Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.47750/jptcp.2023.30.05.057

Prevalence Risk Factors and Management of Dry Eye Disease in The Academic Hospital of Riyadh Saudi Arabia

Hayat Alzahrani[1], Maryam Alharbi[2], Gharam Alanazi[2], Najd AlKhudhairy[2], Raneem Alqahtani[2], Bader AlMehmadi[3*]

[1,2]Department of Clinical Science, College of Medicine, Princess Nourah Bint Abdulrahman University, P.O. box: 84428, Riyadh, 11671, Saudi Arabia

[3]Department of Internal Medicine, College of Medicine, Majmaah University, Al-Majmaah, 11952, Saudi Arabia

***Corresponding author:** Bader AlMehmadi, Department of Internal Medicine, College of Medicine, Majmaah University, Al-Majmaah, 11952, Saudi Arabia, Email: b.almehmadi@mu.edu.sa

Submitted: 10 January 2023; Accepted: 18 February 2023; Published: 10 March 2023

ABSTRACT

Background and Objectives: Dry eye disease is highly prevalent in Arab countries. The study aims to measure the prevalence of dry eye syndrome in Primary Health care settings at King Abdullah bin Abdulaziz University Hospital. To determine the incidence of risk factors with dry eye syndrome, in addition to the effective different therapeutic modalities for dry eye syndrome, finally to assess the patient's satisfaction with their treatment.

Materials and Methods: A cross-sectional study was conducted among patients who attended the outpatient department (OPD) of King Abdullah bin Abdulaziz University Hospital (KAAUH), Riyadh, Saudi Arabia, in 2022. The study used Dry Eye Epidemiologic Projects (DEEP) and the Dry Eye Treatment satisfaction module questionnaire to evaluate the study objectives. Statistical analysis was carried out using RStudio (R version 4.1.1).

Results: The final analysis was conducted on 358 participants. Most were females (73.2%) and Saudis (98.6%). The prevalence of DED in our study was 31.0% (95%CI, 26.3 to 36.1). Based on the multivariate analysis, the female gender (OR=4.49, 95% CI, 1.86 to 11.8, p = 0.001), medication use (OR=2.25, 95% CI, 1.22 to 4.15, p = 0.009) and a history of eye surgery (OR=2.28, 95% CI, 1.25 to 4.16, p = 0.007) were independent risk factors for dry eye disease among the participants. Regarding satisfaction with treatment effectiveness, more than half of the respondents agreed or strongly agreed that the treatment relieved most of the DED symptoms (58.5%) and was happy with how quickly the treatments worked.

Conclusions: In conclusion, female gender, use of medication, and history of eye surgery were identified risk factors for DED. There was an increased prevalence of DED residents of Riyadh in our study. Further prospective clinical studies should be conducted to evaluate the risk factor and causes of increased prevalence in the kingdom.

Keywords: *Dry eye disease, dry eye syndrome; Risk factors, treatment satisfaction, Saudi Arabia*

INTRODUCTION

Dry eye disease (DED) is a chronic condition that affects the corneal surface and is categorized into two types[1]. One is distinguished by reduced tear production, known as an aqueous deficiency, while the other is known by the increased evaporation process of the tear film, and it is of the hyper-evaporative type[1,2]. Dry eye disease is characterised by continuous symptoms, mainly burning associated with ocular pain, foreign body sensation, redness, photophobia, blurred vision, and paradoxical tearing from corneal irritation[3]. These symptoms worsen at the end of the day, leading to inflammation and damage to the cornea and conjunctiva if untreated[4]. A study conducted in 2017 demonstrated that the prevalence rates of dry eye syndrome is higher in female gender and older age group, with a range of 5% to 50%, but can be as high as 75% among adults over age 40 and least percentage among younger adult[5]. Several risk factors have been expected to cause DES. They can be categorized into six main domains, personal including gender, age, ethnicity or wearing contact lenses, as some factors related to the contact lens affect the occurrence of dry eye diseases, such as the thick diameter, the material of CL, the lens curve and its care[4,6].

Moreover, ocular environmental factors include blinking and lipid or tear stability[7]. In addition, environmental which may involve weather, reading or driving for long periods or exposing eyes to sun rays, chronic illness such as diabetes, thyroid disease and depression, autoimmune diseases including rheumatoid arthritis, medications including beta-blockers, diuretics, psychiatric medications, oral contraceptive, and finally injury, for instance, post ophthalmic surgical procedure[1,3,6]. Although most of the risk factors of DES are known yet their relationship with dry eye disease is not established[6]. This study aims to measure the prevalence of dry eye syndrome in Primary Health care settings in King Abdullah bin Abdulaziz University Hospital, and to determine the incidence of risk factors with dry eye syndrome, in addition, to assess the effective difficult therapeutic modalities for dry eye syndrome, finally to assess the patient's satisfaction with their treatment.

MATERIALS AND METHODS

Study design

A cross-sectional study assessed the prevalence, risk factors and management of dry eye among patients who attended the outpatient department (OPD) of King Abdullah bin Abdulaziz University Hospital (KAAUH), Riyadh, Saudi Arabia, in the year 2022. The trained staff of KAAUH filled out the questionnaire. A total of 367 participants participated in the study. However, a few incomplete forms were not included in the final analysis.

Eligibility criteria

All Saudi citizens, irrespective of nationality, who were ≥ 18 years old with no gender restriction, were included in the study. Non-Saudi citizens who were< 18 years old were excluded.

Sampling technique and sample size calculation

The study utilized a convenient sampling technique. The prevalence of dry eyes reported in previous research was approximately 32.1%, with a margin of error of 5 % and a study power of 95 %. In this study, the sample size was estimated to be 335 using the EPITOOLS calculator, but in the end, 358 Saudi males and females aged ≥ 18 were recruited.

Data collection tool

In the current study, the questionnaire was divided into four parts. The first part consists of demographics, while the second part consist of medical history, history of chronic diseases and eye-related diseases/surgeries. The third part comprises questions from Dry Eye Epidemiologic Projects (DEEP) survey, which was used for screening dry eye symptoms. It consisted of 19 items, of which 14 items were used to create a symptoms score. Each item of the symptoms score was collected on a four-point Likert scale. These were coded as follows: 13 items were coded as Never=0, Sometimes=2, Often=4 and Constantly=6, whereas the coding of one item (watering) was reversed. Therefore, the higher the score, the more frequently reported dry eye symptoms. The total symptoms score

ranged between 0 and 84. A sensitivity of 0.6 and specificity of 0.94 was reported based on predictor variables irritation and dryness [8]. The fourth part of the questionnaire consists of Dry Eye Treatment satisfaction module questions, which is a part of the Impact of Dry Eye in Everyday Life (IDEEL) questionnaire. The fourth part was only filled by those participants who have DED (a minimum of two symptoms were responded as "Constantly" in the second part of the questionnaire).

The Arabic language expert did an Arabic translation of the questionnaire. The faculty members performed the face validation of the questionnaire after they reviewed the questions and translation. The final translated version of the questionnaire was approved until the content became clear and covered the study's objectives.

Operational definition

Dry eye disease (DED) was defined as having a confirmed DED diagnosis by a physician (as reported by the participant) or responding as "Constantly" for at least two symptoms of DED based on the 14 symptom-related items of the DEEP questionnaire.

Statistical Analysis

Statistical analysis was carried out using RStudio (R version 4.1.1). Data were described as frequencies and percentages for categorical variables or median and interquartile range (IQR) for numerical variables. Factors associated with DED were assessed using a Fisher's exact or Pearson's Chi-squared test whenever appropriate. The independent risk factors for DED were investigated by constructing a multivariate binary logistic regression model using the significant factors associated with the disease as independent variables. Results were presented as odds ratios (ORs) and their respective 95% confidence intervals (95% CIs). Statistical significance was considered at $p < 0.05$.

RESULTS

Demographic and ophthalmological characteristics

In general, 367 responses were entered in the SPSS. However, the responses of nine participants have been excluded due to missing information. Therefore, we analyzed the data of 358 respondents in the current study. More than half of the participants (56.1%) were aged 18 to < 30. The majority of them were females (73.2%) and Saudis (98.6%). Smokers represented 19.8% of the sample under study. Medications were used among 25.1% of the respondents, whereas almost one-third had at least one chronic disease (33.1%). The most commonly reported conditions were hypertension (33.1%) and thyroid disorders (24.6%, Figure 1). Additionally, 18.4% of the participants had a positive history of eye surgery. The majority of the sample were continually exposed to display monitors (80.2%), and 42.7% of them directly exposed their eyes to air conditioning. More details about other ophthalmological characteristics are listed in Table 1.

TABLE 1: Demographic and ophthalmological characteristics of the participants (n=358).

Parameter	Category	N (%)
Age	18 to < 30	201 (56.1%)
	30 to < 45	99 (27.7%)
	45 to < 60	52 (14.5%)
	60 or more	6 (1.7%)
Gender	Male	96 (26.8%)
	Female	262 (73.2%)
Nationality*	Saudi	350 (98.6%)
	Non-Saudi	5 (1.4%)
Chronic disease¥	No	239 (66.9%)
	Yes	118 (33.1%)
History of eye surgery	No	292 (81.6%)
	Yes	66 (18.4%)

J Popul Ther Clin Pharmacol Vol 30(5):e575–e584; 10 March 2023.

Medication use	No	268 (74.9%)
	Yes	90 (25.1%)
Ever used contact lenses	No	173 (48.3%)
	Yes	185 (51.7%)
Ever had an eye trauma	No	318 (88.8%)
	Yes	40 (11.2%)
Ever directly exposed the eyes to air conditioning	No	205 (57.3%)
	Yes	153 (42.7%)
Outdoor working	No	316 (88.3%)
	Yes	42 (11.7%)
Prolonged exposure to display monitors	No	71 (19.8%)
Prolonged reading paper books	Yes	287 (80.2%)
	No	271 (75.7%)
Prolonged driving	Yes	87 (24.3%)
	No	232 (64.8%)
Smoking	Yes	126 (35.2%)
	No	287 (80.2%)
	Yes	71 (19.8%)

*the variable has three missing records

the variable has one missing record.

TABLE 2: Factors associated with dry eye disease (n=358).

Parameter	**Category**	**Dry eye disease**		
		No, N = 247	**Yes, N = 111**	**p-value**
Age	18 to < 30	145 (58.7%)	56 (50.5%)	0.079
	30 to < 45	70 (28.3%)	29 (26.1%)	
	45 to < 60	28 (11.3%)	24 (21.6%)	
	60 or more	4 (1.6%)	2 (1.8%)	
Gender	Male	85 (34.4%)	11 (9.9%)	<0.001
	Female	162 (65.6%)	100 (90.1%)	
Nationality	Saudi	242 (99.2%)	108 (97.3%)	0.179
	Non-Saudi	2 (0.8%)	3 (2.7%)	
Smoking	Yes	56 (22.7%)	15 (13.5%)	0.044
Chronic disease	Yes	67 (27.2%)	51 (45.9%)	<0.001
History of eye surgery	Yes	34 (13.8%)	32 (28.8%)	<0.001
Medication use	Yes	47 (19.0%)	43 (38.7%)	<0.001
Ever used contact lenses	Yes	110 (44.5%)	75 (67.6%)	<0.001
Ever had an eye trauma	Yes	23 (9.3%)	17 (15.3%)	0.095
Ever directly exposed the eyes to air conditioning	Yes	98 (39.7%)	55 (49.5%)	0.081
Outdoor working	Yes	28 (11.3%)	14 (12.6%)	0.728
Prolonged exposure to display monitors	Yes	189 (76.5%)	98 (88.3%)	0.010
Prolonged reading of paper books	Yes	62 (25.1%)	25 (22.5%)	0.599
Prolonged driving	Yes	93 (37.7%)	33 (29.7%)	0.147

Characteristics of dry eye disease and the associated factors

The median (IQR) dry eye symptoms score was 16.0 (12.0 to 25.0) with a minimum and maximum of 4 and 78, respectively. The distribution of score frequency is depicted in Figure 2. In general, a total of 111 participants had DED with a prevalence of 31.0% (95%CI,

26.3 to 36.1). The female gender was significantly associated with DED (90.1% vs 65.6%, p < 0.001), medication use (38.7% vs 19.0%, p < 0.001), the use of contact lenses (67.6% vs 44.5%, p < 0.001), prolonged exposure to display monitors (88.3% vs 76.5%, p = 0.010), having a chronic disease (45.9% vs 27.2%, p < 0.001) and a history of eye surgery (28.8% vs 13.8%, p < 0.001). Conversely, the proportion of smokers with DED was significantly lower than their peers without DED (13.5% vs 22.7%, p = 0.044, Table 2). However, based on the multivariate analysis, the female gender (OR=4.49, 95% CI, 1.86 to 11.8, p = 0.001), medication use (OR=2.25, 95% CI, 1.22 to 4.15, p = 0.009) and a history of eye surgery (OR=2.28, 95% CI, 1.25 to 4.16, p = 0.007) were independent risk factors for dry eye disease among the participants under investigation (Table 3).

TABLE 3: A multivariate regression analysis for the risk factors of dry eye disease.

Parameter	**Category**	**OR**	**95% CI**	**p-value**
Gender	Male	—	—	
	Female	4.49	1.86, 11.8	0.001
Chronic disease	No	—	—	
	Yes	1.44	0.80, 2.56	0.222
History of eye surgery	No	—	—	
	Yes	2.28	1.25, 4.16	0.007
Medication use	No	—	—	
	Yes	2.25	1.22, 4.15	0.009
Ever used contact lenses	No	—	—	
	Yes	1.53	0.88, 2.71	0.135
Prolonged exposure to display monitors	No	—	—	
	Yes	1.62	0.80, 3.48	0.194
Smoking	No	—	—	
	Yes	1.27	0.56, 2.89	0.567

OR: odds ratio; CI: confidence interval

Satisfaction with DED treatment

Regarding satisfaction with treatment effectiveness, more than half of the respondents agreed or strongly agreed that the treatment relieved most DED symptoms (58.5%) and was happy with how quickly the treatments worked (57.6%). Conversely, less than half of the sample agreed or strongly agreed that they were bothered by how often DED treatments were used (49.5%) and that they felt like they could not go anywhere without the eye drops (38.7%, Table 4).

TABLE 4: Responses of the participants with DED to the IDEEL questionnaire (n=111).

Parameter	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Satisfaction with treatment effectiveness					
I was happy with how quickly my treatments worked	5 (4.5%)	10 (9.0%)	32 (28.8%)	46 (41.4%)	18 (16.2%)
I was happy with how long the effects of my treatments lasted	6 (5.4%)	15 (13.5%)	36 (32.4%)	41 (36.9%)	13 (11.7%)
The treatments I used completely eliminated my dry eye symptoms	17 (15.3%)	21 (18.9%)	29 (26.1%)	33 (29.7%)	11 (9.9%)
The treatments I used relieved most of my dry eye symptoms	7 (6.3%)	9 (8.1%)	30 (27.0%)	48 (43.2%)	17 (15.3%)

Treatment-related bother/inconvenience					
I was bothered by how often I had to use dry eye treatments	7 (6.3%)	19 (17.1%)	30 (27.0%)	33 (29.7%)	22 (19.8%)
I was bothered by blurriness shortly after using my eye drops	17 (15.3%)	29 (26.1%)	24 (21.6%)	29 (26.1%)	12 (10.8%)
I was embarrassed when I had to use my eye drops	47 (42.3%)	40 (36.0%)	9 (8.1%)	12 (10.8%)	3 (2.7%)
I felt like I could not go anywhere without my eye drops	16 (14.4%)	36 (32.4%)	16 (14.4%)	27 (24.3%)	16 (14.4%)

Patterns of using DED eye drops and patterns of visiting primary healthcare centers for DED

In general, the majority of participants with DED (87.3%) have ever used eye drops to treat DED, whereas 62.1% of them used treatments for the disease (always or sometimes) over the last two weeks. Concerning the referral to PHCCs for DED, results showed that 34.2%, 17.1% and 4.5% of the participants visited a PHCC for DED once, twice and thrice over the past three months, respectively. Only 5.4% of the respondents indicated that they always got benefits from PHCCs services (Table 5).

TABLE 5: Patterns of using DED eye drops and patterns of visiting primary healthcare centers for DED.

Parameter	**Category**	**N (%)**
Do you ever use eye drops to treat your dry eyes?	Strongly disagree	2 (1.8%)
	Disagree	3 (2.7%)
	Neutral	9 (8.1%)
	Agree	50 (45.0%)
	Strongly agree	47 (42.3%)
Over the last two weeks, how often did you use treatment for your dry eyes?	Never	15 (13.5%)
	Rarely	27 (24.3%)
	Sometimes	44 (39.6%)
	Always	25 (22.5%)
Over the last year, how often do visit a PHCC because of a DED?	Never	49 (44.1%)
	One visit/3 months	38 (34.2%)
	Two visits/3 months	19 (17.1%)
	Three visits/3 months	5 (4.5%)
Did you get benefits from the services provided by PHCCs for DED?	Never	55 (49.5%)
	Rarely	43 (38.7%)
	Sometimes	7 (6.3%)
	Always	6 (5.4%)
Are there specific reasons for referring your DED case to an ophthalmologist for assessment?	No	94 (84.7%)
	Yes, reason was not specified	15 (13.5%)
	Blurred vision due to severe DED	1 (0.9%)
	Myopia	1 (0.9%)

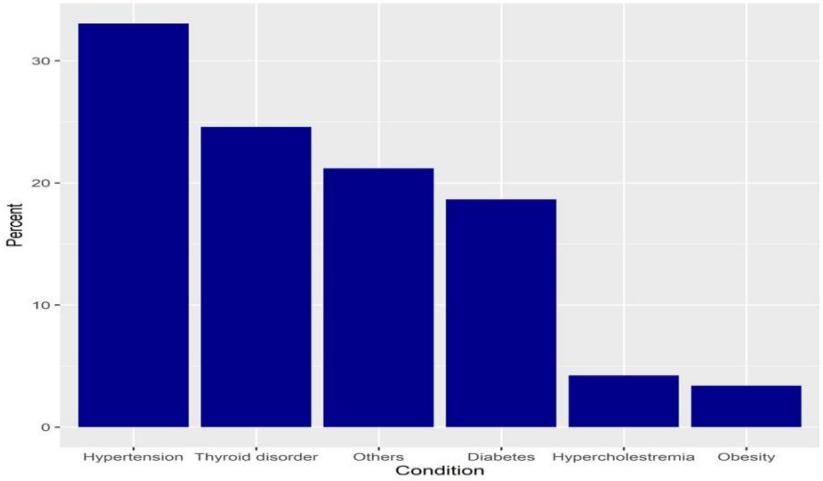

FIGURE 1: The percentages of chronic conditions among a subset of participants who reported having at least one chronic disease (n=118).

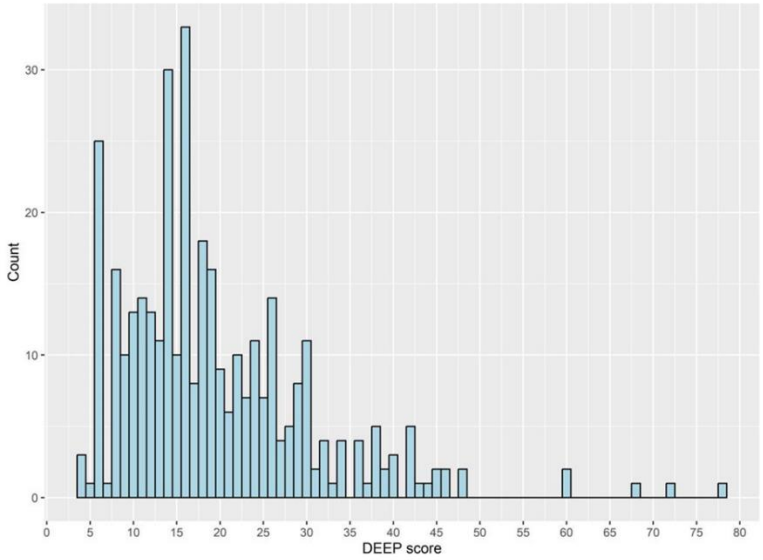

FIGURE 2: A histogram depicting the distribution of the DEEP symptoms score

DISCUSSION

The prevalence of DED has increased in recent years; it was estimated that one in five individuals has DED[7]. The prevalence of DED found in our study was 31.0% in Riyadh, Saudi Arabia. Different studies reported various percentages of DED. For instance, in Jeddah prevalence of DED was 7.4% [9]; in Al-Ahsa, 32.1 %[10]; in Eastern Province, 62%[11] and overall, in the general population in Saudi Arabia was 49.5%[12]. Some Arab countries also showed a higher prevalence of DED, in Egypt 77.6%[13], West Bank-Palestine (69%), and in Jordan 59%. While in the United Kingdom prevalence of DED was 9.6%[14], in the United States of America 6.9%[15]; and in New Zealand 29% [16]. However, these are not comparable due to the different definition of DED, which was utilized in these studies, futher all studies used other questionnaires to assess DED. The recent estimate of DED in Saudi Arabia is continuously increasing[12]; these changes are due to environmental factors like dry low humid weather, hot desert climate with a very high summer temperature and increased use of air conditioners [11]. The above epidemiological studies revealed that the condition is alarming, and a possible relationship exists between the

increased DED prevalence and geographical location[1].

Among risk factors, our study results showed that the female gender has four times more risk of developing DED than males. Several studies showed a higher percentage of DED in females [7]. This might be due to the effect of female hormones, especially androgens, on the lacrimal, Meibomian gland, and ocular surface [1,17]. In contrast, a study reported a weak association between older males' androgen deficiency and DED [18]. However, two Asian studies reported high prevalence of DED in males than in females [19,20]. However, some studies also reported no gender-based differences in the prevalence of DED [21,22]. Some studies have also reported that these differences were lessened and more similar in both sexes in advanced age [5,17]. However, we didn't find any age-related differences in our study. Likewise, care-seeking behaviour is common in women and can influence results in clinic-based studies [5,17].

The use of medication has double the risk of DED compared to those who are not taking any medication. Likewise, a recent systematic review also reported that the high prevalence of DED in the Arab population was attributable to various chronic diseases and excessive use of age-related medications [23]. Other studies also showed that various systematic and topical medicines like antihypertensives, antihistamines, radiotherapy, chemotherapy and antidepressant usage were associated with DED[1,5,16,24].

A history of eye surgery is also a major risk factor for DED[1]. DED has been reported in 95% of ophthalmic surgeries and remains in 60% of post-surgical patients after one month[25]. This is due to lipid layer tear film dysfunction after various ophthalmic surgeries[7]. However, post-surgical dry eye changes improve over time[1,25].

Many treatment options for DED treatment have been available, including tear gels, ointment, lubricant eye drops, liposomal sprays, anti-inflammatory drops, etc. [26]. Our study findings showed that more than half of the respondents were satisfied with the treatment and relived most of the DED symptoms, while they felt like they could not go anywhere without the eye drops. Similarly, a study showed a high rate of treatment satisfaction in patients using different treatments; however, many patients also report dissatisfaction and side effects and need additional/switching treatments for symptomatic relief [27].

There are several methodological limitations related to this study. First, this is a cross-sectional questionnaire-based study. Therefore, there might be over or underreporting of symptoms. Second, we determined prevalence through self-reported symptoms and did not assessed clinically; however, data were collected by trained and tried to reduce error in data collection. Further, these symptoms are more repeatable and reliable in identifying DED[10]. The study's main strength is that we used a validated questionnaire about dry eye symptomatology and assessed patient satisfaction with treatment. Using a validated questionnaire allows accurate quantification of symptoms as a screening tool and monitoring for progression and response to treatments.

CONCLUSIONS

In conclusion, female gender, use of medication, and history of eye surgery were identified risk factors for DED. The prevalence of DED in the cohort of adults in Riyadh in our study was 31.0%. Although the prevalence of DED in Saudi Arabia continuously increases, some studies also showed lower prevalence. These differences are due to the different questionnaires used to evaluate DED, various scoring measures, no proper definition for diagnosing DED, and other region selections (geographical location). Future Studies should include a large prospective cohort, and the signs should be evaluated clinically to confirm the diagnosis and to find the true prevalence of DED in Saudi Arabia. Patient education is also necessary to prevent and use basic treatment for DED (limiting screen time, blinking often, and using artificial tears) while keeping the indoor environment cool and moist.

Institutional Review Board Statement

Ethical review was conducted by the Institutional Review Board of Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia

(protocol code 22-0313) and approval were exempted for this study due to no more than minimal risk to the participants.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

ACKNOWLEDGMENTS

Princess Nourah Bint Abdulrahman University Researchers Supporting Project number (PNURSP2023R354), Princess Nourah Bint Abdulrahman University Riyadh, Saudi Arabia.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Golden MI, Meyer JJ, Patel BC. Dry eye syndrome. In StatPearls [Internet]; StatPearls Publishing: 2022.
2. Craig JP, Nichols KK, Akpek EK, Caffery B, Dua HS, Joo CK, et al. TFOS DEWS II Definition and Classification Report. Ocul Surf. 15:276–283,.
3. Rouen PA, White ML. Dry eye disease: prevalence, assessment, and management. Home Healthc now. 36:74–83.
4. Kojima T. Contact lens-associated dry eye disease: recent advances worldwide and in Japan. Invest Ophthalmol Vis Sci. 59:102– 108.
5. Stapleton F, Alves M, Bunya VY, Jalbert I, Lekhanont K, Malet F, et al. No Title. Vol. 15.
6. ZA IYH. Dry eye syndrome risk factors: A systemic review. Saudi J Ophthalmol Off J Saudi Ophthalmol Soc. 35:131–139.
7. Qian L, Wei W. Identified risk factors for dry eye syndrome: A systematic review and meta-analysis. PLoS One. 17, e0271267.
8. Oden NL, Lilienfeld DE, Lemp MA, Nelson JD, Ederer F. Sensitivity and specificity of a screening questionnaire for dry eye. Lacrimal Gland, Tear Film, and Dry Eye Syndromes 2. Basic Sci Clin Relev. :807–820.
9. Bukhari A, Ajlan R, Alsaggaf H. Prevalence of Dry Eye in the Normal Population in Jeddah, Saudi Arabia. Orbit. 28:392–397,.
10. Alshamrani AA, Almousa AS, Almulhim AA, Alafaleq AA, Alosaimi MB, Alqahtani AM, et al. Prevalence and Risk Factors of Dry Eye Symptoms in a Saudi Arabian Population. Middle East Afr J Ophthalmol. 24:67–73,.
11. Alharbi A, Alanazi N, Alhamad J, Alabdulqader R, Aljamea D, Alabdulqader S. Prevalence of symptomatic dry eye and its risk factors among coastal population in eastern province of Saudi Arabia. J Clin Exp Ophthalmol. 9:34.
12. Alkhaldi SA, Allam KH, Radwan MA, Sweeney LE, Alshammeri S. Estimates of dry eye disease in Saudi Arabia based on a short questionnaire of prevalence, symptoms, and risk factors: The Twaiq Mountain Eye Study I. Contact Lens Anterior Eye. 101770.
13. Aziz B, Tawfik C. Prevalence of dry eye disease among healthy Egyptian population. Vol. 113. p. 133–141,.
14. Vehof J, Kozareva D, Hysi PG, Hammond CJ. Prevalence and risk factors of dry eye disease in a British female cohort. Br J Ophthalmol. 98:1712–1717.
15. Farrand KF, Fridman M, Stillman IÖ, Schaumberg DA. Prevalence of diagnosed dry eye disease in the United States among adults aged 18 years and older. Am J Ophthalmol. 182:90–98.
16. Wang MTM, Vidal-Rohr M, Muntz A, Diprose WK, Ormonde SE, Wolffsohn JS, et al. Systemic risk factors of dry eye disease subtypes: a New Zealand cross-sectional study. Ocul Surf. 18:374–380.
17. Sullivan DA, Sullivan BD, Evans JE, Schirra F, Yamagami H, Liu M, et al. Androgen deficiency, Meibomian gland dysfunction, and evaporative dry eye. Ann N Y Acad Sci. 966:211–222.
18. Azcarate PM, Venincasa VD, Feuer W, Stanczyk F, Schally A V, Galor A. Androgen Deficiency and Dry Eye Syndrome in the Aging Male. Invest Ophthalmol Vis Sci. 55:5046–5053,.
19. Lee AJ, Lee J, Saw SM, Gazzard G, Koh D, Widjaja D, et al. Prevalence and risk factors associated with dry eye symptoms: a population based study in Indonesia. Br J Ophthalmol. 86:1347–1351.
20. Tongg L, Saw S-M, Lamoureux EL, Wang JJ, Rosman M, Tan DTH, et al. A questionnaire-based assessment of symptoms associated with tear film dysfunction and lid margin disease in an Asian population. Ophthalmic Epidemiol. 16:31–37.
21. Guo B, Lu P, Chen X, Zhang W, Chen R. Prevalence of dry eye disease in Mongolians at high altitude in China: the Henan eye study. Ophthalmic Epidemiol. 17:234–241.
22. Lu P, Chen X, Liu X, Yu L, Kang Y, Xie Q, et al. Dry eye syndrome in elderly Tibetans at high altitude: a population-based study in China. Cornea. 27:545–551.
23. Abetz L, Rajagopalan K, Mertzanis P, Begley C, Barnes R, Chalmers R. Development and validation of the impact of dry eye on everyday life (IDEEL) questionnaire, a patient-reported outcomes (PRO) measure for the assessment of the burden of dry eye on patients. Health Qual Life Outcomes. 9:1–16.

24. Yang I, Wakamatsu T, Sacho IBI, Fazzi JH, Aquino AC, Ayub G, et al. Prevalence and associated risk factors for dry eye disease among Brazilian undergraduate students. PLoS One. 16:259399.
25. Al Sabti K, Zechevikj S, Raizada S. Evaluation of lipid layer tear film changes after femtosecond small incision lenticule extraction. Ther Adv Ophthalmol. 14:25158414221129534,.
26. Rauz S, Koay SY, Foot B, Kaye SB, Figueiredo F, Burdon MA, et al. The Royal College of Ophthalmologists guidelines on serum eye drops for the treatment of severe ocular surface disease: executive summary. Eye. 32:44–48.
27. White DE, Zhao Y, Jayapalan H, Machiraju P, Periyasamy R, Ogundele A. Treatment satisfaction among patients using anti-inflammatory topical medications for dry eye disease. Clin Ophthalmol. :875–883.