

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

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## Abstract

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**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 dominance 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.<sup>1</sup> Medical student composed a lot of the sleep-deprived population niche due to the extensive academic, stress, and personal burdens.<sup>2</sup> 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.<sup>3</sup>

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 ( $\Delta = 0.72, 1.74, -1.88$  vs.  $0.02, 0.45, \text{ and } -0.99$ ). The same study also emphasize that the case group did more medical errors (5.48) than the control (3.17) ( $p = .012$ ).<sup>4</sup> 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).<sup>5</sup>

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.<sup>6</sup> DED prevalence needs to be monitored closely. There are 20-50% of DED prevalence globally, while 8.15% were diagnosed in Thailand university students.<sup>7,8</sup> However, six million adults in the United States of America are known to have undiagnosed DED.<sup>9</sup> 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.<sup>10</sup>

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).<sup>11,12</sup> Per the authors' knowledge, this is one of the first studies to observe the sleep quality and DED in medical university students in Indonesia after excluding other influencing factors. The current study consequently investigated the sleep and DED relationship on the medical students with the exclusion of confounding factors as much as possible.

## Material And Methods

### Ethical Consideration & Study Design

The Ethics Committee of Pelita Harapan University had appraised and approved the cross-sectional study through 186/K-LKJ/ETIK/XI/2019 certification, following the Helsinki Declaration and Institutional Review Board (IRB) protocols. All participants of the current cross-sectional study had seen, understood, agreed, and signed the informed consent before taking part in the investigation.

### Sample Size

The authors' calculated a 102 minimal sample size through the analytic independent categoric comparative equation of  $\frac{(Z_{\alpha}\sqrt{2pq}+Z_{\beta}\sqrt{p_1q_1-p_2q_2})^2}{(p_1-p_2)^2}$  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%.<sup>13</sup> 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.<sup>14</sup> 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.<sup>15</sup> 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. Relation 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 dominance 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.<sup>16</sup> Women with higher estrogen levels were observed to have a higher DED severity score like those in the late follicular or luteal phase.<sup>17</sup> 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.<sup>18</sup> 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),  $p = 0.006$ ).<sup>19</sup>

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%).<sup>20</sup> 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.<sup>21</sup> 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.<sup>22</sup> The fluctuating estrogen and progesterone levels in menstruation contributed to the variance of rapid eye movement (REM) and slow-wave sleep phases.<sup>23</sup> Further, progesterone also induces gamma-aminobutyric acid (GABA<sub>A</sub>) receptors to heighten the sleep spindle activity.<sup>24</sup> 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

PSQI score.<sup>25</sup>

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).<sup>26</sup> 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 ( $p = .040$ ).<sup>11</sup>

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.

## References

1. Suni E. How Much Sleep Do We Really Need?. 2021.
2. Azad MC, Fraser K, Rumana N, Abdullah AF, Shahana N, Hanly PJ, et al. Sleep Disturbances among Medical Students: A Global Perspective. *J Clin Sleep Med*. 2015 Jan 15;11(01):69–74. <https://doi.org/10.5664/jcsm.4370>
3. Corrêa C de C, Oliveira FK de, Pizzamiglio DS, Ortolan EVP, Weber SAT. Sleep quality in medical students: a comparison across the various phases of the medical course. *J Bras Pneumol*. 2017 Aug;43(4):285–9. <https://doi.org/10.1590/s1806-3756201600000178>
4. Morales J, Yáñez A, Fernández-González L, Montesinos-Magraner L, Marco-Ahulló A, Solana-Tramunt M, et al. Stress and autonomic response to sleep deprivation in medical residents: A comparative cross-sectional study. Romigi A, editor. *PLoS One*. 2019 Apr 4;14(4):e0214858. <https://doi.org/10.1371/journal.pone.0214858>
5. Lao XQ, Liu X, Deng H-B, Chan T-C, Ho KF, Wang F, et al. Sleep Quality, Sleep Duration, and the Risk of Coronary Heart Disease: A Prospective Cohort Study With 60,586 Adults. *J Clin Sleep Med*. 2018 Jan 15;14(01):109–17. <https://doi.org/10.5664/jcsm.6894>

6. Golden MI, Meyer JJ, Patel BC. Dry Eye Syndrome. Treasure Island (FL): StatPearls Publishing LLC; 2021.
7. Stapleton F, Alves M, Bunya VY, Jalbert I, Lekhanont K, Malet F, et al. TFOS DEWS II Epidemiology Report. *Ocul Surf*. 2017 Jul;15(3):334–65. <https://doi.org/10.1016/j.its.2017.05.003>
8. Supiyaphun C, Jongkhajornpong P, Rattanasiri S, Lekhanont K. Prevalence and risk factors of dry eye disease among University Students in Bangkok, Thailand. Bencharit S, editor. *PLoS One*. 2021 Oct 1;16(10):e0258217. <https://doi.org/10.1371/journal.pone.0258217>
9. Aggarwal S, Galor A. What's new in dry eye disease diagnosis? Current advances and challenges. *F1000Research*. 2018 Dec 19;7:1952. <https://doi.org/10.12688/f1000research.16468.1>
10. Rouen PA, White ML. Dry Eye Disease. *Home Healthc Now*. 2018 Mar;36(2):74–83. <https://doi.org/10.1097/NHH.0000000000000652>
11. Kawashima M, Uchino M, Yokoi N, Uchino Y, Dogru M, Komuro A, et al. The association of sleep quality with dry eye disease: the Osaka study. *Clin Ophthalmol*. 2016 Jun;10:15. <https://doi.org/10.2147/OPTH.S99620>
12. Prakasa AB. Hubungan Tingkat Stress dengan Derajat Kualitas Tidur pada Mahasiswa Fakultas Kedokteran Universitas Lampung. Universitas Lampung; 2016.
13. Jin Cho K, Kyu Kim H, Ho Lim M, Soon Baek H. Depression, ADHD, Job Stress and Sleep Problems with Dry Eye Disease in Korea. *J Psychiatry*. 2015;18(6). <https://doi.org/10.4172/2378-5756.1000331>
14. Manzar MD, Moiz JA, Zannat W, Spence DW, Pandi-Perumal SR, BaHammam AS, et al. Validity of the Pittsburgh Sleep Quality Index in Indian University Students. *Oman Med J*. 2015 May 15;30(3):193–202. <https://doi.org/10.5001/omj.2015.41>
15. Alim IZ. Test Validity and Reliability of The Instrument Pittsburgh Sleep Quality Index Indonesia Language Version. Universitas Indonesia; 2015.
16. Matossian C, McDonald M, Donaldson KE, Nichols KK, MacIver S, Gupta PK. Dry Eye Disease: Consideration for Women's Health. *J Women's Heal*. 2019 Apr;28(4):502–14. <https://doi.org/10.1089/jwh.2018.7041>
17. L ML, Z FL, A SP, P WSL. The Influence of Estrogen on Dry Eye Prevalence in Women. *J Clin Ophthalmol Eye Disord*. 2021;5(1):1–4.
18. Cavdar E, Ozkaya A, Alkin Z, Ozkaya HM, Babayigit MA. Changes in tear film, corneal topography, and refractive status in premenopausal women during menstrual cycle. *Contact Lens Anterior Eye*. 2014 Jun;37(3):209–12. <https://doi.org/10.1016/j.clae.2013.11.005>
19. Liu C, Liang K, Jiang Z, Tao L. Sex hormone therapy's effect on dry eye syndrome in postmenopausal women. *Medicine (Baltimore)*. 2018 Oct;97(40):e12572. <https://doi.org/10.1097/MD.00000000000012572>

20. Vajda C, Czernin M, Matzer F, Schenkeli E, Lorenzoni N, Fazekas C. Gender related difference in sleep quality and tiredness in Austrian medical students. *Eur J Public Health*. 2017 Nov 1;27(suppl\_3). <https://doi.org/10.1093/eurpub/ckx186.258>
21. Fatima Y, Doi SAR, Najman JM, Mamun A AI. Exploring Gender Difference in Sleep Quality of Young Adults: Findings from a Large Population Study. *Clin Med Res*. 2016 Dec 10;14(3–4):138–44. <https://doi.org/10.3121/cmr.2016.1338>
22. Cusmano DM, Hadjimarkou MM, Mong JA. Gonadal Steroid Modulation of Sleep and Wakefulness in Male and Female Rats Is Sexually Differentiated and Neonatally Organized by Steroid Exposure. *Endocrinology*. 2014 Jan 1;155(1):204–14. <https://doi.org/10.1210/en.2013-1624>
23. Brown AMC, Gervais NJ. Role of Ovarian Hormones in the Modulation of Sleep in Females Across the Adult Lifespan. *Endocrinology*. 2020 Sep 1;161(9). <https://doi.org/10.1210/endocr/bqaa128>
24. Plante DT, Goldstein MR. Medroxyprogesterone acetate is associated with increased sleep spindles during non-rapid eye movement sleep in women referred for polysomnography. *Psychoneuroendocrinology*. 2013 Dec;38(12):3160–6. <https://doi.org/10.1016/j.psyneuen.2013.08.012>
25. Tang J, Liao Y, Kelly BC, Xie L, Xiang Y-T, Qi C, et al. Gender and Regional Differences in Sleep Quality and Insomnia: A General Population-based Study in Hunan Province of China. *Sci Rep*. 2017 May 6;7(1):43690. <https://doi.org/10.1038/srep43690>
26. Lee YB, Koh JW, Hyon JY, Wee WR, Kim JJ, Shin YJ. Sleep Deprivation Reduces Tear Secretion and Impairs the Tear Film. *Investig Ophthalmology Vis Sci*. 2014 Jun 6;55(6):3525. <https://doi.org/10.1167/iovs.14-13881>