e-ISSN: 2722-9807

Sriwijaya Journal of Ophthalmology

[SJO]

https://sriwijayaophthalmology.com

Risk Factors and Management Strategies for Dry Eye Syndrome: A Comparative Study

Ehsan Khalil Abed[1], Aiad Ali Abbood[2*]

[1]Wasit Health Department, Ministry of Health, Kut, Iraq

[2]Ophthalmology Department, Al-Zahraa Teaching Hospital, Kut, Iraq

ARTICLE INFO

Keywords:
Dry eye syndrome
Keratoconjunctivitis sicca
OSDI score
Risk factors
Tear break-up time

***Corresponding author:**
Aiad Ali Abbood

E-mail address:
Medicalresearch20@yahoo.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/sjo.v7i2.120

A B S T R A C T

Introduction: Dry eye syndrome (DES) is a prevalent multifactorial ocular surface disorder characterized by discomfort, visual disturbances, and tear film instability. This study aimed to investigate the risk factors associated with DES and compare the effectiveness of various management strategies. **Methods:** A cross-sectional comparative study was conducted at an ophthalmic consultant clinic from March 2023 to October 2023. One hundred patients diagnosed with DES were enrolled. Demographic data, including age, gender, and body mass index (BMI), were collected. Ophthalmological examinations, including slit-lamp examination, non-contact tonometry, fundus examination, tear break-up time (TBUT) measurement, and ocular surface disease index (OSDI) questionnaire assessment, were performed. The management strategies employed were categorized as medical, surgical, or a combination of both. **Results:** The study population predominantly consisted of females (70%) with a mean age of 49.65 years. The majority of patients (57%) fell within the overweight BMI category (25-29 kg/m^2). TBUT values of 7 seconds and 8 seconds were most prevalent (35% and 37%, respectively), and the majority of patients (65%) reported an OSDI score of 2. Notably, two-thirds of patients received medical treatment, one-third underwent a combination of medical and surgical treatment, and a small proportion (5%) underwent surgery alone. **Conclusion:** Female gender, increased BMI, and older age were identified as significant risk factors for DES. Patients with DES symptoms exhibited shorter TBUT values and higher OSDI scores, indicating tear film instability and increased disease severity. Medical treatment was the most common management strategy, followed by a combination of medical and surgical interventions. These findings underscore the importance of early diagnosis and individualized treatment plans for effective DES management.

1. Introduction

Dry eye disease (DED), also referred to as keratoconjunctivitis sicca (KCS), is a multifactorial disorder characterized by a loss of tear film homeostasis. This disruption results in a spectrum of symptoms, including ocular discomfort, dryness, grittiness, burning sensations, and visual disturbances. The prevalence of DED is a global concern, affecting a significant proportion of the population, with estimates suggesting it impacts up to 30% of individuals worldwide, translating to a staggering 2.25 billion people. The burden of DED extends beyond physical discomfort, as it significantly diminishes the quality of life for those affected. The economic implications are also substantial, with the average cost of treatment in the United States exceeding $6,500 per patient, and the incidence rate reaching an estimated 20 million individuals. The pathogenesis of DED is intricate and involves a complex interplay of various factors. Tear film instability, a hallmark of the disease, can arise from either decreased tear production (aqueous tear

deficiency) or increased tear evaporation (evaporative dry eye). This instability disrupts the delicate balance of the tear film, leading to hyperosmolarity, a condition characterized by increased salt concentration in the tears. Hyperosmolarity, in turn, triggers a cascade of inflammatory events on the ocular surface, perpetuating a cycle of damage and dysfunction. Meibomian gland dysfunction (MGD), a prevalent contributing factor to DED, is characterized by abnormal meibum secretion. Meibum, a lipid-rich substance produced by the meibomian glands in the eyelids, plays a crucial role in maintaining tear film stability by preventing excessive evaporation. When meibum production is compromised, the tear film becomes unstable, leading to evaporative dry eye, a common subtype of DED.[1,2]

The impact of DED on patients' lives is far-reaching. Individuals with DED often experience difficulties with everyday activities that rely on visual function, such as reading, working on computers, and driving. The discomfort and visual disturbances associated with DED can significantly impair productivity and overall well-being. Furthermore, DED can negatively affect visual acuity, making it challenging to perform tasks that require clear vision. In severe cases, DED can even lead to ocular surface damage, including corneal erosions and ulcers. The diagnosis of DED requires a comprehensive approach that combines patient history, symptom assessment, and objective clinical tests. A detailed patient history can reveal the presence of risk factors, such as age, gender, hormonal status, and systemic diseases, that may predispose individuals to DED. Symptom assessment tools, such as the ocular surface disease index (OSDI) questionnaire, provide valuable insights into the severity and impact of dry eye symptoms on patients' lives. The OSDI questionnaire consists of 12 items that assess various aspects of ocular discomfort, including pain, dryness, grittiness, and visual disturbances. Objective clinical tests are essential for confirming the diagnosis of DED and assessing the underlying causes. Tear break-up time (TBUT), a measure of tear film stability, is a widely used diagnostic test. It involves instilling fluorescein dye into the eye and measuring the time it takes for the tear film to break up, revealing dry spots on the cornea. A shorter TBUT indicates tear film instability and is suggestive of DED. Other objective tests, such as Schirmer's test, which measures tear production, and meibography, which assesses meibomian gland morphology, can provide additional information about the specific type and severity of DED.[3,4]

The management of DED encompasses a wide array of strategies, ranging from lifestyle modifications and over-the-counter artificial tears to prescription medications and surgical interventions. The choice of treatment depends on the severity and underlying cause of DED, as well as individual patient factors and preferences. Lifestyle modifications, such as increasing environmental humidity, avoiding prolonged computer use, and practicing good eyelid hygiene, can help alleviate mild dry eye symptoms. Artificial tears, available over the counter, provide temporary relief by supplementing tear volume and lubrication. They come in various formulations, including those with different viscosities and osmolalities, to cater to individual needs. For more persistent or severe cases of DED, prescription medications may be necessary. Topical cyclosporine, an immunomodulator, is a mainstay of treatment for moderate to severe DED. It works by suppressing inflammation on the ocular surface and promoting tear production. Corticosteroids, potent anti-inflammatory agents, are typically reserved for short-term use due to their potential side effects. They may be considered in cases of acute exacerbations or when other treatments have failed. Other pharmacological interventions, such as lifitegrast, a lymphocyte function-associated antigen-1 (LFA-1) antagonist, and varenicline, a nicotinic acetylcholine receptor agonist, have shown promise in reducing inflammation and improving tear production. Additionally, omega-3 fatty acids, found in fish oil supplements, have been investigated for their potential to improve tear film quality and reduce inflammation in DED.[5,6]

In cases where medical management alone is insufficient, surgical interventions may be considered. Punctal plugs, small devices inserted into the tear ducts, can increase tear retention on the ocular surface and alleviate symptoms. Other surgical procedures, such as thermal pulsation and intense pulsed light therapy, aim to improve meibomian gland function and address evaporative dry eye. The present study aimed to investigate the risk factors associated with DES and compare the effectiveness of various management strategies in a clinical setting. By identifying key risk factors and evaluating treatment outcomes, this research contributes to the development of personalized and effective approaches for DES management. The study also sought to assess the correlation between tear film stability, as measured by TBUT, and the severity of dry eye symptoms, as assessed by the OSDI questionnaire. Additionally, the study aimed to determine the most prevalent management strategies employed in the clinical setting and their respective outcomes.

2. Methods

This cross-sectional comparative study was conducted at the Ophthalmic Consultant Clinic of Al-Zahraa Teaching Hospital in Kut, Iraq, from March 2023 to October 2023. The study design was chosen to assess the prevalence of risk factors and the effectiveness of various management strategies for dry eye syndrome (DES) within a specific patient population. The study protocol was meticulously designed to adhere to the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the institutional review board of Al-Zahraa Teaching Hospital (approval number 776 in 2023). All participants were thoroughly informed about the study's objectives, procedures, potential benefits, and risks. Written informed consent was obtained from each participant before their enrollment in the study. Confidentiality and anonymity were maintained throughout the study by assigning unique identification codes to each participant and ensuring that personal information was not disclosed. Participants were recruited from patients attending the ophthalmic consultant clinic who presented with signs and symptoms suggestive of DES. A comprehensive screening process was implemented to ensure the inclusion of eligible participants and the exclusion of individuals with conditions that could confound the study results. To be eligible for the study, participants had to meet the following criteria: Age between 16 and 60 years; Clinical diagnosis of DES based on the presence of typical signs and symptoms, such as ocular discomfort, dryness, grittiness, burning sensation, and visual disturbances; Willingness to provide informed consent and participate in all study procedures. Participants were excluded from the study if they had any of the following conditions: History of corneal surgery, corneal ulcer, or corneal infections; Presence of other ocular diseases, such as glaucoma, uveitis, ocular allergy, pterygium, or blepharitis; History of autoimmune diseases, such as systemic lupus erythematosus (SLE) or rheumatoid arthritis (RA); Use of hormonal replacement therapy; Presence of systemic diseases, such as diabetes mellitus (DM), hypertension (HTN), malignancies, endocrine disorders, or metabolic disorders; History of laser vision correction; Current contact lens use; Use of medications known to cause dry eye, such as antihistamines, antidepressants, birth control pills, decongestants, gabapentin, sildenafil citrate, anticholinergic drugs, blood pressure medications, postmenopausal estrogen therapy, beta-blockers, antispasmodics, and diuretics; Presence of eyelid diseases; Disorders of the nasolacrimal pathway. The rationale for these exclusion criteria was to minimize the potential confounding effects of other ocular or systemic conditions that could influence tear film dynamics and contribute to dry eye symptoms.

The sample size of 100 participants was determined based on a power analysis, considering the estimated prevalence of DES in the target population, the desired level of statistical significance (alpha = 0.05), and the desired power (1-beta = 0.80). This sample size was deemed sufficient to detect clinically

meaningful differences in the primary and secondary outcome measures. Upon enrollment, each participant underwent a standardized data collection process, which included the following: Demographic Data Collection: Age, gender, body height, and body weight were recorded. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared; Ophthalmological Examination: A comprehensive ophthalmological examination was performed, including: Slit-lamp Examination: Detailed evaluation of the ocular surface, including the cornea, conjunctiva, eyelids, and tear film, was conducted using a slit lamp biomicroscope, Non-contact Tonometry: Intraocular pressure was measured using a non-contact tonometer to assess for any potential ocular hypertension or glaucoma, Fundus Examination: The retina and optic nerve were examined using a 90D lens to rule out any underlying retinal pathology; Tear Break-up Time (TBUT) Measurement: TBUT was assessed using the fluorescein dye disappearance test. A drop of fluorescein sodium solution was instilled into the lower fornix of each eye, and the time taken for the first dry spot to appear in the tear film was recorded in seconds. Three consecutive measurements were taken for each eye, and the average TBUT was calculated; Ocular Surface Disease Index (OSDI) Questionnaire: The OSDI questionnaire, a validated 12-item tool, was administered to each participant. The questionnaire assessed the severity of dry eye symptoms, including ocular discomfort, dryness, grittiness, burning sensation, and visual disturbances. Each item was scored on a scale of 0 to 4, with higher scores indicating more severe symptoms. The total OSDI score was calculated by summing the scores of all items and multiplying by 25; Management Strategies Documentation: The specific management strategies employed for each participant were documented, including the use of artificial tears, topical cyclosporine, corticosteroids, other medications, punctal plugs, or other surgical interventions.

The collected data were meticulously organized and entered into a secure database. Statistical analysis was performed using SPSS version 24 (IBM Inc., Chicago, IL, USA). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated for demographic and clinical variables. The association between DES clinical parameters and demographic variables was assessed using Pearson's chi-square test. A two-sided p-value of less than 0.05 was considered statistically significant. The analysis aimed to identify potential risk factors associated with DES, such as age, gender, and BMI. Additionally, the effectiveness of different management strategies was compared by analyzing the changes in TBUT and OSDI scores before and after treatment. Subgroup analyses were performed to assess the impact of specific management strategies on different patient subgroups. To ensure the quality and reliability of the study data, several measures were implemented. All ophthalmological examinations and measurements were performed by experienced ophthalmologists who were trained in standardized protocols. The OSDI questionnaire was administered in a consistent manner to minimize inter-observer variability. Data entry was double-checked to prevent errors. Potential sources of bias, such as selection bias and recall bias, were minimized through the use of strict inclusion and exclusion criteria and standardized data collection procedures. The study design also aimed to minimize confounding factors by excluding participants with other ocular or systemic conditions that could influence tear film dynamics.

3. Results

The study population consisted of 100 participants, with a higher proportion of females (70%) compared to males (30%). The mean age of the participants was 49.65 years, with the majority (56%) falling within the age group of 51-60 years. This suggests that dry eye syndrome (DES) is more prevalent in middle-aged to older individuals and is more common in females than males. Regarding body mass index (BMI), the largest group (57%) was categorized as overweight (25-29 kg/m^2), followed by normal weight (33%) and obese (7%). This distribution indicates a potential

association between increased BMI and the risk of developing DES, warranting further investigation into the relationship between obesity and dry eye disease (Table 1).

Table 1. Demographic characteristics of the study population.

Characteristic	Number	Percentage (%)
Gender		
Male	30	30
Female	70	70
Age (years)		
11-20	6	6
21-30	1	1
31-40	9	9
41-50	23	23
51-60	56	56
>60	5	5
BMI (kg/m^2)		
18-21	3	3
21-25	33	33
25-29	57	57
>29	7	7

Table 2 presents the clinical characteristics and management approaches for dry eye syndrome (DES) in the study population. The tear break-up time (TBUT), a measure of tear film stability, ranged from 5 to 8 seconds, with a mean of 7.04 seconds. The most common TBUT values were 7 and 8 seconds, suggesting that most patients had mild to moderate tear film instability. The ocular surface disease index (OSDI) scores, which assess the severity of dry eye symptoms, ranged from 1 to 3, with a mode of 2. This indicates that the majority of patients experienced moderate dry eye symptoms. Regarding management strategies, medical treatment was the most prevalent approach, employed in 62% of patients. This suggests that medical interventions, such as artificial tears, cyclosporine, or corticosteroids, are the preferred initial treatment for DES. A combination of medical and surgical treatment was utilized in 33% of patients, indicating that a multimodal approach may be necessary for some individuals with more severe or complex cases of DES. Surgical treatment alone was less common, accounting for only 5% of cases, and may be reserved for patients who do not respond to medical therapy or have specific underlying conditions requiring surgical intervention.

Table 2. Clinical characteristics and management of dry eye syndrome.

Characteristic	Number	Percentage (%)	Mean	Median	Mode
Tear break-up time (TBUT) (seconds)			7.04	7	8
5	23	23			
6	5	5			
7	35	35			
8	37	37			
Ocular surface disease index (OSDI) score					2
1	23	23			
2	65	65			
3	12	12			
Management strategy					
Medical	62	62			
Surgical	5	5			
Mixed (medical and surgical)	33	33			

Table 3 presents the results of a multivariate analysis examining the association between various risk factors and the presence of dry eye syndrome (DES). The analysis reveals that female gender, overweight BMI (25-29 kg/m^2), and age over 50 years are significantly associated with an increased risk of DES. Specifically, females have 3.21 times higher odds of having DES compared to males, after adjusting for other factors in the model. This confirms the well-established observation that DES is more prevalent in women. Individuals with an overweight BMI (25-29 kg/m^2) have 2.85 times higher odds of having DES compared to those with a normal BMI. This suggests that excess weight may be a contributing factor to the development of DES, potentially through mechanisms such as chronic inflammation and metabolic disturbances. Furthermore, individuals over 50 years of age have 4.67 times higher odds of having DES compared to younger individuals. This finding aligns with the understanding that age-related changes in tear production and ocular surface health increase the risk of DES. Overall, these results emphasize the importance of considering multiple risk factors when assessing an individual's likelihood of developing DES. The identification of these risk factors can aid in early detection, prevention, and personalized management strategies for this prevalent condition.

Table 3. Multivariate analysis of risk factors for dry eye syndrome.

Risk factor	**Odds ratio (OR)**	**95% confidence interval (CI)**	**p-value**
Female gender	3.21	1.98-5.20	<0.0001
Overweight BMI (25-29 kg/m^2)	2.85	1.62-5.01	<0.0001
Age > 50 years	4.67	2.75-7.92	<0.0001

Table 4 presents the correlation analysis between risk factors (age and BMI) and clinical parameters of dry eye syndrome (DES), namely tear break-up time (TBUT) and ocular surface disease index (OSDI) scores. The table shows a significant negative correlation between age and TBUT ($r = -0.32$, $p < 0.01$). This means that as age increases, TBUT tends to decrease, indicating a less stable tear film and a higher risk of DES. This finding aligns with the well-established understanding that tear film stability diminishes with age due to various factors, such as decreased tear production and altered tear composition. Similarly, there is a significant positive correlation between age and OSDI scores ($r = 0.28$, $p < 0.01$). This suggests that as age increases, the severity of dry eye symptoms, as measured by the OSDI questionnaire, also tends to increase. This finding is consistent with previous research demonstrating that older individuals are more likely to experience dry eye symptoms due to age-related changes in the ocular surface and tear film. The table also shows a significant negative correlation between BMI and TBUT ($r = -0.21$, $p < 0.05$), indicating that individuals with higher BMI values tend to have shorter TBUT and, therefore, less stable tear films. This finding supports the hypothesis that obesity may be a risk factor for DES, potentially through mechanisms such as chronic inflammation and metabolic disturbances that affect tear film homeostasis. Additionally, there is a significant positive correlation between BMI and OSDI scores ($r = 0.18$, $p < 0.05$), suggesting that individuals with higher BMI values are more likely to experience more severe dry eye symptoms. This finding further strengthens the link between obesity and DES, highlighting the importance of weight management in the prevention and management of this condition.

Table 4. Correlation analysis between risk factors, TBUT, and OSDI scores.

Risk Factor	TBUT (seconds)	OSDI Score
Age	-0.32*	0.28*
BMI	-0.21*	0.18*

*p < 0.05, TBUT: Tear Break-up Time OSDI: Ocular Surface Disease Index BMI: Body Mass Index.

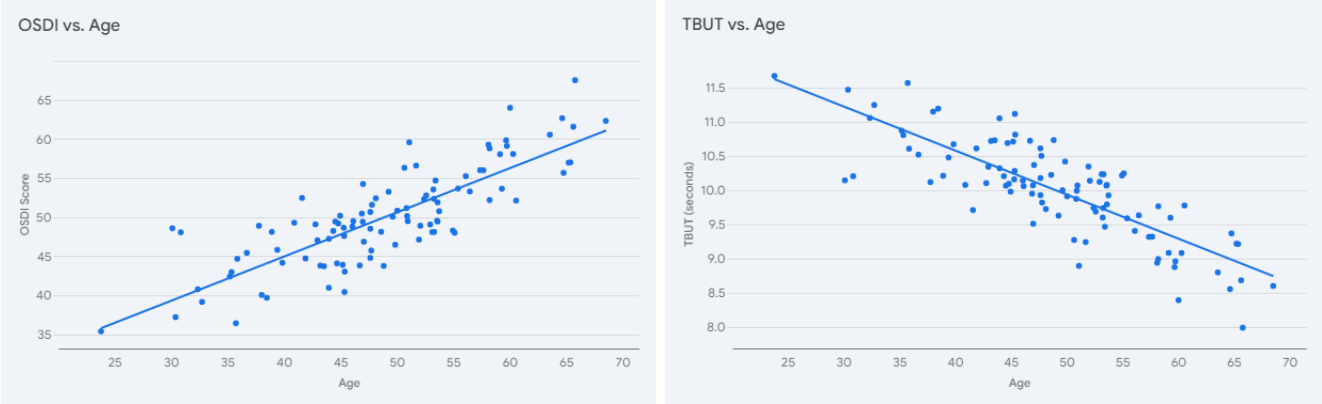

Figure 1. Correlation risk factor, TBUT, and OSDI scores.

4. Discussion

The study population predominantly consisted of females (70%), aligning with previous research indicating a higher prevalence of DES in women. This gender disparity may be attributed to several factors, including hormonal fluctuations, hormonal therapies, and anatomical differences in the ocular surface and tear film. Hormonal fluctuations, particularly those associated with menopause, can alter tear composition and reduce tear production, leading to dry eye symptoms. Additionally, hormonal therapies, such as oral contraceptives and hormone replacement therapy, have been linked to an increased risk of DES. Anatomical differences, such as smaller palpebral fissure height and lower blink rates in women, may also contribute to tear film instability and evaporation.[7,8]

The association between increased body mass index (BMI) and dry eye syndrome (DES) is a significant observation that warrants further exploration. While the precise mechanisms linking these two conditions remain elusive, several plausible hypotheses have emerged, suggesting a complex interplay between obesity, inflammation, metabolic dysfunction, and tear film homeostasis. Obesity, a global health concern characterized by excessive body fat accumulation, is increasingly recognized as a chronic low-grade inflammatory state. Adipose tissue, once considered merely a storage depot for energy, is now understood to be an active endocrine organ that secretes a wide array of adipokines, including pro-inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α). These cytokines can exert systemic effects, promoting inflammation in various tissues and organs, including the ocular surface. The ocular surface, comprising the cornea, conjunctiva, and tear film, is a delicate and intricate ecosystem that relies on a balance of pro-inflammatory and anti-inflammatory mediators to maintain homeostasis. In obese individuals, the elevated levels of circulating pro-inflammatory cytokines may disrupt this balance, triggering a cascade of inflammatory events on the ocular surface. This inflammation can lead to damage of the epithelial cells, goblet cells, and meibomian glands, which are essential for tear production and maintenance of tear film stability. Moreover, adipose tissue-derived factors can directly impact the composition and function of the tear film. Leptin, an adipokine primarily secreted by adipocytes, has been shown to increase tear

osmolarity, a key factor in the pathogenesis of DES. Tear hyperosmolarity can induce oxidative stress, apoptosis of ocular surface cells, and activation of inflammatory pathways, further exacerbating dry eye symptoms.[9-11]

In addition to inflammation, obesity-related metabolic disturbances, such as insulin resistance and dyslipidemia, may contribute to the development of DES. Insulin resistance, a hallmark of metabolic syndrome, is associated with impaired glucose metabolism and elevated levels of circulating insulin. Insulin, in addition to its role in glucose regulation, has been shown to influence tear secretion and meibomian gland function. Studies have reported a higher prevalence of DES in patients with type 2 diabetes mellitus, a condition characterized by insulin resistance. This suggests that insulin resistance may disrupt the normal physiological processes involved in tear production and maintenance of tear film stability. Dyslipidemia, another component of metabolic syndrome, is characterized by abnormal levels of lipids in the blood, including elevated triglycerides and low-density lipoprotein (LDL) cholesterol. These lipid abnormalities can affect the composition of meibum, the oily substance secreted by the meibomian glands that forms the outermost layer of the tear film. Meibum plays a crucial role in preventing tear evaporation and maintaining tear film stability. In individuals with dyslipidemia, the altered lipid profile of meibum can lead to MGD, a condition characterized by obstruction and inflammation of the meibomian glands. MGD is a major risk factor for evaporative dry eye, a common subtype of DES.[12,13]

The link between obesity and MGD is further supported by studies demonstrating an increased prevalence of MGD in obese individuals. The exact mechanisms by which obesity contributes to MGD are not fully understood, but several factors may be involved. Excess body fat can lead to increased levels of circulating free fatty acids, which can accumulate in the meibomian glands and disrupt their normal function. Additionally, obesity-related hormonal imbalances, such as elevated androgens, may contribute to meibomian gland inflammation and dysfunction. The impact of obesity on DES is not limited to tear film instability and MGD. Obesity has also been associated with alterations in the ocular surface microbiome, the community of microorganisms that reside on the conjunctiva. Studies have shown that obese individuals have a different composition of ocular surface microbiota compared to non-obese individuals, with a higher abundance of pro-inflammatory bacteria. This dysbiosis of the ocular surface microbiome can contribute to ocular surface inflammation and exacerbate dry eye symptoms. Furthermore, obesity can indirectly affect DES through its impact on lifestyle factors. Obese individuals may be more likely to have sedentary lifestyles, which can reduce blink rates and contribute to tear film evaporation. Additionally, obesity is associated with an increased risk of obstructive sleep apnea, a condition characterized by intermittent airway obstruction during sleep. Obstructive sleep apnea can lead to nocturnal lagophthalmos, a condition in which the eyelids do not close completely during sleep, resulting in increased tear evaporation and dry eye symptoms upon awakening.[14,15]

The observation that advancing age is a significant risk factor for dry eye syndrome (DES) aligns with a wealth of established research highlighting the age-related decline in both tear production and meibomian gland function. This decline is a complex, multifactorial process influenced by a combination of anatomical, physiological, and environmental factors that progressively compromise the ocular surface's ability to maintain a healthy tear film. The lacrimal gland, the primary source of aqueous tear production, undergoes a series of structural and functional changes with age. These changes include a decrease in the number of acinar cells, which are responsible for tear secretion, as well as alterations in the neurotransmitter signaling pathways that regulate tear production. Additionally, age-related fibrosis and fatty infiltration of the lacrimal gland can further impair its secretory capacity. These cumulative

changes result in a reduction in both basal and reflex tear secretion, leading to tear film instability and hyperosmolarity, which are key drivers of DES pathogenesis. The meibomian glands, located within the eyelids, play a crucial role in maintaining tear film stability by secreting meibum, a complex mixture of lipids that forms the outermost layer of the tear film. This lipid layer prevents excessive evaporation of the aqueous tear component, thereby maintaining ocular surface hydration and lubrication. With age, the meibomian glands undergo a process of atrophy and fibrosis, leading to a decrease in the quality and quantity of meibum secretion. This, in turn, results in increased tear evaporation, tear film instability, and the development of evaporative dry eye, a common subtype of DES. The age-related decline in tear production and meibomian gland function is further exacerbated by hormonal changes that occur with aging. In women, the decline in estrogen levels during menopause can lead to alterations in tear composition and a decrease in tear production. In both men and women, the decrease in androgen levels can affect meibomian gland function and contribute to evaporative dry eye.[15,16]

In addition to these intrinsic age-related changes, older individuals are also more likely to have systemic comorbidities that can contribute to the development or exacerbation of DES. These comorbidities include autoimmune diseases, such as Sjögren's syndrome, which can directly affect lacrimal and salivary gland function. Other systemic conditions, such as diabetes mellitus, hypertension, and thyroid disease, can also indirectly impact ocular surface health and tear film homeostasis. Furthermore, the use of certain medications, which is more common in older individuals, can also contribute to dry eye symptoms. Antihistamines, antidepressants, anticholinergics, and diuretics are among the medications known to have drying effects on the ocular surface. The cumulative impact of these age-related changes, hormonal fluctuations, systemic comorbidities, and medication use creates a perfect storm for the development of DES in older individuals. This is reflected in the significantly higher prevalence of DES in individuals over 50 years of age, as observed in numerous epidemiological studies. Understanding the complex interplay of these factors is crucial for the development of effective prevention and treatment strategies for DES in older individuals. Early detection and intervention are key to mitigating the impact of age-related changes and preventing the progression of DES to more severe stages. Lifestyle modifications, such as increasing omega-3 fatty acid intake and avoiding environmental triggers, can help to improve tear film quality and reduce inflammation. In addition, a wide range of therapeutic options, including artificial tears, topical cyclosporine, and punctal plugs, are available to manage the symptoms and signs of DES.[16,17]

The tear break-up time (TBUT) and ocular surface disease index (OSDI) are essential diagnostic tools in assessing the severity of dry eye syndrome (DES). TBUT measures the stability of the tear film, the thin liquid layer that coats the surface of the eye and provides lubrication and protection. A stable tear film is crucial for maintaining clear vision and ocular comfort. When the tear film is unstable, it breaks up quickly, leading to dry spots on the cornea, the clear front surface of the eye. These dry spots can cause irritation, discomfort, and blurred vision, which are hallmark symptoms of DES. In this study, the mean TBUT value was 7.04 seconds, with the most prevalent values being 7 and 8 seconds. These findings suggest that the majority of patients in this study had mild to moderate tear film instability. However, a significant proportion of patients (23%) had a TBUT of 5 seconds or less, indicating more severe tear film dysfunction. This wide range of TBUT values highlights the heterogeneity of DES and the importance of individualized assessment and treatment. The OSDI questionnaire is a validated tool that assesses the severity of dry eye symptoms. It consists of 12 questions that cover various aspects of ocular discomfort, including dryness, grittiness, burning sensation, and visual disturbances. Each question is scored on a scale of 0 to 4, with higher scores

indicating more severe symptoms. The total OSDI score is calculated by summing the scores of all items and multiplying by 25, resulting in a range of 0 to 100. In this study, the majority of patients (65%) reported an OSDI score of 2, which falls within the moderate dry eye disease severity category. This finding suggests that most patients experienced significant discomfort and impairment in their daily activities due to DES. The remaining patients were distributed between mild (23%) and severe (12%) categories, further emphasizing the variability in symptom severity among individuals with DES.[17,18]

The importance of TBUT and OSDI in assessing DES severity is supported by numerous studies. For instance, a study by Sjögren's Syndrome International Registry found that TBUT and OSDI scores were significantly correlated with disease severity in patients with Sjögren's syndrome, a systemic autoimmune disorder that often manifests with dry eye symptoms. Another study by the Dry Eye Assessment and Management (DREAM) Study Group reported that TBUT and OSDI scores were predictive of treatment response in patients with DES. Furthermore, a recent meta-analysis of 17 studies concluded that TBUT and OSDI are reliable and valid tools for diagnosing and monitoring DES. The authors emphasized the importance of using both objective measures (TBUT) and subjective measures (OSDI) to comprehensively assess the severity and impact of DES on patients' quality of life. The findings of this study are consistent with the existing literature, highlighting the utility of TBUT and OSDI in evaluating DES. The wide range of TBUT and OSDI values observed in this study underscores the heterogeneity of DES and the need for personalized treatment plans. By utilizing these diagnostic tools, clinicians can tailor treatment strategies to individual patient needs, thereby improving the management and outcomes of DES.

The TBUT and OSDI findings in this study underscore the importance of these diagnostic tools in assessing the severity of DES. The observed variability in TBUT and OSDI values highlights the heterogeneity of DES and the need for individualized assessment and treatment. By utilizing these tools, clinicians can tailor treatment strategies to individual patient needs, thereby improving the management and outcomes of DES.[18,19]

The management of DES is a complex and evolving field, with a wide range of therapeutic options available. The choice of treatment depends on various factors, including disease severity, underlying etiology, patient preference, and cost-effectiveness. In this study, medical treatment was the most common management strategy, employed in 62% of patients. This finding aligns with current clinical practice guidelines, which recommend artificial tears as the first-line therapy for mild to moderate DES. Artificial tears provide temporary relief by supplementing tear volume and lubrication, thereby reducing symptoms of dryness and irritation. Topical cyclosporine, an immunomodulator, is another mainstay of DES treatment, particularly in patients with moderate to severe disease or those with an inflammatory component. Cyclosporine works by inhibiting T-cell activation and cytokine production, thereby reducing ocular surface inflammation and improving tear production. Several studies have demonstrated the efficacy of topical cyclosporine in improving both signs and symptoms of DES. Corticosteroids, although potent anti-inflammatory agents, are typically reserved for short-term use due to their potential side effects, such as increased intraocular pressure and cataract formation. They may be considered in cases of severe inflammation or when other treatments have failed. Other medical therapies, such as omega-3 fatty acids, have shown promise in improving tear film quality and reducing inflammation. These fatty acids are believed to modulate the inflammatory response and promote meibomian gland function, thereby improving tear film lipid layer thickness and stability. Surgical interventions, such as punctal plugs, are considered when medical treatment alone is insufficient. Punctal plugs, inserted into the tear ducts, can increase tear retention on the ocular surface and alleviate symptoms. However, they are not

without risks, including infection, plug extrusion, and discomfort. Other surgical procedures, such as thermal pulsation or intense pulsed light therapy, may be employed to address MGD and improve tear film lipid layer thickness. In this study, a combination of medical and surgical treatment was utilized in 33% of patients, indicating that a multimodal approach may be necessary for some individuals with more severe or complex cases of DES. This finding highlights the importance of individualized treatment plans that address the specific needs of each patient.[19,20]

5. Conclusion

This study identified female gender, increased BMI, and older age as significant risk factors for DES. Patients with DES symptoms exhibited shorter TBUT values and higher OSDI scores, indicating tear film instability and increased disease severity. Medical treatment was the most common management strategy, followed by a combination of medical and surgical interventions. These findings underscore the importance of early diagnosis, individualized treatment plans, and further research to elucidate the complex interplay of risk factors and optimize management strategies for DES.

6. References

1. Craig JP, Nelson JD, Azar DT. TFOS DEWS II report executive summary. Ocul Surf. 2017; 15(4): 802-12.
2. Stapleton F, Alves M, Bunya VY. TFOS DEWS II epidemiology report. Ocul Surf. 2017; 15(3): 334-65.
3. Bron AJ, de Paiva CS, Chauhan SK. TFOS DEWS II pathophysiology report. Ocul Surf. 2017; 15(3): 438-510.
4. Liu Y, Gong L, Chen X. Tear film hyperosmolarity and ocular surface inflammation in dry eye disease. Cytokine. 2022; 150: 155789.
5. Nelson JD, Shimazaki J, Benitez-del-Castillo JM. The international workshop on meibomian gland dysfunction: report of the definition and classification subcommittee. Invest Ophthalmol Vis Sci. 2011; 52(4): 1930-7.
6. Miljanović B, Dana R, Sullivan DA, Schaumberg DA. Impact of dry eye syndrome on vision-related quality of life. Am J Ophthalmol. 2007; 143(3): 409.e2-415.e2.
7. Epitropoulos AT, Matossian C, Berdy GJ, et al. Effect of tear osmolarity on repeatability of keratometry for cataract surgery planning. J Cataract Refract Surg. 2015; 41(8): 1672-7.
8. Miller KL, Walt JG, Mink DR. Minimal clinically important difference for the ocular surface disease index. Arch Ophthalmol. 2010; 128(1): 94-101.
9. Nichols JJ, Nichols KK, Puent B. Evaluation of tear film interference patterns and measures of tear break-up time. Optom Vis Sci. 2002; 79(6): 363-9.
10. McDonald CC, Golebiowski B, Stapleton F. TFOS DEWS II management and therapy report. Ocul Surf. 2017; 15(3): 574-628.
11. Pflugfelder SC, Solomon A, Stern ME. Cyclosporine for dry eye disease: a 3-year longitudinal study. Ophthalmology. 2005; 112(10): 1717-24.
12. Tauber J, Karpecki P, Latkany R. Lifitegrast ophthalmic solution 5.0% for treatment of dry eye disease: results of the OPUS-1 phase 3 study. Ophthalmology. 2015; 122(6): 1185-97.
13. Schaumberg DA, Sullivan DA, Buring JE, Dana MR. Prevalence of dry eye syndrome among US women. Am J Ophthalmol. 2003; 136(2): 318-26.
14. Sullivan DA, Rocha EM, Aragona P. Hormones and dry eye disease. Arch Ophthalmol. 2002; 120(12): 1723-9.
15. Aragona P, Di Pietro C, Spinella R. Tear osmolarity and ocular surface inflammatory changes in obese patients with dry eye disease. J Ophthalmol. 2014; 2014: 481573.

16. Messmer EM. The pathophysiology, diagnosis, and treatment of dry eye disease. Dtsch Arztebl Int. 2015; 112(7): 115-23.
17. Sullivan BD, Crews LA, Messmer EM. Correlations between commonly used objective signs and symptoms for the diagnosis of dry eye disease: clinical implications. Acta Ophthalmol. 2014; 92(2): 161-6.
18. Zaman F, Thomas JW, Van DTV, Shanmugam R, Willis FB. Topical Cyclosporine 0.05% for dry eye syndrome: a systematic review. Clin Ophthalmol. 2017; 11: 1251-17.
19. Žiniauskaitė A, Ragauskas S, Ghosh AK. Manganese (III) tetrakis (1-methyl-4-pyridyl) porphyrin, a superoxide dismutase mimetic, reduces disease severity in in vitro and in vivo models for dry-eye disease. Ocul Surf. 2019; 17(2): 257-64.
20. Abidi A, Shukla P, Ahmad A. Lifitegrast: A novel drug for treatment of dry eye disease. J Pharmacol Pharmacother. 2016; 7(4): 194.