Assessment of sleep quality of medical students at Taibah University

Hanan Elsayed¹, Amenah Tashkandi²*, Nourah Alsaiari², Gelan Alyami², Wejdan Abdat Ahmed², Aseel Alrefaei², Farah Alrefae²

ABSTRACT

Background: Sleep is an important part of human physiology. Sleep disorders are common in medical students which may affect their cognitive functions and academic performance.

Methods: The study took place at Taibah University in 2019. A designed questionnaire was performed by the co-authors that measured sociodemographic status, medical or psychiatric diseases, and grade point average (GPA). The Pittsburgh Sleep Quality Index was used to assess sleep quality. Statistical Package of Social Science version 26 was used for data analysis.

Results: The sample size was 567 students. After excluding the students who refused to participate or did not respond, 401 students were included in the final analysis. 59.6% of the participants were females and 40.4% were males. 34% were in their third year, 29% in their fourth year, 23% in their fifth year and 14% in their sixth year. 96.5% were single. The majority were healthy: only 10% have medical diseases and 5.7% have psychiatric diseases. 41.1% had a GPA of 5 to 4.5, 40.1% between 4.5 and 4, 14.2% between 4 and 3.5, and 4.5% below 3.5. A significant relation was detected between sleep quality and academic performance. The poorer the student’s sleep quality, the lower their GPA.

Conclusion: There is a significant relation between sleep quality and academic performance, and between sleep quality and having a poor night’s sleep before examinations. No significant relation was found between sleep quality and sociodemographic factors, medical or psychiatric diseases, caffeine consumption, exercise frequency or cell phone use before sleep.

Keywords: Sleep quality, PSQI, medical students, academic performance.

Introduction

Sleep is an important part of human physiology. It is considered as essential for mental wellbeing and healthy functioning and for increasing life satisfaction [1]. Sleep disorders are very common in the general population. According to a research study conducted at King Abdulaziz Medical City in Riyadh, Saudi Arabia, 77.7% of the Saudi adult population has insomnia [2]. Medical students are one group within this population who are considered to be more vulnerable to poor sleep quality. Studies have shown that the incidence of poor sleep quality among medical students is higher than in the general population [3]. Sleep deprivation can cause many adverse effects on human physiology like daytime sleepiness and fatigue. It also affects the cognitive functions of students, including attention, working memory, long-term memory, and decision making [4]. This aptly indicates the importance of a good sleep quality and its impacts on daily productivity and concentration, which both have a strong relation with academic performance. In Saudi Arabia, there are not enough number of studies that explore the effect of sleep quality on the academic performance of medical students, so this study aims to assess the sleep quality of medical students at Taibah University in Medina, Saudi Arabia.

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Arabia, and its effect on their academic performance, as well as the factors that affect sleep quality.

**Physiology of sleep**

The brain goes through multiple cycles and distinct patterns during sleep that are essential to the performance of normal functioning when awake. Each cycle of sleep lasts approximately 90 minutes and goes through four different stages. The two main types of sleep are rapid eye movement (REM) and non-rapid eye movement (NREM). The first stage, which is NREM sleep, lasts several minutes. During this short period, sleep is relatively light, the eye movements, heartbeats and breathing are decreasing, and the brainwaves are slowing down from their usual pattern. In the second stage, which is also NREM sleep, the senses slow and relax even further, the eye movements stop, and the body temperature drops. This is the stage in which deeper sleep starts, and most of the repeated cycles occur in this stage. The third stage is the most important one and is also NREM sleep. It occurs during more extended periods during the first half of the night; all senses slow to their lowest level, and it is difficult to wake as the muscles are remarkably relaxed. The fourth and final stage, which is the REM sleep during which most of our dreams occur, starts about 90 minutes after falling asleep; most of the senses become faster and irregular, the eyes move rapidly, and the heart rate, blood pressure and brainwave activity levels are more similar to those associated with wakefulness. During this stage, the leg and arm muscles become temporarily paralyzed; this is the body’s way of protecting itself so as not to act out what it is dreaming. People go through these cycles four to five times during their sleep to maintain a healthy brain and body [5].

**Importance of sleep**

Sleep can lift the mood, lower stress, boost the immune system, and improve thinking and memory. Young adults need to sleep from 7 to 9 hours per night to maintain good sleep quality. Studies have shown that the sleep is crucial as it enhances and stabilizes cognitive functions, as well as maintains physical health, both of which are necessary for medical students in effectively processing large amounts of complex knowledge [6,7].

Recently, researchers concluded that sleep disturbance could lead to agitation, an inability to process information and judgment impairment in the short term, contributing to increased mortality and cardiometabolic disorders in the long term [7]. Overall, studies consistently showed that medical students who sleep well at night do better academically.

**Sleep deprivation in medical students**

Sleep deprivation is a common issue among the population of medical students as evidenced by many studies from around the world. For example, studies in China, Lithuania, and Hong Kong have reported a 19%, 40%, and a 70% prevalence of poor sleep quality among medical students, respectively [6]. Many studies have indicated that a poor quality of sleep has a significant negative impact on academic performance and cognitive function since sleep plays an essential role in memory consolidation [8]. Although the exact mechanism behind this role is not yet known, it is believed that the synaptic connections that are active during wakeful periods strengthen during sleep, contributing to the consolidation of memory. In addition to this effect of sleep on memory, sleep deprivation has been linked to poor attention and cognitive functions [8]. Thus, sleep is crucial for memory consolidation, attention, and cognitive functions, which are all critical factors for good academic performance. Beyond this effect on academic performance, sleep deprivation also has a significant negative impact on emotional intelligence, affecting one's ability to show empathy to both patients and colleagues [6].

**Factors affecting sleep quality**

Examination-related stress, caffeine intake, exercise frequency, and cell phone use are common factors that affect students' sleep habits. Some studies have shown that stress significantly increases during examination periods for medical students, leading to poor sleep quality [7], which may negatively impact examination performance. Amount of caffeine that is consumed can be used as a predictor of poor sleep quality, as college students who consume two or more stimulant beverages have poorer sleep quality than those who consume only one. Regular exercise promotes the length, quality, and efficiency of sleep, as evident by the research [9]. The amount of time spent using cell phones and social media has been linked to poor sleep quality among medical students in many studies, one of which was done in King Khalid University, Saudi Arabia, concluding that the majority of students use social media on a daily basis and one-third of them have a poor sleep quality, especially those who spend more than 2 hours per day looking at a screen [10].

**Method**

A descriptive cross-sectional study was conducted on a group of students at Taibah University to assess whether sleep quality can affect their academic performance in 2019. A designed questionnaire (check the appendices) was performed by the co-authors, approved by a psychiatrist consultant, and a pilot study was done. It measured many factors, including sociodemographic status, medical or psychiatric diseases, caffeine consumption, frequency of exercise, using phones before sleep, and having examinations, which can affect the quality of sleep and therefore academic performance. The sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) [11] to differentiate between good and poor sleep quality in adults. It assesses seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances,
Sleep quality of medical students

use of sleep medication, and daytime dysfunction over
the last month. Each one of the seven domains has a score
ranging from 0 to 3, where 0 indicates no disturbance
and 3 indicates severe disturbance. The total score of all
seven domains together represents one global score that
ranges from 0 to 21, where 0 indicates good sleep quality
and 21 indicates poor sleep quality [12].

We targeted Taibah University medical students of
all years except first-year students who were excluded
because they did yet know their grade point average
(GPA). Both genders were included in the study. The
electronic questionnaire, which began with a verification
of the students’ ethical consent, was sent to all students
(total 567 students). No personal data or information
were included in the questionnaire to ensure the students’
privacy and confidentiality. The Statistical Package of
Social Science version 26 was used for data analysis.

Results

The characteristics of the study’s participants are presented
in Table 1. Of the 567 questionnaires distributed, 401
(71%) were completed and returned; 18 (3%) did not
consent to participate and 148 (26%) did not respond to
the questionnaire. Therefore, 401 questionnaires were
included in the final analysis from students in their third
to sixth year in the medical school at Taibah University.
Out of the 401 students, 59.6% (n = 239) were female and
40.4% (n = 162) were male. Regarding the distribution
of students by academic year, 34% of the respondents
were in their third year, 29% in their fourth year, 23% in
their fifth year and 14% in their sixth year. Most students
were single (96.5%; n = 387) and healthy, except for 10%
(n = 40) who have medical diseases and 5.7% (n = 23)
who have psychiatric diseases. The mean GPA was 4.58
± 0.435 for the entire study sample. 41.1% of students
had a GPA of 5 to 4.5, 40.1% below 4.5 but equal to or
greater than 4, 14.2% below 4 but equal to or greater than
3.5 and 4.5% below 3.5.

The PSQI score in this sample ranged from 0 to 18, and
the distribution of the sample is shown in Figure 1. The
highest and the lowest frequencies have PSQI scores of
5 and 18, respectively. The mean PSQI score was 6.78.

The sample in the study was distributed according to
PSQI results into 19 groups (from PSQI score 0 to PSQI
score 18). The GPA means of each group, as well as the
lower and upper GPA in each group, were calculated and
are presented in Table 2.

As shown in Table 3, a negative correlation between
GPA and PSQI score was detected (-0.138), and it was
significant, with a p-value of 0.006. The students who
had high PSQI scores had lower GPAs than the students
who had low PSQI scores.

The one-way analysis of variance (ANOVA) test,
presented in Table 4, comparing the GPA means between
the students in each group of PSQI showed a statistically
significant difference between groups (F = 2.16,
p = 0.004).

Table 1. Characteristics and distribution of participants.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
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</tr>
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<tbody>
<tr>
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<td></td>
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<tr>
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<td>Female</td>
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</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>41</td>
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<tr>
<td>21</td>
<td>114</td>
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<tr>
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<td></td>
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<tr>
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<tr>
<td>&lt;2.5</td>
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<td>Fifth year</td>
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<td>Medical disease</td>
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<td></td>
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<td>90.0</td>
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<tr>
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<td></td>
<td></td>
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<tr>
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<td>94.3</td>
</tr>
<tr>
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<td>5.7</td>
</tr>
<tr>
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<td>401</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Regarding other factors that may affect the sleep quality,
there was no significant correlations between students’
sleep quality and their age, academic year, gender,
marital status, medical and psychiatric diseases, caffeine
consumption per week, exercise per week or phone use.
before sleep. The students who don’t sleep well the night before examinations had significantly poorer sleep quality, with an average PSQI score of 7.47, as shown in Table 5.

Discussion

Medical students may not consider sleep to be a top priority while studying because of their high academic loads; they tend to devote extra hours to studying at the expense of their sleeping time, which causes them to develop poor sleeping habits.

The recommended sleep duration for adults according to the National Sleep Foundation is 7 to 9 hours each night [13]. In the current study, the mean PSQI score of the participants was 6.78, which is similar to the findings of other studies conducted in Saudi Arabian universities, such as the one in King Saud bin Abdulaziz University that measured a PSQI mean of 7.11 [14], in King Khalid University that measured 6.79 [15] and in Imam Abdulrahman Bin Faisal University that measured a slightly higher PSQI mean of 8 [16].

In this study, 59% of participants had a PSQI score greater than 5. Most of the studies that examined sleep problems among medical students around the world showed variable percentages; in a study done in the United States, 50.9% of the medical students were found to have poor sleep quality [17], but this percentage was only 40% in a Lithuanian study [18]. Even lower percentages of poor sleep quality have been found in other studies: 19% in China [19] and 7% in Estonia [20]. However, these variations may be attributed to the different sample sizes and measurement tools used in each study.

In the current study, a significant association was found between sleep quality and academic performance among medical students. This result is consistent with most of the previously mentioned studies. A meta-analytic review with a sample of 61 studies from 71 different populations presented evidence that supports the significance of impacts of short-term sleep restriction on cognitive performance.

Table 2. GPA means of PSQI groups.

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>Std. error</th>
<th>95% confidence interval for mean Lower bound</th>
<th>Upper bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
<td>4.38</td>
<td>0.629</td>
<td>0.315</td>
<td>3.37</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>4.80</td>
<td>0.258</td>
<td>0.082</td>
<td>4.62</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>4.79</td>
<td>0.254</td>
<td>0.062</td>
<td>4.66</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
<td>4.83</td>
<td>0.307</td>
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</tr>
<tr>
<td>4</td>
<td>50</td>
<td>4.50</td>
<td>0.505</td>
<td>0.071</td>
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<tr>
<td>5</td>
<td>54</td>
<td>4.62</td>
<td>0.411</td>
<td>0.056</td>
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</tr>
<tr>
<td>6</td>
<td>49</td>
<td>4.55</td>
<td>0.398</td>
<td>0.057</td>
<td>4.44</td>
</tr>
<tr>
<td>7</td>
<td>33</td>
<td>4.47</td>
<td>0.483</td>
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<tr>
<td>8</td>
<td>40</td>
<td>4.59</td>
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<td>9</td>
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<td>0.415</td>
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<tr>
<td>10</td>
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<td>0.074</td>
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<td>12</td>
<td>19</td>
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<td>0.373</td>
<td>0.085</td>
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<td>13</td>
<td>6</td>
<td>4.58</td>
<td>0.376</td>
<td>0.154</td>
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</tr>
<tr>
<td>14</td>
<td>3</td>
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<td>0.289</td>
<td>0.167</td>
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<tr>
<td>17</td>
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<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>4.50</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Total</td>
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<td>4.58</td>
<td>0.435</td>
<td>0.022</td>
<td>4.54</td>
</tr>
</tbody>
</table>
Sleep quality of medical students

A study published in May 2020 showed that people who were 65 years of age or older are six times more likely to have poor sleep quality than people between the ages of 18 to 24 [22]. In this study, the correlation between PSQI score and age was not significant; however, the sample of the current study was limited to young age groups only. There was a weak correlation between academic year and sleep quality in this study that does not correlate to the cross-sectional study on undergraduates medical college in Botucatu, Brazil [23]. This could be related to the variety of difficulties that students face in their first years regarding the ability to cope with changes in school life and heavy study loads.

No significant difference was detected in sleep quality between males and females, and this result is in line with a study done at Sulaiman AlRajhi Colleges in Al-Qassim, which found no difference in sleep quality (ρ < 0.219) between genders [24]. Furthermore, there was a non-significant correlation between marital status and sleep quality, which corresponds with the results of a cross-sectional study that found the relation between marital status and sleep quality to be insignificant (ρ < 0.638) [25].

Table 3. Correlation between GPA and PSQI.

<table>
<thead>
<tr>
<th></th>
<th>GPA</th>
<th>PSQI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson</td>
<td>1</td>
<td>-0.138</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>401</td>
<td>401</td>
</tr>
</tbody>
</table>

Table 4. One-way ANOVA test of GPA and PSQI.

<table>
<thead>
<tr>
<th>GPA</th>
<th>Sum of squares</th>
<th>df</th>
<th>Mean square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between groups</td>
<td>18</td>
<td>0.388</td>
<td>2.160</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Within groups</td>
<td>382</td>
<td>0.180</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Total</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant association was observed between having a medical or psychiatric disease and being a poor sleeper. This could be attributed to the control of diseases through medication. However, according to Molzon et al. [26], approximately 34% of students who have a medical disease are asthmatic, which was found to have a significant effect on sleep quality. Moreover, a study done in Al-Qassim showed a significant correlation between poor sleep quality in relation to depression (ρ < 0.013) and anxiety (ρ < 0.003) [24].

In this study, there was no significant association between sleep quality and the frequency of caffeine consumption. A similar finding was established in a few previous studies in which no significant relation was found between the use of caffeinated beverages with sleep quality [17]. However, other studies found a strong association between caffeine and sleep quality (ρ < 0.001) and between caffeine and excessive daytime sleepiness (ρ < 0.015) [27,28]. This study also did not find a significant correlation between sleep quality and exercise. A cross-sectional survey conducted in 2016 at Inner Mongolia Medical University found that students who exercised less than three times a week have a higher prevalence of poor sleep quality than students who exercised three or more times a week (ρ < 0.005) [29]. This inconsistency may be the result of an inadequate assessment of exercise type/intensity and the caffeine type, amount, time of intake or its relation to sleep quality, all of which may be considered in future studies.

This study showed a negative correlation between phone use before sleep and PSQI, but it did not reach a significant level. A cross-sectional study conducted on undergraduate medical students in Qom, Iran found a positive significant correlation between phone use and overall sleep quality (ρ < 0.001). However, this correlation was not observed for sleep latency, sleep duration, or habitual sleep efficiency [25]. The difference in results may be due to the difference in the size of samples between studies.
The current study also demonstrated a significant negative correlation between the duration of sleep acquired on nights before examinations and overall sleep quality. Students tend to change their sleeping duration during the period prior to examinations: this delay and change in the circadian rhythm leads to poor sleep quality [30].

**Conclusion**

This study showed a significant relation between sleep quality and academic performance. No significant relation was found between sleep quality and age, academic year, gender, marital status, medical or psychiatric diseases, caffeine consumption, frequency of exercise, or cell phone use. There was a significant relation between

<table>
<thead>
<tr>
<th>Table 5. Correlation between PSQI score and other factors.</th>
</tr>
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<tbody>
<tr>
<td><strong>PSQI</strong></td>
</tr>
<tr>
<td>PSQI Pearson correlation</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Age Pearson correlation</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Academic year Pearson correlation</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<tr>
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<tr>
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<td>Sig. (2-tailed)</td>
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<tr>
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<td>Sig. (2-tailed)</td>
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</tbody>
</table>
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339 sleep quality and having a poor night’s sleep before
340 examinations. Further studies are still needed to assess
341 other factors that could have a role in sleep quality, such
342 as video games, emotional insecurities and synthetic
343 sugar consumption.

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350 List of Abbreviations
351 GPA Grade point average.
352 NREM Non-rapid eye movement
353 PSQI Pittsburgh sleep quality index.
354 REM Rapid eye movement.

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356 The authors declare that there is no conflict of interest
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Appendix

The questionnaire that has been used in the study

This questionnaire is for medical students in Taibah University, and it aims to assess the impact of sleep quality on the academic performance among many factors. All data will be used for research purposes only.

1. Ethical consent
Do you agree to participate in this research?
• Yes.
• No.

2. Sociodemographic state
Gender:
• Male.
• Female.
Age:

Marital state:
• Single.
• Married.
• Divorced.
• Widowed.

GPA:
• 5-4.5
• <4.5-4
• <4-3.5
• <3.5-3
• <3-2.5
• <2.5

Academic level:
• Sixth year.
• Fifth year.
• Fourth year.
• Third year.

Do you have any current medical disease?
• Yes.
• No.

If you chose (yes) in the previous question, mention it, please.

Do you have any current psychiatric disease?
• Yes.
• No.

3. The PSQI
This is an effective instrument used to measure the quality and patterns of sleep in the older adult. It differentiates “poor” from “good” sleep by measuring seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction over the last month.

In the past month, how long (in minutes) has it taken you to fall asleep each night?
• Less than 15 minutes.
• 16-30 minutes.
• 31-60 minutes.
• More than 60 minutes.

In the past month, how many hours of actual sleep do you get at night?
• More than 7 hours.
• 6 hours.
• 5 hours.
• Less than 5 hours.

For the following questions, please answer according to your sleep habits of the majority days and nights in the past month only:

How often have you had trouble sleeping because you cannot get to sleep within 30 minutes?
• Not during the past month.
• Less than once a week.
• Once or twice a week.
• Three or more times a week.

How often have you had trouble sleeping because you wake up in the middle of the night or early in the morning?
• Not during the past month.
• Less than once a week.
• Once or twice a week.
• Three or more times a week.

How often have you had trouble sleeping because you have to get to use the bathroom?
• Not during the past month.
• Less than once a week.
• Once or twice a week.
• Three or more times a week.

How often have you had trouble sleeping because you cannot breathe comfortably?
• Not during the past month.
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How often have you had trouble sleeping because you cough or snore loudly?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How often have you had trouble sleeping because you feel too cold?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How often have you had trouble sleeping because you feel too hot?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How often have you had trouble sleeping because you have bad dreams?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How often have you had trouble sleeping because you have pain?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How often have you taken medicine (prescribed or over the counter) to help you sleep?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How often have you had trouble staying awake while driving, eating or engaging in social activities?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

How much of a problem has it been for you to keep up enthusiasm to get things done?
- Not during the past month.
- Less than once a week.
- Once or twice a week.
- Three or more times a week.

During the past month, how would you rate your sleep quality overall?
- Very good.
- Fairly good.
- Fairly bad.
- Very bad.

4. Factors affecting sleep quality

How much caffeine do you drink per week?
- More than once per day.
- Daily.
- 2-5 times per week.
- Never.

How many times do you exercise per week?
- More than once per day.
- Daily.
- 2-5 times per week.
- Never.

How often do you use your phone before sleep?
- Always.
- Usually.
- Rarely.
- Never.

The nights before exams, how often does your sleep quality become bad?
- Always.
- Usually.
- Rarely.
- Never.