Correlation Between Sleep Quality and Tear Film Tests

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ABSTRACT

Background and Objectives: Several studies have investigated the correlation between sleep and tear film among adults, senior high school students, employees and animals. The aim of this study is to evaluate the correlation between sleep quality and tear film tests among university students.

Materials and Methods: A total of 102 students (52 men and 50 women) were enrolled in this cross-sectional study. Their sleep quality was evaluated using the Pittsburgh standard questionnaire and their tear film by the Schirmer-1 test and the tear film break up time (TBUT).

Results: Out of 102 participants in this study, 69(67.6%) students had poor sleep quality and 64 (62.7%) students based on TBUT and 17(16.7%) students based on Schirmer-1 test had dry eye. There was a significant relationship between the Pittsburgh Sleep Quality Index (PSQI) and the Schirmer-1 test (correlation coefficient:-0.409, $P<0.001$). There was also a significant relationship between PSQI and TBUT (correlation coefficient:-0.484, $P<0.001$).

Conclusion: The results of this study showed that there is a significant correlation between PSQI and tear film tests.

Keywords: Tear film, Sleep quality, Student

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Introduction

Tear film consists of three layers, including the lipid layer, aqueous layer and mucin layer. A reduction of aqueous tear secretion or an increase in the evaporation of tear film leads to instability of tear film and dry eye (Lemp et al., 2007). Dry eye is one of the most common ocular problems in the world (Schaumberg, Sullivan, Buring, & Dana, 2003), in which changes in the lifestyle of people with this condition develop in severe stages (Uchino et al., 2014). Dry eye can cause disturbances in the individuals daily functioning, such as reading and professional working (Miljanović, Sullivan & Schaumberg, 2007). Since proper training and the elimination of risk factors can reduce the symp-

toms of dry eye, early diagnosis can prevent future complications that increase the symptoms of patients (Zhang, Chen, & Wu, 2012). Despite increasing consciousness of people about dry eye, there is no definite treatment for dry eye, and therapeutic measures can only help improve the symptoms of the patients (Pflugfelder et al., 2007).

The lacrimal gland innervation is primarily due to the parasympathetic nervous system and is mainly regulated by the cholinergic fibers of this system. However, stimulation of the sympathetic system and hormonal factors contribute to the modulation of the gland (Dartt, 2004).

On the other hand, it is reported that there is an association between sleep disorders (i.e. sleep apnea syndrome) and ocular problems (Abdal, Pizzimenti, & Purvis, 2006). Studies have shown that sleep deprivation affects the function of the autonomic and endocrine systems (Nascimento et al. 2007; Everson, 1995) and increases the level of stress hormones and decreases parasympathetic tone (Leproult, Copinschi, Buxton, & Van Cauter, 1997). Neurological factors and hormones regulate tear secretion (Janine, 2007). Therefore, tear film and ocular surface may be affected by sleep deprivation (Lee et al., 2014). Regarding the variability of sleep hours of students, at least two-thirds of students have occasional sleep disturbances and about one-third of those report severe and regular sleep difficulties (Lack, 1986; Coren, 1994). Partial sleep deprivation (less than 6 hours of sleep) can lead to disturbance in attention, concentration, memory, irritability and anxiety (Pilcher & Walters,1997). Many studies have reported how sleep disorders can cause poor school performance (Shin, Kim, Lee, Ahn, & Joo, 2003; Wolfson, & Carskadon, 2003; James, Kristjánsson, & Sigfúsdóttir, 2011).

Both sleep disorders and dry eye can have effect on the performance of university students. Several studies investigated the association between sleep and tear film among adults (Lee et al., 2015), senior high school students (Zhang, Chen, & Wu, 2012), employees (Kawashima et al. 2016) and animals (Li et al. , 2018). As few studies have been done on the correlation between sleep quality and tear film among university students, assessing this correlation is necessary. As such, the current study aims to assess the correlation between sleep quality and tear film tests among university students.

Materials and Methods

The study was approved by the Ethical Committee of Iran University of Medical Sciences (process number IR.IUMS.REC.1397054). This cross-sectional study was conducted during April to June 2018 at the Faculty of Rehabilitation, Iran University of Medical Sciences in Tehran, capital of Iran. A total of 102 students based on inclusion and exclusion criteria participated in this study. Students' age ranged from 18 to 30 years. Normal visual acuity (better than20/30), absence of anterior and posterior ocular pathology based on slit lamp examination, no history of ocular surgery, no systemic disease that cause dry eye (Diabetes, Lupus, Thyroid etc.,), not using of systemic drugs such as antihistamines, anticholinergics etc., which cause dry eye, not using contact lenses, no sleep disorders, no depression and no psychiatric disorders were inclusion criteria. Students who did not want to participate in the study or were unable to perform tests were excluded from the study. Prior to the examination, written informed consent was obtained from the participants. After performing initial examinations and considering the inclusion and exclusion criteria, Pittsburgh Sleep Quality Questionnaire was completed by the students. Then, in order to evaluate the tear film, Schirmer-1 test and Tear Break Up Test (TBUT) were used.

Data were analyzed by SPSS software version 22 using frequency distribution and the Pearson correlation coefficient. As the data had normal distribution based on Kolmogorov–Smirnov test, the Pearson correlation was used.

Pittsburgh Sleep Quality Index

The PSQI is a self-report questionnaire that assesses sleep quality over a 1-month time interval. The measure consists of 19 individual items, creating 7 components that produce one global score. Consisting of 19 items, the PSQI measures several different aspects

of sleep; offering seven component scores and one composite score. The component scores consist of subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each item is weighted on a 0–3 interval scale. The global PSQI score is then calculated by totaling the seven component scores, providing an overall score ranging from 0 to 21, where lower scores denote a healthier sleep quality. A score of 5 or greater is considered as poor sleep quality (Buysse, Reynolds III, Monk, Berman, &Kupfer, 1989). This study used an Iranian valid and reliable version of this questionnaire in Persian language (Moghaddam, Nakhaee, Sheibani, Garrusi, &Amirkafi, 2012).

Schirmer-1 test

In this test, the amount of total tear secretion (basal and reflex tear secretion) without anesthesia is measured for 5 minutes. A special filter paper (35 × 5 mm) was used to measure the amount of tears (ERCSaglik. com, Ankara, Turkey). Wetting less than 5 mm was considered as dry eye (Bron et al., 2007).

TBUT test

To measure TBUT, fluorescein is instilled into the patient's tear film and the patient is asked not to blink while the tear film is observed under a broad beam of cobalt blue illumination of slit lamp (Hagg-Streit BQ900). The TBUT is recorded as the number of seconds that elapses between the last blink and the appearance of the first dry spot in the tear film. A TBUT less than 10 seconds is considered abnormal (Bron et al., 2007).

Results

Out of the total subjects, 52 (51%) were males and 50 (49%) were female participants. There was no significant difference with respect to gender effect (P=0.972). The age range of the participants was from 18 to 27 years (mean=21.40±1.708). There was no significant difference among age (P= 0.073). The frequency distribution of Pittsburgh Sleep Quality Index, Schirmer-1 and TBUT in this study according to table 1 shows that 33(32.4%) students enjoyed good sleep quality and 69 (67.6%) students had poor sleep quality. Based on TBUT test, 64 students (62.7%) had dry eye and 38 (37.3%) did not have dry eye. Moreover, 17 (16.7%) students showed positive Schirmer-1's Test (wetting Less than 5 mm) while 85 (83.3%) students had no dry eye.

The correlation coefficient between PSQI, Schirmer-1 and TBUT test is shown in Table 2. The results indicate that there is a significant and reverse correlation between PSQI and Schirmer-1 (correlation coefficient: -0.409, P<0.001), that is, the lower the PSQI score, the more the Schirmer-1. There is also a significant and reverse relationship between PSQI and TBUT (correlation coefficient: -0.484, P<0.001), that is, the lower the PSQI score, the more the TBUT.

Table 1. Frequency distribution of PSQI, Schirmer-1 and TBUT

Variables	Frequency	Percent
PSQI<5(good sleep quality)	33	32.4
PSQI≥5(poor sleep quality)	69	67.6
Schirmer-1<5mm (dry eye)	17	16.7
Schirmer-1≥5mm (non-dry eye)	85	83.3
TBUT<10s (dry eye)	64	62.7
TBUT≥10s (non-dry eye)	38	37.3

Table 2. Correlation coefficient between PSQI, Schirmer-1 and TBUT

	Schirmer-1	TBUT
PSQI	-0.409<0.001	-0.484<0.001
Mean	13.94	8.13
Standard deviation	3.889	9.737

Discussion

In this study, we found that there is a significant correlation between sleep quality and students' tear film. We also found that the prevalence of poor sleep quality and dry eye is high among university students.

According to the present study, the prevalence of poor sleep quality among students was 67.6%. Salehi et al., 2015 in their study, reported that the overall poor sleepers (PSQI≥5) among students of Tehran University were 81.1%. Also, a study found that only 11% of students had good sleep quality and the rest of them had moderate to severe sleep disturbances (Buboltz, Brown, &Soper, 2002). These findings suggest that the prevalence of poor sleep quality is high among university students. Therefore, more attention should be paid to the sleep of students and attempts should be made to decrease this problem. In a study that evaluated proper sleep hygiene knowledge in 963 university students, the average correct response rate was approximately 50% (Hicks, Lucero-Gorman, Bautista, & Hicks, 1999). It can be argued that many students are not aware of sleep hygiene and the problems of poor sleep quality. Thus, many sleeping problems can be prevented by proper sleeping instructions. Having regular sleep-wake schedules is an important aspect of sleep hygiene (Brown, Buboltz, & Soper, 2002).

In the current study, the prevalence of dry eye was 62.7% based on the TBUT test and 16.7% based on the Schirmer-1 test. In other studies, the prevalence of dry eye was reported between 5% and 30% in different age groups across diverse countries (Phadatare, Momin, Nighojkar, Askarkar, & Singh, 2015). The prevalence of dry eye in high risk groups ranges from 20 % to 73% (Patil, Trivedi, Parekh, & Jethva, 2016). According to the current study, dry eye based on TBUT test has a high prevalence among university students. This obvious difference presented in the literature is due to many factors including age, occupation, dry eye assessment methods, etc.

In the present study, a significant correlation was found between sleep quality, the Schirmer-1 test and TBUT. Consistent with the findings of the present study, poor sleep has been reported to be one of the risk factors for dry eye (Zhang, Chen, & Wu, 2012; Lee et al., 2014; Lee et al., 2015; Kawashima et al. , 2016). In a study, the effect of sleep deprivation on metabolic and endocrine performance was evaluated in which 11 people slept 6 nights for 4 hours (per night) and subsequently 6 nights for 12 hours (per night). The results study showed that lack of sleep affects endocrine function and metabolism (Spiegel, Leproult, & Van Cauter, 1999). On the other hand, Lee et al. (Lee et al., 2014) evaluated the effect of sleep deprivation on tear film. In their study, 10 subjects did not sleep for 24 hours; however, 10 subjects in the control group received 8 hours of sleep. It was observed that sleep deprivation would disrupt the tear film and reduce TBUT and tear secretion in the sleep deprived group compared to the control group. The findings of Lee et al. are consistent with our study; in which poor sleep quality was associated with a decrease in Schirmer-1 and TBUT. Our study also matched another study that examined the risk factors for dry eye among high school students and suggested that poor sleep quality can be deemed as a risk factor for dry eye (Zhang, Chen, & Wu, 2012). Their study limitation was not using the standard sleep quality questionnaire for sleep assessment, and the sleep quality was only evaluated by a simple question of good or poor sleep quality. Also, the Schirmer and TBUT tests for tear film evaluation were not utilized in the study. Sleep deprivation reduces androgen levels (Schmid,

Hallschmi, Jauch-Chara, Lehnert, & Schultes, 2012) and decreases parasympathetic tone (Von Treuer, Norman, & Armstrong, 1996). Low androgen levels can result in high tear evaporation (Sullivan, 2004). Tear secretion is effected by parasympathetic nerves (Whitwell, 1958). A number of studies explored that the denervation of parasympathetic nerves to the lacrimal gland can lead to decreased tear secretion (Whitwell, 1958; Nguyen, Vadlamudi, Toshida, & Beuerman, 2006). Therefore, poor sleep quality may have negative impacts on the level of hormones and parasympathetic tone, causing dry eye.

Conclusion

This study indicated that there is a significant correlation between sleep quality and tear film tests and also noted that the prevalence of dry eye and poor sleep quality is high among university students. Due to the limited studies in this field, further research is needed to pay more attention to sleep quality and quantity and its relation with the health of eye and vision.

Conflict of Interest Statement

Authors declared no conflict of interest.

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همبستگی بین کیفیت خواب و تست‌های فیلم اشکی

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چکیده	اطلاعات مقاله

زمینه و هدف: چندین مطالعه ارتباط بین خواب و فیلم اشکی در بزرگسالان، دانش آموزان دبیرستان، کارمندان و حیوانات را ارزیابی کرده‌اند. هدف از این مطالعه ارزیابی ارتباط بین کیفیت خواب و تست‌های فیلم اشکی در دانشجویان است.

روش کار: در این مطالعهٔ مقطعی ۱۰۲ نفر از دانشجویان (۵۲ مرد و ۵۰ زن) وارد مطالعه شدند. کیفیت خواب آنها با پرسشنامهٔ استاندارد پیتزبورگ و فیلم اشکی آنها با استفاده از تست شیرمر-۱ و TBUT بررسی گردید.

نتایج: از ۱۰۲ نفر شرکت کننده در این مطالعه ۶۹ نفر (۶۷/۶٪) کیفیت خواب بد و ۶۴ نفر (۶۲/۷٪) بر اساس تست TBUT و ۱۷ نفر (۱۶/۷٪) بر اساس تست شیرمر-۱ خشکی چشم داشتند. بین کیفیت خواب پیتزبورگ و شیرمر-۱ (ضریب همبستگی: ۰/۴۰۹- ، $P<۰/۰۰۱$) و همچنین بین کیفیت خواب پیتزبورگ و TBUT (ضریب همبستگی: ۰/۴۸۴- ، $P<۰/۰۰۱$) رابطهٔ معنی داری وجود داشت.

نتیجه گیری: نتایج این مطالعه نشان داد ارتباط معنی‌داری بین کیفیت خواب پیتزبورگ و تست‌های فیلم اشکی وجود دارد.

کلید واژه‌ها: فیلم اشکی، کیفیت خواب، دانشجو

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