The Calamity Among Medical Students: Sleep Deprivation and Dry Eye Disease

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Abstract

Background: Medical students’ burden upon academic and professional duties often blinded them from attending to themselves. Piling works and nightshifts interfere ferociously with their self-care behavior, including adequate sleep. The matter not only disrupts concentration and consciousness but also tolls the eye by reducing tear secretion. Hence, the present study urgently assesses sleep quality and dry eye disease (DED) among medical students.

Methods: The cross-sectional study observed 172 eyes among medical students in Indonesia. We assessed sleep quality and dry eye disease through Pittsburgh Sleep Quality Index and Schirmer test. Independent statistician analyzed the data with chi-square.

Result: From the eligible samples, there is a dominancy of females (55.8%) with poor sleep quality (55.2%). There is no significant difference in DED or sleep quality across gender though they lean toward females. Contrarily, poor sleepers significantly correspond to 2.96 times more risk of DED than an adequate sleeper.

Conclusions: Medical students’ well-being is crucial. Aside from the academic burden, institutions and individuals shall strongly emphasize better sleep habits and eye care.

Introduction

Sleep is a transient unconscious state of the body where cells and tissues reparation happened. The National Sleep Foundation recommends seven to nine hours of daily sleep for the youth.¹ Medical student composed a lot of the sleep-deprived population niche due to the extensive academic, stress, and personal burdens.² A Brazilian study in 2017 also found that 39.5% of the respondents had poor or very bad sleep quality, while only 15.9% sleep more than seven hours.³

Abnormal sleeping duration and quality negatively affect an individual’s mental and physical health. Morales et al. observed a significant increase in depression and anxiety as well as a decrease in happiness scores among medical residents who were sleep-deprived compared to those with normal sleep (Δ = 0.72, 1.74, -1.88 vs. 0.02, 0.45, and -0.99). The same study also emphasize that the case group did more medical errors (5.48) than the control (3.17) (p = .012).⁴ Lack of sleep simultaneously contributes highly to the risk of cardiovascular, ophthalmological, and other diseases. A cohort study with 60,586 respondents conclude that daily sleep less than six hours have 1.10 times increase in coronary heart disease risk (0.96-1.26) even after controlling for demographic (e.g., age, gender, education, cigarette, alcohol
consumption, etc.) and medical factors (e.g., body mass index, cholesterol level, glucose, and blood pressure).  

Many sleep-deprived medical students nonetheless also complained about dryness or irritation in the eye. Dry eye disease (DED) is a condition where the eye orbit is too dry due to insufficient tear or unstable tear film. DED prevalence needs to be monitored closely. There are 20-50% of DED prevalence globally, while 8.15% were diagnosed in Thailand university students. However, six million adults in the United States of America are known to have undiagnosed DED. If goes untreated, the dryness of the eye can induce irritation, infection, corneal ulcers, and eventually vision loss or blindness. Upon its natural course, DED also cost an individual from 687 to 1,267 USD every year for medications and other non-pharmacological treatments.

Other studies had tried to examine the relationship between sleep quality to DED; however, they were using an older population (26-64 years old) and no isolation of other factors of DED (i.e., gadget exposure). Per the authors’ knowledge, this is one of the first studies to observe the sleep quality and DED relationship on the medical students with the exclusion of confounding factors as much as possible.

**Sample Size**

The authors’ calculated a 102 minimal sample size through the analytic independent categoric comparative equation of \( \left( Z_{\alpha/\sqrt{2pq+Z_{\beta}v(p_1q_1-p_2q_2)^2}} \right) \) with 5% \( \alpha \) and 20% \( \beta \), which correspond to 1.64 \( Z_\alpha \) and 0.84 \( Z_\beta \). Cho et al. provide a proportion of students with DED and poor sleep amounting to 40.68%, while DED students with adequate sleep to 23.70%. We also added a 10% addition to the minimal participant as a way to combat any loss to follow-up or incomplete filling of the questionnaire.

**Subject Enrollment**

The current study selected all medical students from the Pelita Harapan University, Tangerang to participate. Particularly, they were eligible if they are Indonesian medical students who were over 18 years old, have studied medicine for at least a month, and not in the exam period. However, they were excluded if: (1) wear contact lens, (2) consume daily medications (e.g., antihistamine, antimuscarinic, and oral contraception), (3) did abnormal duration of screen time, (4) had a history or were going to have an ophthalmology surgery, and (5) had systemic comorbidities which may manifest in the eye (e.g., diabetes, hypertension, Sjogren’s syndrome, and thyroid disease).

**Data Collection and Measurement**

The authors’ used a Schirmer primary exam and Pittsburgh Sleep Quality Index (PSQI) to evaluate the subjects’ dry eye disease and sleep quality. Siloam Hospitals Lippo Village and Pelita Harapan University provided the materials and tools for the Schirmer test. The investigation was done in an ophthalmology outpatient department under the direct supervision of a practicing ophthalmologist. Individuals were considered having DED if they tested with under 15-millimeter wet Schirmer strip, and non-DED if
the contrary. Meanwhile, we used PSQI to evaluate the subjects’ sleep quality. The questionnaire containing seven major aspects with a total of ten questions described an adequate capability to investigate an individual’s sleep quality with .74 Cronbach’s alpha reliability and .33-.82 correlation validity. However, the study did not use the original PSQI, but the Indonesian one. Translation to the local language decreased any language and cultural barriers that may arise while improving accuracy at the same time. The Indonesian version also had good capabilities with .79 Cronbach’s alpha reliability, .89 content validity, and $p < .001$ group validity. A score over five units indicates poor sleep and vice versa.

**Statistical Analysis**

Outsourced independent statistician tabulated the data using Microsoft Excel 365 (Microsoft, USA), while he used SPSS 26 (IBM, USA) to analyze it statistically. Relationship on sleep quality and dry eye disease was computed by chi-square and presented with corresponding odds ratio and 95% confidence interval. P-value is considered significant if it is less than .05.

**Results**

From the data collection period in November 2019 to January 2020, we observed a 100% participation rate on the randomly selected participants. Females were dominating among them by 55.8%, with DED and poor sleep happening on 41.3% and 55.23% of the respondents, respectively. Note that despite the gender disparity, it was not significant to both outcomes.

On the contrary, sleep quality had a relevant relationship to DED ($p = .001$), where an individual with poor sleep has a 2.96 increased risk of DED. Table 1 showed a full description of the relationships.

**Discussion**

Amid the three-month observational study, there was a 41.3% of DED prevalence. The cases present with dominancy of females (52.1%). Matossian et al. in their work discovered that DED favors the female with a 1.7-2.6:1 gender ratio after reviewing six DED prevalence studies in the United States. Women with higher estrogen levels were observed to have a higher DED severity score like those in the late follicular or luteal phase. Estrogen and the ovarian hormone modulate the amount of tear secretion, drainage, and evaporation through their bond to the receptors on the cornea, lacrimal gland, and meibomian gland. Liu et al. described that meta-analysis on seven randomized controlled trials yielded significant improvement on the dry eye disease after treatment with sex hormones (2.06 (0.74-4.46), $p = 0.006$).

The female gender likewise possessed more poor sleep quality than males (53.7% vs. 46.3%). Australian medical students reported that females majorly experienced more tiredness and poorer sleep quality compared to males (63.1% vs. 53.2% and 65.6% vs. 34.4%). Even after controlling for race, physical exercise, smoking, gadget use, medications, headache, and depression, the trend persists with the female having a 1.53 (1.23-1.90) times increased risk of poor sleep. Hormonal differences have been insinuated as a culprit in sleep variance between males and females. Cusmano et al. observed that gonadectomy on mice eliminated their gender-specific sleep differences. The fluctuating estrogen and progesterone levels in menstruation contributed to the variance of rapid eye movement (REM) and slow-wave sleep phases. Further, progesterone also induces gamma-aminobutyric acid (GABA$_A$) receptors to heighten the sleep spindle activity. Sleep distraction also happened a lot more in females aside from the hormonal disparity. A Chinese study estimated a 0.7% and 0.21 increase in females’ insomnia prevalence and
Meanwhile, the study calculated a significant 2.96 risk increase of DED incidence in those with poor sleep quality \((p = .001)\). Individuals with a lack of sleep experienced a decreased parasympathetic tone due to a reduced number of circulating hormones in the body (e.g., cortisol, epinephrine, and norepinephrine).\(^{26}\) The impaired hormonal stimulant of tear secretion coupled with tear hyperosmolarity, unstable tear film, and lowered tear break-up time rapidly induce the DED development. Kawashima et al. from Japan also described that DED individuals had a higher PSQI score significantly \((\Delta = 0.8, p = .002)\) with 45.0% having poor sleep quality \((p = .040)\).\(^{11}\)

This study bridges the gap between sleep quality and dry eye disease in Indonesian medical students. There are however some notable limitations, such as the cross-sectional design, small sample size, and not being generalizable to the foreign or non-scholar population. Henceforth, further studies on the topic are needed with cohort or experimental design on a larger sample pool and various populations, including more assessment on the risk factors.

**Conclusion**

Numerous amounts of academic, financial, and personal burdens on medical students eloquently deprived their time to rationally think and take care of themselves. Institutions, caregivers, parents, and individuals shall put more concern on themselves especially upon the students’ physical health and sleep awareness.

**Disclaimer**

The study also serves as a memorandum for the deceased first author, and accordingly, the research data is not available for any sharing or distribution. The authors declare no existing conflict of interest or external funding. We appreciate all of the respondents for their participation. All authors participated equally, from the conceiving of the research ideas to the execution and manuscript concoction.

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