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Prevalence and risk factors of dry eye disease and how it is impacted by prolonged reading among senior medical students in Jeddah, Saudi Arabia

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ABSTRACT

Background: Dry eye disease (DED) is an ocular surface disorder with several causes leading to numerous manifestations. It is common among medical students. *Aim:* This study assesses the associated risk factors and prevalence of DED and how it is impacted by prolonged reading among Saudi undergraduate senior medical students. *Methods:* A descriptive online self-administered questionnaire was distributed among undergraduate senior medical students from the University of Jeddah, Saudi Arabia. Statistical Package for the Social Sciences (SPSS) version 23 was utilized to analyze the data. *Results:* A total of 121 participants completed the questionnaire. They comprised 87 (71.9%) males and 34 (28.1%) females, with a male-to-female ratio of 2.6:1. Their ages ranged from 20 to >25 years, with the majority (54.5%) aged 20–22 years and 63 (52.1%) were fourth-year medical college students. The results showed that 22 (18.2%) had mild DED (*OSDI* (Ocular Surface Disease Index) score 13–22), 10 (8.3%) moderate DED (score 23–32), 45 (37.2%) severe DED (score 33–100) and 44 (36.3%) had normal (0–12) OSDI scores. The male gender, age (20–22 years) and fourth-year medical college were most common with DED. Age group 23-24 was protective against DED development with relative risk 0.264 (95% CI: 0.100-0.696, *P* =0.007). Smoking and chronic disorders were not associated with DED development. *Conclusion:* DED after prolonged reading is common especially severe degree. The male gender, age group (20-22 years) and fourth-year medical students were the most affected group. Age group 23-24 was protective against DED development. Further studies need to be implemented to establish a comprehensible relationship.

Keywords: Dry eye, prolonged reading, Medical students, Jeddah, Saudi Arabia

1. INTRODUCTION

Dry eye disease (DED), also known as dry eye syndrome or keratoconjunctivitis sicca, is common reasons to visit an ophthalmologist. The tear film and ocular surface society dry eye workshop defines DED as "a multi-factorial disease of the ocular surface that is characterized by a loss of homeostasis of the tear film and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage neurosensory abnormalities play etiological roles" (Craig et al., 2017). Many factors contribute to the development of DED, including female gender, older age, prolonged use of digital devices, smoking, air pollution, climate changes and medications such as oral contraceptives, antidepressants and anti-allergic drugs (Castro et al., 2018; Inomata et al., 2020; Makhdoum et al., 2022). The prevalence of DED ranged from 5% to 50%; however, it is generally more common in Asian than Caucasian populations (Li et al., 2018). One study among Brazilian undergraduate students revealed that 23.5% of the study participants had DED (Yang et al., 2021). Another study conducted in Saudi Arabia showed that 49.5% of the study participants encountered DED (Binyousef et al., 2021).

The overwhelming amount of knowledge that medical students must acquire frequently causes them to feel worried and overwhelmed. As a result, students have to spend a lot of time reading and studying to overcome this problem. Daily activities like prolonged reading have been shown in studies to have negative effects on ocular surface and tear film may make DED symptoms worse (Karakus et al., 2018), worsening in corneal and conjunctival staining are most noticeable after prolonged reading (Karakus et al., 2018). However, DED can slow an individual's reading speed by 10%, making it difficult to read for more than half an hour. Patient education regarding lifestyle modification, including limiting prolonged reading, can reduce DED and its severity (Binyousef et al., 2021; Karakus et al., 2018). The goal of this study was to identify potential areas for improvement by analyzing the prevalence, risk factors and effects of prolonged reading on DED in Saudi senior undergraduate medical students. This is the first study that we are aware of that looks at the relationship between prolonged reading and DED among Saudi undergraduate senior medical students.

2. METGODOLOGY

Study Design

A descriptive questionnaire based cross section study

Study Population and Sampling

All undergraduate medical students (fourth, fifth and sixth years) of both genders from the University of Jeddah who lived in Saudi Arabia during the study and agreed to participate were invited to participate in this survey. All the participants had the right to withdraw or stop completing the questionnaire during research. Individuals aged 18 or below and people with learning difficulties, language barriers or psychological disorders were excluded from the study. All the fourth, fifth and sixth-year undergraduate medical students from the University of Jeddah, Jeddah, Saudi Arabia were invited to participate in the study. However, 121 responses were collected out of 130, with a response rate of 93.07%.

Data collection tool

From February to July 2022, senior undergraduate students in medical college in Jeddah, Saudi Arabia, participated in an online descriptive cross-sectional study. An online self-administered questionnaire was distributed via Google forms among the study participants. The survey was sent online using social media apps (WhatsApp, Telegram, Facebook and others). Demographic characteristics of participants was collected as age, gender, current study years, comorbidities, smoking status, time of studying per day, using of digital screen. The Ocular Surface Disease Index (OSDI) score was calculated using 12 questions (three questions related to ocular symptoms, six questions related to vision- functions and three questions related to environmental triggers) to distinguish between healthy subjects and those with DED. Scoring for the OSDI is as follows: 4 = all time; 3 = most time; 2 = half time; 1 = some time; and 0 = none. The following formula was utilized to determine the final OSDI score (Stapleton et al., 2017): OSDI equal (sum of scores) × 25 / number of questions answered.

Statistical analysis

The data were analyzed using SPSS (statistical software package) version 23. Categorical variables were presented as frequencies and percentages and categorized data between groups was compared using the Pearson Chi-square test. Binary logistic regression was used to find out risk factor. A test with $P < 0.050$ was considered significant.

Ethical considerations

The research was approved by Bioethics Committee of Scientific & Medical Research approved University of Jeddah, Saudi Arabia (UJ-REC-039) at 01/04/2022. Consent was obtained via participants reading a script and then agreeing to participate by clicking a link to answer the survey questions. All the students were informed about the study's objectives; therefore, written informed consent get from the participants. After the data were collected, they were stored. They will be kept confidential and only used for research purposes.

3. RESULTS

The participants comprised 87 (71.9%) males and 34 (28.1%) females with a male-to-female ratio of 2.6:1. The male were more than female in No-DED and DED participants with insignificant difference between them (P=0.402). They were 20 to over 25 years old, with the vast majority (n= 66, 54.5%) in age group 20–22 years. Most of the participants in No-DED were in age group 23-24 years (n=22, 50.0%) and those with DED in age group 20-22 years (n= 47, 61.0%) with insignificant difference between two groups (P=0.098). Concerning the current year of study, 63 (52.1%) were fourth-year, 28 (23.1%) in fifth-year and 30 (24.8%) sixth-year medical college students. Most of participants with No-DED and with DED were in 4th year (n=31, 47.7% and n=42, 54.5%) with insignificant difference between groups (P=0.220). Only 21 (17.4%) participants were cigarette smokers, of them 5 (11.4%) were in No DED and 16 (20.8%) were in DED group. Twenty participants in this study had comorbid chronic disorders, of them 5 (11.4%) were in No-DED and 15 (18.5%) were in DED group. Six participants (5.0%) had bronchial asthma, 4 (3.3%) had depression, 3 (2.5%) had diabetes mellitus and each of the following conditions applied to 1 (0.8%) participant each: Allergy, bipolar disorder, chronic sinusitis, gout, generalized anxiety disorder, irritable bowel syndrome and open-angle glaucoma. 112 (92.6%) participants were using digital screen, of them 42 (95.5%) were in No-DED and 70 (90.9%) were in DED group with insignificant difference between them (P=0.485). Regarding the reading time, 33 (27.3%) participants reported studying 0–2 hours/day, 38 (31.8%) studied 3–4 hours/day, 31 (25.6%) studied 5–6 hours/day and 19 (15.7%) reported studying more than 7 hours/day. Time of studying per day was mostly 3-4 hrs in No-DED (n=17, 38.6%) and 5-6 hrs in DED group (n=23, 29.9%) with insignificant difference between groups (P=0.534). Importantly, most of the students (92.6%) preferred to study on a digital device such as tablets or computer with 42 (95.5%) in no-DED and 70 (90.0%) in DED students with insignificant difference between groups (P=0.485) (Table 1).

Table 1 Demographic characteristics of study participants without and with dry eye disease (DED)

Characteristics	Total (n= 121)	No-DED (n= 44)	DED (n= 77)	Significance
Gender				
Male	87 (71.9%)	34 (77.3%)	53 (69.8%)	0.402
Female	34 (28.1%)	12 (22.7%)	24 (31.2%)	
Age groups				
20-22 years	66 (54.5%)	19 (43.2)	47 (61.0%)	0.098
23-24 years	45 (37.2%)	22 (50.0%)	23 (29.9%)	
≥ 25 years	10 (8.3%)	3 (6.8%)	7 (9.1%)	
Current study year				
4th year	63 (52.1%)	31(47.7%)	42 (54.5%)	0.220
5th year	28 (23.1%)	14 (31.8%)	14 (18.2%)	
6th year	30 (24.8%)	9 (20.5%)	21 (27.3%)	
Smoking status				
No	100 (82.6%)	39 (88.6%)	61 (79.2%)	0.221
Yes	21 (17.4%)	5 (11.4%)	16 (20.8%)	
Chronic diseases				
No	101 (83.5%)	39 (88.6%)	62 (80.5%)	0.314
Yes	20 (16.5%)	5 (11.4%)	15 (18.5%)	
Bronchial asthma	6 (5.0%)	2 (40.0%)	4 (26.7%)	
Depression	4 (3.3%)	-	4 (26.7%)	
Diabetes mellitus	3 (2.5%)	1 (20.0%)	2 (13.2%)	
Allergy	1 (0.8%)	-	1 (6.7%)	

Bipolar disorder	1 (0.8%)	-	1 (6.7%)	
Chronic sinusitis	1 (0.8%)	-	1 (6.7%)	
Gout	1 (0.8%)	-	1 (6.7%)	
Generalized anxiety disorders	1 (0.8%)	1 (20.0%)	-	
Irritable bowel syndrome	1 (0.8%)	-	1 (6.7%)	
Open angle glaucoma	1 (0.8%)	-	1 (6.7%)	
Time of studying per day (hours)				
0-2 hours	33 (27.3%)	12 (27.3%)	21 (27.3%)	
3-4 hours	38 (31.4%)	17 (38.6%)	21 (27.3%)	
5-6 hours	31 (25.6%)	8 (18.2%)	23 (29.9%)	0.534
7-8 hours	12 (9.9%)	4 (9.1%)	8 (10.4%)	
9-10 hours	3 (2.5%)	2 (4.5%)	1 (1.3%)	
>10 hours	4 (3.3%)	1 (2.3%)	3 (3.9%)	
Using digital screen				
No	9 (7.4%)	2 (4.5%)	7 (9.1%)	0.485
Yes	112 (92.6%)	42 (95.5%)	70 (90.9%)	

The answers to the questions used to OSDI score calculation revealed that 39 (32.2%), 41 (33.9%), 47 (38.8%) and 44 (36.4%) participants had not experienced sensitivity to light, a gritty feeling, eye pain/soreness or blurred vision, respectively, during the last week. Additionally, nearly half of the study participants (48.8%) did not complain of poor vision during the last week; 25 (20.7%) participants reported eye-related reading problems during the last week and 17 (14.0%), 22 (18.2%) and 15 (12.4%) stated that their eye problems had limited their performances some of the time regarding working on a computer/ATM, watching TV and driving at night, respectively. Only 7 (5.8%), 6 (5.0%) and 5 (4.1%) of the respondents declared that their eyes felt uncomfortable all the time during the last week when they encountered windy conditions, low-humidity areas or areas with air conditioning (Table 2).

Table 2 The response that was utilized to determine the study participants' OSDI scores (n = 121)

Questions	0	1	2	3	4
Experience during last week					
Eyes sensitive to light	39 (32.2%)	34 (28.1%)	25 (20.7%)	14 (11.6%)	9 (7.4%)
Eyes feeling gritty	41 (33.9%)	42 (34.7%)	18 (14.9%)	15 (12.4%)	5 (4.1%)
Sore of painful eyes	47 (38.8%)	41 (33.9%)	18 (14.9%)	11 (9.1%)	4 (3.3%)
Blurred vision	44 (36.4%)	34 (28.1%)	23 (19.0%)	15 (12.4%)	5 (4.1%)
Poor vision	59 (48.8%)	28 (23.1%)	12 (9.9%)	9 (7.4%)	13 (10.7%)
Eye problems during last week that limited you in performing any of following of:					
Reading	58 (47.9%)	25 (20.7%)	21 (17.4%)	10 (8.3%)	7 (5.8%)
Driving at night	67 (55.4%)	15 (12.4%)	20 (16.5%)	11 (9.1%)	8 (6.6%)
Working with a computer or bank machine (ATM)	68 (56.2%)	16 (13.2%)	17 (14.0%)	13 (10.7%)	7 (5.8%)
Watching TV	62 (51.2%)	20 (16.5%)	22 (18.2%)	9 (7.4%)	8 (6.6%)
Uncomfortable eyes during the last week in any of the following situations:					
Windy conditions	56 (46.3%)	23 (19.0%)	18 (14.9%)	17 (14.0%)	7 (5.8%)
Places or areas with low humidity (very dry)	63 (52.1%)	18 (14.9%)	19 (15.7%)	15 (12.4%)	6 (5.0%)
Areas with air conditioned	63 (52.1%)	20 (16.5%)	16 (13.2%)	17 (14.0%)	5 (4.1%)

0: None; 1: Some time; 2: Half time; 3: Most time; 4: All time.

After calculation of OSDI, the results showed that 22 (18.2%) had mild DED (*OSDI* score 13–22), 10 (8.3%) had moderate DED (*OSDI* score 23–32) and 45 (37.2%) had severe DED (*OSDI* score 33–100). Importantly, 44 (36.3%) of the study participants had normal (0–12) OSDI scores and were thus considered healthy individuals (Figure 1).

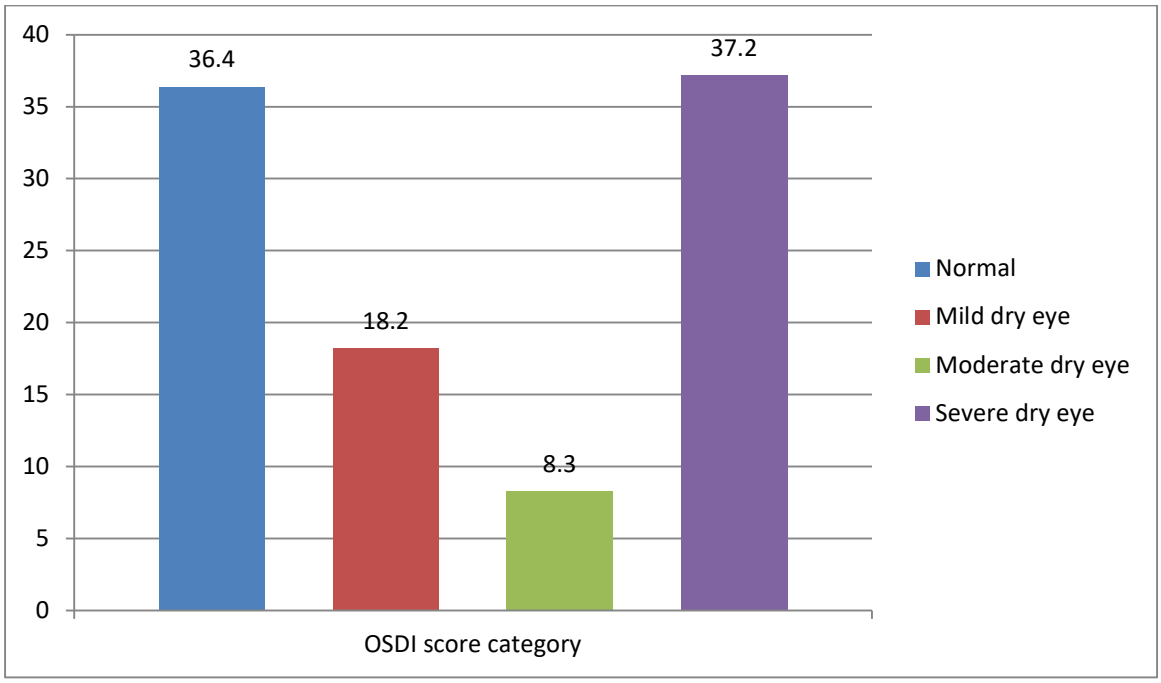

Figure 1 score of OSDI for study participants (n = 121)

Binary logistic regression of the risk factor revealed that age group 23-24 years had low risk relative risk 0.264 (95%CI: 0.100-0.696, P=0.007) to get DED when age group 20-22 years as reference. The other factors as female gender, current studying year, smoking, chronic diseases, studying hours per day, usage digital screen were not risk factor for DED (Table 3).

Table 3 Regression analysis for factors associated with DED

Variable	Relative risk (95% CI)	Significance
Gender		
Male	Reference	
Female	1.364 (0.457-4.072)	0.578
Age groups		
20-22 years	Reference	
23-24 years	0.264 (0.100-0.696)	0.007
≥ 25 years	0.378 (0.068-2.084)	0.264
Current study year		
4th year	Reference	
5th year	0.697 (0.230-2.113)	0.524
6th year	3.268 (0.884-12.006)	0.076
Smoking status		
No	Reference	
Yes	2.383 (0.761-7.459)	0.136
Chronic diseases		
No	Reference	
Yes	1.952 (0.605-6.301)	0.263
Time of studying per day (hours)		
0-2 hours	Reference	
3-4 hours	0.858 (0.317-2.325)	0.763
5-6 hours	1.950 (0.638-5.961)	0.242
7-8 hours	1.259 (0.292-5.428)	0.757
9-10 hours	0.325 (0.025-4.297)	0.394

>10 hours	2.531 (0.227-28.198)	0.450
Using digital screen		
No	Reference	
Yes	0.572 (0.102-3.215)	0.526

4. DISCUSSION

Dry eye disorder is an ocular surface disease that leads to stinging, a burning sensation, tearing and a sandy/gritty feeling in the eyes (Golden et al., 2022). Additionally, blurred vision, visual impairment and pain, along with dryness or redness may occur (Golden et al., 2022). DED affects approximately 5%–50% of general population worldwide; however, multiple factors like age, gender and ethnicity determine its prevalence (Stapleton et al., 2017). In current study, the OSDI score was calculated to distinguish between healthy subjects and those with DED based on 12 questions. The results showed that 63.7% of study participants had DED; while 36.3% had normal OSDI scores (healthy subjects).

A study conducted on Thai University students showed that DED prevalence was 8.15% (Supiyaphun et al., 2021). Another study from Fallujah University reported that DED prevalence was 20.1% (Fayyadh et al., 2020). Hyon et al., (2019) used OSDI score to estimate DED prevalence among medical students in Korea and found that prevalence was 27.1%, lower than result reported in this study. Conversely, Tangmonkongvoragul et al., (2022) reported a high prevalence of DED among Chiang University medical students (70.8%). Therefore, DED prevalence among medical students varies. DED is more common in females, according to Garcia-Queiruga et al., (2022) disparities between the body structure between men and women, hormonal changes during puberty and reproductive periods, along with a possible association with autoimmune disorders, appear to play a principal role in this domain. In United States, prevalence is nearly double among females (Farrand et al., 2017). Numerous studies concluded that female gender is associated with an increased DED risk (Matossian et al., 2019; Tangmonkongvoragul et al., 2022). Interestingly, Vehof et al., (2018) found that male gender associated with an increased DED risk. Here, this study found that DED is more common among males; a possible explanation is that males tend to be exposed to environmental triggers like high temperatures, ultraviolent light, smoking, wind and other air pollution triggers, placing them at high risk. Furthermore, Stapleton et al., (2017) stated that DED prevalence at a younger age (below 40 years) is inconsistent regarding gender and females predominate when their age exceeds 50 years.

Regarding age, this research showed that age group 23-24 years is a protective from risk of DED when taken 20-22 years age group as reference. Being older than 50 years is associated with an increased risk of developing DED (Golden et al., 2022); however, in this study, the participants' ages were from 20-26 years only. The younger population can develop DED due to numerous factors. Prolonged time in front of display devices like computers and increased risk of sun exposure among this group lead to observed finding. Importantly, 92.6% of study participants preferred to study on a digital device like tablets or computer. Therefore, it can state that younger people have their own triggers that led to an increased DED risk (De-Paiva, 2017). Smoking toxins can irritate the eyes and contribute to development of multiple eye conditions; however, most of studies failed to report a significant relationship between smoking and DED (Bhutia et al., 2021; Xu et al., 2016). In this study, smoking was not a risk factor for DED. Also, this survey found insignificant relationship between chronic disorders and DED. The most common chronic disorders associated with DED are autoimmune disorders (Bustamante-Arias et al., 2022) that were not reported by our participants; therefore, such findings were entirely expected. Furthermore, diabetes mellitus, bronchial asthma, bowel conditions and psychiatric disorders were not reported as potential causative factors, which may lead to the negative relationship in this study. Also, this study revealed that the studying hours per day was not a risk factor for DED.

5. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, DED is common in medical students after prolonged reading. The male gender and fourth-year medical students were the most affected groups. While, age group from 23-24 years was protective against DED. Smoking and chronic disorders were not considered risk factors for DED in this study. Further studies need to be conducted to establish a clear and understandable relationship.

Informed consent

Oral informed consent was obtained from all individual participants included in the study.

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Author contribution

EAA, ASA, PB and HAA: Conceptualization, Methodology, Software, Writing-Original draft preparation. ASA and WAA: Data curation, Supervision, Writing- Reviewing and Editing. All authors reviewed the manuscript and have agreed this final form of manuscript for publication.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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