

Sleep Disruption and Its Impact on Academic Performance in Medical Students: A Systematic Review

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Abstract Medical students are prone to sleep deprivation and poor sleep quality. Insomnia and stress are commonly the cause of lack of sleep among students. This systematic review aimed to assess sleep quality that affects the academic performance among medical students by determining the components that help in identifying sleep quality in medical students, to identify how sleep quality affects the academic performance of medical students and determines the factors that cause sleep deprivation in medical students. We conducted a comprehensive screening through various database sources to extract data about the prevalence of poor sleep quality among medical students and its impact on students' academic performance. Findings of the studies showed that the academic performance was significantly affected by sleep deprivation among the medical students and there was a significant correlation between sleep quality, academic performance and the factors affecting sleep quality. These findings calling for immediate attention in order to improve the students sleep quality as poor sleep quality is significantly correlated to their low academic performance. One study showed no significant difference between sleep and academic performance of students but sleep quality is significantly associated with elevated levels of stress. However, longitudinal study is needed to conclude for more certainty.

Keywords Academic Performance, Caffeinated

Beverages, Internet Usage, Medical Students and Sleep Quality

1. Introduction

Subjective well-being is a person's cognitive and affective evaluations in his lifetime, and so adequate sleep of high quality and optimum duration improves one's memory processing and learning. In definition, sleep is the basic physiological body activity controlled by the central nervous system (CNS), characterized by closed eyes, mobility decreased, minimal movement, muscles relaxed, low attention to the environment and lessened consciousness with inactive body in physical state or at complete rest but brain and other organs of body work for physical, mental and emotional health in order to maintain the body homeostasis [1]. Various reported sleep studies conducted with healthy adults showed that sleep quality is associated with superior cognitive functions, such as learning and memory [2]. Lack of sleep may defined as fewer than 7 hours a day for adults and cognitive performance is related to inadequate sleep durations [3]. Such sleep deprived thought patterns may make the brain, difficult to generate new problem-solving ideas. Lack of adequate sleep can even cause chronic patterns of sleep

deprivation and attempts to go sleep may lead to increase variability in sleep patterns, as immune system regulates the sleep by controlling adenosine levels through secretion of cytokines [4]. Contrast, daytime sleepiness may also cause a negative impact on an individual's health, safety, and quality of life [5]. Medical students are shown to have a high incidence of poor sleep quality hour. This may be due to stress and pressure received from their course, which leads to difficulty of sleep [6]. Study showed that students who are at risk of having these disorders have a higher probability of having poor academic performance. It also stated that those whose academic performance below average level was most likely to have at least one of these sleeping disorders [7].

Several factors are known to cause sleep deprivation among medical students. It has been identified that physical, mental, and environmental factors can cause poor sleep quality [8]. A person lifestyle also may lead to lack of sleep with diet, alcohol and caffeine intake (as adenosine that promote sleepiness is blocked by caffeine), exercise and exposure to blue light emitting device. Nicotine acts as an addictive stimulant agent in cigarettes, also can affect the sleep quality by increasing the risk of snoring and sleep apnoea in students [9]. Studies have suggested excessive internet use or internet addiction is associated with depression, anxiety, distraction and lack of sleep. Moreover, studies also proposed that frequent bedtime internet use is inversely related to sleep duration. Generally, internet addiction is the main cause of sleep deprivation and sleep disorders [10]. Nevertheless, it is also reported that insomnia leads to sleep deprivation and one third of adults have been diagnosed with insomnia. According to a research, there is a significant relation between stress, anxiety, and depression with insomnia. When short sleep duration is habitual, it also leads to insulin resistance with increased sympathetic activity, and decrease cerebral glucose utilisation [11]. There is also a risk of developing infectious and inflammatory diseases with reduced sleeping habits. Restless legs syndrome (RLS) is another disorder that may occur due to lack of sleep in long-term and is characterized by an irresistible urge to move one's body to stop unwanted sensations [12].

Sleep assessment is an essential component and method in identifying quality of sleep by Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Perceived Stress Scale (PSS), and Depression, Anxiety, Stress Scale (DASS) [13]. Reviewing the reliability through questionnaires assessing sleep quality is one among study analysis. As medical students are constantly under stress, they are prone to have insomnia and poor sleep quality. Hence, we would like to compile the results gained from studies and learn more about how sleep quality affect academic performance especially among medical students. To assess the sleep quality that affects the academic performance among medical students, this systematic review determines the components that help in identifying sleep quality in medical students, identify how sleep

quality affects the academic performance of medical students and also identify the factors that cause sleep deprivation in medical students.

2. Materials and Methods

2.1. Study Design, Search Strategy and Selection Criteria

The systematic review used the studies related to the sleep quality impact on academic performance which was identified by conducting literature search. For this systematic review, we conduct an online search strategy in which involves 6 electronic database search engines: PubMed, Online Wiley Library, SpringerLink, ProQuest, Science Direct and Google Scholar for the articles published in English from 2010 to February 2021. The following keywords were used during the search strategy: "Sleep Quality" OR "Quality of Sleep" OR "Academic performance" OR "Academic achievement" AND "Medical student" OR "MBBS Student" OR "Undergraduate Medical Student".

2.2. Inclusion and Exclusion Criteria

Inclusion criteria:

1. Full-text articles
2. Original article published in English language
3. Publication date between January 2015 and February 2021 (To get recent and advanced data, due to sleep impacts on internet usage)
4. Studies include numerical value for sleep quality
5. Respondent for the studies must be undergraduate medical student

In order to eliminate or reduce the random error, selection bias and ambiguity in the results of the article selected for this systematic review, exclusion criteria are applied.

Exclusion criteria:

1. The year of study of the medical student (Not particularly year 1 or Year 2 students, described as whole academic years)
2. Narrative review.
3. Position statement.
4. Nature of the articles (Not only research articles, includes review articles)

2.3. Study Selection

The full-text version of the articles obtained were screened, extracted, and analysed for methodologic consistency and reliability of the finding by six researchers. All the workloads were distributed equally. Data extraction involves study details which include time of publication published, origin of the articles, type of studies and sample

size. The procedures were carried out independently using Microsoft Excel and the final number of articles obtained was added up during the final data selection process. The final analysis of the combined articles must be relevant and the research questions stated in Table 1 must be answered accordingly. After eliminating the full-text article which is not significant to the subject of the studies, a total of 13 full-text English articles were selected for qualitative review.

2.4. Quality Appraising

For the purpose of quality assurance, PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) were used to ensure the transparent and complete reporting of this systematic review research as shown in Figure 1. Other sources of information were obtained from clinical keys, thesis and dissertation parts from Proquest.

Table 1. List of questions addressed in this systematic review

No.	Systematic review Questions
1.	What are the components in identifying sleep quality in medical students?
2.	How does sleep quality affects medical students' academic performance?
3.	What are the factors causing sleep deprivation among medical students?

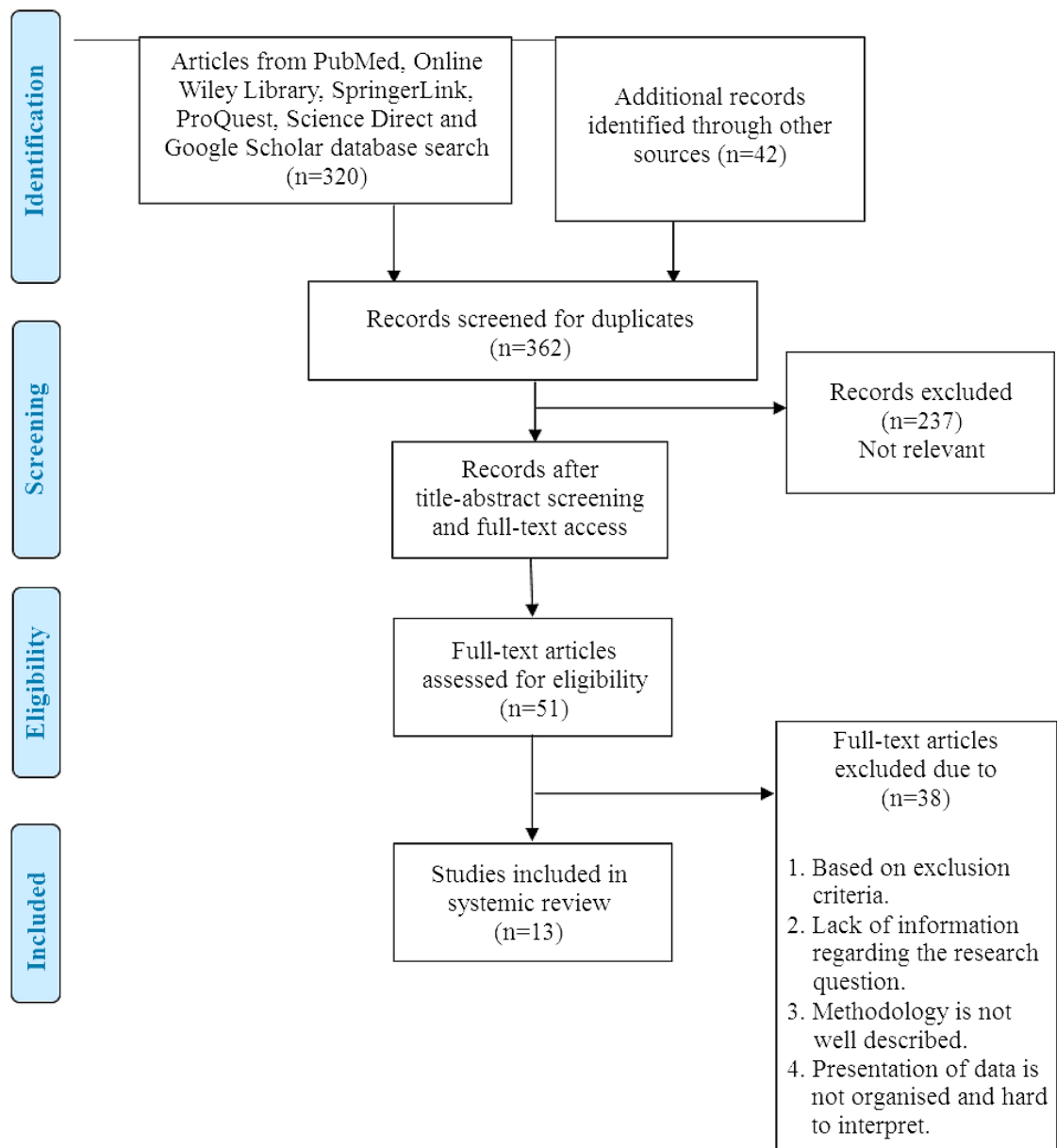


Figure 1. The PRISMA Flow Diagram

3. Results

108 references, 14 references, 14 references, 114 references, 17 references and 32 references were found using a combination of keywords from six databases mentioned. A library of references collected was created using Microsoft Excel and the total number of references downloaded and exported was 320. There were 237 duplicates found and eliminated. Only systematic review

was conducted using PRISMA method that includes 13 articles.

3.1. Data Extraction

Data from relevant studies were extracted, organized, and summarized according to the research question as shown in Table 2.

Table 2. Prevalence of study showing sleep quality affecting the academic performance among medical students

Author	Method	Results
Ahmed Yassin, 2020 ⁶	A cross-sectional study	66.2% of the students showed of having at least 1 sleep disorder; hypersomnia (23.1%) and insomnia (18.3%) were the most common. Students with academic performance below the average were more common to have at least 1 sleep disorder
Julián Esteban Barahona-Correa, 2018 ¹⁴	A cross-sectional study	65.7% of the students showed of having poor sleep quality, 65% of them also reported of having Excessive Daytime Sleepiness (EDS), 26% reported of having major depression. Those with major depression showed an association with poor sleep
Henry Jeremy Lawson, 2019 ⁸	A cross-sectional study	56.2% reported of having poor sleep quality. There was also a significant relation between sleep quality and academic performance.
Sepehr Rasekhi, 2016 ¹⁵	A cross-sectional study among 1 st , 2 nd and 3 rd year medical students.	66.66% of the subjects had abnormal PSQI scores. Abnormal PSQI scores were associated with lower academic achievement (P<0.05).
Abdelkader Jalil El Hangouche, 2018 ⁷	A cross-sectional study	58.2% of the students were considered as poor sleepers, 86.4% reported of having psychological stress and 36.6% had EDS. Poor sleep quality was statistically associated with bad academic performance.
Ibrahim NK, 2017 ¹⁶	A cross-sectional study among completed freshman year medical students	70.4% and 37.3% of the students reported of having poor sleep quality and EDS respectively. Excellent grade group of students had a significantly greater occurrence of having poor sleep quality (P<0.05).
Hyder Osman Mirghani, 2015 ¹⁷	A case-control study	Significant differences of poor sleep quality (p<0.001) were found between the 2 groups of students (36% for excellent and 94.6% for passing groups) in terms of overall sleep quality.
Mohammed A. Alsaggaf, 2016 ¹⁸	A cross-sectional study among clinical year medical students.	65% of students show of having a high stress level. 30% of the students reported of having sleep quality to be fairly poor or very poor during the previous month. 40% reported of having EDS.
Abdullah Murhaf Al-Khani, 2019 ¹⁹	A cross-sectional study	63.2% of the students were poor sleepers; higher among those who were physically inactive and had greater screen time. Poor sleepers showed better academic performance compared to those who slept sufficiently.
Abdullah D. Alotaibi, 2020 ²⁰	A cross-sectional study	77% of the students reported to have a poor sleep quality, 63.5% having some level of psychological stress and >43% reported to have daytime nap. However, students' GPAs did not show any significant relationship with poor sleep quality or distress level.
Mubashir Zafar, 2020 ²¹	A cross-sectional study	82.5% of students experienced poor sleep quality, 56.6% suffered EDS. Sleep duration, sleep medication consumption, PSQI score and EDS were statistically significant to be associated with poor academic performance.
Malak A Al Shammari, 2020 ²²	A cross-sectional study	80.6% of the subjects showed having poor sleep quality, 37.8% of them experienced EDS. Bad sleep quality was significantly associated with poor academic achievement
Bothaina Ahmed Attal, 2021 ²³	A cross-sectional study	68% of the subjects had poor sleep quality. 65% of them agreed that sleep disturbances affect their academic performance.

4. Discussion

The aim of this systematic review is to assess how sleep quality affects academic performance among medical students. The result obtained from the findings is used to assess the sleep quality that is significantly associated with academic performance. However, one article stated there was no significant association between sleep quality and academic performance. After filtering 320 articles using the PRISMA flowchart, 13 articles were chosen to be included in this systematic review. Medical students are a population that is prone to face sleep deprivation problems related with insomnia due to high work load and more stress [17, 24]. From the online survey conducted among medical students of two universities with 30% response rate, it was found that the prevalence of sleep disorders ranged from 0.6% for sleep state misperception (SSM) to 23.1% for hypersomnia using SLEEP-50 questionnaires. This study concluded saying that SLEEP-50 is not a confirmatory diagnostic test and definitive diagnostic tools such as polysomnography give better investigation for the evaluated sleep disorders [6].

Other than that, a study in Colombia by Julien Esteban Barahona-Correa in 2018 [14], 50% of the students was observed with an overall GPA of 4.0. However, the author reported GPA > 4 was more frequently seen in students with PSQI scores less than 5. Overall, a positive association was found between academic performance and bad sleeping patterns in students. The result was not influenced by the gender and age group factors since gender and age did not show any significant difference on any scale. This study concluded that Fostering sufficient sleep habits with training on sleep medicine may partly counteract these issues. Based on the studies done among Sudanese medical students and the result obtained support the hypothesis that poor sleep quality is related to bad academic performances. In this study, students are classified into two groups according to their GPA and the sleep quality is measured using PSQI. They found a huge statistical difference in terms of overall sleep quality ($p < 0.001$) between the two groups of students: excellent students and average students. This study further showed a significant positive correlation between sleep quality and nocturnal awakenings due to noise and to use washrooms. About 63.3% of students with better sleep quality achieve excellent academic performance was analyzed [8].

Another study is also done in undergraduate medical students that aimed at examining the sleep quality related to the academic achievement of students. Academic performance in this study was measured using students' GPA and stratified into high (>3.5), good (3-3.49), normal (2-2.99) and low (<2) with 14.7%, 44.06%, 36.72% and 4.52% of students obtained the scores respectively. It shows that students with good academic performances had a better sleep quality compared to students with lower academic performances. Here, 66% of the participants were considered poor sleepers and 33.34% of the students

were good sleepers with normal PSQI scores [15].

In addition, an investigation was conducted in Morocco, one month before the examination period revealed that the factors which can cause low academic performance among medical students are old age and poor sleep with no significant difference according to sex, age and level of psychological distress [7]. The author mentioned they found there is no association between daytime sleepiness and academic performance among medical students. After adjusting for some other factors, poor sleep quality was associated with poor academic performance. Similar finding was also revealed in a study conducted among Pakistani medical students. Among the population, most of the students with GPA lower than 2.7 had a subjective bad sleep quality and these students experienced at least once or twice per week sleep disturbances. Sleep latency and sleep duration among the students with lower academic performance were 29.05% and 29.4% respectively [25].

A study conducted among medical students at King Abdul Aziz University reported 70.4% and 37.3% of the students had poor sleep quality and EDS respectively. Findings also revealed obese students, night users of social media and smokers were having a higher prevalence of poor sleep quality but without any statistical huge difference ($P < 0.05$). Association between sleep quality and academic performance was found where excellent group students with GPA more and equal to 4.5 showing higher prevalence of poor sleep quality compared to others [16].

Similar report was noted in another study where the significant difference between the excellent and average groups was found for overall sleep quality in a case-control study among 165 male and female medical students between two Sudanese universities. Study assessed the relationship between sleep quality and academic performance using Pittsburgh Sleep Quality Index (PSQI) [17].

In a previous study conducted in Saudi Arabia, there are other factors that can lead to lack of sleep quality and eventually cause poor academic performance. High stress levels among medical students show a strong relationship with poor sleep quality [18]. Other than that, greater frequency of insomnia symptoms was reported among the students with lower academic performances. However, the association between academic performance and sleep quality was not mentioned as the findings found academic performance is associated with insomnia symptoms. Study by Abdullah Murhaf Al-Khani in Saudi Arabia reported there was association between sleep quality and academic performance with poor sleepers showed better academic performance compared to those who slept sufficiently. However, academic performance was also associated with the academic year. 42% of the poor sleepers were most likely to become bad achievers in academic performance [19]. An electronic self-administered questionnaire including the Pittsburgh Sleep Quality Index (PSQI), the Kessler Psychological Distress Scale (K10) was used to assess quality of sleep and psychological stress among

medical students in order to understand its relationship with academic performance. 77% of the participants reported poor quality of sleep and when assessing the sleep quality with other factors using logistic regression model showed that stress and daytime nap were associated with poor sleep quality, however, poor sleep did not show any significant association with academic performance. Therefore, this particular study showed no relationship between sleep quality and academic performance [20]. However, in a study in Sudan the association of poor sleep quality and low academic performance was not clearly stated but author found a statistically significant association between poor academic performance with sleep duration, use of sleep medication and daytime sleepiness [21].

Lastly, a previous study reported 80.6% of the subjects showed to have poor sleep quality while 37.8% of them experienced excessive daytime sleepiness (EDS). Bad sleep quality was significantly associated with poor academic achievement with no significant difference between genders. Moreover, excessive daytime sleepiness increases the tendency of having low academic performances. The result was not influenced by any consumption of caffeinated drinks since less intake of caffeine can decrease symptoms of insomnia and increase sleep quality [22]. Next, in study conducted in Yemen 65% of the students were reported to believe there is an association between their sleep disturbances and their academic performances. These students experienced sleep disturbances due to mental stress and followed by large academic workload with variation result between male and female. Females were more affected due to mental stress (36%) compared to males (24%). Early lectures and high load of academic syllabus led to short bedtime and poor sleep quality in the population [23]. Most of the reviews say that sleep quality had a significant impact on medical students' academic performance. However, single study does not find a significant association between sleep quality and academic performance. Increased workload and high stress levels were the major factors mentioned in the reviews. Poor sleep quality can lead to increased levels of anxiety, depression and increase stress scale. Poor sleep quality due to later bedtime and early wake time to attend classes' affect the students' concentration during classes due to excessive daytime sleepiness and students tend to doze off during the lectures. Sleep problems were a common issue among medical students due to the high academic workload and high concentration during studying required during the learning sessions. As result, most of the medical students were reported in most studies to have poor sleep quality.

5. Conclusions

Based on the study articles, most of the medical students are having poor sleep quality. A significant relationship between sleep quality and academic performance has been

observed. Most of the studies show students with poor sleep quality have low academic performance. This is important to know the factor contributing poor sleep habits among future medical trainees to enhance the medical students' sleeping habits along with academic achievement. Health care delivery quality can be enhanced by improving physician well-being and so it is significant to study the impact of good sleep quality on the mental and physical health of future medical professionals. Another element that is related to sleep quality among medical students is stress level. The study findings can be used for doing intervention planning to enhance students' sleep habits by providing education on the importance of general sleep by making a programme for medical students which may help to improve academic performance.

Conflict of Interest

Nil.

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