EDUCATIONAL PSYCHOLOGY & COUNSELLING | RESEARCH ARTICLE

Excessive daytime somnolence in a sample of Ecuadorian undergraduate medical students and its relationship with academic performance.

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Abstract: Medical students do not sleep enough hours, they should study at night and, therefore, they have excessive daytime somnolence that could produce attention disorders affecting their academic performance. The objective was to determine the prevalence of excessive daytime somnolence and prevalence of poor quality in students of a private university in Ecuador, and the relation existing between these disorders and their academic performance. A cross-sectional study that included 219 undergraduate medical students, 57.5% of them, female. Spanish paper-based Epworth Somnolence Scale and the Pittsburgh Sleep Quality Index were applied. Sociodemographic variables were also measured. Statistical methods were performed to make comparisons between groups (comparison of proportions and means) and bivariate and multivariate regression logistic were performed to assess the association between academic performance and sleep quality after adjusting for other covariates. Excessive daytime somnolence occurred in 42.0% (95%CI 35–49) of students, slightly higher in women and 83.1% reported bad quality of sleep according to the Pittsburgh scale. It was found that 40.6% had a poor academic performance being alcohol consumption a risk factor for it. There

ABOUT THE AUTHOR

This is a multidisciplinary group made up of scientists interested in the well-being of our students. Our objective is to increase the capacity to carry out research on mental health in Ecuador and to identify new preventive and therapeutic strategies for affected students. It is integrated by different specialists such as family doctors, nurses, biostatisticians, and psychologists. We are working on different research issues like depression and other mental diseases and in the validation of instruments to assess these conditions. This paper is part of the results of a project supported by Universidad de Las Américas.

PUBLIC INTEREST STATEMENT

Some studies have shown that excessive daytime somnolence and poor quality of sleep are related to students’ academic performance. There are some lifestyle factors like gender, age, alcohol consumption, coffee intake among others that can influence the relationship between sleepiness and the way medical students learn. There is a need to conduct research in this field to obtain information to make decisions regarding the wellbeing of the students. This study was performed to determine the prevalence of excessive daytime somnolence in medical students and to assess the association between sleep quality, somnolence, and academic performance. Researchers used validated instruments to collect data and analyzed it quantitatively them. Results showed that there is a high prevalence of these conditions and that alcohol is a risk factor to predict low academic performance. The findings of this study did not support the theory of the relationship between Excessive Daytime Somnolence and poor quality of sleep and academic performance in medical students.
was no statistical association between excessive daytime somnolence, poor sleep quality, and academic performance. Excessive daytime somnolence and bad quality of sleep are very common among medical students, but this disturbed sleep pattern seems no to be associated with poor academic performance.

**Subjects: Public Health Policy and Practice; Occupational & Environmental Medicine; Sleep Medicine**

**Keywords: excessive daytime somnolence; sleep quality; academic performance; medical students; Epworth Sleepiness Scale; Pittsburgh Sleep Quality Index; prevalence; risk factors**

1. **Introduction**
Academic performance is a key component of medical education to assess whether a medical graduate is sufficiently competent and fit to practice medicine and proper sleep needs to be considered as a multidimensional structure that needs to be favored. Sleepiness and poor sleep quality among students in the university are frequent and it is possible to affect their academic performance and daytime functioning.

There are many negative consequences for health in a general manner. The consequences of sleep problems, whether due to insufficient sleep or an untreated sleep disorder can be serious.

Specifically, medical students could be more affected than students in other careers and there are different results worldwide regarding academic performance.

A common sleep problem among these students is sleep deprivation and resulting in excessive daytime sleepiness (EDS) which could also contribute to poor quality of sleep. Lifestyle factors such as alcohol, caffeine, tobacco use may contribute to sleep disturbances but also low academic performance. Next, a brief review of the literature will be presented.

2. **Literature review**
Sleepiness is defined as the inability or difficulty in maintaining alertness during the major wake period of the day, resulting in unintended lapses into drowsiness or sleep (The international classification of sleep disorders: diagnostic & coding manual, 2005)

Sleep as a physiological function influences very much the psychological and cognitive performance of the students in a learning phase. Academic performance of medical students depends on a number of factors, including excessive daytime sleepiness (EDS), mainly due to physical exhaustion caused by a reduction in the number of hours of sleep, the time that they spend in the classrooms or health institutions for clinical practices, and the number of extra hours of night study. (Hershner & Chervin, 2014)

Also, sleep has a circadian rhythm and its deprivation leads to a malfunction of concentration activity, to avoid the establishment of flexible thinking, not to face new knowledge and not to have an adequate expression of ideas and not to respond fluently to questions of the professor. (Ohayon, 2008).

The sleep of sufficient duration, continuity, and intensity (depth) without circadian disruption is necessary to promote high levels of attention and cognitive performance during the wake period, and to prevent physiological changes that may predispose individuals to adverse health outcomes. (Buxton et al., 2012)
Inadequate sleep decreases general alertness and impairs attention, resulting in slowed cognitive processing. Lack of adequate sleep also interferes with the function of brain structures critical to cognitive processes. (Zeek et al., 2015)

Higher education students usually have an irregular sleep pattern, which is characterized by changing the start and end time of it. During the week, sleep time is shorter compared to the weekend, students suffer sleep deprivation during the day in college or clinical practice, as in the case of medical students. (Araújo & Almontes, 2010)

Such irregularities can have a negative impact on the health of students (Min et al., 2015), and therefore it could be a risk factor for low academic performance. (Owens & Adolescent Sleep Working Group & Committee on Adolescence, 2014) (Ng et al., 2009)

The National Sleep Foundation (NSF) consensus report has stated that seven to 9 h are recommended for adults aged 18 to 64 years. (National Sleep Foundation, 2020)

Lack of sleep also may result in a reduced amount of hours and/or inadequate sleep quality. In the case of an insufficient amount, most of the time the student does not fall asleep for an entire night. (Cirelli, 2016)

A reduction of night time sleep may not generate apparent consequences on performance or the development of sleepiness if total sleep is not 6 h or less. The nature of this poor sleep may also affect the student psychologically by making them feel depressed, anxious, and insomnious. (Winsler et al., 2015) (Fawcy and Hamet, 2017)

Most of the studies evaluating the impact of sleep on academic performance are done on teens, adolescents, and undergraduate students. Only a few studies have explored sleep habits in students who are pursuing health-care degrees. (Zeek et al., 2015)

Some studies have shown that figure EDS of can vary from country to country, for example, 37.8% of the medical students in Saudi Arabia (Al-Zahrani et al., 2016) or 49.8% in a study in Colombia. (Machado-Duque et al., 2015) Similarly, in one study it was established that medical interns make more diagnostic errors when they work in shifts of more than 24 h. (Barger et al., 2006)

The relationship between sleep quality and academic performance of medical students and the influence of sleep on academic performance is variable. There are some studies that show different results. (Araújo & Almontes, 2010) (Alotaibi et al., 2020) (Bahammam et al., 2012)

The Epworth Sleepiness Scale (ESS) is used as a subjective method to assess the presence of EDS and this scale in its Spanish version has demonstrated reliability of 89% (Sandoval et al., 2013) and Cronbach Alpha ranging from 0.79 (Rosales, 2007) to 0.85. (Luz et al., 2007)

The Pittsburgh Sleep Quality Index has also been validated into Spanish by various groups of authors. (Luna et al., 2015) (Jiménez et al., 2008) (Escobar & Eslava, 2005). This is an internationally recognized tool for the evaluation of sleep quality and consists of seven subscales: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction.

Research indicates an association between irregular self-reported sleep patterns and increased alcohol consumption. (Van Reen et al., 2016). Students with alcohol use disorders report more insomnia, hypersomnia, and greater variability in weekday to weekend sleep duration. (Hershner & Chervin, 2014)
Tembo et al. (2017) reported that students who were unable to concentrate in the class were 2.6 times more likely to consume alcohol at hazardous or harmful levels than those who did not. He also found that students who failed to complete assignments were 3.5 times more likely to drink alcohol at hazardous or harmful levels than those who did not.

Nicotine and caffeine can cause insomnia and withdrawal symptoms. Smoking may also create other sleep disturbances. Research has shown that smokers spend more time sleeping lightly and less time in deep sleep than nonsmokers. Cigarette smoking has also been shown to be related to sleep quality. Findings from clinical and population-based studies have consistently found that smokers experience poorer sleep compared to nonsmokers. (Conway et al., 2008)

In Ecuador, there is information that shows that EDS occurs in 22% in a small rural population (Del Brutto et al., 2014), 51.7% of the cadets of the Eloy Alfaro Military School (De La Vega Granizo & Soraya, 2014); and 23.3% in a study on its relation with alterations in facial morphology in a rural population of Guayaquil (Castillo et al., 2014), although no data have been found on their presence in medical science or health-care professional students in the country.

It is known that medical students usually sleep a shorter amount of time, so the presence of EDS is higher in them compared to students in other careers. (Azad et al., 2015).

The impact of sleep loss on academic performance might be understated. The objective of this work was to determine the prevalence of excessive daytime somnolence in students of the university, sleep quality, and the relation existing between this disorder and their academic performance, trying to understand their sleep habits.

3. Material and methods

3.1. Design

This is a quantitative study with a cross-sectional approach. In a cross-sectional study, the investigator measures the outcome and the exposures in the study participants at the same time and is used to assess the prevalence of diseases in clinic-based samples. (Setia, 2016)

The information was collected during January to May of 2017 from students of the career of Medicine (second to 12 semesters). The age range of this group was 18–32 years old.

3.2. Sample size and sampling methods

The sample consisted of 219 undergraduate medical students out of 1080 medical students. The expected prevalence of Excessive daytime somnolence was 35%, accuracy of 6%, 95% confidence level, and 5% of the losses.

The formula was the following:

\[ n = \frac{N \times Z^2_{\alpha/2} \times p \times q}{d^2 \times (N - 1) + Z^2_{\alpha/2} \times p \times q} \]

A randomized-stratified sampling was carried out proportional to the size of the semester of the career, for which a list of students per semester was available, and a simple random sampling was carried out within each stratum. The population of students was defined using inclusion and exclusion criteria, and the semester was considered as the stratum, once the sample size was calculated, a proportionate stratification was the next step; random numbers were generated to choose the students.
3.3. Ethics aspects
After written informed consent was provided, students completed a survey. The institutional review board of the university gave ethical approval to perform this study. We follow the STROBE guidelines for the report of this study.

3.4. Sleep variables and academic performance
The level of daytime sleepiness was measured through the Epworth Sleepiness Scale (ESS), which is a questionnaire to assess the probability of falling asleep in a variety of situations. The total score is 24 points and students will be considered to suffer from excessive daytime excessive drowsiness if the total score is eleven or more points.

Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI), which consists of 19 items resulting in seven component scores (0-3) about subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The sum of all component scores yields a global score (range 0–21), with higher scores indicating worse sleep quality. A total score of “5” or greater is indicative of poor sleep quality.

Both scales were validated versions of Spanish and paper-based instruments.

Academic performance: Students were asked to report their general average mark of the previous semester. The Ecuadorian grading system ranges from 1.0 to 10.0, the latter being the highest possible. The minimum grade required to pass a semester is 6. From 8 to 10 is considered a very good rating, it was considered for purpose of this study that 8 or above points were acceptable, otherwise poor performance.

3.5. Sociodemographic variables
Sex, age (categorized in two groups), alcohol consumption (yes or no), smoking history (yes or no), and coffee intake (yes or no) were inquired about. Drinking one cup or more per day the student was considered as a coffee drinker. Drinking one cup or more per week the student was considered an alcohol drinker.

3.6. Statistical analysis
Descriptive statistics were reported as means and standard deviation (SD) for quantitative variables as age, a score of ESS and PSQI, and average grade. Frequencies (absolute and relative) were reported for qualitative variables as a group of age, coffee intake, alcohol consumption, and use of tobacco.

Normality of data was checked using Kolmogorov-Smirnov test and since they were not a normal nonparametric test of Mann–Whitney U for mean comparisons was used. Chi-square was used to test for a significant associations between categorical variables.

Bivariate and multivariate logistic regression were performed between excessive daytime sleepiness and sleep quality, gender, age, coffee intake, alcohol consumption, use of tobacco, and academic performance. Odds ratio nonadjusted and adjusted and their CI 95% were calculated. A p-value of <0.05 was accepted as statistically significant. Data were analyzed using statistical software (SPSS version 24, 2016).

4. Results
We included 219 medical students in the study. There was a slight female predominance in the sample (57.5%). From the total of students, 63% of the students were in the second and third year of the career.

The normality assumption was checked out using a Kolmogorov-Smirnov test to examine whether the data meet the requirement of parametric tests. It was concluded that the data gathered were not normal (p = 0.01).
The general mean of EES and standard deviation was 10.21 and 3.98, respectively. For men was 9.36 ± 3.86 while for women was 10.84 ± 3.96, with a significant statistical difference (p-value = 0.006).

Mean age and standard deviation of students having somnolence were 20.9 ± 0.24 and its CI95% (20.5–21.4) while for those without excessive somnolence was 21.1 ± 0.20 and it CI95% (20.7–21.5) with no significant statistical differences in age means (p = 0.65). The general prevalence of excessive somnolence was 42.0% (95%CI 35.0–49.0). Among women, the prevalence was 48.4% (95%CI 39.5–57.2) while for men was 34.4% (95%CI 24.5–44.2).

Sample characteristics and descriptive statistics of some variables according to excessive somnolence are provided in Table 1. We found that bad sleepers, female students, and those younger than 25 years old, and those sleeping less than 6 h had a higher percentage of students with excessive somnolence.

Pittsburgh Sleep Quality Index (PSQI) has a general mean and SD of 8.0 ± 2.8. In women, it was 8.1 ± 2.7 and in men 7.9 ± 2.9. No differences were found between these means (p = 0.73). A total of 37 (16.9%) students turned out to be good sleepers, while 183 (83.1% 95% CI 78.1–88.1) were classified as bad sleepers (PSQI ≥ 5). We found significant statistical differences in sleep quality, hours of night sleep, and gender according to academic performance.

In general, medical students reported sleeping an average of 5.3 h ± 1.84, and only 7.3% sleep 7 h or more per night.

Table 2 shows different variables in relation to academic performance. In general, 40.6% of the student had poor academic performance in the previous semester. The mean grade score and SD was 7.9 ± 0.6 with no statistical differences between men and women.

Around 40.0% of the students with poor academic performance had excessive somnolence and a high percentage of those with less than 6 h of night sleep had a poor performance. No significant differences were elicited in all variables compared except in alcohol consumption and coffee intake.

In the multivariate analysis, it is observed that only alcohol consumption is a significant predictor of poor academic performance. Students that drink alcohol have almost twice the chance to have a poor performance in comparison with those that do not drink (OR 2.64 IC95% 1.48–4.69). Excessive somnolence was found no significant between the groups (Table 3).

In Table 4 we reported the means and SD of the two scales according to student academic performance. For the Epworth scale the mean was 10.2 ± 3.9 while the Pittsburgh scale had a mean and SD of 8.0 ± 2.8. There were no significant differences between groups according to academic performance (p-value more than 0.05)

5. Discussion
We evaluated the prevalence of daytime sleepiness and explored the relationship between daytime sleepiness, quality of sleep, and academic performance among 219 medical students from Universidad de Las Américas in Ecuador. Medical students in this study were found to have higher than normal daytime sleepiness and overall poor sleep quality.

The general prevalence of excessive daytime sleepiness in our study was 42.0% (students with 11 or more in Epworth Somnolence Scale), with a higher percentage in women. It seems that this disorder is more frequent in female students. (El Hangouche et al., 2018) (Shen et al., 2019)
### Table 1. Main characteristics of medical students according to excessive daytime somnolence

| Baseline characteristics | No n = 127 (58.0%) | Excessive daytime somnolence | Yes n = 92 (42.0%) | p value* |
|--------------------------|--------------------|------------------------------|---------------------|----------|
| Sleep quality            |                    |                              |                     |          |
| Bad sleepers             | 107                | 84.3                         | 91                  | 98.9     | 0.00     |
| Good sleepers            | 20                 | 15.7                         | 1                   | 1.1      |          |
| Night sleep hours        |                    |                              |                     |          |
| < 6 hours                | 86                 | 68.3                         | 78                  | 75.2     | 0.00     |
| >6 hours                 | 40                 | 31.7                         | 14                  | 24.8     |          |
| Gender                   |                    |                              |                     |          |
| Male                     | 61                 | 48.1                         | 32                  | 34.4     | 0.05     |
| Female                   | 66                 | 51.9                         | 60                  | 65.2     |          |
| Age (years)              |                    |                              |                     |          |
| 18–24                    | 115                | 90.5                         | 86                  | 93.5     | 0.43     |
| 25–32                    | 12                 | 9.5                          | 6                   | 6.5      |          |
| Coffee Intake            |                    |                              |                     |          |
| Yes                      | 80                 | 63.0                         | 59                  | 42.5     | 0.86     |
| No                       | 47                 | 37.0                         | 33                  | 41.2     |          |
| Alcohol consumption      |                    |                              |                     |          |
| Yes                      | 74                 | 58.3                         | 56                  | 58.7     | 0.94     |
| No                       | 53                 | 41.7                         | 58                  | 41.3     |          |
| Tobacco                  |                    |                              |                     |          |
| Yes                      | 35                 | 25.6                         | 23                  | 25.0     | 0.67     |
| No                       | 92                 | 72.4                         | 69                  | 75.0     |          |

Note: Chi-square test.
Table 2. Characteristics according to academic performance

| Academic performance | Poor n = 89(40.6%) | Acceptable n = 130(59.4%) | p value |
|-----------------------|----------------------|---------------------------|---------|
|                       | n  | %    | n  | %    |         |
| Excessive Somnolence  |    |      |    |      |         |
| No                    | 52 | 40.9 | 75 | 59.1 | 0.91   |
| Yes                   | 37 | 40.2 | 55 | 59.8 |         |
| Night sleep hours     |    |      |    |      |         |
| < 6 hours             | 71 | 79.8 | 18 | 20.2 | 0.19   |
| > 6 hours             | 93 | 73.1 | 36 | 24.9 |         |
| Sleep quality         |    |      |    |      |         |
| Bad sleepers          | 82 | 41.4 | 116| 58.6 | 0.47   |
| Good sleepers         | 7  | 33.3 | 14 | 66.7 |         |
| Gender                |    |      |    |      |         |
| Female                | 48 | 38.1 | 78 | 61.9 | 0.37   |
| Male                  | 41 | 44.1 | 52 | 55.9 |         |
| Age (years)           |    |      |    |      |         |
| 18-24                 | 82 | 40.8 | 119| 59.2 | 0.87   |
| 25-32                 | 7  | 38.9 | 11 | 61.1 |         |
| Coffee Intake         |    |      |    |      |         |
| Yes                   | 53 | 38.1 | 86 | 61.9 | 0.31   |
| No                    | 36 | 45.0 | 44 | 55.0 |         |
| Alcohol consumption   |    |      |    |      |         |
| Yes                   | 64 | 50.0 | 64 | 50.0 | 0.00   |
| No                    | 25 | 27.5 | 66 | 72.5 |         |
| Tobacco               |    |      |    |      |         |
| Yes                   | 31 | 53.5 | 27 | 46.5 | 0.02   |
| No                    | 58 | 36.1 | 103| 63.9 |         |

Note: Chi-square test.

There is female vulnerability to poor sleep quality but as being the quality of sleep a subjective issue it could be affected by different lifestyle factors as smoking history, alcohol consumption, or medical factors such as depression or chronic diseases, and not only by gender differences.

Some studies reported similar figures for excessive somnolence. (Alsagaf et al., 2016) (Escobar-Córdoba et al., 2008) (Kaur & Singh, 2017). Other authors have reported higher values than ours. (Niño et al., 2019) (Pagnin et al., 2014).

Machado et al. also reported higher figures of ESD among medical students (49.8%). The authors found that the average value after applying the Epworth scale was 8.4 ± 3.7. (Machado, 2015). We are reporting a mean of 10.21 ± 3.98, higher in women.

Other authors have reported lower figures of excessive daytime somnolence. (Shen et al., 2019)

The evaluation of quality sleep through the Pittsburg scale showed an average of 8.0 ± 2.8 points and more than 80% of our students has a poor quality of sleep. Similar findings are reported by Machado (2015). Maheshwari and Shaukat (2019) reported that 64.24% of the students had a global PSQI score of ≥5 indicating poor sleep quality. Other studies have also
reported the prevalence of poor sleepers lower than ours. (PSQI ≥5). (El Hangouche et al., 2018) (Shimura et al., 2018) (Choueiry et al., 2016) (Rosario et al., 2014)

The nonsignificant difference was demonstrated in the academic performance of those having normal sleep versus those with excessive daytime sleepiness. In a study performed in Morocco, it was found that almost one-third of the students (36.6%) had excessive daytime sleepiness and this was more frequently observed in female students (43% vs 20.1%, <0.001)
and that being a poor sleeper was statistically associated with poor academic performance ($b = -0.07; 95\% CI = -0.14$ to $-0.002; P = 0.04$) in the multivariate analysis. They also concluded that daytime somnolence was not statistically associated with academic performance, the same result as our study. (El Hangouche et al., 2018)

The sleeping average was of 5.3 h only 7.3% of them sleep 7 h or more per night. This contrasts with a study carried out on medical students in Malaysia in which it was shown that sleep time was 6 h per night and 51.2% sleeps 7 or more hours. (Maheshwari & Shaukat, 2019)

In the same way, it has been studied that the Peruvian students of the same semesters of the career third and fourth years, periods in which they start attending hospitals (coinciding with those of the university of this study), slept an average of 5.5 h in the years specified academics. (Barrenechea et al., 2010)

We could not find significant differences between acceptable and poor academic performance according to excessive somnolence, quality sleep, hours of sleep, tobacco use, gender, or age, which is similar to the results by Araujo et al. that did not find an association between quality of sleep and academic performance. (Araújo & Almontes, 2010)

In a study performed in Saudi Arabia, it was found that age and smoking were not associated with academic performance. (Al-Khani et al., 2019).

Students with poor academic performance spend more hours at night reading and often deprive themselves of sleep in a bid to improve their grades. This creates a vicious cycle that is associated with an adverse effect on sleep quality and mental health. (Lawson et al., 2019)

It is a fact that a tired and sleepy medical student does not learn well. Even in this study level of stress was not measured, medical students suffer from poor sleep quality due to stress and anxiety related to the high load of subjects, numerous exams, and fear of failure.

Alcohol consumption was the only variable that was identified as a risk factor for poor academic performance, there are some studies that have reported that alcohol consumption has negative associations with academic performance. (Slutske, 2005) (El Ansari et al., 2013) (Machado, 2015) (Mekonen et al., 2017)

In other students, heavy alcohol use, alcohol-related problems, and drinking opportunities do not appear to have an important effect on students’ academic performance according to Paschall and Freisthler (2003).

We found that excessive daytime somnolence and poor sleep quality does not seem to affect the academic performance of the student of this university. This is consistent with what was reported by Al-Zahrani et al. (2016) and Alsaggaf et al. (2016).

Possible reasons for having these results are that we did not study all the possible variables that are influent in the occurrence of daytime somnolence in medical students, as well as the use of other quantitative methods for achieving elucidative information on the relationship between sleep and academic performance. Bedtime and wake-up times are examples of measures that must be considered when exploring this relationship. Most of the time establishing a causal relation will require experimental manipulations in randomized-controlled trials.
6. Limitations
This is a cross-sectional study causal relationships among the variables studied was not examined. This study has not considered other factors such as exam stress or exam difficulty. Recall biases might exist due to the utilization of self-reported measurements (self-reported academic performance).

7. Conclusions
There was a high prevalence of excessive daytime sleepiness and bad sleep quality among undergraduate medical students. This disturbed sleep pattern was not associated with poor academic performance. Further longitudinal studies are needed to confirm whether excessive daytime sleepiness affects academic performance among Ecuadorian medical students.

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Author contribution
MF participated in the design of the study, collected data, performed all statistical analyses, interpreted the data, as well as drafted the manuscript. MR and NA participated in the design of the study, collected data, and interpreted data. PG participated in the design of the study and contributed to the manuscript writing. All authors reviewed and approved the final manuscript.

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