Original Research Article

Association between caffeinated beverages consumption and sleep quality of undergraduate medical students: A cross-sectional study

ABSTRACT

Introduction: Caffeine is one of the most common brain stimulants used by people nowadays to stay awake. This is especially seen in youngsters including medical students around the world.

Aim: This study aimed to investigate the association between caffeine intake and sleep quality of undergraduate medical students.

Study design: A cross-sectional analytical study

Methodology: This study was conducted from January to February 2022 among undergraduate medical students (MBBS) in a private medical university in Malaysia. The respondents were recruited by purposive sampling and self-administered validated questionnaire was used for data collection. The data was analysed using Epi Info software (version 7.2.5.0). The descriptive statistics was calculated as frequency, percentage, mean, standard deviation, and range. The Chi-square test was used in inferential statistics.

Results: There were 111 students who agreed to participate in this study. After the data analysis and processing, 89.19% of the students reported of having low caffeine intake while 10.81% having high caffeine intake. The results showed that 53.15% of the students had good sleep quality while the remaining 46.85% had bad sleep quality. There was no significant association between age, gender, ethnicity, caffeine intake, and sleep quality. However, there was a significant association between the semester that the student was currently taking and sleep quality.

Conclusion: Although there was no significant association between the caffeine intake and sleep quality, 46.85% of the respondents reported poor sleep quality. Therefore, it would be beneficial if sleep hygiene education sessions are included in university education programme.

Keywords: Caffeine Intake, Sleep Quality, Cross sectional Study, Medical students, Malaysia

1. INTRODUCTION

Caffeine, being one of the most consumed brain stimulants, stimulates the hypothalamo-pituitary-adrenal axis and increases the levels of plasma cortisol in the body by acting primarily on A1 and A2A receptors, which are related to the brain functions which are associated with sleep, arousal, and cognition [1,2]. Caffeine also helps to enhance relaxation and a sense of wellbeing during stressful situations due to the sensitization of a specific subset of cannabinoid receptors in the brain caused by this cortisol stimulation [3]. Caffeine usually promotes alertness and decreases sleepiness, but it can also displace adverse effects on sleep quality, decrease sleep duration, and prolong the perceived sleeping onset [4,5]. This is because caffeine is a non-specific inhibitor of adenosine receptors, which prevents melatonin secretion [6,7]. Melatonin is an important neurohormone that regulates sleep. The decrease in the secretion of melatonin can cause disruption in the sleep-wake cycle [6]. For example, people in Massachusetts who consume a large amount of caffeine were proven to have a shorter sleep duration, more frequent disturbed sleep, increased latency of sleep, and inadequate sleep quality than those who consume less caffeine [8]. The effects of caffeine are proven to be dependent on the dose ingested, and the time that drink was consumed [9,10]. It appears that the lower end of the caffeine dose range may have beneficial behavioral effects [8]. Some studies proved that the moderate use of stimulants among healthy individuals might be associated with jitteriness and nervousness, experiencing sleeping difficulties, appetite loss, and discomfort in the stomach [11,12]. On another note, the use of high-dose caffeine and late-day caffeine consumption is related to insomnia, palpitation, arrhythmias, seizures, and stroke [12,13]. Germany, Ireland, and New Zealand have a high incidence of energy-drink-related toxicity. Studies in these countries reported an association between this high consumption and organ failures like liver, kidney, and heart, which predisposes to death [12].

Sleep need is subjective, and it can be different for each person, but the recommended amount of sleep every night that an adult should get is roughly 7 to 9 hours [14]. College students nowadays have irregular sleep patterns due to attempting to compensate for the prolonged sleep deprivation periods, typically associated with poor academic performances, increased depression symptoms, psychiatric distress, and addictive behaviours [1,5,15,16]. Hence, they compensate by depending on energy drinks and other caffeinated beverages, especially coffee, which continues into adulthood [5]. College students consume these beverages to promote wakefulness during studying, overcome tiredness and promote cognitive performance [1,16]. Based on a self-report survey, about 30% to 50% of young adults and adolescents in the United States of America (USA) consume energy drinks. Another survey was conducted on USA college students where results show that 51% of the sampled population consumes more than one energy every month. The majority of the students consumed energy drinks multiple times a week [12]. There were also reports in Chile that stated roughly a 26.7% increased energy drink consumption between 2004 to 2010. This surge might be due to the marketing efforts of these drinks, which may be targeted towards young adults [11].

Previously, a cross-sectional study was conducted to assess the relationship between caffeine consumption and caffeine expectancy among undergraduate medical students in a private institution in Malaysia. According to this study, around 70.9% of the students consumed tea, and 68.5% consumed coffee [17]. The Malaysian Ministry of Health statistics showed that there was a rise in mental health issues among Malaysian students in 2011 and 2016. Some of the contributors to the said issue were academic pressure, financial burden, rise in higher education accessibility, increased technology use, increased female-to-male ratio, and dramatic lifestyle changes in students [18]. Another study that was conducted in a

medical institution in Egypt showed that there is an association between the consumption of caffeine in both young and older adult groups and their self-rated health. It was proven that caffeine consumption is often associated with an unhealthy lifestyle, such as cigarette smoking, irregular sleeping patterns, and high body mass index (BMI), which is indicative of overweight or obesity [19]. There is also evidence that most of the medical students who consume caffeine do not have sufficient knowledge of the stimulant's pros, cons, and withdrawal symptoms, and they also seemed to be unaware of the total amount of caffeine that they consume each day [20,22]. Most of the students consume caffeine once to thrice a week, giving the reason that they are fond of the taste, helping them to stay alert during the day and stay up late at night [23]. However, some medical students who consume caffeine on a regular basis experience either caffeine toxicity or withdrawal symptoms, and present with restlessness, nervousness, and anxiety [24]. There are multiple studies confirming the positive association between caffeine consumption and anxiety and related symptoms. However, there was no evidence that there is an association between caffeine consumption and depressive symptoms among medical students [25].

The mentioned studies showed that the majority of undergraduate medical students consume caffeinated drinks. However, the study did not assess the sleep quality of the caffeine-consuming students. Hence, the purpose of our study is to investigate the association between caffeinated beverages consumption and sleep quality of undergraduate medical students in a private medical university in Malaysia.

2. MATERIAL AND METHODS

2.1 STUDY SETTING AND POPULATION

The cross-sectional study was conducted in February 2022 in a private medical university in Malaysia. The students studying the undergraduate medical programme were recruited in this study.

2.2 SAMPLE SIZE AND SAMPLING

The sample size for this study was calculated by using the CDC Epi Info sample size calculator. The estimated total population was 815 medical students. The minimum sample size required was 118 with an expected frequency of 50%, an acceptable margin of error of 8%, and a confidence level of 92%.

A purposive sampling method was chosen for our research. This is a type of non-probability sampling method. The sampling method was chosen based on the characteristics of the population as well as the objective of the study. The inclusion criteria were medical students in the study institution, who had voluntarily agreed to participate in the study and completed the given questionnaire including the written informed consent form. The exclusion criteria of this study are students in semesters 4 and 5 (currently in India), students studying in other programmes.

2.3 STUDY INSTRUMENT AND DATA COLLECTION

The structured questionnaire was used to collect the data consisting of three parts. The first part of the questionnaire contained demographic data which included age, gender, ethnicity, and the semester that the student was currently in. The second part of the questionnaire contained questions regarding caffeine intake (serving size) and its frequency of consumption, taken from the previously published article [26]. The third part of the questionnaire contained questions regarding sleep quality using the Pittsburgh Sleep Quality

Index (PSQI) [27]. The self-administered questionnaire will be distributed to eligible undergraduate students, and they were informed that it would take approximately 5 to 10 minutes to complete this questionnaire. The informed consent was taken from the respondents prior to the questionnaire.

2.4 DATA ANALYSIS

The data collected from the distributed questionnaires was analyzed using CDC Epi Info version 7.2.4.0. The independent variable used in this study was caffeinated drinks consumption whereas the dependent variable used in this study was the sleep quality of undergraduate medical students. A four-point Likert scale was used for the assessment of sleep quality among medical students (0 - not during the past month, 1- less than once a week, 2 - once or twice a week, 3 - three or more times a week). A total score of '5' or greater is indicative of poor sleep quality. The frequency of caffeine intake and type of caffeinated beverages consumption throughout the day was among medical students (during breakfast, between breakfast and lunch, during lunch, between lunch and dinner, dinner and after dinner). The types of beverages consisted of coffee, decaffeinated coffee, espresso, tea, cocoa drink, energy drink, and soft drinks. Chi-square test was used to assess the factors associated with sleep quality.

3. RESULTS

Table 1 shows the frequency and percentage of the variables such as age, gender, ethnicity, the semester that the student was currently taking, and their caffeine intake. The respondents' age was divided into two groups, less than or equal to 22 years old and more than 22 years old. Out of 111 respondents, 69.37% were less than or equal to 22 years old. Among the respondents, approximately two-third were females (63.06%). For ethnicity, 54.95% were Indians, 30.63% were Chinese, 12.61% were of other ethnicities, and 1.80% were Malay. The majority of the respondents (89.19%) reported to have low caffeine intake (Table 1).

Table 1. Socio-demographic data of undergraduate medical students (n= 111)

Variables	Frequency (%)
Age (years)	
≤ 22	77 (69.37)
> 22	34 (30.63)
Mean (SD)	21.9 (1.14)
Minimum – maximum	18 - 25
Gender	

Male	41 (36.93)
Female	70 (63.06)
Ethnicity	
Malay	2 (1.80)
Chinese	34 (30.63)
Indian	61 (54.95)
Others (Sri Lankan)	14 (12.61)
Semester	
3	43 (38.74)
6	52 (46.85)
7	16 (14.41)
Caffeine Intake	
Low	99 (89.19)
High	12 (10.81)

Table 2 shows the integer value of PSQI data according to the respective subsections based on the validated reliable questionnaire, which is the Pittsburgh Sleep Quality Index (PSQI), with 0 being the lowest score and 3 being the highest score. PSQIDURAT indicated the duration of sleep of the student. 38.23% of the respondents had the value of 0, 29.73% of them had 1, 24.32% had 2, and 11.71% of them had 3. For the next category, PSQIDISTB measured the sleep disturbance. 12.61% had a value of 0, 77.48% of them had 1, 8.11% of them had 2, and 1.80% of them had the value of 3. PSQILATEN measures the sleep latency, and 36.04% of them had the score of 0, 47.75% of them had 1, 16.22% had 2 and none of them had the score of 3. As for PSQIDAYDYS which was the day dysfunction due to sleepiness, 16.22% of them scored 0, 51.35% of them scored 1, 25.23% of them scored 2 and 7.21% of them scored 3. For PSQIHSE which measures the sleep efficiency, 73.87% scored 0, 18 (16.22%) scored 1, 6.31% scored 2, and 3.60% scored 3. PSQISLQUAL described about the overall sleep quality, where 18.92% of the respondents had the score of 0, 63.06% had the score of 1, 15.32% had the score of 2, and 2.70% had the score of 3. The last section in the PSQI questionnaire was PSQIMEDS which indicated the need of medicine to sleep. 98.20% of the total respondents scored 0, 1.80% scored 1, and none of them scored 2 and 3 (Table 2).

Table 2. Frequency and Percentage of Integer value of PSQI data (n= 111)

PSQI Sections	0 n(%)	1 n(%)	2 n(%)	3 n(%)
PSQIDURAT	38 (38.23%)	33 (29.73%)	27 (24.32%)	13 (11.71%)
PSQIDISTB	14 (12.61%)	86 (77.48%)	9 (8.11%)	2 (1.80%)
PSQILATEN	40 (36.04%)	53 (47.75%)	18 (16.22%)	0 (0.00%)
PSQIDAYSDYS	18 (16.22%)	57 (51.35%)	28 (25.23%)	8 (7.21%)
PSQIHSE	82 (73.87%)	18 (16.22%)	7 (6.31%)	4 (3.60%)
PSQISLPQUAL	21 (18.92%)	70 (63.06%)	17 (15.32%)	3 (2.70%)
PSQIMEDS	109 (98.20%)	2 (1.80%)	0 (0.00%)	0 (0.00%)

Table 3 shows the frequency and percentage of students' total PSQI score and sleep quality, The PSQI score was divided into two groups, which was people who had the total score of 5 or less (indicative of good sleep quality) and people who had the total score of more than 5 (indicative of bad sleep quality). 53.15% of the respondents scored 5 or less whereas 46.85% of them scored more than 5 (Table 3).

Table 3. Frequency and Percentage of Total PSQI Score and Sleep Quality (n= 111)

PSQI Score	Frequency (%)
≤ 5 (Good sleep quality)	59 (53.15)
> 5 (Bad sleep quality)	52 (46.85)

Table 4 shows the association between age, gender, ethnicity, study semester, caffeine intake, and sleep quality among the medical undergraduate students. Based on the age, the students who were 22 years old or younger were more likely to have poor sleep quality compared to those older than 22 years with the odds ratio of 1.17 (95% CI: 0.52 - 2.63). The p value was 0.701, which indicates that this data is not statistically significant. Regarding gender, female students were 1.41 (95% CI: 0.65 - 3.07) times more likely to have poor sleep quality compared to male students. P value was 0.384 and therefore there was no statistically significant association between gender and sleep quality. Among the different ethic respondents, other ethnicities (OR: 3.30; 95% CI: 0.90 - 12.11) were more likely to have poor sleep quality, followed by Indians (OR: 1.56; 95% CI: 0.65 - 3.69) when compared to Chinese. However, both the p values (Others: 0.066; Indians: 0.315) show that there was no significant association between ethnicity and sleep quality. The respondents in semester 3 were 5.47 times (95% CI: 1.36 - 22.03) more likely to have poor sleep quality when compared to those who were in semester 7, followed by those who were in semester 6 who were 4.01 times (95% CI: 1.02 - 15.76) more likely to have poor sleep quality compared to

those in semester 7. Both the p values (Semester 3: 0.011; Semester 6: 0.037) showed that this data was statistically significant. The students who had high caffeine intake were 1.20 (95% CI: 0.36 - 3.98) times more likely to have poor sleep quality. The p value (p value: 0.765) shows that there was no significant association between caffeine intake and sleep quality of the undergraduate medical students (Table 4).

Table 4. Association between characteristics of undergraduate medical students, caffeine intake and sleep quality (n= 111)

Variable	Odds Ratio (OR)	95% Confidence Interval	P value
Age (years)			
> 22	1 (Reference)	-	-
≤ 22	1.17	0.52 - 2.63	0.701
Gender			
Male	1 (Reference)	-	-
Female	1.41	0.65 - 3.07	0.384
Ethnicity			
Chinese	1 (Reference)	-	-
Malay	Undefined	Undefined	0.068
Indian	1.56	0.65 - 3.69	0.315
Semester			
7	1 (Reference)	-	-
3	5.47	1.36 - 22.03	0.011
6	4.01	1.02 - 15.76	0.037
Caffeine Intake			
Low	1 (Reference)	-	-
High	1.20	0.36 - 3.98	0.765

4. DISCUSSION

This study assessed the sleep quality among medical students in Malaysia and factors associated with the sleep quality. Based on the findings, it is proven that medical student has inadequate sleep duration as over half of the students had poor sleep duration. This is expected as medical students have a heavier study load comparatively to other course students and poor sleep quality was reported in 46.85% of the respondents in our study. A study conducted among medical students in Ethiopia reported the higher number of poor sleep quality (62%) compared to the respondents in our study [28]. Furthermore, higher prevalence of poor sleep quality was reported in previous studies conducted among medical students in Sudan (61.4%) [29], and Iraq (60.4%) [30]. University students have longer class hours and must sacrifice sleep duration to compensate for their own activities whether it be preparation for exams or to maintain their social life [1]. For sleep disturbance, the majority of the students had high sleep disturbance. Next, sleep latency is measure with 36.04%. This correlates with the initial factor since exhausted students are more likely to fall asleep faster and hence have low sleep latency [14]. The next section describes about the day dysfunction due to sleepiness where it measures how well the students function during the day. Majority of the students had day dysfunction. This might be due to lack of sleep that affects the students' alertness and attention during the day [1,13]. Regards to sleep efficiency, a large portion (73.878%) of the students had good sleep efficiency. In addition, sample answer overall sleep quality as low (81.98%). Accounting all the previous factors this data is to be expected as medical student overall sleep quality [1]. Lastly, the need of medicine to sleep data result is low among the respondents. The people who need medication to sleep might have insomnia or perhaps an overwhelming amount of stress keeps the student awake, hence needing medication [4].

In our study, study semester was found to be significantly associated with the sleep quality. Those who are currently in semester 3 (year 2) are 5.47 times more likely to have poor sleep quality when compared to those who are in semester 7 (year 4). A study conducted among 540 undergraduate medical students in Brazil revealed that the first- and second-year students had poor sleep quality compared to the senior years [31]. The junior year students might need to learn new subjects which could be stressful for them affecting their sleep. Meanwhile, in senior years, they are more likely to cope better and understand how to maintain a healthy sleeping schedule.

Medical students might have abuse on using caffeine as a cognitive stimulant in order for them to compensate for the heavy study loads, preparation for examination or maintaining their social life which eventually adds up on their sleep deprivation, since caffeine act as a brain stimulant which keeps one awake. Besides, exhausting clinical hours spend in the hospital and studies might have cause student to have a low sleep latency, which in turns causes students to take caffeine, and as time progresses their caffeine intake increases because of their increase in tolerance. This cause students to fully depend on caffeine in order to stay awake and when the caffeine effect wears out, students feel extremely tired and the average sleep hours might not be enough for them to compensate on their long hours of awakeness. However, in our study, caffeine intake was not associated with sleep quality of undergraduate medical students in this study. An interventional study about the impact of caffeine intake on night-time sleep among young adults revealed that caffeine intake in the morning and afternoon did not show strong impairment on the sleep quality [32]. Another study conducted in an environment with little light, less noise pollution, and no shift work reported that caffeine did not impact on the sleep pattern among the respondents in a rural Ecaudorian village [33]. The effect of caffeine on the sleep quality could be intercalated with other conditions such as person's fatigue, environment noise, light, as well as dietary factors [2,33].

There are a few limitations while conducting this study. First of all, the data was collected from undergraduate medical students from a private medical university. Therefore, it might limit the generalizability of the findings. Secondly, some respondents might be selecting their answers they think that the researcher desires rather than what they truly think. There could also be extraneous factors such as stress that may affect our dependent variable.

5. CONCLUSION

In this study, one out of ten respondents reported of having high caffeine intake. Nearly half of the study respondents had bad sleep quality. However, the caffeine intake was not significant factor for the bad sleep quality. Therefore, there is a need to screen for the individual sleep quality, delivering education sessions to improve awareness on sleep hygiene and consequences of poor sleep quality.

CONSENT

Informed consent was obtained from the study respondents.

ETHICAL APPROVAL

Ethical approval was granted by the Research Ethics Committee (Faculty of Medicine), Manipal University College Malaysia.

REFERENCES

1. Sawah MA, Ruffin N, Rimawi M, Concerto C, Aguglia E, Chusid E, et al. Perceived stress and coffee and energy drink consumption predict poor sleep quality in podiatric medical students: A cross-sectional study. J Am Podiatr Med Assoc. 2015;105(5):429-34.

2. O'Callaghan F, Muurlink O, Reid N. Effects of caffeine on sleep quality and daytime functioning. Risk Manag Healthc Policy. 2018;11:263-71.

3. Aslam HM, Mughal A, Edhi MM, Saleem S, Rao MH, Aftab A. Assessment of pattern for consumption and awareness regarding energy drinks among medical students. Arch Public Health. 2013;71(1):1-11.

4. Kerpershoek, ML, Antypa N, Van den Berg JF. Evening use of caffeine moderates the relationship between caffeine consumption and subjective sleep quality in students. J Sleep Res. 2018; 27:e12670.

5. Sanchez SE, Martinez C, Oriol RA, Yanez D, Castañeda B, Sanchez E, et al. Sleep Quality, Sleep Patterns and Consumption of Energy Drinks and Other Caffeinated Beverages among Peruvian College Students. Health. 2013;5(8B):26-35.

6. Shilo L, Sabbah H, Hadari R, Kovatz S, Weinberg U, Dolev S, et al. The effects of coffee consumption on sleep and melatonin secretion. Sleep Med. 2002;3(3):271-3.

7. Hu Y, Stephenson K, Klare D. The dynamic relationship between daily caffeine intake and sleep duration in middle-aged and older adults. J Sleep Res. 2020;29:e12996.

8. Lemma S, Patel SV, Tarekegn YA, Tadesse MG, Berhane Y, Gelaye B, et al. The epidemiology of sleep quality, sleep patterns, consumption of caffeinated beverages, and Khat use among Ethiopian college students. Sleep Disord. 2012;2012:1-11.

9. Hindmarch I, Rigney U, Stanley N, Quinlan P, Rycroft J, Lane J. A naturalistic investigation of the effects of day-long consumption of tea, coffee and water on alertness, sleep onset and sleep quality. Psychopharmacology. 2000;149(3):203-16.

10. Khan F, Haroon H, Murtaza H, Anwar E. Determinants of sleep quality among undergraduate students of universities of Karachi. Ann Psychophysiol. 2016;3(1): 4-13.

11. Velez JC, Souza A, Traslavina S, Barbosa C, Wosu A, Andrade A, et al. The epidemiology of sleep quality and consumption of stimulant beverages among Patogonian Chilean college students. Sleep Disord. 2013;2013:910104.

12. Lohsoonthorn V, Khidir H, Casillas, G. et al. Lohsoonthorn V, Khidir H, Casillas G, Lertmaharit S, Tadesse MG, Pensuksan WC. Sleep quality and sleep patterns in relation to consumption of energy drinks, caffeinated beverages, and other stimulants among Thai college students. Sleep Breath. 2013;17(3):1017-28.

13. Drake C, Roehrs T, Shambroom J, Roth T. Caffeine effects on sleep taken 0, 3, or 6 hours before going to bed. J Clin Sleep Med. 2013;9(11):1195–1200.

14. Watson EJ, Coates AM, Kohler M, Banks S. Caffeine Consumption and Sleep Quality in Australian Adults. Nutrients. 2016;8(8):479.

15. Harris KM. Caffeine consumption as a predictor of sleep quality, sleep hygiene, subjective sleepiness and academic performance among North Texas female college students. ProQuest Dissertations Publishing. 2009.3384563

16. AlSharif SM, Al-Qathmi MS, Baabdullah WM, Alhrkan TA, Fayoumi YA, Alhejaili FF, et al. The effect of caffeinated beverages on sleep quality in college students. Saudi J Intern Med. 2018;8(1):43-8.

17. Ramesh D, Dey PK, Kularathne MM, Perera KCD, Maheshwaran GR. A survey on the effect of screen time before bed on sleep quality among medical students of Melaka-Manipal Medical College. Int J Nurs Health Sci. 2020;7(1):1-11.

18. Isa ZM, Anuar AA, Azmi AD, Selvan ST, Hisham NS, Yong ZQ. Does caffeine intake influence mental health of medical students. MJPHM. 2021;21(2):22-8.

19. Mohamed AAER, Tawfik EH. Association of caffeine consumption and self-rated health among young and older adults. Int J Nurs Sci Pract Res. 2018;4(2).

20. Lee KH, Human GP, Fourie JJ, Louw WAN, Larson CO, Joubert G. Medical students' use of caffeine for 'academic purposes' and their knowledge of its benefits, side-effects and withdrawal symptoms. S Afr Fam Pract. 2019;51(4): 322-7.

21. McIlvain GE, Noland MP, Bickel R. Caffeine consumption patterns and beliefs of college freshmen. Am J Health Educ. 2013;42(4):235-44.

22. AtikahRamli NA, Sriperumbuduru VPK, Ghazi HF, Dalayi NJ. A study of caffeine consumption patterns and dependence among management and science university students. Indian J Forensic Med Toxicol. 2019:13(1):101-5.

23. Khan MS, Nisar N, Naqvi SAA, Nawab F. Caffeine consumption and academic performance among medical students of Dow University of Health Science (DUHS), Karachi, Pakistan. Ann.Abbasi Shaheed Hosp. Karachi & K.M.D.C. 2017;22(3):179-84.

24. Samaha A, Tassi AA, Yahfoufi N, Gebbawi M, Rached M, Fawaz MA. Data on relationship between caffeine addiction and stress among Lebanese medical students in Lebanon. Data Brief. 2020;28:104845.

25. Mino Y, Yasuda N, Fujimura T, Ohara H. Caffeine consumption and anxiety and depressive symptomatology among medical students. Japanese J Alcohol Stud Drug Depend. 1990;25(6): 486-96.

26. Bühler E, Lachenmeier DW, Schlegel K, Winkler G. Development of a tool to assess the caffeine intake among teenagers and young adults. Sci Res. 2013; 61(4): 58-63.

27. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res. 1989;28: 193-213.

28. Wondie T, Molla A, Mulat H, Damene W, Bekele M, Madoro D, et al. Magnitude and correlates of sleep quality among undergraduate medical students in Ethiopia: cross – sectional study. Sleep Sci Pract. 2021;5:7.

29. Mirghani HO, Mohammed OS, Almurtadha YM, Ahmed MS. Good sleep quality is associated with better academic performance among Sudanese medical students. BMC Res Notes. 2015;8(1):706.

30. Al-Humairi AK. Sleep quality and academic performance among medical college students. J Univ Babylon. 2018;26(3):142-52.

31. Corrêa CC, Oliveira FK, 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;43(4):285-9.

32. Weibel J, Lin YS., Landolt HP, Kistler J, Rehm S, Rentsch KM, et al. The impact of daily caffeine intake on nighttime sleep in young adult men. Sci Rep. 2021;11, 4668.

33. Del Brutto OH, Mera RM, Zambrano M, Castillo PR. Caffeine intake has no effect on sleep quality in community dwellers living in a rural Ecuadorian village (The Atahualpa Project). Sleep Sci. 2016;9(1):35-9.