# DRY EYE DISEASE AND SMOKING

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## *ABSTRACT*

***PURPOSE & BACKGROUND:*** *The ocular surface is the most exposed mucosal surface of the body. Exposure to tobacco smoke damages the ocular surface and is one of the risk factors of tear film dysfunction which leads to dry eye disease (DED). The study aim was to evaluate the dry eye symptoms in tobacco smokers.*

***METHODS:*** *It was a cross-sectional study done at Federal Government Services Hospital Islamabad, during Jan2015-Jan2016. All 314 subjects (154 smokers and 160 age-matched healthy non-smokers, age 25–47 years, attending refraction clinic were screened for DED by a trained researcher while dry eye tests were performed under the same physical conditions by a single surgeon after taking permission from Ethical committee. The diagnosis was based on three out of five parameters. Statistical analysis was by simple frequencies/ percentages.*

***RESULTS:*** *Among the smoker group, 124 (80.5%) reported symptomatic (symptoms experienced often or all the time). Burning was the most common symptom in 72 (46.7%) subjects which used to increase after smoking. 26% of subjects had low tear break-up time (TBUT),12% showed low Schirmer test while 31% showed corneal fluorescein staining among heavy smokers. 17% had some lid plugging with mucous threads among light smokers.*

***CONCLUSION:*** *Our results showed DE like symptoms and decreased DE tests values after smokingin the general population.*

***KEYWORDS:*** *Dry eye, smoking, fluorescein staining, burning sensations*

## INTRODUCTION

Dry eye disease is a multifactorial disease characterized by tear film and ocular surface changes[1] due to decreased tear secretions showing low tear film break up time and Schirmer tests values and affects 5%-35% population of different ages. Its increasing incidence and prevalence is becoming a public health problem.[2] More than 1.6 million male and 3.2 million female population above 50 years in the United States are affected.[3]

Environmentally, the ocular surface is the most exposed mucosal surface of the body. Exposure of tobacco smoke affects ocular surface causing tear film dysfunction.[4] Annually over five million people are killed by tobacco use worldwide[1] and the number will increase over eight million people per year by the year 2030.[5]

Toxic elements and heavy metals in tobacco smoke affect different organs and the eyeby causing tear proteins changes, low corneal/ conjunctival sensitivity, andconjunctival squamous metaplasia.[6] The toxins of smoking decrease blood flow or help in the clot formation within capillaries, thus cutting off essential nutrients for eye health.[7] In Pakistan, insufficient studies are available showing the effects of smoking on the tear film. 25-40%of employees face tobacco smoke in their offices where about 20% complain of DE like symptoms.[8]

Other epidemiological studies noted the relation between dry eye and smoking which is an irritant causing DE symptoms like burning, foreign body sensation, and grittiness producing tear film instability.[9] Studies have shown that the cessation of smoking reduces the risk of DE.[10] Aim was to investigate tobacco smoke effects on tear film parameters.

### MATERIALS & METHODS

All 154 willing male smokers (age 25–47 years) mean age 35.7±7.6 years who smoked cigarettes for more than 6 years along with 160 age-matched control non-smokers were included after taking their consent and permission from the Ethical committee. Depending on the number of cigarettes smoked/day, two subgroups were made. Light smokers who smoked 10 or fewer cigarettes and heavy smokers who smoked > 20 cigarettes/day. Smoking time duration and number of cigarettes smoked/day were calculated.

Subjects with any systemic/ocular surface disease, recent

eye surgery, use of contact lenses/glasses, and those using eye drops were excluded. Subjects with smoke exposure history during the past 6 months were also excluded from this study.

Baseline characters were recorded and dry eye questionnaire (DEQ-6) was administered to all subjects by a trained researcher. Detailed eye examination along with various dry eye tests was performed by a single surgeon under the same physical conditions.

**DEQ 6**

1. Do your eyes ever feel dry?
2. Do you ever feel a gritty or sandy sensation in your eye?
3. Do your eyes ever have a burning sensation?
4. Are your eyes ever red?
5. Do you notice much crusting on your lashes?
6. Do your eyes ever get stuck shut in the morning?

Possible answers to the questions were 'none', 'rarely or sometimes', and 'often or all the time'.

Subjectively dry eye was defined as having one or more symptoms 'often or all the time'.

Subjects having 1 or more symptoms often or all the time and if those symptoms increased after smoking, tear film break-up time (TBUT) of ≤10 seconds in 1 or both eyes, Schirmer's test (ST) ≤5 mm in 5 min, corneal fluorescein staining (CFS) of ≥1 (staining grades 0-3 in each of five quadrants (central, nasal, temporal, superior and inferior cornea)) and slit-lamp examination of the lid for mucous threads/telangiectasias were positive signs according to Japanese Diagnostic Criteria for dry eye. The diagnosis was based on three out of five parameters.

**RESULTS**

Baseline demographics are shown in Table 1. Seventy four (48%) subjects were smoking since 6 or feweryears and 52% were smoking for the last 12 or fewer years while 88 (57.1%) smokers used 10 cigarettes/day (light smokers) and 66 (42.9%) smoked 20 cigarettes/day (heavy smokers).

Dry eye was defined as the simultaneous presence of symptoms and at least one sign. Among the smoker group, 124 (80.5%) reported symptomatic (symptoms experienced often or all the time). Burning was the most common symptom in 87 (56.4%) subjects, 76 (49.3%) had foreign body sensation while redness was present in 71 (46.1%) subjects.82 (53.2%) complained that these symptoms always increased after smoking. 35 (22.7%) subjects stated often and 20 (13%) noted the occasional rise of their worst symptoms after smoking. 17 (11%) never experienced an increase in their worst symptom after smoking. (Table-2)

26% of subjects in the smoker group had low tear break-up time (TBUT<10 seconds) while in non-smokers group 7% of subjects had low values doubting unstable tear film.In our study tear film breakup time (TBUT) was shorter while fluorescein staining score was higher among smokers than controls. (Table-3)

Among heavy smokers 7% subjects showed low Schirmer test value (ST) ≤5 mm in 5 min, 31% showed corneal fluorescein staining and 22% had some lid plugging with mucous threads compared to 5%, 11% and 13% subjects among non-smokers (control group) reflecting changes in the tear film. In our study, Schirmer's test values were not different between smokers and non-smoker controls.

71% of smokers knew the ill effects of smoking while 26% wanted to quit after physician's advice or financial reasons.

**Table 1:** Basic demographics

| | Smokers | Non-Smokers |
|---|---|---|
| Age Group | | |
| 25-31 years | 50 (32.4%) | 54 (33.7%) |
| 32-39 years | 62 (40.2%) | 58 (36.2%) |
| 40-47 years | 42 (27.2%) | 48 (30.0%) |
| Smoking | | |
| >6 years | 74 (48.0%) | |
| >12 years | 80 (52.0%) | |
| Number of cigarettes smoked per day | | |
| <10 | 88 (32.4%) | |
| 10-20 | 66 (40.2%) | |
| Symptoms Intensified | | |
| Yes | 82 (52.2%) | |
| No | 75 (47.8%) | |
| Geographic | | |
| Urban | 116 (75.3%) | 110 (68.7%) |
| Rural | 38 (24.7%) | 50 (31.3%) |
| Occupation | | |
| Government Servant | 96 (62.3%) | 110 (68.7%) |
| Laborer | 58 (37.7%) | 50 (31.3%) |
| Educated | 102 (66.0%) | 102 (63.7%) |
| Uneducated | 52 (33.0%) | 58 (36.3%) |
| Knew the effects | 109 (70.7%) | |
| Wanted to quit | 40 (26.0%) | |

**Table 2:** Dry eye symptoms after smoking

| Symptoms | never | rarely | sometimes | often | All the time | %age |
|---|---|---|---|---|---|---|
| Burning/dryness | 20 | 20 | 27 | 38 | 49 | 56.4% |
| F.B.sensations | 26 | 26 | 26 | 33 | 43 | 49.3% |
| Redness | 23 | 31 | 29 | 25 | 46 | 46.1% |
| Watering | 22 | 24 | 37 | 22 | 45 | 43.5% |
| Discharge | 40 | 32 | 29 | 14 | 39 | 34.4% |
| Blurring | 36 | 36 | 30 | 20 | 32 | 33.7% |

**Table 3:** Dry eye tests among smokers and non-smokers

| Variable | 0-6 years | 6-12 years | Non-smokers |
|---|---|---|---|
| TBUT | 14% | 26% | 7% |
| Schirmer's | 5% | 7% | 5% |
| CFS | 21% | 31% | 11% |
| Lid Plugging | 17% | 22% | 13% |

## DISCUSSION

Cigarette smoking is one of the factors that cause tear film dysfunction resulting in dry eye. Smoking disrupts the precorneal tear film and is multifactorial. Lipid peroxidation of the precorneal tear film is the probable cause of tear film breakdown leading to dry eye symptoms.[11]

Only four studies are available reporting smoke effects on the tear film and ocular surface in the literature mentioning tear film instability and ocular surface damage following smoking.[12] Our study confirms the changes in tear film after smoking.

The DE prevalence according to other studies was 60% among the smokers.[9] In the present study, 62 (80.5%) of smokers were symptomatic similar to other studies.

Burning was the most common symptom among smokers in 32-39 years age group. This group belonged to laborers and outdoor field workers. Also, this was a heavy smokers group who used to smoke 20 or more cigarettes/ day. In the present study also redness and watering was more common in 25-31 years age group who were students and indoor workers similar to other studies .[13]

In this study 22% of our subjects among heavy smoker group had mucous threads on slit-lamp examination showing meibomian gland dysfunction (MGD) similar to other studieswhich showed a slowing of lipid spread time of tear film and high tear evaporation rate in chronic smokers compared to non-smoker (control) group.[14] Banskent University Ankara, Turkey study found that tobacco smoke breaks down the lipid layer of the tear film, producing symptoms of dry eye.

One another study also noticed that even spreading of the tear film over the cornea is prevented from the damaged lipid layer in smokers.[15] Another explanation may be the decrease in Goblet cell in smokers which secrete MUC5AC into the tears causing tear film instability.[16]

35.6% of our study subjects had redness similar to other studiesshowing the presence of irritants/toxins in smoke causing redness and conjunctival reaction.[17] These changes resulted in dry-eye-like symptoms in smokers.

One study reported squamous metaplasia of the conjunctival epithelium in smokers than in non-smokers which may be due to the presence of toxic irritants present in cigarette smoke.[18] In our study, we did not find any case of squamous metaplasia of conjunctiva.

In the present study, 31% of individuals showed corneal fluorescein staining (CFS) higher than the control group (11%) is akin to other studies .[19] Our study also showed higher CFS scoring among smokers of 6-12 years duration compared to those of less than 6years duration. In dry eye disease, proteolytic enzymes as plasmin and matrix metalloproteases damage ocular surface epithelium and thus increase the CFS in group1.[20]

In this study, 82 (53.2%) subjects complained that their symptoms increased after smoking similar toanother study while 17 (11%) never had the same feeling after smoking. Yoon et al,[21]study showed the relation between ocular surface damage and the amount of smoking, which was noted also in our study.The definition of dry eye was based on the tear break-up time (TBUT) and Schirmer score while smoking was found to decrease TBUT and Schirmer score in other studies[6] like ours.

The present study showed low TBUT and ST values in 26% and7% individuals among heavy smokers respectively compared to7% and 5% in control group similar to other studies .[22]Yoon et al[21] did not find changes in symptoms score, in TBUT and corneal staining between smokers and non-smokers which is not consistent with our study results.The first Brazilian National Survey (BNAS)[23]report compared disruption of the ocular surface health both qualitatively and quantitatively. Our study results noticed that smoking affects the precorneal tear film and the conjunctival epithelial cells showing 21% and 31% CFS among light and heavy smokers group which is consistent with many other study findings.[24]

In our study 109 (70.7%) of group1subjects knew the deleterious effects of smoking but only 31 (20%) wanted to quit smoking either on physician's advice or for financial restraints.

## CONCLUSION

The number and duration of cigarette smoking determine DE like symptoms by disrupting precorneal tear film.

## RECOMMENDATIONS

Patients with ocular surface disorders should avoid smoking to prevent dry eye disease.

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