DRY EYES AND ASSOCIATED RISK FACTORS

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Abstract

Objective: To establish an association between dry eye disease and its risk factors, particularly environmental pollution.

Methodology:

This was a cross-sectional study conducted in 2019 at the ophthalmology out-patient department, Ziauddin Hospital Kemari, Karachi. The sample size was 200 and patients with symptoms related to dry eye disease including gritty sensation, dry eye, burning, redness, crusting of eye lashes, sticking of eyelids and others were included in the study. The risk factor assessment was done by a self-administered questionnaire. Data regarding complaints and findings was taken from the patient's file after obtaining consent. Data entry and analysis was done on SPSS.

Results: Our study included 200 participants with a mean age of 32.4 ± 13.0 years with n= 103 51.8% males and n=96 48.2% females. Only a small proportion n=54 (27%) had outdoor occupations. N=27 13.6% were diagnosed with dry eye disease while in n=172 86.4% it was absent. A significant majority n=153 76.9% of the sample were nonsmokers. Majority of the people n=166 83.4% were using sui gas stoves. The most common ocular complaints were eyelash crusting (49.6%), eye feeling dry (45.7%), gritty sensation (49.8%), blurred vision (39.2%), burning sensation (42.2%) and redness (38.7%). Various risk factors had a significant association with dry eye disease, including recent history of Lasik procedure (p-value=0.008), exposure to chemical (p-value=0.013) or thermal radiation at work (p-value=0.001), decreased blinking frequency (p-value=0.01). High temperature (p-value=0.00) and low humidity (p-value=0.03) also had highly significant associations with the occurrence of dry eye disease.

Conclusion: Environmental pollution has a crucial role in the occurrence of ocular complaints related to dry eye disease. Therefore, appropriate actions should be taken to reduce pollution and implement protocols at workplaces to minimize chemical and radiation exposure to the workers.

Keywords: Dry eye disease; environmental pollution; visual problems; ocular complaints

Introduction

Dry eye Disease is characterized by a loss of homeostasis of the tear film and presents with ocular symptoms due to tear film instability, hyperosmolarity, ocular surface inflammation, damage, and neurosensory abnormalities. (1) It is a multifactorial disease with environmental factors being the most important contributor. These factors include high temperature,

atmospheric precipitation, humidity, ultraviolet radiation, and air pollutants including particulate matter and various gases including carbon dioxide, nitrous oxide and others. correlated with ocular and systemic diseases. (2) Due to the increased duration of exposure, the communities mostly affected by dry eye disease are usually outdoor workers belonging to the lower socioeconomic group. (3) Symptoms of dry eye disease range from asthenopia, foreign body sensation, burning, eye watering to more serious complaints like corneal ulcerations leading to a decrease in vision. (4) Moreover, it may also cause a decrease in the corneal refractive power, visual acuity, and ocular comfort. Among other causes of dry eye disease are infectious diseases such as trachoma and hypovitaminosis A. (5) Dry eye disease decreases work hours, the quality of work and patient's quality of life by being a source of constant irritation. (6)

Researches have revealed that the incidence of dry eye disease has increased in the out-patient departments in Pakistan. (7) The prevalence of dry eye disease in a hospital-based study in Lahore was 18.7% which was associated with an increased risk in people working outdoors or in air-conditioned areas, housewives, diabetics and smokers. (8) This has been attributed to the unfavorable working conditions due to an increase in population growth, urbanization, industrialization, motorization and energy consumption. (9) Air pollutants are responsible for allergic conjunctivitis, exacerbation of asthma and possibly modification of the tear film resulting in dry eye disease. (10) Therefore, great emphasis has been laid recently on identifying the association between dry eye disease and environmental factors. A research conducted in South Korea concluded that prevalence of dry eye disease can be affected by the degree of urbanization and environmental factors such as humidity and sunshine duration. (6) Epidemiological studies conducted globally have also shown an increase in the number of cases.

Dry eye disease is fairly difficult to treat but it is a preventable condition. (5) Not much research has been conducted in our region to determine the association between environmental exposure and the development of dry eye disease. Therefore, our study aims to find the association with environmental and other significant risk factors so it can serve as the basis for future research and derivation of governmental policies for the possible reduction and elimination of such pollutants.

Materials and methods:

This was a cross-sectional study conducted between July and September 2019. The estimated sample size was 200 and a stratified random sampling technique was applied. The target population were patients visiting ophthalmology out-patient department at Ziauddin Hospital, Kemari Campus, Karachi. Inclusion criteria was based on people who presented with symptoms of dry eye, including gritty sensation, dry eye, burning, redness, crusting of eye lashes, sticking of eyelids and others. Exclusion criteria was based on absence of the abovementioned symptoms and those with other eye diseases were also excluded. The data was collected by a self-administered questionnaire. An informed consent was taken at the beginning of the survey and those who did not wish to continue were allowed to leave the survey. The questionnaire was developed using a validated tool for ocular symptoms and through literature review and

researches conducted on similar topics (11). Demographic profile variables included age, gender, residence and occupation. Data regarding complaints and findings was taken from the patient's history and examination file after obtaining consent. The questions were related to ocular complaints and risk factors associated with dry eye disease particularly environmental pollution and its role in the development of dry eye disease. Data entry and analysis was done on SPSS Version 20. Descriptive analysis for numerical data was done through mean and standard deviation and for categorical data through frequencies and percentages. Chi square test was applied to identify associations between demographic factors and burden of dry eye disease. A p-value of less than 0.05 was taken as significant. Institutional ethical approval was taken from the institute prior to the initiation of the study.

Results:

Our study included 200 participants with a mean age of 32.4 ± 13.0 years. Our study had an equal representation from both genders with n= 103 51.8% males and n=96 48.2% females. Their occupations were listed with regards to being outdoors or indoors. Outdoor workers included n=8 (4.0%) agricultural workers, n=21 (10.5%) fishermen, and n=25 (12.5%) food vendors. Indoor workers included n= 29 (14.5%) factory workers, n=30 (15%) homemakers and n=81 (40.5%) had other professions with a combination of indoor and outdoor activities. In our sample, n=27 13.6% were diagnosed with dry eye disease whereas, in n=172 86.4% dry eye disease was ruled out.

A significant majority n=153 76.9% of the sample were nonsmokers whereas, n=46 23.1% were smokers. Moreover, participants were asked about the type of fuel used for cooking, majority of the people n=166 83.4% were using sui gas stoves, n=18 9.0% were using electric stoves whereas, n=10 5.0% were using wood while n=5 2.5% were also using coal as a fuel.

Figure 1.0: Common ocular complaints

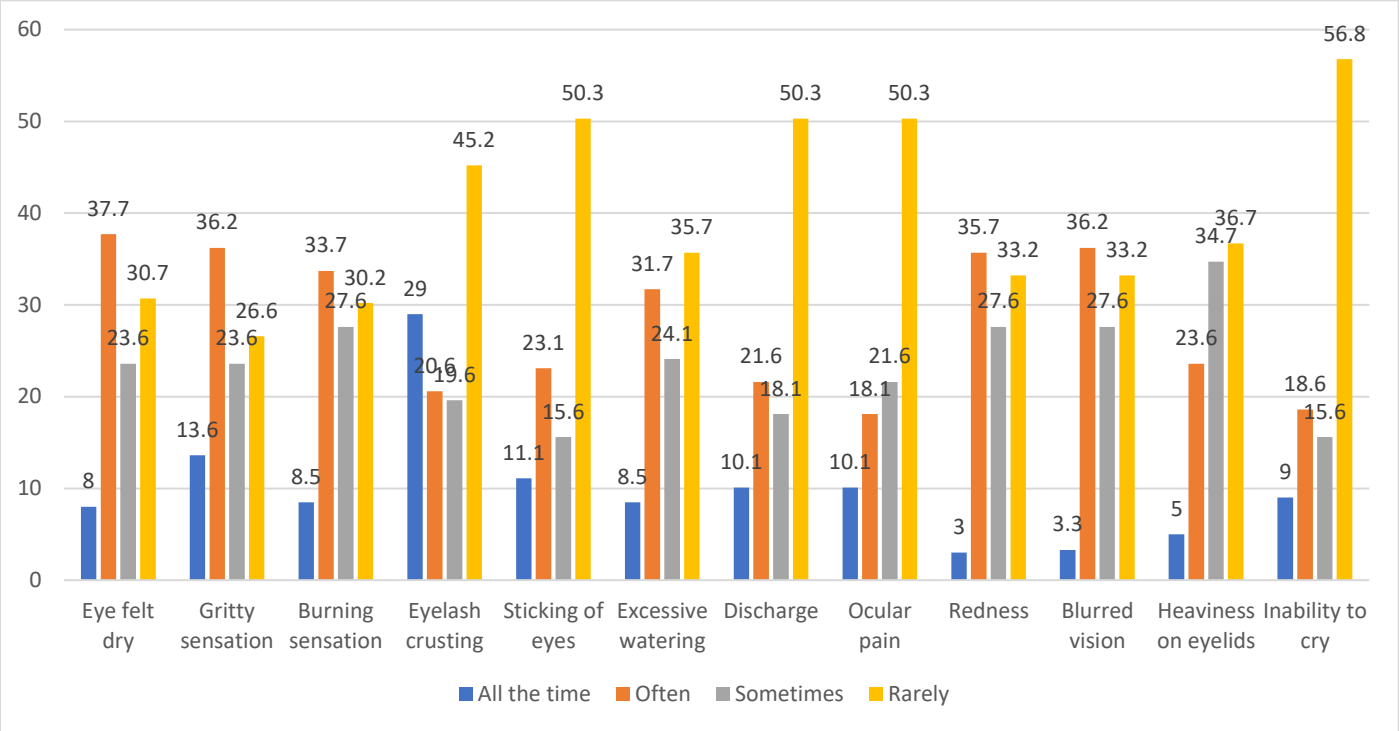

Figure 1.0 lists the common ocular complaints listed by the participants. Moreover, a significant majority, n=124 62.3% reported feeling uncomfortable after wearing contact lenses rarely. On the contrary, n=12 6.0% felt uncomfortable all the time, n=23 11.6% felt it sometimes and n=40 20.1% felt it often. Participants were asked if they felt uncomfortable while reading, n=16 8.0% stated all the time, n=45 22.6% often, n=38 19.1% sometimes while n=100 50.3% felt it rarely. Participants were asked if their eyes felt tired after watching a screen for long duration, they had mixed responses. While n=66 33.2% experienced it rarely, n=46 23.1% felt it sometimes, n=68 34.2% felt it often and n=19 9.5% stated they always felt tired with longer screen exposure. Moreover, the participants also had varying responses to eye fatigue with n=62 31.2% experiencing it rarely, n=71 35.7% experiencing it often, n=43 21.6% only feeling it sometimes and n=23 11.6% felt eye fatigue all the time.

Table 1.0: Dry eye disease and its associations

RISK FACTORS		Dry eye disease				p-value
		Present		Absent		
		n	%	n	%	
1. Associated skin disease	Yes	0	0	16	100	0.088
	No	27	15	156	85	
2. Associated other eye diseases	Yes	0	0	09	100	0.261
	No	27	14.2	163	86	
3. Pregnancy	Yes	02	40	03	60	0.137
	No	25	12.9	169	87.1	
4. Recently done Lasik	Yes	03	75	01	25	**0.008**
	No	24	12.3	171	87.7	
5.Surgery for refractive error	Yes	0	0	02	100	0.746
	No	27	13.7	170	86.3	
6. Exposed to chemical in your job	Yes	04	50	04	50	**0.013**
	No	23	12	168	88	
7. Exposed to thermal radiation	Yes	05	62.5	03	37.5	**0.001**
	No	22	11.5	169	88.5	
8.Suffer from any allergy	Yes	02	6.5	29	93.5	
	No	25	15	142	85	
9 Time spent on the computer	Yes	04	10.3	35	89.7	
	No	0	0	01	100	
10. Recently used vitamin supplement	Yes	07	14.3	42	85.7	0.516
	No	20	13.3	130	86.7	
11. Suffer from any other chronic disease	Yes	02	12.5	14	87.5	0.627
	No	25	13.7	158	86.3	
12. Feel dry eye more in summer or winter	Yes	07	17.1	34	82.9	0.306
	No	20	12.7	138	87.3	
13.Eye Makeup	Yes	02	6.7	28	93.3	0.184
	No	25	14.8	144	85.2	
14. Blinking frequency	Yes	10	27.8	26	72.2	**0.010**
	No	17	10.4	146	89.6	

Table 1.0 aims to determine associations of dry eye disease with various risk factors. A significant association was found between dry eye disease and previous history of lasik procedure, exposure to chemical and thermal radiation at work, and decreased frequency of blinking.

The participants were asked about the drugs they used on a regular basis. N=159 79.9% denied the use of antihistamines while n=40 20.1% were using it (p-value=0.210). Nasal decongestants

were being used by n=22 11.1% while n=177 88.9% were not using it (p-value=0.503). Only n=18 9.0% were taking sleeping pills whereas n=181 91.0% denied its use (p-value=0.298). N=25 12.6% were using antihypertensives on a regular basis while n=174 87.4% were not (p-value=0.024). Only n=10 5.0% of the sample was taking antidepressants whereas n=189 95% were not using them (p-value=0.119). N=6 3% of the population was also using anti-parkinsons drugs while n=193 97% were not using them (p-value=0.822).

Environmental factors played a significant role in the development of dry eyes. N=117 58.8% experienced humidity while n=81 41.2% did not experience any humidity. Moreover, n=126 63.3% were exposed to higher environmental temperatures as opposed to n=73 36.7% who were not. Majority of the population n=130 65.3% reported exposure to an environment polluted with dust while n=69 34.7% did not have exposure. Furthermore, a considerable proportion of the population n=112 56.3% were also exposed to automobile fumes whereas, n=87 43.7% were not exposed. The use of helmets while riding on bikes was crucial and only n=53 26.6% were using them while n=146 73.4% were not using helmets. The use of glasses while riding bikes was important n=67 33.7% were using them but n=132 66.3% were not using glasses. Personal hygiene was of significant importance, n=182 91.5% washed hands regularly while n=17 8.5% did not. N=157 78.9% were bathing daily whereas n=42 21.1% did not bathe daily.

Table 2.0: Effect of environmental risk factors on the development of dry eye disease

ENVIRONMENTAL FACTORS		Dry eye disease				
		PRESENT		ABSENT		p-value
		N	%	n	%	
1. HUMIDITY	Yes	21	17.9	96	82.1	0.03
	No	6	7.3	21	17.9	
2. TEMPERATURE	Yes	26	20.6	100	79.4	0.00
	No	1	1.4	72	98.6	
3. POLLUTANT CONTAINING DUST	Yes	18	13.8	112	86.2	0.88
	No	9	13	60	87	
4. AUTOMOBILE FUMES	Yes	17	15.2	95	84.8	0.45
	No	10	11.5	77	88.5	

Table 2.0 reveals the association between environmental risk factors including humidity, temperature, dust pollution and automobile fumes on the development of dry eye disease. There was a significant association with high environmental temperature and low humidity as 20.4% and 17.9% of those exposed to high temperatures and humidity respectively, developed dry eye disease.

Discussion:

Dry Eye Disease (DED) is a major concern particularly in our population as it is more prevalent among Asians. Environmental factors, climatic changes and geographic locations are significant contributors to the development of DED. (11) Among the most common symptoms identified by our sample population were eyelash crusting, eye feeling dry, gritty sensation, blurred vision, burning sensation and redness. Various studies have revealed redness and intermittent blurry vision as the most common ocular complaint in patients with DED. (11) Tear film instability has been associated with fluctuation in vision with blinking and scattering of light causing glare and halos. (12) A significant majority of the participants reported feeling uncomfortable after wearing contact lenses rarely while 20.1% felt it often. Studies conducted in the past have revealed a 2.38 times higher risk of having a diagnosis of dry eye disease in contact lens wearers than non-contact lens wearers. Moreover, a 3.61 times higher risk of having severe dry eye symptoms than non-contact lens wearers. (13) This is mostly due to the division of tear film into two layers including pre- and post- lens tear film which results in thinning of tear film thickness and increased friction between the contact lens and ocular surface. This has resulted in patients either changing contact lenses due to dissatisfaction or terminating its use completely. (14)

In accordance with previous studies, a significant association was found between previous Laser-Assisted In Situ Keratomileusis (LASIK) procedure and occurrence of dry eye disease in our study. DED is one of the most common post-operative complications related to this procedure and a significant proportion resolves on its own within the first post-operative year. A significant risk factor for the development of DED post-operatively is preexisting dry eye disease. Therefore, a careful examination including tear film assessment is crucial prior to the procedure. (15)

Other prominent risk factors for the development of DED are aging and systemic diseases. (16) Most of our sample population was young with a mean age of 32.4 years and did not have significant comorbid conditions which can be reflective of the reduced burden of DED. Previous studies have established a significant association between dry eye disease and conditions including hypertension, diabetes mellitus and autoimmune conditions. The effect may be due to the direct ocular damage due to these conditions, however, most of the impact is from the drugs taken for these conditions. These medications include anticholinergics, diuretics and even metformin. Moreover, antidepressants and anxiolytics also have an established relation with the development of DED. (17) However, in our study, majority of the population was not using any medications on a regular basis. Among those using antihypertensives, a significant association was found with the occurrence of DED which is in accordance to the previous studies conducted. Furthermore, patients with suspected dry eye disease should be screened for sleeping disorders characterized by short duration, poor sleep index, long sleep latency and others. These are more commonly found in women than in men. (18)

Occupation is a significant determinant for the incidence of dry eye disease. Studies have revealed the highest prevalence among professionals in legal, health, business and administration, clerical support workers. Furthermore, building workers and metal or machinery

workers also showed an elevated risk. However, skilled agricultural workers and elementary level professions had the lowest risk. A significant association was also found in our study among participants exposed to thermal radiations or chemicals at work. This is in accordance with various studies that have established changes in ocular surface and tear films among people who have occupational exposure to organic solvents for dry or other sorts of cleaning agents. (19)

A study conducted recently revealed the mean blinking rate of 19.74 ± 9.12 per minute at baseline. The rate of blinking reduces significantly with reading from a tablet or a book, with a higher reduction in the latter. A normal blinking rate is crucial to the maintenance of ocular surface and normal distribution of the tear film. Therefore, the increase in the hours of screen time with technological advances is resulting in a higher burden of dry eye disease. (20) Our study yielded similar results with a highly significant association between decreased blinking frequency and dry eye disease. The increase in the usage of smartphones and other devices in young children is predisposing them to the development of chronic eye conditions including dry eye disease. (21) Therefore, early intervention can be extremely helpful in reducing the burden of dry eye disease.

Among the most important contributors to the burden of dry eye disease is environmental pollution. The presence of various environmental pollutants including nitrogen dioxide, sulfur dioxide, carbon dioxide, particulate matter and others inflict direct alterations in the tear film, impairing its stability. (22) In accordance with existing research, our study also emphasized on the relation of high temperature and low humidity with DED. (23) The excessive dryness, hot temperatures and wind result in the evaporative form of dry eye disease, which is also the most common subtype. This occurs due to involvement of the lipid layer, further contributing to accelerated tear loss, decreased tear production and distribution. (24) The significant association between dry eye disease and environmental pollution indicates the importance of environmental protection acts.

In Karachi, particularly in the Kemari district where this research was conducted, the environmental pollution level is high. The proximity to various oil and gas storage facilities with direct access to port and hence movement of heavy transport vehicles contribute to the high level of environmental contamination. Despite these conditions, a significant proportion traveling on motor bikes were not using helmets or glasses, which could prevent the development of dry eye disease in the general population. Therefore, appropriate recommendations should be made at the governmental level and to organizations concerned with environmental pollution to ensure provision of protective equipment to the community residing in this area.

Moreover, this study can serve as the basis for studies in other areas of the city to build a comparative analysis with environmental pollution and various other causes. A reduction in reading and screen time can also serve as a healthy initiative. Early diagnosis and intervention at all ages can prevent the development of this condition and hence reduce the burden of disease. Dry eye disease is a chronic condition and once established, can affect routine activities including an individual's productivity at work. Therefore, measures should be focused towards prevention of dry eye disease. (25)

Conclusion:

Our research concluded a significant association of environmental pollution with ocular complaints related to dry eye disease of individuals residing in polluted areas. Therefore, appropriate actions should be taken to reduce pollution and provide ensure usage of protective materials to prevent the onset of dry eye disease. Moreover, protocols need to be devised and implemented at workplaces with significant exposure to chemicals and radiation to protect the health of all workers involved.

Conflict of interest: The authors have no conflict of interest to declare.

Acknowledgements: We would like to acknowledge the institute for allowing us to conduct this study.

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