was observed that environmental factors like screen time and hot air exposure correlated with shorter TBUT, while humid environments supported tear stability. This is consistent with study by Garcia et al.18, emphasizing the protective effects of humidity

Although statistical analysis did not show significant correlations between TBUT and DED severity with comorbidities (p = 0.98) or environmental factors (p = 0.52), the present findings align with evidence that systemic health and environmental exposures can exacerbate DED symptoms.

CONCLUSION

This study reveals significant insights into the complex interactions underlying dry eye disease (DED), emphasizing age, gender, comorbidities, and environmental influences. With a predominance of middle-aged and older male participants, key complaints included irritation and foreign body sensation. Notably, high rates of ocular conditions such as arcus senilis and immature cataracts suggest age-related contributions to DED. Common comorbidities like diabetes and hypertension were linked to mild to moderate tear instability, while environmental factors—such as screen time and hot air exposure—were associated with lower TBUT scores, underscoring their impact on tear film stability. Despite no statistically significant correlation between TBUT, DED severity, and comorbid or environmental factors, these findings support the need for a multifactorial approach in DED management. Tailoring treatments to address systemic health, age-related changes, and lifestyle factors may enhance outcomes and improve patient quality of life.

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