Sleep Deprivation and Dry eyes. Are they Associated?

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ABSTRACT

Introduction: Lack of sufficient production of tear film leads to symptoms of dry eyes. Sleep deprivation is known to cause various physiological changes in the body including hormonal and neuronal changes. These changes can lead to disturbance in development of a proper tear film and hence dry eyes. Current research objective was to study the association of sleep deprivation and occurrence of dry eyes in the sleep deprived individuals.

Material and methods: Medical students from a tertiary care center were included in the study. Sleep deprivation was estimated using Sleep-quality questionnaire (The Sleep Revolution by Arianna Huffington). Dry eyes questionnaire was taken and the severity assessed using Ocular Surface Disease Index Scale (OSDI). Schirmer's test, Tear Film Break-up Time (TBUT) and IOP measurement were carried out on the test subjects. The results were compared between sleep-deprived and non-sleep deprived individuals.

Results: Out of total 50 test subjects, 25 were controls and 25 were sleep deprived. Significant association was found between sleep deprivation and severity of dry eye symptoms, tear film break up time and results of Schirmer's tests. However, no significant association was found between sleep deprivation and increase in IOP.

Conclusion: Sleep deprivation induces reduction in tear secretion; increase in tear osmolarity and shortens tear film break-up time. These changes can later lead to development of ocular surface diseases. Hence, a larger study is needed to be carried out to further study the association and spread awareness regarding need of good quality sleep in order to reduce occurrence of dry eyes and other ocular disorders.

Keywords: Sleep Deprivation, Dry eyes

INTRODUCTION

Tear film consists of three layers, including the outer lipid layer, aqueous layer, and inner mucin layer.[1,2] Dry eye syndrome is a common ocular surface disease associated with symptoms of eye discomfort, grittiness, and visual disturbance.[1,2] The changes and inflammation of the ocular surface subsequently lead to tear instability, which causes increased tear osmolarity and aggravates the inflammatory cascades.[2]

Sleep deprivation (SD) is known to cause profound impairments in executive function and vigilant attention.[3,4] Sleep deprivation is also known to be associated with hormonal and neurological functioning.[5,6,7] And the regulation of tear film secretion is under neural and hormonal control.[2,8] Therefore, we investigated the effect of sleep deprivation on dry eye in this study.

MATERIAL AND METHODS

The study was performed among medical students belonging to a tertiary care hospital in a rural area in Indore district of Madhya Pradesh. In total, 50 students were studied. The age group chosen was 20-30 years.

Study Design

Inclusion criteria: No history of ophthalmic surgery or dry eye symptoms/treatment within preceding 6 months. No history of any systemic illness and/or medication for chronic illness.

Exclusion Criteria: Subjects with dry eye symptoms within the previous 6 months. Subjects who had any systemic diseases such as systemic lupus, rheumatoid arthritis, Sjögren's syndrome, a history of ocular disease, anddisorders of the lid margin, nasolacrimal duct, and cornea.

All subjects had signed an informed consent form before participating in the study. All the participants were required to complete sleep-quality as well as dry eye questionnaires. The sleep-quality questionnaire was taken from The Sleep Revolution by Arianna Huffington.

Scoring	Grade
0-9	Severe
10-18	Some Sleep Problem
19-27	Sleep in Good Shape
28-36	Sleep in Great Shape

Dry Eye Syndrome Questionnaire was graded as per Ocular Surface Disease Index Scale.

Scoring	Grade
0-12	Normal
13-22	Mild
23-32	Moderate
32-100	Severe

The subjects as per the scoring in the questionnaire were divided into two groups: the SD group (25 subjects)and control groups (25 subjects).

2.3 Testing Protocols: All the subjects were evaluated by the same investigator. Tear film break-up time (TBUT) and

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How to cite this article: Supriya Mushriff, Ambica Agarwal, Vimlesh Choyal. Sleep deprivation and dry eyes. are they associated? International Journal of Contemporary Medical Research 2019;6(12):L9-L11.

DOI: http://dx.doi.org/10.21276/ijcmr.2019.6.12.23

	Control group	Sleep Deprived group	P-value
Mean age	24.12 ±1.28	24.92 ± 1.42	0.041
Mean Sleep Deprivation score	23.68 ±0.54	12.56 ± 0.66	0.0001
Mean dry eye score	7.4 ±0.36	30.32 ± 1.6	0.0001
Mean Schirmer's	22.46 ± 2.1	10.28 ±0.89	0.0001
Mean TBUT	14.26 ± 1.5	6.9 ± 1.23	0.0001
Mean IOP	15.2 ±1.3	14.24 ± 1.45	0.0673

Table-1: Sleep Deprivation

performance on Schirmer's tear secretion test were evaluated. All subjects underwent the same examinations, including Schirmer's (I) tear test, TBUT, and IOP.

The TBUT evaluation was performed in a dimly lit room. Fluorescein was placed in the lower conjunctival sac using a fluorescein strip. The subjects were asked to blink and the time before the first defect appeared on the stained tear film was recorded as the TBUT.[9,10]

Schirmer's test was performed to evaluate the effect of sleep deprivation on tear secretion. Filter papers were placed in the lateral canthus for 5 minutes; readings were recorded as millimeters of wetting.[9,10]

The IOP was measured by Goldmann Applanation Tonometer (GAT). Intraocular pressure was expressed in millimeters of mercury (mm Hg).

Analyses were performed with SPSS software. A *p*-value of <0.05 was considered statistically significant.

RESULTS

Mean age of the control group was 24.12 years and that of the sleep deprived group was 24.92 years (table-1).

Mean Sleep Deprivation (SD) Score was 23.68 (±0.54) for the control group and 12.56 (±0.66) for the sleep deprived group. The p-value for the mean sleep deprivation score was calculated to be 0.0001 i.e., significant (table-1).

Mean dry eye score was 7.4 (±0.36) for controls and 30.32 (±1.6) for the sleep deprived. The results were again significant (p-value 0.0001) (figure-1).

Mean Schimer's test scores were 22.46 (±2.1) and 10.28 (±0.89) for the control group and sleep deprived respectively (p-value 0.001). Mean TBUT scores were 14.26 (± 1.5) and 6.9 (±1.23) for control and sleep deprived groups respectively. There was no significant difference in the IOP values (fig-2).

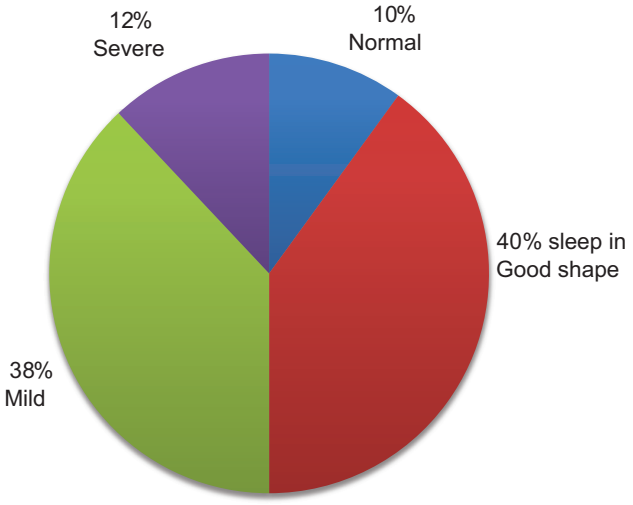

Figure-1: Sleep Distribution

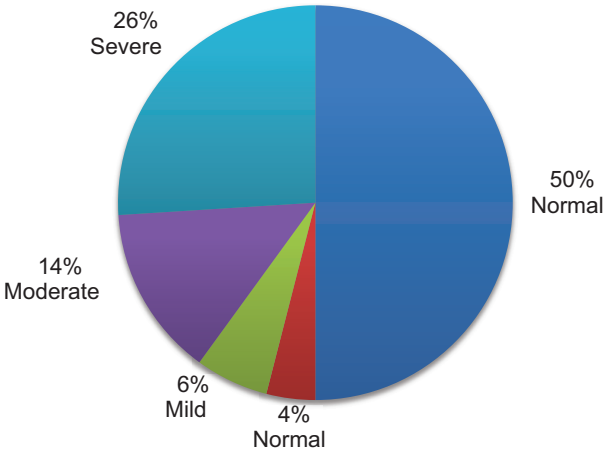

Figure-2: Dry Eye Distribution

DISCUSSION

Dry eye is a multi-factorial disease involving the tear film and ocular surface.[1] Recently, dry eye syndrome has been reported to be associated with depression and post-traumatic stress disorder.[11]

Sleep deprivation has been reported to alter cellular response[12], oxidative stress[13], heighten the levels of stress hormones including cortisol, epinephrine, and norepinephrine.[5,14] It decrease parasympathetic and increase sympathetic tone.[5,15] Hyper-osmolarity has been suggested as the primary causative mechanism in dry eye syndrome.[1] Tear osmolarity represents variations in tear dynamics and is an accepted method for diagnosing dry eye syndrome.[1,9]

Tear secretion has been reported to be affected by a variety of factors.[8] First, tears are produced by the lacrimal glands, which are innervated by parasympathetic and sympathetic nerves.[8,16] Sleep deprivation has been reported to heighten the levels of stress hormones, and to decrease parasympathetic and increase sympathetic tone.[5,17] Typically, activation of the parasympathetic pathway stimulates tear secretion because parasympathetic fibers are predominant in the lacrimal glands.[8] Second, SD leads to mild activation of the hypothalamic–pituitary–adrenal axis and elevated plasma concentrations of glucocorticoids in humans.[18] It also reportedly causes excess diuresis and natriuresis. Although renal water control and arginine vasopressin levels remain unaltered during SD, the circadian rhythm of the renin–angiotensin–aldosterone system hormones is altered

significantly.[3] It has been suggested that the underlying mechanism of dehydration following SD could be a reduced nighttime dip in blood pressure and a decrease in renin–angiotensin–aldosterone system levels.[3,4] These alterations in hormone levels and excess dieresis could induce a relatively dehydrated state, which can affect tear secretion.

The TBUT has been reported to represent tear stability. Sleep deprivation shortened TBUT.[1] Subjects in the SD group complained of eye discomfort, dryness, and grittiness, and SD was shown to decrease tear secretion by Schirmer's test. Several mechanisms potentially could explain these findings. Sleep deprivation was shown to decrease tear secretion by Schirmer's test.

This study is limited by the small sample size.It is a pilot study designed to assess the effect of sleep deprivation on tear film and the ocular surface.The tear osmolarity has not been calculated.Further studies in a large population are needed to establish associations between sleep disorder and dry eye syndrome and the underlying mechanisms of this relationship.

CONCLUSION

Sleep deprivation induces reduction in tear secretion; increase in tear osmolarity and shortens tear film break-up time. These changes can later lead to development of ocular surface diseases.Hence, a larger study is needed to be carried out to further study the association and spread awareness regarding need of good quality sleep in order to reduce occurrence of dry eyes and other ocular disorders.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 08-11-2019; **Accepted:** 03-12-2019; **Published:** 31-12-2019