The Correlation of Sleep Quality and Cognitive Function In Students Of the Faculty Medicine during the Covid-19 Pandemic

Clarissa Felicia[1], Irawaty Hawari[2]

[2]Pendidikan Dokter, Fakultas Kedokteran, Universitas Tarumanagara Jakarta
[1]Ilmu Penyakit Saraf, Fakultas Kedokteran, Universitas Tarumanagara Jakarta

Email corespondensi : clarissa.405190001@stu.untar.ac.id

Abstract

Sleep deprivation often occurs in those who live in social situations and lifestyles that support the occurrence of these conditions, for example in people who have a large workload or academic demands, including medical students. Moreover, the outbreak of the COVID-19 pandemic since 2020 has made various universities suspend face-to-face learning which has an impact on increasing assignment assignments. This study aims to determine the relationship between sleep quality and cognitive function in the Class of 2020-2021 Students of the Faculty of Medicine of Tarumanagara University during the COVID-19 pandemic. The research method used is an analytical observational study using a cross-sectional analysis design. Data was collected online through filling out the Pittsburgh Sleep Quality Index (PSQI) and Indonesian-language Montreal Cognitive Assessment (MoCA-INA) questionnaires by respondents during the period of December 2021 to May 2022. The results of the study obtained 249 respondents, of which 159 respondents had poor sleep quality (63.9%). Poor sleep quality was more commonly found in respondents in the age group of 20-22 years (67.2%), female gender (68.2%), group with history of routine drug consumption (88.2%), and history of consuming caffeinated drinks >2x/day (76.3%). There is a significant relationship between sleep quality and cognitive function in the Class of 2020-2021 Students of the Faculty of Medicine of Tarumanagara University during the COVID-19 pandemic (RR=6.575, p<0.0001) as a conclusion. It is hoped that the results of this study can serve as educational material and reference especially for university students so that they can apply good sleep hygiene practices to optimize sleep quality and cognitive function.

Keywords: COVID-19, PSQI, MoCA-INA

INTRODUCTION

Sleep is a condition of human behavior that is beneficial to release fatigue both mentally and physically after activity (Mander et al., 2017; Medic et al., 2017). If the anxiety you feel is interfering with your daily activities, you should look for it help by visiting a psychologist or psychiatrist to get proper handling (Handayani, 2022). Besides, it has an important role in improving the brain work, which supports cognitive function. Some studies suggest that sleep improves memory consolidation, which is a process of storing new memories to the brain for time to time (Steiger & Pawlowski, 2019). Consolidation depends on mechanisms related to neuronal plasticity that reactivate and stabilize memory representations, as well as reorganize and integrate memory with pre-existing knowledge, which can facilitate other cognitive

functions, including problem solving and creativity (Chambers, 2017; Handojo M et al., 2018).

Questionnaire of *The Pittsburgh Sleep Quality Index* (PSQI) is an instrument developed to classify individuals with good sleep quality and poor sleep quality. The PSQI questionnaire measures sleep quality at intervals of one month and consists of 19 questions that measure seven components of the assessment, namely subjective sleep quality, sleep latency, sleep duration, *habitual sleep efficiency*, sleep disturbance, the use of sleeping pills (*sleep medication*), and *daytime dysfunction*. Meanwhile, the questionnaire of *Montreal Congnitve Assessment* (MoCA) is used to assess the decrease in cognitive function by evaluating eight cognitive domains, including executive function, visuospatial ability, attention and concentration, memory, language, thinking concepts, calculation, and orientation; and is considered more sensitive than *Mini Mental State Examination* (MMSE).

Sleep deprivation common occurs in those who live in social and lifestyle situations that favor the occurrence of the condition, for example in people who have a great workload or academic demands, including medical students. In addition, the outbreak of the COVID-19 pandemic since March 2020 has brought major changes in the college system in Indonesia (Agnesiana et al., 2023; Sukmawati, 2022). The government's appeal to carry out social restrictions has an impact on the suspension of face-to-face teaching at various universities, as stated in the circular of the Director General of Higher Education of the Republic of Indonesia Number 1 of 2020 (Kemendikbud DJPT, 2020; Musa et al., 2023) However, the *online* learning process shows a general description that students' understanding of the material given is less than optimal and an increase in the number of tasks given has an impact on reducing the quality of student sleep (Joesyiana, 2020). Other causes that can cause poor sleep quality include alcohol and caffeine intakes, stimulants, and technology use. A cross-sectional study found that 71% of students did not achieve the recommended minimum eight hours of sleep duration and 60% of them were classified as poor quality sleep (Patrick et al., 2017).

The results of a survey on students of the Faculty of Medicine, University of Tarumanegara, found that 8 out of 10 students stated that they lacked sleep due to assignments during the COVID-19 pandemic because learning was carried out online and by assignments. Risk factors that trigger poor sleep quality include older age group, female gender, history of regular drug consumption, and history of caffeine consumption. The high prevalence of sleep deprivation in medical students and the need for optimal cognitive function to support the academic process, especially during the COVID-19 pandemic, encourages the researchers to

determine the effects of decreased cognitive function as a result of poor sleep quality. Other previous studies have discussed about the correlation between sleep deprivation and cognitive function with varying results (Lowe et al., 2017). According to these facts, the authors wanted to examine the correlation of sleep quality with cognitive function in students of the Faculty of Medicine, Tarumanagara University batch 2020-2021.

METHODS

The research design was an analytical observational with a cross-sectional study conducted on 249 students with total population 440 students of the Faculty of Medicine, Tarumanagara University batch 2020-2021 during the period of December 2021 to May 2022. Sampling techniques used *stratified random sampling* (Sugiyono, 2019), the samples were selected by batch with samples from each batch taken randomly (Sugiyono, 2018).

The instrument employed a questionnaire of Indonesian *The Pittsburgh Sleep Quality Index* (PSQI) and Questionnaire of Indonesian *Montreal Cognitive Assessment* (MoCA-INA)with data retrieval through questionnaires and online interviews. The data obtained were then processed using a statistical test of Chi-square 2x2 with a significance level of 95% ($p < 0,05$) and presented into a table with SPSS Statistic 22.0. This research has passed the assessment and recommendation of the feasibility of research ethics based on letter number 089/KEPK/UPPM/FK UNTAR/XI/2021.

RESULTS

Table 1. Characteristics of Respondents

Characteristics	Frequency	Percentage
Age (years)		
17-19	191	76,7
20-22	58	23,3
Gender		
Male	73	29,3
Female	176	70,7
History of Routine Drug Consumption		
Yes	17	6,8
No	232	93,2
Consumption History of Caffeinated Beverages		
>2x/day	38	15,3
0-2x/day	211	84,7
Sleep Quality		
Poor	159	63,9
Good	90	36,1
Cognitive Function		
Disturbed	164	65,9
Normal	85	34,1

Based on the results of the study, it was found that there is a quite high prevalence of poor sleep quality in students of the Faculty of Medicine, Tarumanagara University batch 2020-2021, which covered 63,9% of the total sample. These results support a meta-analysis study conducted by Rao, et al in 2020, in which the prevalence rate of poor sleep quality in medical students was 52,7% of the total 57 studies. The study, which included medical students from different continents, stated that poor sleep quality was most common in medical students in Europe (65,3%), followed by America (59,92%), Africa (54,54%), Asia (47,44%), and Oceania (30,51%) (Rao et al., 2020). In addition, a study conducted by Handojo, et al in 2018 also supported the results of this study with a prevalence of poor sleep quality in medical students of 76,2%.

Analysis of the correlation of respondents' characteristics and sleep quality to determine the risk factors that may affect the sleep quality of respondents are presented in Table 2.

Table 2. Correlation of respondent characteristics and sleep quality

Characteristics	Sleep Quality		Relative Risk (RR)	p-value
	Poor	Good		
Age (years)				
17-19	120 (62,8)	71 (37,2)	0,934	0,540
20-22	39 (67,2)	19 (32,8)		
Gender				
Male	39 (53,4)	34 (46,6)	0,784	0,027
Female	120 (68,2)	56 (31,8)		
History of Routine Drug Consumption				
Yes	15 (88,2)	2 (11,8)	1,422	0,030
No	144 (62,1)	88 (37,9)		
Consumption History of Caffeinated Beverages				
>2x/day	29 (76,3)	9 (23,7)	1,239	0,082
0-2x/day	130 (61,6)	81 (38,4)		

The results of bivariate analysis between age and sleep quality in this study were considered less meaningful (p=0,540), so there was no significant difference between the quality of sleep in the younger age group (17-19 years) and the older age group (20-22 years).

Table 3. Correlation between sleep quality and cognitive function

Sleep Quality	Cognitive Function [n (%)]		Relative Risk (RR)	p-value
	Disturbed	Normal		
Poor	151 (95,0)	8 (5,0)	6,575	0,000
Good	13 (14,4)	77 (85,6)		

Based on statistical test results of *Chi-square*, obtained a very meaningful/significant correlation (p<0.0001) between sleep quality and cognitive function with a value of RR=6,575.

DISCUSSION

The results of this study are in accordance with the results by Madrid-Valero, et al states that age is inversely significant with sleep quality. This is related to the evolutive changes that occur throughout adult life that involve an increase in the vulnerability of the sleep-wake cycle regulation system, and can ultimately affect sleep quality (Madrid-Valero et al., 2017). However, research conducted suggests that the relationship of age and sleep quality also cannot be separated from daily habits, one of which is the use of gadgets. The habit of using devices (tablets, mobile phones, etc.) can increase a person's risk of having poor sleep quality. This is related to the use of devices that can often make the users are busy and forget the time. Based on a survey conducted by *The National Sleep Foundation* in 2011, about 25% of respondents had a sleeping habit by keeping their cell phone in bed and about 10% often woke up at night because they had to answer the phone, sms, or electronic mail. This condition was more often reported by respondents aged young adults (13-29 years).

In contrast, statistical tests using *Chi-square* for the correlation of gender and sleep quality showed significant results (p=0,027) with RR=0,784 for male to female sex. This has the possibility due to the much higher population of female respondents in this study, which includes 70,7% of the total respondents. However, these results are also in line with Xu, et al.' s assertion that female are more suffer from insomnia than male at all ages, although significantly more at an advanced age. The underlying mechanism of this condition is still unclear, but the changes a female experiences during menopause are believed to be related to this. Various factors are involved in the menopause process and simultaneously affect the quality of a person's sleep including vasomotor symptoms, changes in temperature and skin, lifestyle and changes in hormone levels that can affect circadian rhythms.

Respondents with a history about routine consumption of non-psychotropic drugs, such as asthma drugs, TB drugs, antacids, and NSAIDs showed a significant correlation of poor sleep quality (p=0,030) when compared with those who did not have a history of drug consumption. However, in this study, the population of respondents who had a history of routine drug consumption was only 6,8%. According to a reference written by Novak, et al, drugs known to induce apnea during the neonatal and childhood periods include some neuromuscular blocking agents, such as succinylcholine and cardiovascular agents. In addition, several agents, including thyroxine, antidepressants, progestationals, nicotie and theophylline were reported to improve breathing patterns during the night.

In this study, respondents with a history of consumption of caffeinated beverages >2x/day (15,3%) tend to have poor sleep quality (76,3%). However, the results of *Chi-square*

statistical tests showed a less significant relationship (p=0,082) between the history of consumption of caffeinated beverages and sleep quality. This may be due to respondents' varying and not specifically known ranges of caffeine consumption, as Weibel, et al, explained in their study. According to Weibel, especially caffeine consumed at night can prolong sleep latency, reduce total sleep time (TST), shorten the duration of deep sleep, and decrease slow wave activity on electroencephalography (EEG), while there is an increased activity in the sigma range (Weibel et al., 2021). However, night caffeine intake only accounts for about 10-20% of total daily caffeine intake (Lieberman et al., 2019). Thus, further explanation is needed regarding the effect of limiting caffeine intake habits in the morning and evening on sleep quality.

A previous study that analyzed the correlation between dose and time of consumption with the body's response to caffeine intake and sleep quality explained that the average sleep quality was similar between nightly and non-nightly caffeine consumers. This is due to the mechanisms of vary self-regulation in each individual (O'callaghan et al., 2018). Other studies suggest that there are individual differences related to the sensitivity on caffeine, which ultimately affects the speed of a person's body when metabolizing caffeine. In addition, repeated caffeine use is also stated to induce tolerance mechanisms, i.e. a reduced sensitivity of a person to certain effects of caffeine (Grant et al., 2018; Temple et al., 2017).

Based on statistical test results of *Chi-square*, obtained a very meaningful/significant correlation (p<0.0001) between sleep quality and cognitive function with a value of RR=6,575 (Table 3). It means that respondents with poor sleep quality have a 6,575 times greater risk of experiencing impaired cognitive function than those who have good sleep quality. These results are in line with research conducted by Handojo, et al who said that there is a decrease in cognitive function in PPDS after night watch, which caused to be the impact of prolonged fatigue. This condition may be related to a lack of adaptation rate of irregular circadian rhythms. Another study that also supports these results was conducted by Yousefpour, et al.which showed that there is a significant difference between the average selective attention in respondents and poor sleep quality compared to those who have good sleep quality(Yousefpour et al., 2019). Kim, et al also mentioned the similar results, namely there is a significant correlation between a reduction in sleep time with a decrease in the level of attention and learning difficulties(Kim et al., 2014).

A possible mechanism that might be effected has been elucidated in their study, that in healthy adults, sleep deprivation can induce extensive neurophysiological and endocrine changes, characterized by impaired cognitive function, despite increased regional brain

activity. Activation of the dopaminergic system accompanied by decreased cortisol response induces increased motivation *top-down* control and requires increased involvement of prefrontal and limbic cortical areas as compensatory mechanisms (Holst et al., 2017; Jiang, 2020). The Waking State is believed to be related to D2 receptor activation (DRD2) and stimulation of *corticotropin-releasing hormone* (CRH) in the presence of changes in emotional function. A decrease in DRD2 affinity can occur as a brain response for the increase dopamine levels caused by a state of sleep deprivation. In addition, lack of sleep can also blunt the wick of *hypothalamic-pituitary-adrenal* (HPA) which has an impact on the absence of stress when waking up and lowering consciousness.

CONCLUSIONS

The conclusion of this study found a meaningful correlation between sleep quality and cognitive function in students of the Faculty of Medicine during the COVID-19 pandemic. It is hoped that the results of this study can serve as educational material and reference especially for university students so that they can apply good sleep hygiene practices to optimize sleep quality and cognitive function. In addition, future researchers are expected to consider other factors that can affect sleep quality, such as psychological conditions, time of consumption of caffeine and the age range of the extended sample in order to obtain more comprehensive research results.

REFERENCE

Agnesiana, B., Mahendika, D., Rumfot, S., & Sukmawati, E. (2023). The Analysis of Teacher Efforts to Developing Students Interpersonal and Intrapersonal Intelligence in Learning Activities. *Journal on Education*, *05*(04), 11661–11666.

Chambers, A. M. (2017). The role of sleep in cognitive processing: focusing on memory consolidation. In *Wiley Interdisciplinary Reviews: Cognitive Science* (Vol. 8, Issue 3). https://doi.org/10.1002/wcs.1433

Grant, S. S., Magruder, K. P., & Friedman, B. H. (2018). Controlling for caffeine in cardiovascular research: A critical review. In *International Journal of Psychophysiology* (Vol. 133). https://doi.org/10.1016/j.ijpsycho.2018.07.001

Handayani, K. D. (2022). Masalah Kesehatan Mental di Tengah Pandemi Covid-19: Peningkatan Masalah Gangguan Kecemasan Dan Penanganannya Mental Health Problems in the Midst of the Covid-19 Pandemic: Increasing Anxiety Disorder Problems and How to Handle Them. *Contagion : Scientific Periodical of Public Health and Coastal Health*, *4*(1), 56–66. https://doi.org/10.30829/contagion.v4i1.10844

Handojo M, Pertiwi J.M, & Ngantung D. (2018). Hubungan Gangguan Kualitas Tidur Menggunakan PSQI Dengan Fungsi Kognitif Pada PPDS Pasca Jaga Malam. *Jurnal Sinaps*, *1*(1), 91–101.

Holst, S. C., Müller, T., Valomon, A., Seebauer, B., Berger, W., & Landolt, H. P. (2017). Functional Polymorphisms in Dopaminergic Genes Modulate Neurobehavioral and

Neurophysiological Consequences of Sleep Deprivation. *Scientific Reports*, *7*. https://doi.org/10.1038/srep45982

Jiang, F. (2020). Sleep and Early Brain Development. In *Annals of Nutrition and Metabolism* (Vol. 75, Issue Suppl1). https://doi.org/10.1159/000508055

Joesyiana, K. (2020). The Effectiveness Of Online Classes During The Covid-19 Pandemic (Case Study : Students Of The Management Study Program Of Persada Bunda). *Media Bina Ilmiah*, *15*(2), 4045–4056. https://doi.org/10.33758/mbi.v15i2.730

Kemendikbud DJPT. (2020). *Surat Edaran Direktur Jenderal Pendidikan Tinggi Republik Indonesia Nomor 1 Tahun 2020* (Issue 1).

Kim, E. J., Baek, J. H., Shin, D. J., Park, H.-M., Lee, Y.-B., Park, K.-H., Shin, D. H., Noh, Y., & Sung, Y. H. (2014). Correlation of Sleep Disturbance and Cognitive Impairment in Patients with Parkinson's Disease. *Journal of Movement Disorders*, *7*(1), 13–18. https://doi.org/10.14802/jmd.14003

Lieberman, H. R., Agarwal, S., & Fulgoni III, V. L. (2019). Daily Patterns of Caffeine Intake and the Association of Intake with Multiple Sociodemographic and Lifestyle Factors in US Adults Based on the NHANES 2007–2012 surveys. *Journal of the Academy of Nutrition and Dietetics*, *119*(1), 106–114. https://doi.org/10.1016/j.jand.2018.08.152

Lowe, C. J., Safati, A., & Hall, P. A. (2017). The Neurocognitive Consequences of Sleep Restriction: a Meta-analytic Review. *Neuroscience & Biobehavioral Reviews*, *80*, 586–604. https://doi.org/10.1016/j.neubiorev.2017.07.010

Madrid-Valero, J. J., Martínez-Selva, J. M., Couto, B. R. do, Sánchez-Romera, J. F., & Ordoñana, J. R. (2017). Age and Gender Effects on the Prevalence of Poor Sleep Quality in the Adult Population. *Gaceta Sanitaria*, *31*(1), 18–22.

Mander, B. A., Winer, J. R., & Walker, M. P. (2017). Sleep and Human Aging. In *Neuron* (Vol. 94, Issue 1). https://doi.org/10.1016/j.neuron.2017.02.004

Medic, G., Wille, M., & Hemels, M. E. H. (2017). Short- and long-term health consequences of sleep disruption. In *Nature and Science of Sleep* (Vol. 9). https://doi.org/10.2147/NSS.S134864

Musa, M., Arifin, Sukmawati, E., Zulkifli, & Mahendika, D. (2023). The R elationship between Students ' S piritual and Emotional Intelligence with Subjects Learning Outcomes. *Journal on Education*, *05*(04), 11729–11733. https://doi.org/10.31004/joe.v5i4.2128

Musa, M., Sukmawati, E., Mahendika, D., Muhammadiyah Kupang, U., H Ahmad Dahlan, J. K., Putih, K., Oebobo, K., Kupang, K., Tenggara Timur, N., Negeri Gorontalo, U., Jend Sudirman No, J., Timur, D., Kota Tengah, K., Gorontalo, K., Serulingmas, S., Raya Maos No, J., Cilacap, K., Tengah, J., Tinggi Teknologi Bontang, S., … Timur, K. (2023). The Relationship between Students' Spiritual and Emotional Intelligence with Subjects Learning Outcomes. *Journal on Education*, *05*(04).

O'callaghan, F., Muurlink, O., & Reid, N. (2018). Effects of caffeine on sleep quality and daytime functioning. *Risk Management and Healthcare Policy*, *11*, 263–271. https://doi.org/10.2147/RMHP.S156404

Patrick, Y., Lee, A., Raha, O., Pillai, K., Gupta, S., Sethi, S., Mukeshimana, F., Gerard, L., Moghal, M. U., & Saleh, S. N. (2017). Effects of Sleep Deprivation on Cognitive and Physical Performance in University Students. *Sleep and Biological Rhythms*, *15*(3), 217–225. https://doi.org/10.1007/s41105-017-0099-5

Rao, W.-W., Li, W., Qi, H., Hong, L., Chen, C., Li, C.-Y., Ng, C. H., Ungvari, G. S., & Xiang, Y.-T. (2020). Sleep Quality in Medical Students: a Comprehensive Meta-Analysis of Observational Studies. *Sleep and Breathing*, *24*(3), 1151–1165. https://doi.org/10.1007/s11325-020-02020-5

Steiger, A., & Pawlowski, M. (2019). Depression and sleep. In *International Journal of*

Molecular Sciences (Vol. 20, Issue 3). https://doi.org/10.3390/ijms20030607

Sugiyono. (2018). *Metode Penelitian Kualitatif, Kuantitatif, dan R&D*. CV.Alfabeta.

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (1st ed.). Penerbit Alfabeta.

Sukmawati, Ellyzabeth, N. (2022). Pembelajaran Daring Berbasis Masalah Dalam Peningkatan Motivasi Belajar. *Juli*, *2*(2), 196–199. https://doi.org/10.55606/jurdikbud.v2i2.299

Sukmawati, E., Heri Fitriadi, Mk., Yudha Pradana, M., Dumiyati, Mp., Arifin, Mp., Sahib Saleh, Mp. M., Hastin Trustisari, Mp., Pradika Adi Wijayanto, Ms., Khasanah, Mp., & Kasmanto Rinaldi, Mp. (2022). *Digitalisasi Sebagai Pengembangan Model Pembelajaran Penerbit Cendikia Mulia Mandiri*.

Temple, J. L., Bernard, C., Lipshultz, S. E., Czachor, J. D., Westphal, J. A., & Mestre, M. A. (2017). The Safety of Ingested Caffeine: A Comprehensive Review. In *Frontiers in Psychiatry* (Vol. 8). https://doi.org/10.3389/fpsyt.2017.00080

Weibel, J., Lin, Y.-S., Landolt, H.-P., Kistler, J., Rehm, S., Rentsch, K. M., Slawik, H., Borgwardt, S., Cajochen, C., & Reichert, C. F. (2021). The Impact of Daily Caffeine Intake on Nighttime Sleep in Young Adult Men. *Scientific Reports*, *11*(1), 1–9. https://doi.org/10.1038/s41598-021-84088-x

Yousefpour, M., Jafari, M.-J., & Mirzaii-Dizgah, I. (2019). The Effect of Partial and Chronic Sleep Deprivation on Working Memory and Attention in Emergency Medicine Interns. *Annals of Military and Health Sciences Research*, *17*(1), e89917. https://doi.org/10.5812/amh.89917