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Original Article

Ophthalmology Section

Prevalence and Risk Factors of Dry Eye Disease at a Tertiary Care Centre in Haryana, India: A Cross-sectional Study

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ABSTRACT

Introduction: Dry Eye Disease (DED) is a multifactorial disease which causes ocular discomfort and visual disturbances. It is one of the major causes of patients' visit to the clinic. The prevalence of DED has increased in recent times due to increased time spent on computers and mobile phones, ageing population and highly stressful social environment. Various studies done in past on DED prevalence have given the variable results.

Aim: To determine the prevalence of DED and analyse the associated risk factors in a tertiary care centre in Sonepat, Haryana, India.

Materials and Methods: Present study was a cross-sectional observational study done in Outpatient Department of Ophthalmology at Bhagat Phool Singh Government Medical College for Women, Sonepat, Haryana, India, from April 2021 to December 2021. Total 820 patients, aged >18 years were administered Ocular Surface Disease Index (OSDI) questionnaire. Patients with OSDI score >12 and positive one or both of the dry eye objective tests of Schirmer's and Tear film Break Up Time (TBUT) below cut-off value were labelled as DED and were evaluated for association with various risk factors. Data were statistically analysed by Chi-square test, Wilcoxon-Mann-Whitney U test and Fischers-exact test.

Results: The mean age of patients were 39.65±15.52 years ranging between 18-79 years. DED was found to be more prevalent in females 120 (56.1%) compared to males 94 (43.9%). The prevalence of DED was 26.1% (214/820). Maximum prevalence was found in the age group 18-40 years (43.9%). Out of the 214 DED patients, 113 (52.8%) had mild, 95 (44.4%) had moderate and 6 (2.8%) had severe dry eye. The risk factors significantly associated ($p<0.05$) with DED were: more than 3.71 hours of Visual Display Terminal (VDT) use, occupational VDT users, homemakers, previous ocular surgery, uncorrected refractive error, diabetes mellitus, hypertension, Chronic Obstructive Pulmonary Disease (COPD), alcohol intake and mask use.

Conclusion: The DED is a significant cause of ocular morbidity, affecting more than quarter (26.1%) of the study population. Awareness and identification of risk factors for dry eye which are occupational VDT users, previous ocular surgery, uncorrected refractive error, diabetes mellitus, hypertension, COPD, alcohol intake and mask use is important for effective prevention and management of DED.

Keywords: Mask associated dry eye, Ocular morbidity, Visual display terminal

INTRODUCTION

Dry eye is a multifactorial disease of the tear film and ocular surface that results in symptoms of discomfort, visual disturbances and tear film instability with potential damage to ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of ocular surface [1]. Dysfunction of any lacrimal function unit component can lead to DED by causing alterations in the volume, composition, distribution, and/or clearance of the tear film [2]. Dry eye symptoms cause a long-term decline in patients' Health-Related Quality of Life (HRQL) and decrease productivity at workplace [3]. Various factors like increased use of VDT, ageing and highly stressful social environment might be responsible for increase in prevalence of DED in recent times. DED is a major cause of patient visit to ophthalmology clinic. Hence, early diagnosis by appropriate subjective and objective tests and risk factor identification is important in prevention and management of DED [4].

Prevalence of DED is greatly influenced by geographic location, weather conditions and lifestyle of people, similar studies done in past have given variable results [5-7]. Also the present study is more relevant during Coronavirus Disease-2019 (COVID-19) pandemic considering the social, psychological and behavioural changes it brought in people's lives. Due to lockdown in COVID-19 pandemic, most of the people were confined to indoors and work from home, more use of VDT changed the social and behavioural pattern. The present study was aimed to determine the prevalence of DED and its associated risk factors in rural population attending ophthalmology OPD at a tertiary care centre in Haryana, India.

MATERIALS AND METHODS

Present study was a cross-sectional observational study done in outpatient services of Department of Ophthalmology at Bhagat Phool Singh Government Medical College for Women, Sonepat, Haryana, India, from April 2021 to December 2021. After Institutional Ethics Committee (IEC) approval (BPSGMCW/RC689/IEC/21), the study was conducted on consecutive patients attending the investigating doctor after written informed consent.

Inclusion criteria: Patients aged 18 years or older attending the Ophthalmology department, who were cooperative and gave written consent for participation, were included in the study.

Exclusion criteria: Patients presenting with any structural abnormality of the lids, any sign of trauma to the eye, acute infection in the eyes were excluded from the study.

Sample size calculation: Sample size was calculated to be 816 by using nMaster 2.0 software with relative precision 10% and taking prevalence as 32% at 95% confidence interval [5]. A total of 820 patients were enrolled in present study.

The OSDI questionnaire was administered to all the patients. Patients in whom the OSDI score was more than 12 were further taken up for complete ophthalmic work-up and evaluated by objective tests of TBUT and Schirmer's test and DED diagnosis was confirmed [6,7]. An interval of 10 minutes was given between the two objective tests.

OSDI questionnaire: The OSDI questionnaire consists of 12 questions and is used to give/scores in three (vision-related, ocular-symptoms

related and environmental-trigger) categories. Patients rate their responses on a 0-4 scale with 0 corresponding to symptoms present "none of the time" and 4 corresponding to "all of the time." A final score was calculated which ranges from 0-100 with scores 0-12 representing normal, 13-22 representing mild dry eye DED, 23-32 representing moderate DED, and greater than 33 representing severe DED [6]. (Allergen Inc, Irvine, Calif, USA).

Schirmer's Test: Schirmer's test was performed for assessing quantity of tears. A Schirmer's strip was placed at the junction of medial two-third and lateral one-third of the lower conjunctival fornix of both eyes. The strip was removed after 5 minutes. Wetness on the filter paper was measured. Wetness ≤10 mm was accepted as cut-off value for dry eye diagnosis. In each patient the mean score of both the eyes was calculated [7].

TBUT: Tear film stability was evaluated by using TBUT test. Commercially available fluorescein strip was applied on the inferior palpebral conjunctiva. The patient was asked to blink to distribute the fluorescein over the cornea. The tear film was examined with slit lamp biomicroscope. The interval between a complete blink and the first appearance of a dry point on the cornea was measured. An average of three measurements was recorded. A TBUT <10 sec was accepted as cut-off score for diagnosis of dry eye [7].

Patients diagnosed with DED were further analysed for risk factors by comparing the data with non DED patients. The risk factors analysed were-age, gender, occupation, duration of VDT use, previous ocular surgery, uncorrected refractive error, smoking, alcohol intake, use of face mask, systemic diseases like hypertension, diabetes mellitus, rheumatoid arthritis and COPD. Data for DED prevalence rate in the age groups of 18-40 years, 41-60 years and more than 60 years, was analysed to determine age as risk factor for DED.

DED prevalence was also assessed among various occupational groups given as below [8]

- Homemakers-those who stay at home and do household chores
- Outdoor workers-those who remain outdoors like farmers, drivers, labourers, etc
- VDT users-those who spend more than four hours a day on VDT like computer professionals, students and teachers involved in online classes, etc
- Others-Healthcare workers, shopkeepers, persons doing desk jobs without computer

STATISTICAL ANALYSIS

The collected data was entered on Microsoft excel sheet and then analysed on Statistical Package for Social Sciences (SPSS) version 22.0. Mean±Standard Deviation (SD) was calculated for quantitative data. Percentage and proportion was calculated for qualitative data. Chi-square test was used to establish association between categorical data. Fisher's exact test was used in case the frequency in contingency table was <5 for >25% of values. Wilcoxon-Mann-Whitney U Test was used for non normally distributed data. The p<0.05 was considered as statistically significant. The Odds Ratio (OR) was calculated and logistic regression analysis was done for significant risk factors.

RESULTS

In the present study, 820 patients presenting in OPD were administered OSDI questionnaire. Out of 820 patients, 384 patients were found to have OSDI score >12. On further subjecting these patients to TBUT and Schirmer's tests, 214 were found to have DED (26.1% prevalence).

The mean age of patients enrolled in the study was 39.65±15.52 years ranging between 18-79 years. DED was found to be more prevalent in females 120 (56.1%) as compared to males 94 (43.9%) which was not statistically significant (p=0.488). Among the three age groups, DED was found to be more prevalent in younger age group (18-40 years) accounting 94 (43.9%), which was statistically significant (p<0.001). Out of the 214 DED patients, 113 (52.8%) had mild dry eye, 95 (44.4%) had moderate and 6 (2.8%) had severe dry eye [Table/Fig-1].

Parameters	Dry Eye Disease (DED)		p-value
	Present (n=214) Frequency (%)	Absent (n=606) Frequency (%)	
Age group (years)			
18-40	94 (43.9)	371 (61.2)	<0.001[1]
41-60	73 (34.1)	178 (29.4)	
>60	47 (22)	57 (9.4)	
Gender			
Male	94 (43.9)	280 (46.2)	0.488[2]
Female	120 (56.1)	326 (53.8)	
Severity*			
Mild (12-22)	113 (52.8)	-	1.000[2]
Moderate (23-32)	95 (44.4)		
Severe (≥33)	6 (2.8)		

[Table/Fig-1]: Demographic profile of DED and non DED patients.
Significant at p<0.05, [1]: Wilcoxon-Mann-Whitney U Test, [2]: Chi-squared Test, n=No. of patients
*Severity based on OSDI score

Mean OSDI score in DED patients was 23.34±5.72 which was significantly higher (p<0.001) than the mean score of 11.31±6.97 in patients without DED. Mean Schirmer's score and mean TBUT was 7.07±3.23 mm and 5.63±1.93 seconds, respectively in DED patients which was significantly lower (p<0.001) than 26.77±6.41 mm and 12.42±2.98 seconds, respectively in non DED patients [Table/Fig-2].

Parameters	DED (mean±SD)	Non DED (mean±SD)	p-value
Schirmer's test (mm)	7.07±3.23	26.77±6.41	<0.001[1]
TBUT (sec)	5.63±1.93	12.42±2.98	<0.001[1]
OSDI Score	23.34±5.72	11.31±6.97	<0.001[1]

[Table/Fig-2]: Mean OSDI, Schirmer and TBUT scores in DED and non DED patients.
Significant at p<0.05, 1: Wilcoxon-Mann-Whitney U Test

Risk factors found to be significantly associated (p<0.05) with DED were-more than 3.71 hours of VDT use (p<0.001), previous ocular surgery (p=0.026), uncorrected refractive error (p=0.018), diabetes mellitus (p=0.001), hypertension (p=0.019), COPD (p=0.012), alcohol intake (p<0.001), mask use (p<0.001), occupational VDT users (p=0.001) and homemakers. No significant association was found with rheumatoid arthritis (p=0.090) and smoking (p=0.394). The mean duration of VDT use in DED patients was 3.71±2.70 hours and it was significantly higher than mean duration of VDT use of 2.59±0.66 hours in non DED patients (p<0.001) [Table/Fig-3].

Among the occupational risk factors, VDT users and homemakers were found to have significant association with DED (p=0.001, p=0.004, respectively). The mean duration of VDT use was 7.28±2.04 hours in occupational VDT users. Multivariate logistic regression analysis demonstrated significant odds of having DED in uncorrected refractive error (OR=1.66), more than 3.71 hours of VDT use (OR=2.48), diabetes mellitus (OR=1.93), COPD (OR=4.85), alcohol intake (OR=11.67) and mask use (OR=5.65) [Table/Fig-4].

DISCUSSION

The DED is a major cause of ocular morbidity globally affecting the daily lives of people. The prevalenpce of DED varies in different geographical areas due to variable climatic conditions, demographic and occupational profile. Reported DED prevalence in literature varies from 1.46-64% [9-11]. In the present study, prevalence of DED was found to be 26.1%. A similar North Indian tertiary hospital based study done by Titiyal JS, et al., reported DED prevalence to be 32% in which most of the patients had moderate dry eye

Parameters	Dry eye disease		p-value
	Present (n=214) Frequency (%)	Absent (n=606) Frequency (%)	
VDT hours*** (Mean±SD)	3.71±2.70	2.59±0.66	<0.001[1]
Occupation***			0.003[2]
Homemakers	87 (40.7)	182 (30.0)	0.004[2]
VDT users	60 (28.0)	246 (40.6)	0.001[2]
Outdoor workers	44 (20.6)	100 (16.5)	0.18[2]
Others	23 (10.7)	78 (12.9)	0.41[2]
Previous ocular surgery***	43 (20.1)	83 (13.7)	0.026[2]
Uncorrected refraction error***	113 (52.8)	263 (43.4)	0.018[2]
Systemic disease: DM***	68 (31.8)	127 (21.0)	0.001[2]
Systemic disease: HTN***	66 (30.8)	138 (22.8)	0.019[2]
Systemic disease: RA	6 (2.8)	6 (9.9)	0.090[3]
Systemic disease: COPD***	6 (2.8)	3 (0.5)	0.012[3]
Alcohol***	95 (44.4)	48 (7.9)	<0.001[2]
Smoking	46 (21.5)	114 (18.8)	0.394[2]
Mask use***	69 (32.24)	60 (9.9)	<0.001[2]

[Table/Fig-3]: Association between DED and Risk factors.
***Significant at p<0.05, [1]: Wilcoxon-Mann-Whitney U Test, [2]: Chi-squared Test, [3]: Fisher's Exact Test, n=No. of patients

Dependent: Dry eye disease		No	Yes	OR (univariable)	OR (multivariable)
Age (years)	Mean±SD	38.0±14.8	44.5±16.5	1.03 (1.02-1.04, p<0.001)	1.06 (1.04-1.08, p<0.001)
Occupation n (%)	Homemaker	182 (67.7)	87 (32.3)	-	-
	VDT users	246 (80.4)	60 (19.6)	0.51 (0.35-0.74, p=0.001)	0.18 (0.09-0.36, p<0.001)
	Outdoor worker	100 (69.4)	44 (30.6)	0.92 (0.59-1.42, p=0.710)	0.42 (0.23-0.74, p=0.003)
	Other	78 (77.2)	23 (22.8)	0.62 (0.36-1.04, p=0.074)	0.48 (0.23-0.96, p=0.042)
VDT	Mean±SD	2.6±0.7	3.7±2.7	1.58 (1.41-1.79, p<0.001)	2.48 (2.03-3.08, p<0.001)
Previous ocular surgery n (%)	No	523 (75.4)	171 (24.6)	-	-
	Yes	83 (65.9)	43 (34.1)	1.58 (1.05-2.37, p=0.027)	0.91 (0.50-1.62, p=0.740)
Uncorrected refraction error n (%)	No	343 (77.3)	101 (22.7)	-	-
	Yes	263 (69.9)	113 (30.1)	1.46 (1.07-2.00, p=0.018)	1.66 (1.09-2.52, p=0.018)
Systemic disease: DM n (%)	No	479 (76.6)	146 (23.4)	-	-
	Yes	127 (65.1)	68 (34.9)	1.76 (1.24-2.48, p=0.002)	1.93 (0.99-3.78, p=0.055)
Systemic disease: HTN n (%)	No	468 (76.0)	148 (24.0)	-	-
	Yes	138 (67.6)	66 (32.4)	1.51 (1.07-2.13, p=0.019)	0.66 (0.34-1.30, p=0.235)
Systemic disease: COPD n (%)	No	603 (74.4)	208 (25.6)	-	-
	Yes	3 (33.3)	6 (66.7)	5.80 (1.52-27.67, p=0.014)	4.85 (1.05-26.47, p=0.048)
Alcohol n (%)	No	558 (82.4)	119 (17.6)	-	-
	Yes	48 (33.6)	95 (66.4)	9.28 (6.26-13.93, p<0.001)	11.67 (6.98-19.97, p<0.001)
Mask use n (%)	No	546 (79.0)	145 (21.0)	-	-
	Yes	60 (46.5)	69 (53.5)	4.33 (2.93-6.42, p<0.001)	5.65 (3.10-10.41, p<0.001)

[Table/Fig-4]: Regression analysis for various significant risk factors.
The factors in which the odds ratio is >1 are significantly related to DED. All the values are at 95% CI

whereas in the present study, majority (52.8%) of the patients had mild dry eye [5].

It included both subjective (OSDI questionnaire) as well as objective tests (TBUT test and Schirmer's test) to diagnose DED whereas most of the previous studies have used either OSDI questionnaire or TBUT to diagnose DED. Most studies associate older age with increased risk of dry eye, whereas in this study, maximum prevalence of DED was found in the age group 18-40 years [12,13]. This can be attributed to the fact that this study was conducted during the COVID-19 pandemic in which online education and work-from-home was prevalent among younger population. Increased time spent indoors on digital screens and smart phones might have led to increased DED prevalence among younger age group. It is also evident from the results of mean duration of VDT use in DED patients of 3.71±2.70 hours which was considerably high.

In an Italian study done by Rossi GC et al., on professional VDT users, it was found that VDT use of more than four hours a day is a major risk to develop dry eye and these persons should take precautions to prevent the onset of the disease [14]. In the present study, occupational VDT users (those using VDT for more than four hours per day) were found to be at risk of developing DED with the mean duration of VDT use in those developing DED being 7.28±2.04 hours. Peck T et al., in their study on dry eye syndrome in menopausal and perimenopausal women concluded that alteration of sex hormones plays an important role in the pathophysiology of DED in this age group women [15]. Most of the homemaker population included in the present study were women of perimenopausal or postmenopausal age. This explains their significant association with DED.

Uncorrected refractive error was another significant risk factor predisposing to DED. People in rural areas are less likely to be compliant with spectacles and DED can result from eye rubbing or decreased blink rate in such people. Uncorrected refractive error was also found to be significantly associated with dry eye in the study of Jie Y et al., among adult Chinese in the Beijing Eye Study [16]. In the study on young adults of age 19-25 years, Fahmy RM

and Aldarwesh A concluded that refractive error could be linked to DED but the mechanism by which refractive error induces eye dryness is unknown [17].

Consistent with various other studies, previous ocular surgery was found to be a risk factor for developing DED, since ocular tear film is disturbed in the process [18,19]. DED was prevalent in 35% (68/195) of diabetics and 32% (66/204) of hypertensives. Al Houssien AO et al., in their study on magnitude of diabetes and hypertension among patients with dry eye syndrome at a tertiary hospital of Riyadh, Saudi Arabia concluded that the prevalence of hypertension, dyslipidaemia and diabetes among dry eye patients was 48.5%, 55.9% and 47.1%, respectively [20].

The COPD was another risk factor for DED identified in present study. Majority of the patients who had COPD were hookah smokers. This may lead to tear film instability by its irritant action. Baisoya P et al., studied prevalence and clinical profile of dry eye in tertiary hospital based normal healthy population and found smoking as most frequent risk factor (5.95%) [21]. You YS et al., did meta-analysis on relation of alcohol with DED and proposed that all alcoholics are at increased risk of developing dry eye [22]. In their study, majority of the male patients were alcoholics with regular consumption of alcohol (daily to thrice weekly). In the present study too, the odds ratio at 95% confidence interval, of regular alcohol consumption as a risk factor for dry eye was 11.67 which was significantly high.

Mask wearing was selected as one of the risk factors for analysis because this study was conducted during COVID-19 pandemic. Due to lack of awareness among rural population, only 129 people out of 820 were using mask despite the government advisory. Out of these, 69 patients (23%) were diagnosed with DED which was statistically significant ($p<0.001$). This reinforces the hypothesis of Mask Associated Dry Eye (MADE) suggested by Pandey SK and Sharma V [23].

Limitation(s)

Since this was a hospital-based study done on patients presenting with some ocular complaints in out-patient services, the sample population might not have truly represented the normal rural population. Another limitation was less participation of elderly population in 41-60 years age group as many denied to give consent.

CONCLUSION(S)

The DED is a significant cause of ocular morbidity in Haryana with a prevalence of 26.1%. Previous ocular surgery, uncorrected refractive error, hypertension, diabetes, COPD, alcohol intake, homemakers, occupational VDT users, mask use are the factors increasing the risk of developing DED. During the COVID-19 pandemic, DED was found to be more common in younger age group (18-40 years) which may be due to increased use of digital screens. Wearing mask is also associated with DED and MADE is an emerging significant disease entity. Looking at the enormous socio-economic impact associated with dry eye, more studies should be conducted in a diverse country like India with wide regional, cultural, occupational and climatic differences to enable identification of various risk factors of DED which is key to its early diagnosis, prevention and effective management.

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