ABSTRACT

Background and objective: Good quality sleep and adequate amount of sleep are important in order to have better cognitive performance and avoid health problems and psychiatric disorders. Sleep-related disturbances affect a large percentage of university students and may cause impairments in their academic performance. Among the wide range of factors that can influence the sleep habits, university schedules are strongly related with sleep deprivation in students. This longitudinal study aims to investigate the effect of university schedules on medical students’ sleep-wake cycle.

Methods: We evaluated the Pittsburgh Sleep Quality Index (PSQI), a Sleep Habits Questionnaire and a sleep diary in three university semesters with different class starting times.

Results and Conclusion: The results demonstrated that when classes started earlier in the morning, the students had shorter sleep duration during weekdays, greater difference between weekday and weekend sleep duration (restriction-extension pattern) and worse sleep quality, showing the influence of class starting time on students’ sleep habits.

Keywords: sleep habits, class starting time, sleep deprivation, sleep quality.
of sleep deprivation is daytime somnolence and its inevitable outcomes. One author observed excessive sleepiness prevalence of 93.2% in a population of medical students (7). Daytime sleepiness may result in mood disturbances and increased vulnerability to substance use (8). Another study showed that employees with subjective daytime sleepiness lose more working days due to health reasons than their more alert colleagues (9).

Sleep-related disturbances affect a huge part of the population, regardless of age, gender and ethnic group. However, there are certain population groups that are more susceptible to sleep disorders. University students, for instance, usually exhibit irregular sleep-wake cycles, with short sleep duration on weekdays and bedtime delays on weekends, which can lead to daytime sleepiness, depressive mood, and sleep-wake behavior problems (10). Medical students, in particular, are often overloaded with classes and hospital activities. In addition, they have to cope with anxiety and stress due to academic demands and the constant contact with patients’ suffering and death.

Academic performance is one of the major goals of university students. One study reported the relationship between sleep habits, particularly wake-up times, and grade point average in university students (11). Another study demonstrated that students with irregular sleep-wake cycles and sleep deprivation show worse academic performance than those with regular sleep-wake cycles and sufficient sleep duration (12). And, most alarming of all, university students are not aware of the extent to which sleep deprivation negatively affects their cognitive performance (13).

Multiple factors influence the sleep-wake cycle. Along with endogenous factors (chronotype, circadian timing system, core body temperature, and hormones), there is a wide range of environmental cues, including the light-dark cycle, professional activities, and social interaction, which can affect sleep habits. In a study with university students, for example, about one third of the sample that reported insufficient sleep indicated visual media, particularly computers, as the primary reason (14). Several other researchers have pointed out to study and work schedules as the primary reason (15). The One-way Within-Subjects (repeated measures) ANOVA test with ANOVA was used. The bedtime, sleep duration, and PSQI scores were compared between the semesters with the One-way Within-Subjects (repeated measures) ANOVA. The level of significance was established at $p<0.05$.

RESULTS

According to the Morningness/Eveningness Questionnaire, 71.4% of the students were classified as indifferent type, 14.3% as moderate morning type, 11.4% as moderate evening type, and 2.9% as extreme evening type. The linear correlation between bedtime (based on sleep diary) and chronotype scores ($p<0.04$) is evidence that the subjects’ answers were coherent on both questionnaires.

Based on the sleep diary, the students’ average bedtime during the first period was 23:47h ± 57min on weekdays and 00:18h ± 77min on weekends. Sleep duration was 397min ± 52min and 459 min ± 59min, on weekdays and weekends, respectively. During the second period, the students delayed their bedtime to 00:18h ± 77min on weekdays and 01:00h ± 90min on weekends. Sleep duration was 414min ± 55min and 465 min ± 59min, on weekdays and weekends, respectively. During the second period, the students delayed their bedtime to 00:18h ± 77min on weekdays and 01:00h ± 90min on weekends. Sleep duration was 414min ± 55min and 465 min ± 59min, on weekdays and weekends, respectively.
00:25h ± 58min on weekdays and 01:14h ± 65min on weekends. During the weekdays, the sleep duration increased to 437min ± 50min, but the weekend duration remained the same. In the third data collection, the bedtime and sleep duration data were obtained from the Sleep Habits Questionnaire. We had already found a strong correlation between the data from the sleep diary and the Sleep Habits Questionnaire during the second period and chose not to use the sleep diary during the third period. The results revealed that weekdays and weekend bedtimes were 23:38h ± 53min and 00:29h ± 88min, respectively, and sleep duration of 385min ± 56min and 519min ± 91min (Figure 1).

Fig. 1. Sleep duration on weekdays and weekends, showing the 'restriction-extension' pattern. Data are presented as mean ± s.d.

PSQI scores range from 0 to 20 and a value above 5 indicates bad sleep quality. During the first period analyzed, the average PSQI score was 5.00 ± 1.5, with 42.3% of the students presenting bad sleep quality. During the second period, this percentage decreased to 11.5% and PSQI mean score was 3.86 ± 1.5. During the third period, PSQI increased to 5.57 ± 2.8 and bad sleep quality was detected in 60% of the students (Figure 2). ANOVA comparison between the PSQI scores revealed a statistically significant difference between the first and second periods (p=0.044) and between the second and third periods (p=0.002), but no significant difference was found between the first and third periods.

Fig. 2. Pittsburgh Sleep Quality Index on the 3rd, 4th and 7th semesters

**DISCUSSION**

The normal distribution of chronotype frequencies revealed that the studied group is a homogeneous representation sample of the general population, with no significant predominance of morning or evening types.

Evaluation of the same group of students throughout the entire experimental period allowed us to use One-way Within-Subjects (repeated measures) ANOVA, and thus, we were able to consider the subjects' individual characteristics, such as personality and chronotype, as constant variables with little effect on the comparisons.

When the students went from the first analyzed period to the second, their morning classes starting time was delayed by 2 hours on Mondays, Wednesday and Fridays and by 3 hours on Tuesdays and Thursdays. This allowed them to delay their wake-up time by about 78min during college mornings. But they also delayed their bedtime, which seems to be associated with a tendency of the human circadian system to maintain a delayed phase (17). Despite this delay in bedtime, the students were able to increase their sleep duration by 40 minutes. During the third period, their class starting time went back to 07:00h and the students were forced to adopt a wake-up time, as well as a bedtime and sleep duration, similar to the first period. These results suggest that the class starting time affected the sleep-wake cycle and that the students slept less when classes started earlier in the morning.

When we compared the sleep onset on weekdays with that of weekends, we observed a delay of 31, 49 and 51 minutes on weekends for the third, fourth and seventh semesters, respectively. This was probably due to the already mentioned tendency of human beings to delay their sleep wake cycle (17) in addition to their engagement in social activities, such as parties.

We also found an increase in sleep duration on weekends compared to weekdays. During the third semester, the students slept approximately one hour more on the weekends and on the seventh semester, the difference between weekdays and weekends exceeded two hours. During the fourth semester, on the other hand, sleep duration during the weekend increased only 22 minutes. The reduced sleep length during weekdays and extended sleep length during weekends is denominated restriction-extension pattern and indicates partial sleep deprivation (Figure 1). During the third semester, 88.9% of the students presented this pattern. This percentage decreased to 66.7% during the fourth semester and reached 93.5% during the seventh semester. These results confirm the link between class starting time and sleep deprivation.

Even though the difference in weekdays sleep duration between the third and seventh semesters was subtle, the greater percentage of restriction-extension pattern found for the seventh semester indicated that the students were more sleep deprived at this time, which suggests that night work in hospitals during the professional cycle of the medical course could be another interfering factor on the sleep-wake cycle of students. Studies have demonstrated that fatigue in medical students and professionals is due to long hours of study and work and the associated sleep deprivation is the main factor that influences performance as reviewed by Gaspar et al. (20).

Sleep quality was also affected by class starting time. When classes started later in the morning, i.e., during the fourth semester, the students reported better sleep quality than during the third and seventh semesters, when classes started earlier. But, once again, we cannot rule out the possible influence of hospital night work on sleep quality since it was slightly worse on the seventh
It is essential for students and health professionals to understand the importance of sleep deprivation and other sleep disorders and their consequences. Loayza and colleagues (3) showed an association between sleep disturbance and suspicion of psychiatric disorders in medical students. As demonstrated, sleep-related disorders affect not only the individuals’ health and well-being (1), but also their performance. The effect of sleep loss on cognitive performance of resident physicians is well documented by Jacques and co-workers (6) in a study that demonstrated a decline in composite test score with decreasing sleep on the night before the examination.

Sleep medicine is an important field in the medical study and allows medical students and professional to diagnose their own sleep disorders as well as their patients’. Despite the numerous publications regarding the subject, students and professionals tend to ignore the sleep disorders and their possible consequences (13,21).

Medical students suffer high levels of stress due to academic demands, particularly during examination periods, and the constant contact with patients’ suffering. Stress, associated with insufficient sleep and excessive daytime sleepiness (7) can lead to difficulties in interpersonal relationship, depression, anxiety (22), and alcohol and drug abuse (8). Even though a number of studies have supported the need of stress-management programs for medical trainees (23), most of these programs do not take sleep habits into account. One way to improve sleep quality, avoid sleep disorders, and decrease stress is to have good sleep habits, which include regular bedtimes and wake-up times, sufficient sleep duration, appropriate sleep environment, and, particularly for students, better organization of their study schedule.

In this study we investigated the influence of class starting time on sleep deprivation and the effect of hospital night work on sleep. These are only two of the numerous causes of disruption of sleep habits. The identification and analyses of these factors contribute to an increased understanding of their relationship with the sleep-wake cycle and, most importantly, to the elaboration of intervention methods to avoid sleep-related disorders and their consequences.

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