International Journal of Natural Sciences: Current and Future Research Trends (IJNSCFRT)
ISSN (Print) , ISSN (Online)

https://ijnscfrtjournal.isrra.org/index.php/Natural_Sciences_Journal/index

The Effect of Smoking on the Ocular Surface, Tear Film, and Central Corneal Thickness

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Abstract

Background: As a global health issue, smoking is a growing concern for Saudi Arabia and the world. It is known that exposure to harmful chemicals in cigarettes can affect the anterior ocular surface. Main purpose: The objective of this study is to investigate the effects of smoking on the central corneal thickness and the ocular surface parameters at smokers. It also compares the results with those of non-smokers and passive smokers. Materials and Methods: A cross-sectional study was adopted and comprised 118 participants: 50 smokers, and 68 non-smokers. The goal of the Speed II Questionnaire was to assess the severity of ocular surface disease symptoms. Participants were tested using various methods, such as the Schirmer's II test, tear Meniscus height (TMH), the Non-Invasive Break-Up Time (NIK-BUT), and Central corneal thickness (CCT). Results: The difference in Schirmer's scores and those of the other parameters were statistically significant. The mean values of all dry eye parameters were also different between the groups of smokers and non-smokers. The mean Corvis ST was less for both right and left eyes, but this difference was not significant. The dry eye symptoms (Dryness, Grittiness or Scratchiness, Soreness or Irritation, Burning or Watering, and Eye Fatigue) showed a statistically significant association among groups ($p < 0.01$). Conclusion: Cigarette smoking causes dry eye parameters like Schirmer test score, TMH, and TBUT to deteriorate. Also, we found a strong correlation among groups and dry eye symptoms in terms of frequency and severity. The smoker group had the most suffering of dry eye symptoms in terms of frequency and severity. However, CCT was discovered to be unrelated to smoking. More researches are needed to identify the molecular basis of the relationship between smoking intensity and its effect on the tear film and corneal thickness in terms of free radicals.

Keywords: Cigarette smoking; Ocular surface; Dry eye; Central Corneal Thickness; Speed Dry Eye.

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1. Introduction

Smoking is one of the most prevalent problems in today's world, and it has a hugely detrimental impact on people. Many people develop this habit due to stress, personal problems, and other factors [1]. Cigarette smoke contains a lot of oxidants, which depletes antioxidants in the blood and tissues. Nicotine has been shown to suppress the immune system, making it more difficult to defend the body from illness and mend or repair tissues. Cigarette smoking has been found to cause morbidity and early death, with the most common causes being myocardial infarctions, cerebrovascular accidents, lung cancer, and chronic obstructive pulmonary disease. Cigarettes can destroy the eye as well as practically every other organ in the body. Unlike the other health implications of smoking, vision impairment does not kill people, but it has a significant impact on their quality of life [2].

When a person smokes a cigarette, they are harming themselves and those around them. Smoking has several negative consequences for the human body. It has long been proven to cause cardiovascular disease and lung cancer, but many people are unaware that it can also cause vision loss. Cigarette smoke is a significant source of heavy metals and hazardous mineral elements, toxic at high doses [1]. These poisonous chemicals have various negative physiologic effects, including severe pathological changes in several organs, including the eye. Smoke particles and noxious gases like nicotine and carbon monoxide can affect the circulatory system by causing vasospasm, platelet aggregation, or oxidative damage to lipids, proteins, and cellular DNA [2].

Among the five most significant factors that can affect a person's life, smoking is regarded as the most avoidable cause of death. It accounts for over one out of ten adult fatalities annually. Tobacco use is expected to kill over eight million people by 2030 [3]. Cigarettes consist of over 4000 toxic substances that have been linked to malignant diseases, respiratory, and a variety of cardiovascular, as well as ophthalmological conditions like ocular inflammation, thyroid ophthalmopathy, age-related macular degeneration (ARMD), diabetic retinopathy (DR), primary open-angle glaucoma (POAG), dry eye disease (DED), and optic neuritis (ON) [4].

Smoking affects the eyes as well. The toxins in cigarettes also may lead to a decrease in the flow of blood in the eye's blood vessels, which can lead to the formation of blood clots. Smoking produces free radicals, which decrease cell activity and have been linked to ocular illnesses. Smoking has been linked to various eye health problems, including cataracts and age-related macular degeneration (ARMD). Recent studies have shown that the link between smoking and inflammation is stronger than previously believed. In addition, smokers are more prone to developing severe diseases such as cataracts, glaucoma, and poor of the vision. Smoking has also been demonstrated to increase the impact of genetic predisposition on the occurrence and progression of ARMD [4,5].

Studies have shown that cigarette smoking can increase the risk of developing various eye diseases such as age-related macular degeneration, glaucoma, cataracts, and dry eye disease. Dry eye disease (DED), also known as keratoconjunctivitis sicca, is a multifactorial condition marked by ocular surface irritation and a high tear osmolality. DED affects the ocular surface, Meibomian glands, the major lacrimal glands, and innervation. Dry eye disease was once assumed to be a problem with insufficient tear volume, but it is now recognized as a tear

composition abnormality in which the tear loses its ability to maintain the ocular surface. Either episodic or chronic DED can occur. Extensive visual activity with decreased blinking is among the factors that contribute to episodic DED. Chronic DED is exacerbated by the same factors that cause acute DED, but the symptoms last longer [6,7].

Although it has been known that smoking can increase a person's risk of chronic diseases, such as diabetes, it is still not known if it can also increase the risk of dry eye [8]. Dry eye is a multifactorial illness characterized by ocular surface changes that result in tear film damage, irritation, redness, light sensitivities, decreased vision, and other signs and symptoms. Dry eye is expected to impact 5 % to 35 % of the global population at various ages, with the frequency of occurrence increasing [9].

Dry eye is linked to several risk factors, including the environment, lifestyle, age, sex, drug history, and systemic illnesses, with lifestyle variables having the most influence. Although it has been known that smoking can increase a person's risk of chronic diseases, such as diabetes, it is still not known if it can also increase the risk of dry eye [10]. In the Saudi setting, there is little evidence of the effects of cigarette smoke on the eye, particularly in terms of anterior ocular surface-related pathology [11].

The Saudi government is dedicated to increasing the quality of preventative and therapeutic health care services as part of its Vision 2030. The government is focusing its efforts on improving preventive care and reducing outbreaks of infectious diseases. It has been estimated that tobacco use kills around 7 million people annually. This is considered a major public health crisis by the WHO. More than 6 million individuals die as a direct result of tobacco use, while 890,000 nonsmokers die due to secondhand smoke exposure. In Saudi Arabia, the prevalence of tobacco use is considered one of the most serious public health issues. This issue has implications for both users and secondhand smokers. Due to the increasing number of smokers and the rising number of deaths caused by smoking-related illnesses, it is important that the government and health organizations take effective measures to control tobacco use in Saudi Arabia [12,13,14]. The objective of this study is to determine smoking effects on the tear film and central corneal thickness. It also aims to compare the results with those of non-smokers and passive smokers in Saudi Arabia.

2. Materials and Methods

2.1 Study Design, sample, and sampling

Cross-Sectional Study Design. All participants signed informed consent before the start of the study and after explaining all study procedures. There was no particular order in which the participants were examined. Because most of the participants were students, they came to the clinic in their own free time for the measurements to be done. To avoid the effect of diurnal variation on tear stability, most of the examinations were done in the morning between 9.00 a.m. and 1.00 p.m. Participants first completed the SPEED questionnaire of dry eye score. They were examined Visual acuity (VA), Schirmer test, Tear Film Break-Up Time (BUT) & Tear meniscus height (TMH) by using an oculus keratography, and measure the CCT by using the Corvis ST (CST) device as follows:

2.2 Visual acuity (VA)

The vision will be measured using The Visual acuity (VA), the most widely used and well-understood measure of visual acuity. Visual acuity is significant because it allows for assessing central corneal clarity, central lens clarity, central macular function, and optic nerve conduction all at the same time. The most common method is to utilize the Snellen chart. There are various types of eye charts available. These include the log-MAR chart, Landolt C, the E chart, the Lea test, the Golovin–Sivtsev table, the Rosenbaum chart, and the Jaeger chart. So, the (VA) will be measured by using Snellen chart. Ametropia, or a difference of more than two diopters between the two eyes, will be excluded in my study [15].

2.3 Schirmer's II test

The Schirmer test will use filter paper and anesthetic to see if the eye generates enough tears to keep it moist. The Schirmer strip's rounded wick end will be folded and placed one-third of the distance between the lateral canthus and the lower fornix of the eye. The subjects will be asked to close their eyes for 5 minutes before the strip is removed and the wet length (mm) to the folded line is measured. Borderline dry eye is less than 10 to 5 mm, while the dry eye is less than 5 mm. A value of more than 10 mm is regarded as normal [16].

2.4 Oculus keratography

Keratograph 4 (Oculus GmbH, Wetzlar, Germany) will be used to image all of the participants. Keratograph 4 is a non-contact device that integrates a single unit's keratometric and topographic measurement methodologies. Using the Oculus noninvasive Keratograph 4 tear breakup time (NIKBUT) equipment. The corneal surface will be measured using a system of rings reflected at the cornea, each with over 1,000 measurement points, yielding thousands of evaluated data points every frame. Dry eye affects people who have less than 10 seconds of breakup time. BUT >10 seconds is normal, 5 to 10 seconds mild to moderate dryness, and 5 seconds severe dryness. Also, I will measure the TMH by (OCULUS Keratograph) The TMH is categorized into three classes from grade 0 to grade 2 according to the approach established by Santodomingo-Rubido and his colleagues (2012), showing the normal value (>0.2mm), the critical value (0.2mm), and the dry eye (<0.2mm) [17,18].

2.5 The Corvis ST (CST)

I will measure the central corneal thickness by using the Corvis ST, It is a non-contact tonometer that can be used to investigate the cornea's dynamic response to an air impulse. The camera has an image resolution of 640 480 pixels and can cover up to 8.5 mm of a cornea. Riccardo and Paolo Vinciguerra from Italy created the Corvis Biomechanical Index to diagnose early keratoconus based on the cornea's biomechanical response. Tonometry and pachymetry can both be measured using this gadget. The average corneal thickness ranges from 470 to 630 microns. CCT was measured using Corvis ST pachymetry. Before measurements, I will ask the participants to completely blink twice to establish a smooth tear film on the cornea [18].

This study included around 200 eyes of 50 smokers & 68 nonsmokers. Their age ranged from 18-35 years. They were recruited from King Saud University and the Saudi community in Riyadh, Saudi Arabia.

2.6 Inclusion and Exclusion Criteria

Aged from 18-35 years, who were smokers and non-smokers. Normal Subjects. The participants should not have ametropia, or the difference between the two eyes more than two diopters. The study will only be conducted on participants who don't have a history of having any type of eye surgery, including LASIK, and who are not currently using contact lenses. It will also exclude those who have conditions such as dry eyes and ocular surface diseases such as herpes simplex virus infection, varicella-zoster virus infection, Stevens-Johnson syndrome, and having chronic allergic eye disease. In addition to some of the medications that may trigger dry eyes include antihistamines, antiglaucoma drugs, and vasoconstrictor.

2.7 Ethical considerations

Ethical approval was obtained from the ethical review board at King Saud University and will follow the principles outlined in the Helsinki Declaration; therefore, informed consent will be obtained. Financial support will not be obtained. Participants' consent to participate will be gained before the clinical examination and using the survey. No identifying information will be obtained, and all other information will be kept confidential.

3. Results

This study comprised 118 participants: 50 smokers, 50 nonsmokers, and 18 passive smokers. The mean age of the smoker group was 28.82 ± 5.344 years, and the mean age of the nonsmoker group was 24.36 ± 4.645 years, while the mean age of the passive smoker was 25.56 ± 5.543 years. There was a statistically significant difference in mean age between groups; smoker men were older than other groups ($p < 0.001$). About sex, there was a statistically significant difference between male and female, men have the highest percentage among smokers (n = 42, 84%) ($P < 0.001$) ,which meanssmoking was less prevalent among females in the study area [Table 1]**.**

Table 1: Age and sex distribution of study participants

		Nonsmoker (n=50)		**Passive Smoker (n=18)**		**Smoker (n=50)**		**p-value**
Variables		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	
Age (year)		24.36	4.645	25.56	5.543	28.82	5.344	<0.001**[a]
Sex		n	%	n	%	n	%	
	Male	9	18	5	27.8	42	84	<0.001**[b]
	Female	41	82	13	72.2	8	16	

**: Significant at 0.01, a: ANOVA Test, b: Chi square- Test

Schirmer's scores for nonsmokers and passive smokers were higher than smokers' scores, who had the least Schirmer's mean scores (23.70 ± 7.94) for the right eye and (23.14 ± 8.32) for the left eye. The difference in Schirmer's scores was found to be statistically significant (P < 0.001). Mean TMH was lower among smokers (0.22 ± 0.04 mm) than in both nonsmokers (0.27± 0.0.04 mm) and passive smokers (0.26± 0.03 mm). The difference in TMH was found to be statistically significant (P < 0.001). Also, the mean NIKBUT was less in the smokers (8.91 ± 3.77 s) for the right eye than in both nonsmokers (12.35 ± 5.38 s) and passive smokers (9.56± 4.90 mm). For the left eye, the smokers had (9.08 ± 3.69 s) less than both nonsmokers (12.48 ± 5.32 s) and passive smokers (9.77± 4.57 mm). The difference in NIKBUT was found to be statistically significant (P < 0.001). However, the mean Corvis ST was less AMONG smokers for both right and left eyes, but no statistically significant difference was found (p >0.05) [Table 2].

Table 2: Comparison of dry eye parameters between smokers, passive smoker and nonsmoker

Parameters		**Nonsmoker**		**Passive Smoker**		**Smoker**		**ANOVA (p-value)**
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	
Schirmer II Test	R	28.3000	3.36397	25.0000	6.73883	23.7000	7.93661	<0.001**
	L	28.2200	3.51260	24.9444	6.80374	23.1400	8.32015	<0.001**
Tear Meniscus Height (TMH)	R	0.2712	0.04570	0.2550	0.03382	0.2216	0.04391	<0.001**
	L	0.2726	0.04351	0.2611	0.03939	0.2212	0.04317	<0.001**
NIK_BUT	R	12.3560	5.38134	9.5611	4.90104	8.9120	3.76903	<0.001**
	L	12.4800	5.32131	9.7778	4.57044	9.0800	3.69859	<0.001**
Central Corneal Thickness (Corvis ST)	R	549.7600	26.38225	547.1111	27.94720	545.7200	29.09873	0.765
	L	549.6000	25.15990	546.5556	26.68602	542.7000	30.32629	0.462

**: Significant at 0.01

The dry eye symptoms (Dryness, Grittiness or Scratchiness, Soreness or Irritation, Burning or Watering, and Eye Fatigue) showed a statistically significant association among the groups, (p <0.01). Where the smokers had the highest percentage of those symptoms [Table 3].

Table 3: Comparison of dry eye symptoms type between smokers, passive smoker and nonsmoker

			Nonsmoker	Passive Smoker	Smoker	Chi-Square	p-value
Dryness, Grittiness or Scratchiness	No	n	41	12	25	11.428	0.003**
		%	52.6%	15.4%	32.1%		
	Yes	n	9	6	25		
		%	22.5%	15.0%	**62.5%**		
Soreness or Irritation	No	n	49	17	38	12.380	0.002**
		%	47.1%	16.3%	36.5%		
	Yes	n	1	1	12		
		%	7.1%	7.1%	**85.7%**		
Burning or Watering	No	n	48	13	28	21.697	<0.001**
		%	53.9%	14.6%	31.5%		
	Yes	n	2	5	22		
		%	6.9%	17.2%	**75.9%**		
Eye Fatigue	No	n	50	14	39	12.636	0.002**
		%	48.5%	13.6%	37.9%		
	Yes	n	0	4	11		
		%	0.0%	26.7%	**73.3%**		

**: Significant at 0.01

Comparing the frequency of dry eye symptoms between smokers, passive smokers, and non-smokers showed statistically significant relationships between the group and the frequency of dry eye symptoms. The frequency of dry eye symptoms among the smoker's group was significantly constant and more often ($p < 0.05$) [Table 4]. Comparing the frequency of dry eye symptoms between smokers, passive smokers, and non-smokers showed statistically significant relationships between the group and the frequency of dry eye symptoms. The frequency of dry eye symptoms among the smoker's group was significantly constant and more often ($p < 0.05$) [Table 4].

Comparing the dry eye symptoms severity between smokers, passive smokers, and nonsmokers showed statistically significant relationships between the group and the dry eye symptoms severity in three types (dryness, grittiness or scratchiness, burning or watering, and eye fatigue), where the of dry eye symptoms severity among the smoker's group was significantly higher in cases of discomfort, bothersome and intolerable than the other two groups ($p < 0.05$). However, the severity of soreness or irritation showed a nonsignificant difference among groups ($p > 0.05$) [Table 5].

Table 4: Comparison of dry eye symptoms frequency between smokers, passive smoker and nonsmoker

			Nonsmoker	**Passive Smoker**	**Smoker**	**Chi-Square**	**p-value**
Dryness, Grittiness or Scratchiness	Never	n	45	10	25	22.495	0.001**
		%	56.3%	12.5%	31.3%		
	Sometimes	n	5	8	21		
		%	14.7%	23.5%	61.8%		
	Often	n	**0**	**0**	**3**		
		%	**0.0%**	**0.0%**	**100.0%**		
	Constant	n	**0**	**0**	**1**		
		%	0.0%	0.0%	100.0%		
Soreness or Irritation	Never	n	46	14	35	9.615	0.047*
		%	48.4%	14.7%	36.8%		
	Sometimes	n	4	3	14		
		%	19.0%	14.3%	66.7%		
	Often	n	**0**	**1**	**1**		
		%	**0.0%**	**50.0%**	**50.0%**		
Burning or Watering	Never	n	48	11	28	26.038	0.000**
		%	55.2%	12.6%	32.2%		
	Sometimes	n	2	5	18		
		%	8.0%	20.0%	72.0%		
	Often	n	**0**	**0**	**2**		
		%	**0.0%**	**0.0%**	**100.0%**		
	Constant	n	**0**	**2**	**2**		
		%	**0.0%**	**50.0%**	**50.0%**		
Eye Fatigue	Never	n	48	11	36	20.467	0.002**
		%	50.5%	11.6%	37.9%		
	Sometimes	n	2	5	10		
		%	11.8%	29.4%	58.8%		
	Often	n	**0**	**0**	**3**		
		%	**0.0%**	**0.0%**	**100.0%**		
	Constant	n	**0**	**2**	**1**		
		%	**0.0%**	**66.7%**	**33.3%**		

*: Significant at 0.05, **: Significant at 0.01

Table 5: Comparison of dry eye symptoms severity between smokers, passive smoker and nonsmoker

			Nonsmoker	Passive Smoker	Smoker	Chi-Square	p-value
Dryness, Grittiness or Scratchiness	Never	n	46	10	26	22.489	0.001**
		%	56.1%	12.2%	31.7%		
	Tolerable	n	4	6	19		
		%	13.8%	20.7%	65.5%		

	Uncomfortable	n	**0**	**1**	**1**		
		%	**0.0%**	**50.0%**	**50.0%**		
	Bothersome	n	**0**	**1**	**4**		
		%	**0.0%**	**20.0%**	**80.0%**		
Soreness or Irritation	Never	n	49	15	37	14.225	0.076
		%	48.5%	14.9%	36.6%		
	Tolerable	n	1	2	10		
		%	7.7%	15.4%	76.9%		
	Uncomfortable	n	**0**	**0**	**1**		
		%	**0.0%**	**0.0%**	**100.0%**		
	Bothersome	n	**0**	**1**	**1**		
		%	**0.0%**	**50.0%**	**50.0%**		
	Intolerable	n	**0**	**0**	**1**		
		%	**0.0%**	**0.0%**	**100.0%**		
Burning or Watering	Never	n	47	14	31	22.619	0.004**
		%	51.1%	15.2%	33.7%		
	Tolerable	n	3	1	14		
		%	16.7%	5.6%	77.8%		
	Uncomfortable	n	**0**	**2**	**2**		
		%	**0.0%**	**50.0%**	**50.0%**		
	Bothersome	n	**0**	**1**	**1**		
		%	**0.0%**	**50.0%**	**50.0%**		
	Intolerable	n	**0**	**0**	**2**		
		%	**0.0%**	**0.0%**	**100.0%**		
Eye Fatigue	Never	n	49	13	39	12.984	0.043*
		%	48.5%	12.9%	38.6%		
	Tolerable	n	1	2	7		
		%	10.0%	20.0%	70.0%		
	Uncomfortable	n	**0**	**1**	**1**		
		%	**0.0%**	**50.0%**	**50.0%**		
	Bothersome	n	**0**	**2**	**3**		
		%	**0.0%**	**40.0%**	**60.0%**		

*: Significant at 0.05, **: Significant at 0.01

The total SPEED score for nonsmoker group was had the lowest mean value 0.44 ± 1.26 ranged between 0 and 8, while the mean score for passive smoker was 3.83 ± 5.84 ranged between 0 and 20, and the mean for smoker was 3.84 ± 5.28 ranged between 0 and 22. There was a statistically significant difference in total SPEED score between groups; smoker had the highest total SPEED score among groups ($p < 0.001$) [Table 6].

Table 6: Total SPEED score among groups

Variables	Nonsmoker (n=50)		Passive Smoker (n=18)		Smoker (n=50)		p-value
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	
Total SPEED score	0.44	1.26	3.83	5.84	3.84	5.28	<0.001**[a]

**: Significant at 0.01, a: ANOVA Test

4. Discussion

Dry eye disease is a common condition that causes inflammation and hyperosmolarity in the eye's surface. It is characterized by neurosensory abnormalities and tears film instability [19,20]. Many risk factors are linked to dry eye, with lifestyle variables playing a significant influence [21]. Despite the fact that smoking is now acknowledged as a substantial risk factor for a range of chronic diseases, it is still unknown as a risk factor for DED [21]. According to the Blue Mountains Eye Study, cigarette smoking is a substantial risk factor for dry eye [22]. There have also been studies that demonstrate a link between smoking and the risk of dry eyes [22].

Our study found that the prevalence of smoking among females was lower than that of males. According to other studies, smoking has detrimental effects on the tear film and ocular surface [23]. Our study found that smoking cigarettes had a negative impact on tear film stability and precorneal surface [24,25]. In addition, smokers had lower Schirmer's score and NIK-BUT than nonsmokers. This result agrees with the results of a study conducted by Bhutia, Pinkila and his colleagues and Norhani Mohidin and his colleagues [26].

Heavy metals and hazardous minerals are the principal components of cigarettes, which include almost 4,000 compounds [27]. Toxic substances in cigarettes cause harm to the circulatory systems, and respiratory, as well as multiple other organs, including the eyes [28,29] .The particles of nicotine, Smoke, and toxic chemicals like carbon monoxide cause vasospasm and platelet aggregation, which harms the tissues in the eye. Nicotine stimulates macrophages, which induces inflammation the ocular surface. According to earlier study, the inflammation can be triggered by the lipid layer of the tear film on the surface of the eye in the smokers' eyes [30,31]. In a study by Altinors and his colleagues the tear lipid layer stability was investigated using DR1 lipid layer interferometry, and it was discovered that the cigarette smoking group had no lipid distribution on the ocular surface. This lipid layer damage in smokers may be a sign of meibomian gland loss, which can contribute to evaporative DED [31].

The function of the lipid layer on the surface of a tear film makes to prevent the formation of aqueous vapor in response to certain substances [32]. Cigarette smoking has been shown to increase the production of various

inflammatory cytokines such as tumor necrosis factor-alpha and interleukin (IL). Also, It can suppress the production of anti-inflammatory cytokines such as IL10. Cigarette smoking has been linked to meibomian gland dysfunction, which can lead to DED, by generating inflammatory reactions in the ocular surface, and meibomian glands [32].

TMH was identified in lower amounts among smokers, passive smoker than nonsmokers in this study [33]. In a study conducted on office workers, Uchino and his colleagues noted that smoking cigarettes could decrease the tear secretion and the goblet cell density in the eye. It was also found that the percentage of goblet cells that are present on the surface of the eye is decreased during chronic cigarette smokers [32].

Antioxidant theory and ischemic theory are two prominent theories that could explain the current findings [34]. Ischemic alterations, such as decreased blood flow or the formation of a clot within ocular capillaries, are caused by the toxins associated with smoking. These factors eventually lead to a lack of nourishment, which is necessary for the physiology of eye cell [35].

Among our participants, I found a strong association between groups and dry eye symptoms in terms of frequency and severity. The smoker's group had the most suffering of dry eye symptoms in terms of frequency and severity by using the SPEED questionnaire dry eye score. Similar to the present study, a comparative study conducted among smokers and nonsmokers by Tank & Kulkarni and his colleagues [36]. Also found that a higher proportion of smokers had severe SPEED questionnaire dry eye scores than nonsmokers.

Irritative gases in the air, smoke, and chemicals produced from cigarette smoking are extremely irritating to the conjunctival mucosa. These gases excite the free nerve endings on the ocular surface, causing excessive lacrimation, stinging, and redness conjunctival [37,38]. Burning, stinging, and itching of the eyes are all symptoms of cigarette smoking. This could explain why smokers have a higher speed questionnaire dry eye score. In this study, the mean CCT was lower in smokers than in passive smokers and non-smokers. However, the difference was not statistically significant. The results of this investigation are similar to those of a study conducted by Bhutia, Pinkila and his colleagues [23], which demonstrated no link between smoking and CCT. On other hand, this result contrasted with the study conducted by Sara Ghaffarri and his colleagues [39], concluded smoking may cause significant changes in some cells of the corneal endothelial, but not all of them. In primary open angle glaucoma, Wang and his colleagues [40] discovered evidence that smoking is linked to a lower CCT. They believe that cigarette smoking has this effect due to drop the collagen and hypoxia in the cornea, and that smoking affects collagen biosynthesis and extracellular matrix turnover, resulting in decreased corneal thickness [40].

5. Conclusion

Cigarette smoking causes dry eye parameters like Schirmer test score, TMH, and TBUT to deteriorate. Also, we found a strong correlation among groups and dry eye symptoms in terms of frequency and severity. The smoker group had the most suffering of dry eye symptoms in terms of frequency and severity. However, CCT was discovered to be unrelated to smoking. More researches are needed to identify the molecular basis of the

relationship between smoking intensity and its effect on the tear film and corneal thickness in terms of free radicals. Further studies are suggested on both genders and in different cities. Public alert and awareness studies and activities are recommended to explore the information and culture of the danger and impact of smoking. Cigarette smoking may cause vasospasm and platelet aggregation, which harms the tissues in the eye and lead to inflammation of the ocular surface. Further studies are recommended to verify this.

6. Limitation of study

The limitations of study were small sample size, and lack of other tests to detect inflammatory of ocular surface, and cytokines of the tears, which could have provided a more thorough findings.

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