

## Sleep Disturbances among Medical Students: A Global Perspective

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Medical students carry a large academic load which could potentially contribute to poor sleep quality above and beyond that already experienced by modern society. In this global literature review of the medical students' sleep experience, we find that poor sleep is not only common among medical students, but its prevalence is also higher than in non-medical students and the general population. Several factors including medical students' attitudes, knowledge of sleep, and academic demands have been identified as causative factors, but other potential mechanisms are incompletely understood. A better understanding about the etiology of sleep problems in medical trainees is essential if we hope to improve the overall quality of medical students' lives, including their academic performance. Sleep self-

awareness and general knowledge appear insufficient in many studied cohorts, so increasing education for students might be one beneficial intervention. We conclude that there is ample evidence for a high prevalence of the problem, and research in this area should now expand towards initiatives to improve general sleep education for medical students, identify students at risk, and target them with programs to improve sleep.

**Keywords:** sleep, medical students, academic performance, mental health

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Sleep problems are common in the general population, and approximately one-third of adults report some form of insomnia.<sup>1</sup> An international survey in 10 countries showed 32.6% prevalence of insomnia among primary care patients, and data from other countries are fairly consistent with this result.<sup>2,3</sup> Medical students are one subgroup of the general population who appear to be especially vulnerable to poor sleep, perhaps due to the long duration and high intensity of study, clinical duties that include overnight on-call duties, work that can be emotionally challenging, and lifestyle choices.<sup>4</sup> Research on sleep disturbances in undergraduate medical students is of particular interest because of the known relationship between sleep and mental health<sup>5</sup> and the concern that the academic demands of medical training can cause significant stress.<sup>6</sup> Any additional undiagnosed sleep problem can presumably exacerbate mental stress in these students with potential long term consequences for both individual's health and the overall performance of the health care system.<sup>7</sup> A large body of evidence supports the notion that good quality sleep is important for optimal neurocognitive and psychomotor performance as well as physical and mental health.<sup>8</sup> In general, the following four fundamental sleep characteristics influence academic performance: sleep quantity, sleep quality, sleep regularity, and sleep phase scheduling.<sup>9</sup> Medical students go through long and intensive academic years before becoming physicians. So, it is important to know whether they have a sleep problem, the extent of the

### BRIEF SUMMARY

**Current Knowledge/Study Rationale:** Medical students carry a large academic load which could potentially contribute to poor sleep quality above and beyond that already experienced by modern society. So, it is important to know whether they have a sleep problem, the extent of the problem, and also whether their sleep disturbance has any effect on academic performance or quality of life. This review aims to summarize, organize, and clarify the current literature on sleep problems among undergraduate medical students around the world.

**Study Impact:** This review documented the magnitude of sleep problem, sleep awareness, factors associated with poor sleep among medical students and the impact of sleep problem on medical students' academic performance and mental health. The findings of this review will make the medical educators and planners aware to take necessary steps for the improvement of medical students' quality of life.

problem, and also whether their sleep disturbance has any effect on academic performance or quality of life. This review aims to summarize, organize, and clarify the current literature on sleep problems among undergraduate medical students around the world.

### GLOBAL EPIDEMIOLOGY OF SLEEP PROBLEMS AMONG MEDICAL STUDENTS

In Asia, epidemiological data of sleep problems among medical students are available from China, Hong Kong, Malaysia,

India, and Iran. In a Chinese study, 19% of the medical students were found to have poor sleep quality as assessed by the Pittsburgh Sleep Quality Index (PSQI), with differences seen between years of study but not between genders.<sup>10</sup> Another study in Chinese medical students reported that more than 90% of the undergraduates had experienced excessive sleepiness in class, with more males than females affected.<sup>11</sup> About 70% of Hong Kong medical students self-reported sleep deprivation, confirmed by objective actiwatch recordings, with no significant gender and age differences.<sup>12</sup> The mean nocturnal sleep period for all of the surveyed students was only 6.6 hours (SD 1.2 h).<sup>12</sup> A large survey study of Malaysian medical students revealed that daytime sleepiness occurred in 35.5% (as assessed by Epworth Sleepiness Score [ESS] > 11), and poor sleep quality was reported by 16%.<sup>13</sup> Daytime sleepiness was significantly more common among the clinical students (vs. pre-clinical), and in those with self-reported poor sleep quality and psychological distress; but in this group, daytime sleepiness was unrelated to the number of hours sleep at night.<sup>13</sup> In a survey of 150 Indian medical students, 30.6% reported an ESS > 10, indicating daytime sleepiness; sleep quality in females was better than in males.<sup>8</sup> Sleep and sleepiness was found to be worse for interns and postgraduate trainees than for medical students.<sup>8</sup> In a study on 244 Iranian medical students, 40.6% reported poor sleep quality; this was significantly associated with lower grades, economic and marital status, and type of training, but not gender.<sup>14</sup> Another study on sleep satisfaction of Iranian medical students reported that only 14% of students reported their sleep as “perfect,” while 44% and 30% reported “good” and “fair” satisfaction, respectively.<sup>15</sup>

In North and South America, epidemiological data on medical students' sleep problems are available from United States, Brazil, and Mexico. In the United States, medical students' sleep quality (measured by PSQI) was significantly worse than a healthy adult sample.<sup>16</sup> In a study in Brazil, 28.2% of medical students had insomnia; females had more difficulty in maintaining sleep than males, and males were more likely to report “falling asleep later.”<sup>17</sup> Another study among Brazilian medical students showed that at the beginning of a semester, 39.5% of the students already reported excessive daytime sleepiness.<sup>18</sup> Among the remaining students, 22% developed daytime sleepiness by the end of the semester.<sup>18</sup> Another Brazilian study confirmed sleep deprivation in medical students and reported that 38.9% of the students had poor sleep quality measured by the PSQI.<sup>19</sup> In Mexico, 24% of first year medical students (mean age 18 years) reported some sleep difficulties in the week prior to the survey, and the insomnia symptoms were associated with various measures of psychological health on the Symptoms Check List 90 (SCL-90), but not with gender.<sup>20</sup>

In Europe, one Lithuanian study revealed poor sleep quality in 40% of medical students as measured by the PSQI.<sup>21</sup> Conversely, among Estonian medical students assessed with the self-reported Sleep and Daytime Habits Questionnaire (S & DHQ), only 7% rated their sleep as poor to very poor, with 24% reporting satisfactory and 69% reporting good to excellent.<sup>22</sup> Nonetheless, the reported difficulties in initiating and maintaining sleep were more common in the medical students than young adults who were not students.<sup>22</sup>

In summary, the exact prevalence of poor sleep in medical students varies between studies based on the measurement tools

used but also related to the significant differences in baseline demographics including age, gender, and marital status of students admitted to the medical school. Apart from these issues, cultural differences would be an important aspect that will contribute towards the variability of sleep problems across countries, but this theme has not been mentioned clearly in available studies. But if we consider the broad cultural grouping (e.g., Western and non-western countries), they all showed more or less similar patterns in the studies. In general, the current data consistently show that medical students around the world frequently report symptoms of either insomnia or sleepiness, and that the effect of gender is inconsistent. In several studies, it appears that the prevalence of sleep complaints exceeds that of the general population. The next logical question is whether or not the prevalence exceeds that in other student populations, and if so, why?

### SLEEP PROBLEMS IN MEDICAL STUDENTS VS. NON-MEDICAL STUDENTS

Among university students around the world from both the East and the West, sleep deprivation is common. Different studies have indicated that 24% of university students in the United Kingdom,<sup>23</sup> 30% in Korea,<sup>24</sup> and 49% in Taiwan<sup>25</sup> reported that they obtained < 7 h of sleep per night. In a Lithuanian survey, more than half (59.4%) of the university students scored > 5 on the PSQI, indicating poor sleep quality.<sup>21</sup> That study compared sleep problems in medical students with students in law and economics and concluded that medical students had the highest prevalence of poor sleep and poorer associated quality of life compared to other student groups.<sup>21</sup> Another study compared sleep patterns between medical and law students in India and found that 60.8% of law students had refreshing sleep at night as opposed to just 47.1% of medical students, and initial insomnia occurred more frequently in medical students than in law students.<sup>7</sup> That study showed differences in dream pattern between medical and law students; most of the medical students' nightmares were related to exam failure, which was not the case in the law students.<sup>7</sup> The self-reported depth of sleep was also better in law students than in medical students.<sup>7</sup> The exact cause of these differences in sleep quality is difficult to pinpoint due to presence of many confounders both intrinsic and extrinsic. The main factors which discriminate the medical students from their peers were academic loads, attitude towards study, and lifestyle.<sup>7,21</sup>

In summary, comparison studies of sleep problems between medical students and other undergraduate students are limited but it appears that medical students' sleep difficulties are more intense than those of law or economics students. Law and economics students were selected because their academic programs were considered to be potentially stressful; comparisons with students in other academic discipline might clarify which factors in medical students are responsible for their experience of poor sleep.

### SLEEP AWARENESS AMONG MEDICAL STUDENTS

Several studies have been carried out to assess baseline knowledge, attitudes, beliefs, and perceptions about sleep

among medical students. In Asia, data regarding sleep awareness among medical students are available from China, India, Nepal, Malaysia, and Singapore. A study by Luo et al. in 2013 showed that Chinese medical students generally understood sleep disorders to be an important problem, but they knew little about actual sleep disorders. For example, more than 50% of those students were unaware that restless legs syndrome, sleep-talking, and bruxism are considered sleep disorders, and only a small percentage of students were aware that sleep disorders could be linked to diabetes, anaemia, metabolic syndrome, and attention deficit disorder. But sleep problems were considered as significant clinical issue by 93% of the students, and they believed that people with sleep disorders should seek treatment; 81.3% of the students showed interest in sleep medicine as a career and recommended for setting up the specialized sleep medicine department. Interestingly, 76.8% of the students assumed that they or their friends had sleep disturbances, and 44.8% had consulted doctors about sleep problems.<sup>26</sup> Studying the knowledge, belief, and practice of sleep hygiene among final year medical students of six medical colleges of Tamil Nadu, India, the authors found inadequate knowledge and many misconceptions regarding sleep.<sup>27</sup> Examples of the medical students' false beliefs or misconceptions included the beliefs that by willpower one can overcome sleepiness, or a minimum of eight hours of sleep is mandatory for any human being.<sup>27</sup> Another very interesting cultural belief that was prevalent among these students were the belief that keeping a broom or footwear nearby the bed while sleeping drives away evil forces, which in turn promotes sleep.<sup>27</sup> The authors reported these sleep related beliefs to be significantly different between the students originating from the urban and rural background.<sup>27</sup> A study on knowledge, attitude, and practice (KAP) towards sleep among students at Manipal College of Medical Sciences in Nepal revealed a satisfactory level of sleep knowledge.<sup>28</sup> But the Nepalese students scored low in the attitude or beliefs questions.<sup>28</sup> That study covered certain, important basic aspects of sleep physiology, pharmacology, sleep requirements, use and toxicity of hypnotics, consequences of sleep deprivation, sleep hygiene misconceptions, and sleep practices of respondents.<sup>28</sup> Among 240 Singaporean medical students, sleep medicine knowledge was found to be poor, with no significant gender differences in the level of awareness.<sup>29</sup> A Malaysian survey also found poor knowledge of sleep medicine among medical students.<sup>30</sup> A study among Ethiopian students also determined that medical students had generally low levels of awareness, perception, and practice with respect to sleep.<sup>31</sup>

Among the sleep awareness studies done in Asia, most of the studies found that medical students generally had poor knowledge and misconceptions about sleep. The only exception was the study done in Nepal, where sleep knowledge was satisfactory, although the attitude score was found to be low.<sup>28</sup> This body of literature suggests that sleep education in current medical curricula is generally inadequate, at least in those countries that have assessed it.<sup>28-30</sup> Such inadequacy of sleep education in medical school curriculum is also evident from surveys done in United States. The American Sleep Disorders Association Survey in 1978 and the National Commission on Sleep Disorders Research in 1990 showed that 46%, and 37% of medical schools, respectively, offered no education in sleep

medicine.<sup>32,33</sup> A national survey of 126 medical schools in the US also documented that 37 schools had no structured teaching time for sleep and on average, less than two hours of teaching time was allocated to sleep disorders.<sup>34</sup> The most serious consequence of sleep education deficiency could be the increased rate of misdiagnosis and maltreatment of sleep disorders by primary care physicians; the authors of that survey recommended a major curriculum reform in the area of sleep education.<sup>34</sup>

## FACTORS ASSOCIATED WITH POOR SLEEP AMONG MEDICAL STUDENTS

Identification of factors which influence medical students' sleep is necessary if educators and students want to improve outcomes. Sleep problems are associated with both intrinsic and environmental factors. Biological factors such as hyperarousal of the autonomic nervous system and hypothalamic-pituitary-adrenal axis overactivation can be predisposing factor; stressful events such as examinations and relationship problems can be precipitating factors, and rumination and worry can be perpetuating factors for the sleep problems.<sup>35</sup> Pre-sleep cognitions, i.e., active thinking, worrying, planning, and analyzing at bedtime are significantly correlated with insomnia.<sup>36</sup>

A study of Lithuanian students which tried to address this issue indicated that attitude was the main factor which discriminated medical students from their peers in other university programs.<sup>21</sup> That study hypothesized that medical students remain "submerged in studies" based on their findings of longer study times, studying just prior to sleep, and associated anxiety about their studies and results.<sup>21</sup> They reported that these behaviors were not as successfully balanced with leisure time as in economics students.<sup>21</sup> Another study among Chinese medical students determined the factors which influenced the quality of sleep and found important contributions from worry about sleep, irregular work/rest schedules, worry about examinations, stress, relationships with classmates, self-reported health conditions, the dormitory environment, and late bedtimes.<sup>10</sup> Among Hong Kong university medical students, the factors significantly associated with higher likelihood of poor sleep were female gender, relatively higher year of study, and perceived adequate sleep in the past month.<sup>37</sup> A study in Nepal revealed that 31.5% of medical students suffered from sleep deprivation due to late night internet surfing.<sup>38</sup> Class starting time can affect sleep-wake behavior of medical students. One study in Brazil observed that late class starting time was associated with good sleep quality, delayed sleep onset, and longer sleep duration among medical students.<sup>39</sup> Type of rotations in medical school might be an influencing factor of the sleep deprivation across the study years.<sup>40</sup> Surely, the period in surgery or emergency medicine rotation would be much more demanding in terms of sleep deprivation than rotations in relatively less demanding departments. Physical problems such as sleep apnea can also be a factor for sleep disturbance. One study evaluated risk factors for sleep apnea among Pakistani medical students and reported that 27% of males and 12% of females had disruptive snoring.<sup>41</sup> Furthermore, the authors reported that symptoms of nocturnal choking, waking up with dry mouth, morning headache, and unrefreshing sleep were experience by 6%, 25%, 10%, and 27% of males, and 5%, 26%, 23%, 27% of females, respectively.<sup>41</sup>

In summary, medical students' attitudes, life style choices, academic load, internet usage, and potentially sleep apnea can contribute to sleep disturbances, and some factors are likely interrelated. For example, late bedtime may be influenced by lifestyle, academic load and internet usage in addition to underlying biological rhythms. Further studies should seek to clarify the relative importance of these factors in order to appropriately design interventions that will improve sleep.

### ASSOCIATION BETWEEN SLEEP PROBLEMS AND ACADEMIC PERFORMANCE OF MEDICAL STUDENTS

A review by Curcio et al. in 2006 suggested that student learning and academic performance are closely linked to sleep quality and quantity.<sup>42</sup> Sleep stabilizes and enhances cognitive processes. Cognitive competences such as consolidation and encoding of memories are very important for higher education, especially for medical education, because medical students need to retain a substantial amount of complex factual knowledge within short period of time.<sup>43</sup> A systematic random sample of healthy medical students in King Saud University of Saudi Arabia showed that the students with "average" performance were subjectively sleepier during class and reported higher ESS compared to "excellent" students.<sup>44</sup> The "excellent" performers reported earlier bedtimes and higher sleep duration during weekdays.<sup>44</sup> That study concluded that decreased nocturnal sleep time, late bedtimes during weekdays, and increased daytime sleepiness were negatively associated with academic performance in medical students.<sup>44</sup> A study on a group of Brazilian medical students showed that excessive daytime sleepiness adversely affected their academic performance.<sup>18</sup> Another Brazilian study showed a correlation between sleep onset, sleep regularity, and sleep length with academic performance of medical students.<sup>19</sup> Among a group of Hong Kong medical students, there were significant correlations between the written examination results and usual bedtimes/rise times; and also between clinical skills assessment and self-rated sleep quality.<sup>45</sup> These results suggested that students with later sleep phase and poorer sleep quality are at a higher risk of impaired academic performance.<sup>45</sup> Interestingly, a study at the University of Munich, Germany, also detected that the timing of sleep-wake behavior was a more important predictor of medical school performance than sleep quality or sleep length.<sup>46</sup> Another study at the same university with the aim to describe the interrelationship of academic performance, sleep, and stress found that low academic performance correlated with low sleep quality and high stress prior to the exams—leading to a vicious cycle.<sup>43</sup> In another study among students of liberal arts, it was observed that students with later class starting time had longer sleep duration and less daytime sleepiness, but they were at greater risk for increased alcohol consumption, which ultimately impaired academic performances.<sup>47</sup> These examples illustrate the potentially complex interactions of sleep, academic performance, stress, class schedules, social influences, and personal choice. In our summary of these correlations, we need to be careful not to attribute causation. Prospective studies are required if we are to begin to understand these relationships but even well-controlled experiments (where ethically possible) might not tease out the nuances of these interactions.

While it is clear that sleep disruption should be minimized for all humans who are trying to optimize their learning potential, there are some very specific effects of sleep deprivation to consider in medical students. Medical school is a time during which students develop lifelong professional attitudes and habits. But sleep deprivation has been shown to have major negative effects on emotional intelligence, including the ability to show empathy.<sup>48</sup> One disturbing trend that has been reported is that medical students actually become less, rather than more empathetic as they progress through their years of training.<sup>49</sup> While the underlying cause of this trend is likely multifactorial, it is certainly possible that sleep habits of medical students are eroding their abilities to be empathetic to patients and colleagues alike. An awareness of this potential is at least a step forward in addressing the quality of healthcare professionals graduating from school.

Overall, studies consistently showed that medical students who sleep well at night do better academically. Additionally, sleep timing may be more important than sleep length or quality, but one would expect that this could be dependent on environmental factors such as the timing of classes and examinations, which were not well described in studies to date. Poor academic performers may benefit from screening for sleep issues and targeted interventions.

### ASSOCIATION BETWEEN SLEEP AND MENTAL HEALTH PROBLEMS AMONG MEDICAL STUDENTS

There is a clear correlation between sleep disorders and various psychiatric illnesses, especially mood and anxiety disorders. Poor sleep quality that is associated with many sleep disorders can predispose to the development or exacerbation of psychological distress and mental illness. Likewise, the presence of psychiatric illness may complicate the diagnosis and treatment of sleep disorders.<sup>50</sup> Many studies have been done to investigate the association between psychiatric disorders and sleep disturbances in the general population. Those studies indicate that sleep disturbance can be either a comorbidity, a cause, or a symptom of psychiatric disorders.<sup>51</sup> There is evidence that psychiatric disorders like depression and psychosocial stress can be caused by insomnia.<sup>52</sup> In fact, insomnia increases the risk for subsequent development of depression by a factor of four.<sup>51</sup> Insomnia can also be an early marker for depression, anxiety, and alcohol abuse.<sup>53</sup>

Thus, it continues to be difficult to ascertain the relative importance of insomnia as a precursor or a consequence of depression.<sup>52</sup> Another interesting relationship is that between the evening chronotype circadian rhythm disorder and depressive disorder,<sup>54</sup> with ongoing debate regarding the direction of the relationship between them. Chronic sleep deprivation can also lead to substance abuse disorders. To regulate sleep/wake schedule, young people can use alcohol and over-the-counter drugs in higher frequency. The ultimate consequence of such behaviors can lead to "the stimulant-sedation loop" that is use of stimulant to counteract daytime sleepiness and subsequent use of sedative to counteract the effects of stimulant.<sup>35</sup> Presence of such relationship between sleep deprivation and substance abuse among medical students needs to be explored. Few studies have been done among medical students to detect

the relationship between sleep problems and mental health. The Johns Hopkins Precursors Study, a long-term prospective study, was conducted on 1,053 men who provided information on sleep habits during medical school. This study advocated that insomnia in young men was indicative of a greater risk for subsequent clinical depression and psychiatric distress that continued for at least 30 years.<sup>52</sup> A study in Brazil found a cumulative risk ratio of 5.47 for minor psychiatric disorders among the medical students who presented with sleepiness, occasional sleep disruption, insomnia, or < 7 h sleep per day.<sup>55</sup> Another Brazilian study revealed a strong association between presence of a minor psychiatric disorder, identified by the Self-Reporting Questionnaire (SRQ-20)<sup>56</sup> and insomnia, measured by a 6-item questionnaire.<sup>17</sup> The authors concluded that insomnia assessment might be a good tool for the identification of medical students who could benefit from psychiatric assessment and preventive measures.<sup>17</sup> In a group of Estonian medical students, initial insomnia, waking due to nightmares, nocturnal eating habits, daytime sleepiness, and sleeping during school were associated with depression and anxiety. The relationships between sleep symptoms and emotional symptoms were different in male and female medical students.<sup>57</sup> A study of Mexican medical students concluded that the best predictors for sleep difficulties were symptoms associated with stress, anger, worry, cognitive hyperarousal, and hypervigilance.<sup>20</sup> A group of Chinese medical students also showed significant correlation between sleep quality and depression or anxiety.<sup>10</sup>

## VARIABILITY ACROSS THE STUDIES

Summarizing all the studies is difficult due to the great variability of methodologies, characteristics of study populations, and even the measures used to define “poor sleep.” Correlative studies identified multiple potential factors contributing to poor sleep, yet rarely corrected for (or described their correction for) multiple comparisons. Furthermore, the rationale behind choosing specific associative factors to study has not been described by most authors and the significant findings of some studies have not been replicated. Moreover, there are some major limitations to direct comparisons between medical students in different countries because the age at which the student is admitted to a given program and the duration of the program varies. Some students enter longer programs just out of high school, and others are admitted to medical school only after completing undergraduate and possibly graduate degrees. For example, in the study of sleep practices among US medical students, participants’ age range was from 21 to 43 years,<sup>16</sup> but in an Ethiopian study with same objective, participants’ age range was from 18–28 years.<sup>31</sup>

## CONCLUSION

Sleep disturbances are not only common among medical students but their prevalence is also higher than in non-medical students and the general population. In this review, we have documented the presence of this phenomenon in the world literature in spite of obvious differences between cohorts in terms of student characteristics such as gender, marital status, medical curricula, and culture. Several factors including medical

students’ attitudes and academic overload have been identified as causative factors but several others have not been sufficiently researched. Information about contributing causes to this epidemic of poor sleep in medical trainees is essential if we hope to improve the overall quality of medical students’ life and their academic performance. Equally important to consider is the effect of improved sleep on the physical and mental health of our future medical professionals. Optimizing physician wellness will ultimately improve the quality of health care delivery in the respective health systems. Sleep self-awareness and general knowledge appear insufficient in many studied cohorts, so increasing education about sleep for students might be beneficial. Optimizing schedules for students to accommodate different intrinsic circadian rhythms might also be beneficial. Moreover, newer technologies for delivering instructional content could allow for a better alignment between educational activities and learners intrinsic rhythms, but to our knowledge there are not yet any studies of such an approach in medical schools. Sleep disturbances may be a marker of current or future psychiatric problems in medical students, but the utility of using insomnia or any other screening tool to diagnose and treat students is far from proven. Research in this area should now expand towards initiatives to improve general sleep education for medical students, identify students at risk, and target them with programs to improve sleep. Long-term follow-up of such study cohorts will be useful to educators, administrators, and practitioners to inform efforts to optimize the health, safety, and efficiency of our future medical practitioners.

## ABBREVIATIONS

ESS, Epworth Sleepiness Score  
 PSQI, Pittsburgh Sleep Quality Index  
 SCL 90, Symptom Check List 90  
 SRQ, Self-Reporting Questionnaire  
 S & DHQ, Sleep and Daytime Habits Questionnaire

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