Original Article :

Prevalence of Dry Eye Syndrome Among the Population of Saudi Arabia

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Abstract

Background and Aims:

This study aims to estimate the prevalence of Dry eye disease symptoms in all regions of Saudi Arabia and assess its relation to sociodemographic data and medical history. Dry eye disease is considered one of the most common ocular complaints encountered in ophthalmology clinics. It is a common condition worldwide, and the available data in the literature about its prevalence remains unclear in many countries. As per our knowledge, there is no single study in the literature about its prevalence on the country level of Saudi Arabia.

Methods:

A Cross-Sectional study covered all the regions of Saudi Arabia, using an online, self-administered, validated Ocular Surface Disease Index questionnaire. A total of 1817 adult participants were chosen by simple random sampling technique. Participants with a previous history of contact lens use or previous eye surgery were excluded.

Results:

The estimated prevalence of dry eye disease symptoms was 71%. 40.3% were between 18-26 years old; both genders had almost equal participation. There was a statistically significant association between participants with a free medical history, diabetes mellitus, tear substitutes use, and high school level with dry eye. We found no association between dry eye disease and gender, age, or other medical conditions in the survey.

Conclusions:

The prevalence of dry eye disease symptoms was significantly high (71%), and more than 90% of them had a severe level of symptoms in all regions of Saudi Arabia. Dry eye syndrome was significantly associated with diabetic patients, medically free participants, and participants at the high school level. Further clinical evaluation is needed for more accurate prevalence.

Keywords:

Dry eye disease, Dry eye syndrome, Keratoconjunctivitis sicca, Prevalence, Saudi Arabia.

Introduction

Dry eye disease (DED), or dry eye syndrome, is a common disease of tears and ocular surface. It is a chronic multifactorial condition and is considered one of the most common complaints encountered at the ophthalmology clinic. The tear film consists mainly of three components (aqueous, mucin, and lipid), which make up the three layers of the film with a total thickness of 2-5 μm. The Meibomian glands produce the lipid which makes the superficial layer. The orbital and accessory lacrimal glands produce the aqueous portion, making it the thickest layer. The basal layer consists of mucin and glycoprotein that regulate surface tension and allow the spread of tear film, and it is produced by conjunctival goblet cells. The tear film components are regulated according to the influence of the endocrine system, environmental factors, and nervous system. Moreover, the disruption of the tear film integrity could result from systemic or local autoimmune disease or a lack of systemic androgen support to the lacrimal gland. Dry eye disease (DED), or dry eye syndrome, can arise from any disturbance in the tears film homeostasis. Such in disturbance of Lacrimal Functional Unit (LFU), which consists of main and accessory lacrimal glands and ocular surface (cornea, conjunctiva, and Meibomian glands) and the nerves interconnecting everything together, including sensory and motor nerves. The primary function of LFU is to maintain a clear transparent corneal surface to allow projecting the best quality images to the retina, which is achieved by maintaining the tear film integrity[1,2].

When DED develops, it results in various symptoms of discomfort such as burning sensation, stinging, redness, and sensation of a foreign body in the eye. Also, it can result in visual disturbance, inflammation, and damage to the ocular surface and can even end up with vision loss. Generally, the disease is categorized into two major types: (Aqueous-deficient and an Evaporative). Each type is divided into further subtypes. Usually, eye dryness and lacrimal deficiency in the aqueous type are due to lacrimal acinar destruction. The aqueous type can be categorized into Sjogren and non-Sjogren, since Sjogren syndrome is a well-known cause of tears deficiency.

On the other hand, the Evaporative type can be intrinsic or extrinsic. Intrinsic evaporative causes include Meibomian gland dysfunction, eyelid disorders, or low blink rate. Extrinsic evaporative causes can be preventable, and some examples are Vitamin A deficiency, contact lens wear, and allergies[1, 3].

It has been demonstrated that inflammation negatively influences the lacrimal unit function, as it interferes with the normal

secretomotor neural pathway with an unknown mechanism. DED diagnosis cannot be made on clinical presentation or scoring systems alone. The diagnostic key is to assess the lacrimal unit function and measure the amount of tear production. Clinical diagnostic tools accuracy increases when combined with clinical presentation and other questionnaires. Schirmer's test (I) is one of the most important tests to help diagnose DED, and it is a simple, cheap, and fast test used to measure the amount of tear produced after eye stimulation in a specific time using 5 X 35 mm strips of paper. After five minutes of eye stimulation, tear production is considered abnormal if tears do not reach the 10 mm mark on Schirmer's strip, and DED can firmly be considered if tears do not reach the 5 mm mark. Another essential tool to assess eye dryness is to test tear film breakup time (TFBUT). TFBUT is considered abnormal when below 10 seconds but, below 5 seconds is highly suggestive of DED. Also, fluorescein staining, and the Rose Bengal test can be used to look for any corneal damage. Other tests such as ocular ferning test for the evaluation of mucus deficiency, tear film osmolarity, autoimmune disease screening, tear lysozyme test, and corneal residence time tests can be helpful for diagnosis[4].

Materials & Methods

This was a cross-sectional descriptive study to estimate the prevalence of dry eye disease in Saudi Arabia. Sample selection was made with a simple random sampling technique using a pre-tested, self-administered online questionnaire. The ocular Surface Disease Index (OSDI) questionnaire was adopted for use in this study, available for free access. Data were collected after obtaining the institutional review board's (No: 05-20062021) from Almaarefa University, and we asked all individuals to sign a consent before participating in the study. Data collection was organized to involve all the parts of Saudi Arabia and was distributed according to the main geographically five regions (Central, Northern, Southern, Eastern, and Western region). With an estimated population of around 34000000, the sample size was calculated by openEpi as 2401 individuals with confidence level of 95%, using the following formula: n = [DEFF*Np(1-p)]/ [(d2/Z21-α/2)*(N-1)+p*(1-p)]. Where, N = Total population size (34000000), p = Hypothesized % frequency of outcome factor in the population: (50%+/-2), d = Confidence limits as % of 100(absolute +/- %): (2%), DEFF = Design effect: (1), Z1−α/2 = 1.96. The OSDI questionnaire is a 12-item screening tool that assesses the symptoms and their effect on the last week of a pa-

tient's life. It has three subscales with 12 questions that focus on symptoms, visual function, and environmental triggers. The questionnaire was translated to Arabic for data collection. A total score is calculated from the sum of the answered questions and compared to a predefined chart to estimate dry eye severity. A normal ocular surface was defined by a final score of 0-12, while a score of 13-22 defined the mild form of dry eye. Moderate DED was defined by a final score of 23-32, and the severe form of DED was defined by an OSDI score of 33 and above. [5] Data analysis was done using IBM SPSS software version 26, and Microsoft Excel version 2016 was used to generate tables and charts. Frequencies and percentages were used to present all categorical variables. Positive predictive value was calculated as true positive plus false positive, divided by true positive. The overall probability and accuracy of the diagnosis were calculated using the following equation: Sensitivity x Prevalence + Specificity x (1-Prevalence). Pearson Chi-Square and Fisher exact tests were used to observing associations between qualitative variables (demographic, comorbidities) and the development of dry eye symptoms. Logistic regression was also performed to observe the odds. A p-value of < 0.05 was considered statistically significant.

Results

The study included 1817 participants. Out of 3006 participants; 36 were excluded as they did not agree to sign the consent to take the survey, 141 excluded as they were below 18 years old, 506 were excluded because they had eye surgery. Another 412 were excluded due to contact lenses wearing. Ninety-four had eye surgery and wear contact lenses both together. Socio-demographic data are represented in Table 1, which showed almost equal participation between males and females (n=949, 52.2 %) and (n=868, 47.8 %) respectively. Most of our participants fell between the 18-25 age group (n=732, 40.3%). Most of the participants were Saudis (n=1683, 92.6%), and most of the participants had a university level of education (n=1329, 73.1%). The majority (n=1395, 76.8%) were medically free with no comorbidities. Based on the sensitivity and specificity of the OSDI questionnaire, a positive predictive value was calculated. The overall estimated prevalence of DED in individuals who participated in this study is 71% (1290/1817) (95% CI: 70.60%- 73.30%), with OA 74% (95% CI: 72.72%- 75.49%). There was a statistically significant association between the education level and medical history with DED. Participants with high school education had a p-value

Table 1: Demographic data

Characteristic	n	%
Gender		
Male	949	52.2
Female	868	47.8
Age		
18-25	732	40.3
26-37	550	30.3
38-50	355	19.5
50 and above	180	9.9
Nationality		
Saudi	1683	92.6
Non-Saudi	134	7.4
Marital status		
Single	904	49.8
Married	828	45.6
Divorced	41	2.3
Widowed	44	2.4
Education		
No education	12	0.7
Primary	16	0.9
Intermediate	49	2.7
High school	411	22.6
University	1329	73.1
Employment		
Student	626	34.5
Private/Public servant	644	35.4
Self-employee	85	4.7
Military	73	4.0
Retired	96	5.3
Unemployed	293	16.1
Comorbidities		
Hypertension	51	2.8
Diabetes mellitus	80	4.4
Cardiac disease	22	1.2
Renal disease	8	0.4
Asthma	61	3.4
Seasonal allergy	97	5.3
Other conditions	103	5.7
Medically free	1395	76.8
Total	1817	100.0

Note: Geographic distribution of participants is represented .in another graph. N= Number, %= Percentage

of 0.02; intermediate education and uneducated participants showed a p-value of 0.06 and 0.014, respectively. Most of our participants had an unremarkable medical history, with a significant association with DED with a p-value of 0.0001 and an almost similar association with diabetes. We found no statistical relation of DED with other conditions like asthma, cardiac disease, hypertension, renal disease, and seasonal allergy. Figure 1 illustrates the coverage of Saudi Arabia's regions in the survey, the highest geographic participation was in the central region with (n=416, 22.9%) participants, and almost the same was from the western region (n=396, 21.8%), followed by eastern (n=289, 21.4%), southern (n=317, 17.4%) and the least were from northern region (n=299, 16.5%).

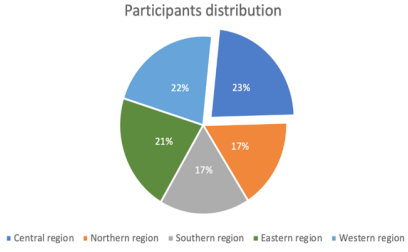


Figure 1. Distribution of study participants according to main regions of Saudi Arabia.

Nevertheless, Table 2 demonstrates the severity of OSDI grades according to the region of the country, and it shows that participants in all regions had above 90% severe grades. The highest prevalence was found in the western region with (98.2%) severe grades. The lowest was found in the central region, with 391 out of 416 (93.9).

Table 2: Distribution of OSDI grade according to main regions of Saudi Arabia

OSDI grade, n (%)					Total
Region	Normal	Mild	Moderate	Severe	
Central	4 (0.9)	5 (1.2)	16 (3.8)	391 (93.9)	416
Northern	0 (0.0)	4 (1.3)	9 (3.0)	286 (95.6)	299
Southern	1 (0.3)	0 (0.0)	14 (4.4)	302 (95.2)	317
Eastern	4 (1.0)	3 (0.7)	6 (1.5)	376 (96.6)	389
Western	0 (0.0	1 (0.2)	6 (1.5)	389 (98.2)	396
Total	9 (0.4)	13 (0.7)	51 (2.8)	1744 (95.9)	1817

.Note: The majority of participants had severe grade, some regions showed no normal results. N= number, %= percentage

Table 3 demonstrates the relation between tears substitutes and dry eye symptoms. We found that most of the participants (n=1285, 70.7%) are not using eye drop moisturizers, and the remaining (n=531, 29.2%) answered yes.

Table 3: The relation between artificial tears usage and dry eye disease.

Using artificial tears	n (%)	Missing	p-value
Males	Yes= 214 (11.7) No= 735 (40.4)	1 (0.1)	0.001
Females	Yes= 317 (17.4) No= 550 (30.2)		
Total	Yes= 531 (29.2) No= 1285 (70.7)		

.Note: There was a significant statistical association between dry eye and the use of artificial tears. N= number, %= Percentage

Also, there was a statistically significant association between tears substitutes and DED development, with a p-value of 0.001. The median OSDI score was 75. Participant's responses about the following two questions: 1- Have you experienced a poor vision in the last week? 2- Have you experienced an eye problem limiting your computer use in the last week? Were answered: At all the time, 271, 258 times respectively. Approximately (n=1744, 96%) had severe dry eye symptoms according to the OSDI score, (n=51, 2.8%) had moderate score, and (n=13, 0.7%) had mild score. Out of 1817 participants, only (n=9, 0.5%) had a normal score. The odd ratio with a 95% confidence interval was calculated in Table 4 to predict the risk of developing DED in association with other demographic data and comorbid conditions. The OR was 2.7

Table 4: Odd ratio estimates

OR		
Variant	Estimate	95% CI
Gender Male Female	 Reference 0.85	 Reference 0.523-1.39

OR		
Variant	Estimate	95% CI
Education		
University	Reference	Reference
High School	2.7	1.15-6.36
Intermediate	0.36	0.12-1.0
Primary	0.36	0.04-3.0
Uneducated	0.1	0.08-0.58
Medical history		
Seasonal allergy	Reference	Reference
Asthma	1.77	0.57-5.42
Hypertension	2.42	0.59-9.8
Medically free	3.88	1.96-7.68

Note: OR= Odd Ratio, CI= Confidence interval

for participants in high school (95% CI: 1.15-6.36), the OR for Asthma was 1.77 (95% CI: 0.57-5.42), the OR for hypertension was 2.42 (95% CI: 0.59-9.8), and the OR for the medically free group was 3.88 (95% CI: 1.96-7.68).

Discussion

Based on reported data in the literature, it was already expected to find a high prevalence of DED in Saudi Arabia, but the accurate prevalence was unknown. As far as we know up to this moment, there is no single study in the literature about the prevalence of DED on the country level. The overall result showed a significantly high prevalence of DED, and almost 95% of the participants reported severe dry eye symptoms. Although the condition cannot be diagnosed based on the questionnaire alone, the OSDI questionnaire showed to be a good screening tool. It showed a good prediction with 83% sensitivity and 61% specificity. Unlike other screening tools, it also can assess the frequency and the effect of dry eye symptoms on visual function[6]. There are many questionnaires used to evaluate and diagnose dry eye symptoms, and the reported findings in the literature about its prevalence showed different results for that specific reason. In a study done by Alshamrani et al. (2017)[7] in Al-Ahsa city, the prevalence was 32.1%. The questionnaire used in that study included six items about dry eye syndrome and four items about factors related to the condition. Unlike our study, most participants were between 36 and 45 years old. Also, he reported that female gender, age greater than 55, active smoking, and history of diabetes mellitus were significantly associated with DED. Our results found no difference between males and females, and the prevalence of DED in both genders was almost equal.

The prevalence of DED varies hugely from country to country, and there is a

lack of accurate data regarding the prevalence in many countries. The reason could be attributed to many factors such as the climate, prevalence of related conditions, lifestyle, and risk factors, in a cross-sectional study conducted by Ferrand et al. (2017)[8]. It was found that the prevalence of DED in the United States population was 6.8%, using National Health and Wellness Survey, and including all the adults above 18 years old. He also found that the prevalence is higher in females and increases as the age advances. That prevalence cannot be compared with ours, nor to other studies conducted in Saudi Arabia since there were no similarities between the tools used for data collection, cultural and lifestyle factors, and different climate and geography. Nonetheless, we can compare other findings, such as the relationship between age and gender. However, we found no relation to gender, nor to age group, except that 5 out of 9 normal OSDI scores were between the age of 18- 25 years. In another cross-sectional study for DED prevalence by Yasir et al. (2019)[9], and using the McCarty symptoms questionnaire, it was found that the prevalence of DED in the Riyadh region was 45.1%. Also, it was found that the prevalence was significantly higher in females than males. Although almost half of the survey takers had DED symptoms, two-thirds had a mild form. Also, they found no association between hypertension and DED symptoms, which was contrary to what we found in our result that showed an association between HTN and DED (OR=2.42) (95% CI- 0.59-9.8). According to Bukhari et al. (2009)10. The prevalence of dry eye disease In Jeddah (Western region) was significantly high. The authors recruited 251 subjects who underwent clinical assessment with detailed dry eye history. The prevalence of DED was 93.2% (234/251) which was almost similar to our findings. 35.1% of recruited participants had fluorescein corneal staining of grade 1 and above, 23.1% with Schirmer's score of $\leq$ 5 mm, and 66.9% with TFBUT $\leq$ 10 seconds. There was no association with age or gender but, it was found that 91% of those who had DED have associated blepharitis, and 76.1% have an associated Meibomianitis. Both these findings may contribute to the development of DED. The etiologies of DED are broad, and the diagnosis is challenging since there is no universal consensus on diagnosis guidelines. A combination of clinical tests and questionnaires showed better accuracy for the diagnosis than clinical tests or questionnaires alone. TFBUT was found to be the most sensitive test (98%), whereas Schirmer's I test was found to be the most specific with 100% accuracy, and Rose Bengal was the most accurate one[11].

Treatment of DED varies widely according to the cause. It usually involves but is not limited to the environmental modification, elimination of causative factors, discontinuation of medication if found to be related, punctal plug/ occlusion, and continued use of tears substitutes[12].

Conclusion

Results showed that the overall prevalence of Dry Eye Disease symptoms was significantly high. There was a correlation between participants in high school level, HTN, Asthma, medically free group, and DED development. The majority of those with DED had a severe form of symptoms. Further studies with ocular surface evaluation are warranted to provide a more accurate prevalence of DED.

Conflict of interest:

None

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