Ocular Surface Status in Individuals Having Long-Term Occupational Sunlight Exposure

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Abstract- To investigate the ocular surface status in individuals having long-term occupational sunlight exposure. This study was carried out with a historical cohort design. Long-term occupational sunlight exposure was considered the main exposure. The exposure group included individuals who had direct sunlight exposure in their workplace (124 people with a mean age range of 31.6±6.32), and the non-exposure group was comprised of 182 people (mean age range of 31.6±6.32) who worked indoors and had no long-term exposure to sunlight during work hours. The mean of TBUT in the Sun-exposure group (10.91±6.64 sec.) was significantly lower than the non-exposure one (13.91±9.67 sec.) (*P*=0.001). 42.9 percent of the members of the non-exposure and 58.9 of the sun-exposure group demonstrated TBUT values lower than 10 seconds. While the mean of OSDI in the exposure group was higher than in the non-exposure group, this difference was not statistically significant. Based on the OSDI results, 51.6 percent of the non-exposure group and 58.9 percent of the exposure group suffered from dry eye. The prevalence of diseases such as Pterygium, blepharitis, and pinguecula in the sun-exposure group was significantly higher than in the non-exposure group (*P*<0.0001). Based on the results of this study, people who have long-term occupational sunlight exposure tend to have more unstable tear films compared with people who do not have such exposure. In addition, the prevalence of diseases such as Pterygium, blepharitis, and pinguecula is higher among these people.

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Introduction

Long-term sunlight exposure, due to its ultraviolet waves, can cause serious damage to the body's surface, including the eye and skin (1-4). Research has shown that ultraviolet rays can cause disorders such as lid malignancies, climatic droplets, keratopathy, Pterygium, ocular surface squamous neoplasia, and cortical cataract (5-7). On the other hand, there is some evidence denoting the relationship between the long-exposure to ultraviolet rays and pinguecula and nuclear and sub-capsular cataracts (3,8-10).

In a number of previous studies, long-term exposure to sunlight and living in tropical and hot climates regions have been considered risk factors for ocular/eye diseases (6,11,12). The high prevalence of dry eye occurring in some tropical regions in some studies is believed to be connected with heat and long-term exposure to sunlight (11-13). In addition, a number of studies have reported considerable prevalence of Pterygium and pinguecula in tropical regions and have considered constant exposure to sunlight as a source of ultraviolet rays as a risk factor for these diseases (5,6,10,14).

People who are working in some occupations are exposed to long-term sunlight. Such conditions can raise concerns over the skin and eye diseases. Since ocular adnexa, especially eyelids and the surface of the eye,

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including cornea, conjunctiva, and tear film, have high levels of exposure, it is necessary that a complete ocular surface examination be carried out for such people so that possible ocular damages are diagnosed, and preventive measures are considered for further action. The aim of the present study is to investigate the ocular surface health status among individuals who have long-term occupational sunlight exposure and compare the findings with people who do not have similar sunlight exposure.

Materials and Methods

General methodology

This study was carried out via a historical cohort design in 2018 in Iran. Long-term occupational sunlight exposure was considered the main exposure, based on which two groups were formed. The exposure group included individuals who had direct sunlight exposure in their workplace; on the other hand, the non-exposure group was comprised of people who worked indoors and had no long-term exposure to sunlight during work hours. Both of the study groups were selected from staff working in Tehran's airports.

The mean current job experience was 9.08±4.78 years in the exposure group, with a mean exposure of 106.61±48.96 hours per month. This study only included individuals who did not use any ocular protection during working hours, including sunglasses and hats.

Having any history of eye/ocular surgery, including cataract and any type of corneal surgery, were considered as the exclusion criteria from both groups. Helsinki Declaration principles were fully observed in this study. The study was confirmed by the Ethics Committee of "…" the University of Medical Sciences. Written informed consent was obtained from all the participants of the study. The participants were assured that all information was to be treated confidentially and anonymously. The airport staff was invited for a complete ocular examination after coordination with Tehran's airport management. The examinations were carried out in the clinic located at the airport.

Ocular examinations

Having met the inclusion criteria, the participants were asked about their demographic information, which was recorded in the examination forms. Then, the participants were asked about the number of hours of sunlight on daily and monthly bases. Questions were also asked about the number of years in that occupation. Next, the OSDI questionnaire was filled out by the participants. The questionnaire includes 12 questions dealing with problems related to dry eye. Complaints such as sensitivity to light, foreign body sensation, discomfort, and other symptoms of dry eye in various activities such as driving or using computers are investigated. In addition, it investigates any other ocular discomfort in various environments, such as humidity and the existence of air conditioning. Then, the visual acuity was assessed, and refraction was carried out for both eyes of all participants. In this stage, a complete examination was performed on the eyelids and the ocular surface using a slit lap. To do so, via a diffuse illumination method, firstly, an overall view of the whole ocular surface. In case of the existence of any kind of abnormality in any of the eye structures, including eyelid, tear film, conjunctiva, and cornea, further, and more detailed examination would be run in that region. The bulbar and palpebral surfaces of conjunctiva were examined regarding the occurrence of any hyperemia, inflammation, and degenerations, including pinguecula and Pterygium. The corneal surface was screened for any change in color and transparency. The Upper and lower lid margins of both eyes were also examined. The existence of any type of seborrhea, hyperemia, telangiectasia, and other signs of lid diseases was investigated and recorded. The Meibomian gland orifices in the lid margin were meticulously observed, and any pouting, recession, or plugging in the meibomian orifice was recorded if it existed. Furthermore, the surface of the tear film was scanned via the diffuse method, and then the existence of any abnormal and extra lipid, extra debris, and foam in the tear was analyzed with higher magnification and via the parallelepiped method. The tear meniscus on the eyelids was checked for the existence of any particles or foam, and any abnormality was recorded.

After completing the examinations, a fluorescein strip was wetted with a drop of normal saline and touched the inferior bulbar conjunctiva while the participant was asked to look upward and then blink slowly twice so that the fluorescein is spread in the eye. Then the ocular surface was examined with regard to any staining, and cases of staining were recorded in case of existence. After a short pigmentation test, it was time for the tear break-up time (TBUT) test. To run this test, we prepared broad cobalt blue light with low magnification (around×6 or ×10) with the slit lamp. The participant was asked to open his/her eye slowly, and the light was focused on the surface of the cornea. The participant was asked not to blink until told. We started the chronometer immediately after the patient opened his/her eye. In this condition, an even green surface was seen in the cornea. As opening the eye continued, upon the appearance of the first place with a black or dark stain anywhere on the surface of the cornea, the time was recorded as the tear break-up time. This test was carried out three times for each eye, and the average time was recorded as the result of TBUT per second on the participants' record sheet.

Definitions and criteria

In this study and for the TBUT test, values more than15 seconds were considered normal, between 10 and 15 as borderline, and less than 10 as abnormal and hence dry eye. To analyze the results of the questionnaire, firstly, each participant's score was calculated as follows. The sum of all scores in each questionnaire was multiplied by 25, and this was divided by the number of answers in each questionnaire. Like some other studies, a score that was equal to or more than 23 was considered symptom positive.[15] In addition, to demonstrate the intensity of the symptoms, OSDI was categorized into four groups normal (0-12), mild (13-22), moderate (23-32), and severe (X≥33) (15).

Statistical analyses

Data in the present study were analyzed using SPSS software. Independent samples T-test was used to compare the results of TBUT tests between exposure and non-exposure groups. In addition, chi-square was used to compare the frequency of eye disorders such as dry eye, pinguecula, Pterygium, and blepharitis.

Ethical issues

The Ethics Committee of Baqiyatallah University of Medical Sciences approved the study protocol, which was conducted in accordance with the tenets of the Helsinki Declaration. All participants signed written informed consent.

Results

In the present study, data obtained from 124 participants in the sun exposure (101 male) and 182 participants in the non-exposure group (110 male) was analyzed. The mean age of the sun-exposure was 31.60±6.32 and 32.01±5.96 years in the sun-exposure and non-exposure, respectively. Based on the results of the independent samples test, there was no statistically significant difference between the groups. The mean occupational exposure in the sun-exposure group was 9.04±4 years. To investigate the prevalence of eye disorders, including Pterygium, pinguecula, and other ocular disorders and abnormalities, the existence of such diseases in one or both eyes was considered a positive symptom for the participant. To study the results of the TBUT test, the information related to the eye with the worse condition was considered for comparison.

The descriptive indices related to the TBUT and the OSDI questionnaire are presented in Table 1.

Table 1. Mean and standard deviation values of the tear break up time and ocular surface disease index

		TBUT		OSDI	
	n	**Mean**	**SD**	**Mean**	**SD**
Sun-exposure	124	10.91	6.64	18.04	15.10
Non-exposure	182	13.91	9.67	15.25	12.92

TBUT: Tear Break Up Time, OSDI: Ocular Surface Disease Index, SD: Standard Deviation

According to this table, the TBUT values were lower among the sun-exposure group compared with those of the non-exposure group, and this difference was statistically significant (*P*=0.001). Considering TBUT<10 as the indicator for tear instability, 42.9% and 58.9% of non-exposure and sun-exposure were included in this range and showed tear film instability.

In addition to the analysis of the TBUT indicator as the indicator for the quality of tears, which is considered an objective diagnostic criterion for dry eye, the results of the OSDI questionnaire were also analyzed. As indicated in Table 1, the mean of the OSDI indicator in the sun exposure was higher than in the non-exposure group. However, this difference did not prove to be statistically significant.

Considering OSDI>13 as dry eye, 51.6% of the non-exposure and 58.9% of the sun-exposure group were afflicted with this disease. The results of OSDI based on the dry eye categorization are presented in Table 2. The frequency and prevalence of pinguecula, Pterygium, and blepharitis in two groups of the study are presented in Table 3. According to the table above, the prevalence of eye diseases and disorders in the sun-exposure group is higher than those of the non-exposure group. All three of these differences indicated a statistically significant difference. The observed difference in the prevalence of all three diseases among sun exposure and non-exposure was also statistically significant (*P*<0.0001).

Table 2. Classification of severity of the dry eye based on the Ocular Surface Disease Index findings

	The severity of the dry eye			
	Normal	**Mild**	**Moderate**	**Severe**
Non-exposure	48.4%	30.8%	9.9%	11.0%
Sun-exposure	41.1%	33.9%	9.7%	15.3%

Table 3. The prevalence (percentage) of the ocular surface diseases

	Blepharitis	**pterygium**	**Pinguecula**
Sun-exposure	46	1.61	9
Non-exposure	43	0.54	5

Discussion

The present study was carried out aiming to comprehensively investigate the ocular surface of individuals who had long-term occupational sunlight exposure with people who did not have such exposure. According to the results of this study, people who have long-term exposure to sunlight tend to have more unstable tears compared with people who do not have such exposure. The difference in TBUT between groups was three seconds. This finding is statistically significant, and clinically it is partly noticeable. A number of reasons could be mentioned for such a result. The high prevalence of pinguecula, Pterygium, and blepharitis in the sun-exposure group could be among the likely reasons for the unstable tear (16-18). Various studies have reported that ocular problems such as Pterygium and pinguecula, which cause elevated surface in the conjunctiva or cornea, may give rise to disruption in tear distribution and eventually reduce the TBUT and cause evaporative dry eye (12,19).

Blepharitis, as inflammation of the lid margin, is usually a chronic disorder and can be another reason for tear instability (20-22). Posterior blepharitis, which is inflammation of the meibomian gland and is usually called meibomian gland dysfunction, is known to be the main cause of evaporative dry eye (22,23). In this disease, the meibomian glands, responsible for the release of the fat layer of tears, experience disorder and release excessive and abnormal fat. This, in turn, causes an increase in tear density and, therefore, its instability on the ocular surface (22). The results of our study indicated that blepharitis is more prevalent among the sun-exposure group compared with the non-exposure one. Whereas the difference was not statistically significant, this factor can provide still another explanation for the low tear stability in the sun-exposure group.

Based on the results of this study, nearly 43% of participants in the non-exposure group and 60% of the sun-exposure group had less than 10-second TBUT and, therefore, suffered from tear instability and dry eye. These objective findings were in line with the subjective evaluation of the tear system done by the OSDI questionnaire. According to OSDI results, around 50% of participants in the non-exposure and 60% of the sun-exposure groups suffered from dry eye. Accordingly, it can be said that the objective and subjective evaluations of the tear system were, to a great extent, compatible. Both of these findings were indicative of a higher prevalence of dry eye among members of the sun-exposure group. Nevertheless, it should be noted that the difference in the OSDI in our study was not statistically significant, probably due to the low volume of the sample. Previous studies have shown that the prevalence of dry eye tends to be higher in tropical and hot climates. In addition, high temperature and long-term sun exposure have been considered risk factors for dry eye (11,12).

The prevalence of diseases such as Pterygium and pinguecula as the most common degenerative ocular surface disorders in the sun-exposure group was found to be higher than non-exposure. This finding is in agreement with findings from previous studies (6,10,24,25). In general, long-term exposure to sunlight, as one of the main sources of ultraviolet light, has been regarded as one of the main risk factors for Pterygium and pinguecula (3,5,14). Studies have further indicated that people living in hot tropical climates and having long-term exposure to sunlight demonstrate a higher prevalence of such disorders (24,26,27).

Generally, based on the present study, it can be concluded that the tear film stability among individuals with long-term occupational sun exposure is lower compared with people who do not have such exposure. The prevalence of abnormality in the TBUT indicator is higher in the sun-exposure group. Based on the results of OSDI, the sun-exposure group showed higher rates of dry eye compared with the non-exposure group. This difference, however, failed to prove statistically significant. Prevalence of ocular surface diseases such as Pterygium and pinguecula, as well as blepharitis, was found to be higher in the sun-exposure group, and differences were statistically more significant. Clinically, these differences were negligible, though. It is recommended that supportive facilities against sunlight, including caps and absorbent sunglasses, be used by people who have long-term exposure to sunlight so that the possibility of afflicting ocular surface disorders is reduced.

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