The Interrelationship between Perceived Stress Level, Sleep Quality, and Academic Performance among Students of a Caribbean Medical School

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Abstract

Objective: Stress and sleep are essential elements of life and how these two factors affect academic performance of medical students must be studied properly in order to maximally and efficiently facilitate the medical training of future physicians.

Methods: 77 medical students who had similar work-load participated in this study. Participants were asked to answer the Pittsburgh Sleep Quality Index (PSQI) questionnaire and the Perceived Stress Scale questionnaire. The analyzed variables, quality of sleep and individual subjective perception of stress were linked to students' grade point average (GPA). The SPSS version 24 was used for the regression analysis and determination of a Pearson correlation coefficient between perceived stress level, sleep quality, and academic performance.

Results: The majority of participants (80%) experienced a moderate level of stress but the correlation between a perceived stress level and GPA was not found (p>0.7). The distribution of sleep quality among showed that 58% of students described good quality of sleep. There was a correlation (R= -0.67) between the PSQI and GPA (p<0.03), supporting a relationship between higher GPA and good sleep quality.

Conclusion: Adequate sleep is imperative to learning and it is evidenced that a reasonable amount of stress is not only realistic but may also be advantageous to the learning process. Therefore, both sleep and stress interact in a mutual fashion and affect memory retention, and by extension, learning.

Keywords: Preceived stress; Oxidative stress; Physicians; Long-term memory; Physiological responses

Abbervations: PSQI: Pittsburgh Sleep Quality Index; GPA: Grade Point Average; TSOM: Trinity School of Medicine

Introduction

Stress is a part of our life, since the most elementary bodily reactions produce oxidative stress. Psychologist Richard Lazarus defined stress as a moment in which a person perceives that the "demands exceed the personal and social resources that the individual is able to mobilize" [1]. It would be wrong to say that stress is completely bad, since some stress is beneficial in the learning process and memory consolidation [2]. However, the problem arises when there is too much stress, which ironically becomes counter-productive in the learning process and in long-term memory retrieval [2].

In a similar fashion, sleep is also a vital part of life as well [3,4]. The National Sleep Foundation has found that staying awake for twenty-four hours yields reaction times equivalent to having a blood alcohol concentration of 0.10, which is greater than the legal driving limit in the United States [5]. Sleep also plays a crucial role in memory consolidation, or stabilization, which includes integrating recently encoded memories into existing memory networks, as well as the development of hippocampal independence for declarative memories [6]. So, stress and sleep are essential elements of life and we may stand to benefit from studying how the two factors affect the mind and memory in medical students, in order to maximally and efficiently facilitate the medical training of future physicians.

Materials and Methods

The study was conducted at Trinity School of Medicine (TSOM), Saint Vincent & the Grenadines. The subjects were seventy-seven medical students with mean age of 24.7 years (SD=2.3), 33 male and 44 females, who had a similar academic load. Participation in the study was voluntary, and informed consent was obtained from all participants. Students who did not give consent and those who filled the questionnaire incompletely were excluded from this study. The analyzed variables, quality of sleep and individual subjective perception of stress were linked to students' grade point average (GPA). Participants were asked to answer the Pittsburgh Sleep Quality Index (PSQI) questionnaire [7], which consisted of 10 questions related to their normal sleep

habits. Sleep quality was considered bad for individuals who obtained a score higher than 5. The Perceived Stress Scale [8] was used for an evaluation of the level of stress. This scale includes 10 items and uses 5 points, rating scale ranging from 0 to 4: 0 – never; 1- almost never; 2- sometimes; 3- fairly often; 4 - very often; items 4, 5, 6, 7, and 8 are reversed scored. Data obtained were interpreted regarding the following scale: 0-13 - low-stress level; 14-26 - moderate stress level; 27- 40 - high-stress level. All data were tabulated in Microsoft Excel. The SPSS version 24 was used for the regression analysis and determination of a Pearson correlation coefficient between perceived stress level, sleep quality, and academic performance. A $P < 0.05$ was considered as statistically significant.
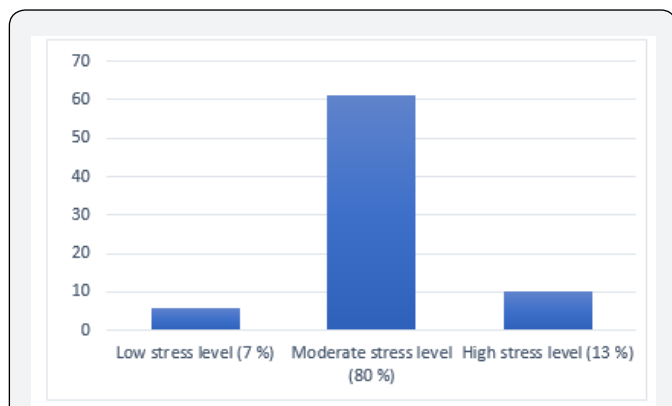
Results

Figure 1: Distribution of a perceived stress level among students.
Source: Authors.

The distribution of perceived stress level among TSOM students showed that the majority of participants (80%) experienced a moderate level of stress, 13% of participants had a high stress level and only 7% of students were not stressed out (Figure 1) Several studies were conducted to identify the sources of stress among medical students and the most stressful conditions were found to be related also to medical training rather than social or personal issues [3,9]. Stress in medical students has been a global problem [10].
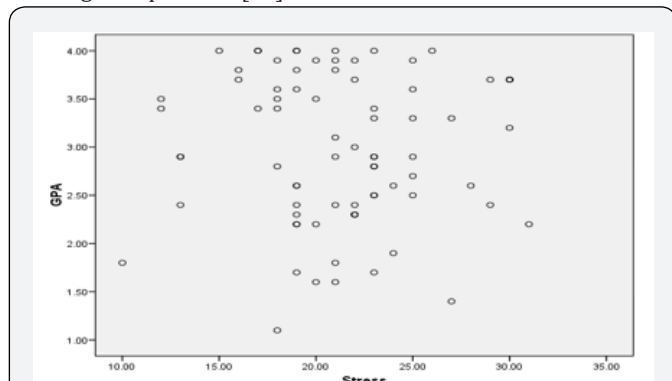

Figure 2: Relationship between GPA and perceived stress level among students.
Source: Authors.

We also found that there is no correlation between a perceived stress level and GPA ($p > 0.7$). Figure 2 indicates that students with moderate stress level (14-26) had a GPA which ranged from 4.0 to 1.0. These data also supported by several reports in the published literature as stress has physical and emotional effects and can create a positive or negative influence on us [3,11]. The stress responses differ depending on the type of stress and the individual's physiological responses. Some researchers have explored the impact of stress on student's performance with respect to change in time period and identified that initially there exists a positive relationship between stress and students' performance to some specific limit after which stress impacts an academic performance negatively [12].

Figure 3: Distribution of sleep quality among students.
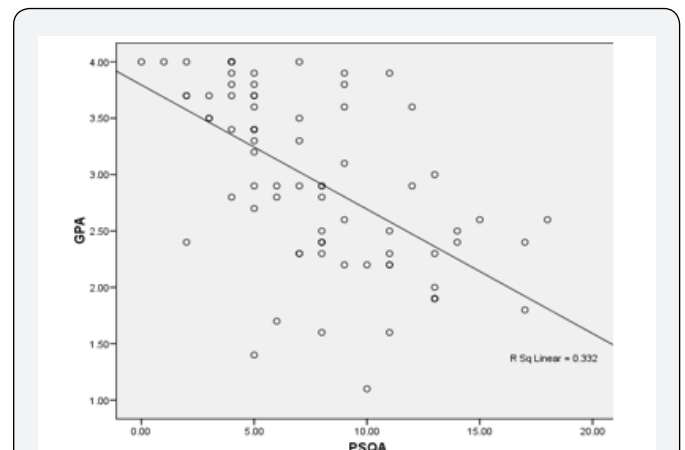**Source:** Authors.

Figure 4: Relationship between GPA and sleep quality (PSQA) level among students.
Source: Authors.

The distribution of sleep quality among TSOM students showed that a majority of participants (58%) had a good sleep quality (Figure 3), which had a positive effect on a students' GPA (Figure 4). There was a correlation (R= -0.67) between the PSQA and GPA ($p < 0.03$), supporting a relationship between higher GPA and good sleep quality (Figure 4). There is a correlation (R= -0.37) between the PSQA and perceived stress level ($p < 0.001$), which is an indication that heightened levels of perceived stress and poor sleep quality are inter-related (Figure 5).

Figure 5: Relationship between perceived stress level and sleep quality among students.

Source: Authors.
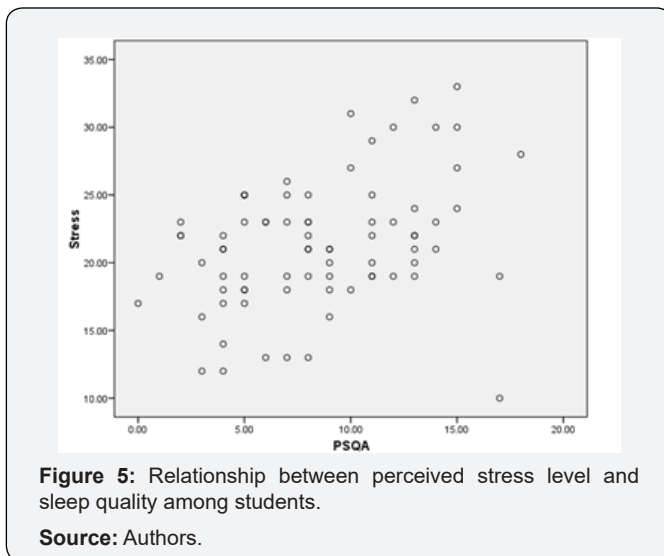
Discussion

Previous studies have reported a high prevalence of stress in medical students, ranging from 30% to 50% [13, 14]. A student can be stressed due to different reasons or stressors such as academic, financial or health problems, loss of a close family member or friend. Stress in academic situation can have both positive and negative consequences and can be viewed as the bodies' reaction both neurologically and physiologically to adapt to the new circumstance [15]. Academic stress is the product of a combination of academic related demands that exceed the adaptive resources available to an individual. If a student is unable to cope effectively with academic stress, then serious psychosocial emotional health consequences may result [16,17]. Students who experience mental and physical health problems are then at greater risk for poor academic performance, thus increasing academic stress and perpetuating a cycle of stress, maladaptive coping, and compromised health [3,18]. In addition, some studies have shown that stress can induce a change in the way that memories are recorded and consolidated, namely going from a "cognitive" hippocampal bias toward a "habitual" dorsal striatal pathway [19].

Among several hypotheses [10,20,21], it was suggested that sleep is involved in the processes of brain plasticity for memory consolidation. Memory consolidation is defined as the time dependent process that converts labile memory traces into more permanent and or enhanced forms [22]. In this hypothesis, the information acquired during wakefulness would be actively altered, restructured and strengthened during sleep. Consolidation and encoding of memories are very important for medical education, as medical students need to retain a substantial amount of complex factual knowledge within short period of time [23]. A review by Curcio et al. in 2006 suggested that student learning and academic performance are closely linked to sleep quality and quantity [24]. A study conducted among medical students in King Saud University of Saudi Arabia showed that decreased nocturnal sleep time, late bedtimes during weekdays, and increased daytime sleepiness were negatively associated with their academic performance [25]. These results and results of our research suggested that students with later sleep phase, disorganized daily schedule/ time management and poorer sleep quality are at a higher risk of impaired academic performance [3,26,27]. The University of Munich (Germany) also detected that the timing of sleep-wake behavior was an important predictor of medical school performance [27].

Conclusion

Considering the data of this study and literature review, it is clearly apparent that the learning process and memorization of information require a certain amount of good quality sleep [3,6,23-27]. The sleep quality and its duration play a tremendous role in the consolidation of procedural memory (a part of a long-term memory) and episodic memory and is a key point in the academic success [24]. Therefore, medical students must not neglect sleep during their academic life, and they should also try to minimize unnecessary stress, as the results of this study showed a negative effect of increased stress level on sleep quality and academic performance. According to this study, students whose stress level exceeded an adaptive threshold experienced academic difficulties and lowered GPA, but for another cohort of students the moderate stress level helped to enhance learning ability and GPA.

Adequate sleep is imperative to learning and it is evidenced that a reasonable amount of stress is not only realistic but may also be advantageous to the learning process. Therefore, both sleep and stress interact in a mutual fashion and affect memory retention, and by extension, learning.

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