**Relationship Between Depression Scores, Sleep Quality, Chronotype and Cardiorespiratory Fitness Among Undergraduate Health Students**

**ABSTRACT:** **Introduction:** University students face challenges that impact both their physical and mental health. However, studies that integrate depressive symptoms, sleep quality, chronotype, and cardiorespiratory fitness remain scarce. **Objective:** This study aimed to analyze the relationships among these factors in a sample of university students. **Materials and Methods:** The Beck Depression Inventory (BDI) was used to assess depressive symptoms, the Pittsburgh Sleep Quality Index (PSQI), the Morningness–Eveningness Questionnaire by Horne and Östberg (1976), and the University of Montreal Track Test (UMTT) to estimate cardiorespiratory fitness. **Results:** The findings revealed a high prevalence of depressive symptoms (46.9%) and poor sleep quality (75.5%), as well as low cardiorespiratory fitness levels compared to population standards. A moderate negative correlation was identified between depressive symptoms and sleep quality (r = -0.524; p = 0.0002), reinforcing the reciprocal influence between mental health and sleep. **Conclusion:** These findings highlight the need for multidimensional interventions that support both the psychological well-being and physical health of this population.

**Keywords: Depression Scores, Sleep Quality, Chronotype,** **Cardiorespiratory Fitness**

**1. INTRODUCTION**

Depression is a multifactorial disorder that ranks fourth among the leading causes of global burden and represents the leading cause of disability worldwide, according to the World Health Organization (WHO) (1). It is a condition that compromises essential functions of daily life, such as the sleep-wake cycle (2), eating (3), leisure (4), and academic (2) and professional (1) performance. WHO estimates indicate that, in 2019, approximately 280 million people worldwide lived with depression, corresponding to approximately 5% of the adult population (1). Symptoms vary in intensity, from mild to severe, and directly impact the performance of daily activities.

In Brazil, data from the 2019 National Health Survey indicate a prevalence of 10.8% of positive screening for depression (3). The highest incidence occurs among young people aged 18 to 29, the predominant age group among university students, which positions this population as especially vulnerable to depressive disorders, exacerbated by academic and social demands. During the COVID-19 pandemic, a systematic review and meta-analysis of 130 articles from around the world revealed that combined prevalence estimates showed that 45% of medical students have experienced anxiety and 48% have experienced depression (5).

The impacts of depression go beyond the emotional and behavioral realm, also involving biological mechanisms, such as those related to the sleep cycle (6). Evidence shows that individuals with an evening chronotype tend to have more depressive symptoms and worse sleep quality when compared to those with a morning chronotype (7,8). This effect appears to be mediated by factors such as greater rumination before bedtime and lower sleep efficiency (5). Adjustments in the circadian cycle, influenced by genetic and environmental aspects, affect the expression of biological clock genes, responsible for regulating biological rhythms, mood and sleep patterns. Thus, changes in sleep can be a consequence of depressive symptoms or act as an aggravating factor, especially due to the presence of recurrent negative thoughts, self-criticism and, in severe cases, suicidal ideation (9).

The chronotype reflects each individual's biological preference for performing activities at certain times of the day, and is classified as morning, intermediate or evening, with subdivisions that specify this inclination (10). Misalignment between the chronotype and the demands of academic and work schedules favors negative repercussions, such as headaches, insomnia, daytime sleepiness, gastrointestinal discomfort and increased sedentary lifestyle (11). This misalignment has even been associated with decreased performance in elite athletes (12).

External factors, such as inadequate exposure to light, also modulate the sleep-wake cycle (13). Meta-analyses demonstrate that artificial light at night significantly reduces melatonin production (14), impairing circadian rhythms and directly impacting sleep quality (15). Thus, changes in the routine of exposure to light, both natural and artificial, directly affect mental health (16). Moreover, the absence of good quality sleep significantly increases the likelihood of depressive symptoms in this population (17).

Among college students, the combination of long study hours, personal demands, and often work, creates a mismatch between the internal biological clock and social demands. This situation favors the occurrence of sleep disorders, depressive symptoms, and, possibly, reduced cardiorespiratory fitness. Although there are studies that explore these variables in isolation, few analyze, in an integrated manner, the relationship between depressive symptoms, sleep quality, chronotype, and cardiorespiratory fitness in this population. Investigating these connections comprehensively is essential to support care and intervention strategies aimed at the physical and mental well-being of college students.

Given this scenario, the present study aims to analyze the relationship between symptoms of depression, sleep quality, chronotype and cardiorespiratory fitness in university students.

**2. MATERIALS AND METHODS**

This study is characterized as a quantitative, cross-sectional research that aimed to analyze the depression, chronotype, sleep quality and cardiorespiratory fitness scores of university students. A total of 45 questionnaires were collected from students of the Medicine, Nursing and Physiotherapy courses at the University of Gurupi (UnirG), from July 2024 to May 2025. The collection was carried out through an electronic form via Google Forms, consisting of three standardized instruments, in addition to a physical test applied in person to measure cardiorespiratory fitness.

To assess chronotype, the Horne and Östberg (1976) Morningness/Eveningness Questionnaire (10) was used, validated for the Brazilian population by Benedito-Silva et al. (1990) (18). This instrument contains 19 questions that classify individuals into five categories: definitely morning (70–86 points), moderately morning (59–69), indifferent (42–58), moderately evening (31–41) and definitely evening (16–30).

Depression scores were assessed using the Beck Depression Inventory (BDI), which consists of 21 items covering emotional, behavioral and cognitive symptoms associated with depression (19).

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI-BR), which assesses seven components related to sleep efficiency, duration, latency, disturbances, medication use and daytime dysfunctions (20).

For cardiorespiratory fitness, the University of Montreal Track Test (UMTT) was applied, which estimates the maximum oxygen consumption (VO₂max) of the participants. This incremental test starts at a speed of 7 km/h, with an increase of 1 km/h every two minutes, according to the protocol of Léger and Boucher (1980) (21). The last sustained speed determines the Maximum Aerobic Speed ​​(MAV) of the individual. To control the volunteer's pace, a cyclist with a speedometer was imposed (22).

The data were organized in spreadsheets and presented in tables, aiming to analyze the relationships between the instrument scores and the results of the cardiorespiratory fitness test. Statistical analyses were performed using SPSS software, version 22. Mean and standard deviation (±SD) were calculated for continuous variables. Data normality was verified by the Kolmogorov-Smirnov test with Lilliefors correction. For correlation analysis, Pearson's coefficient was used for normally distributed variables and Spearman's for those with nonparametric distribution. The significance level adopted was p<0.05.

**3. RESULTS**

The results show that most students are young, have adequate nutritional status, but have a high prevalence of depressive symptoms, poor sleep quality and low cardiorespiratory fitness. In addition, a significant negative correlation was identified between depressive symptoms and sleep quality.

Table 1 describes the sociodemographic characteristics of the 45 participants. The sample is composed mainly of men (66.7%), aged between 18 and 41 years, with 82.2% being in the 18-24 age range, which reflects the predominant age profile in higher education.

Regarding the courses, the majority of participants are from the Medicine course (82%), followed by the Nursing and Physiotherapy courses. Regarding the academic period, there is a greater concentration in the 4th period (31.1%), indicating a predominance of students in the intermediate phase of graduation.

**TABLE 1 – Sociodemographic Characteristics of the Students Participating in the Research.**

|  |  |  |
| --- | --- | --- |
| **VARIABLE** | **N** | **%** |
| **Gender** |  |  |
| Masculine | 30 | 66.7 |
| Feminine | 15 | 33.3 |
|  |  |  |
| **Age** |  |  |
| 18 to 24 years old | 37 | 82.2 |
| 25 or older | 8 | 17.8 |
|  |  |  |
| **Course** |  |  |
| Medicine | 37 | 82.2 |
| Nursing | 5 | 11.1 |
| Physiotherapy | 3 | 6.7 |
|  |  |  |
| **Graduation period** | |  |
| 1st | 9 | 20.0 |
| 2nd | 4 | 8.9 |
| 3rd | 6 | 13.3 |
| 4th | 14 | 31,1 |
| 5th | 3 | 6.7 |
| 6th | 2 | 4.4 |
| 7th | 3 | 6.7 |
| 8th | 2 | 4.4 |
| 9th | 0 | 0.0 |
| 10th | 0 | 0.0 |
| 11th | 0 | 0.0 |
| 12th | 2 | 4.4 |

Regarding the Body Mass Index (BMI), presented in Table 2, most participants had a weight within the normal range (55.6%), while 31.1% were overweight. The average BMI was 24.1 ± 3.7 kg/m², which indicates that most of the students remain within the parameters considered healthy. However, a relevant proportion is overweight.

**Table 2 – Distribution of participants according to Body Mass Index (BMI).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Body Mass Index** | | **N** | | **%** | |
| Low weight | 3 | | 6.7 | |
| Normal weight | 25 | | 55.6 | |
| Overweight | 14 | | 31.1 | |
| Obesity | 3 | | 6.7 | |

Regarding symptoms of depression, assessed by the Beck Depression Inventory (Table 3), 53.3% of the students did not present depressed mood. On the other hand, 46.7% were classified as having some degree of depression, 35.6% with mild to moderate depression and 11.1% with moderate to severe depression. These results indicate a significant proportion of students with depressive symptoms, which deserves attention, especially since they are young adults in a university environment, often exposed to high levels of stress.

**Table 3 – Classification of depression symptoms among university students.**

|  |  |  |
| --- | --- | --- |
| **CLASSIFICATION** | **N** | **%** |
| Individual is not depressed | 24 | 53.3 |
| Mild to moderate depression | 16 | 35.6 |
| Moderate to severe depression | 5 | 11.1 |
| Severe | 0 | 0.0 |

The assessment of sleep quality using the Pittsburgh Sleep Quality Index (Table 4) indicated that 75.5% of the students had poor sleep quality. Of this total, 62.2% reported poor sleep and 13.3% reported sleep disorders. Interestingly, when analyzing the specific components of the index, the majority classified their subjective sleep quality as good (57.8%) or very good (22.2%).

Sleep latency between 16 and 30 minutes was reported by 42.2% of participants. Regarding duration, 46.7% reported sleeping more than seven hours per night. Sleep efficiency was predominantly between 75% and 84% (60.0%). In addition, 68.9% did not report frequent sleep disturbances and 82.2% never used sleeping medications. However, 44.4% reported some degree of daytime dysfunction, with difficulty staying awake during the day, although this occurred with low frequency.

These data reveal a complex picture: although many participants perceive their sleep as satisfactory, objective indicators show a significant impairment in sleep quality.

**Table 4 – Sleep quality among college students according to the Pittsburgh Sleep Quality Index.**

|  |  |  |
| --- | --- | --- |
| **CATEGORIES** | **N** | **%** |
| **SOMA PSQI** |  |  |
| Good | 11 | 24.4 |
| Roomy | 28 | 62.2 |
| Disorder | 6 | 13.3 |
|  |  |  |
| **Subjective Sleep Quality** |  |  |
| Very good | 10 | 22.2 |
| Good | 26 | 57.8 |
| Roomy | 8 | 17.8 |
| Very bad | 1 | 2.2 |
|  |  |  |
| **Sleep Latency** | | |
| *There is no time to hang* |  |  |
| < or + 15 minutes | 11 | 24.4 |
| 16 to 30 minutes | 19 | 42.2 |
| 31 to 60 minutes | 14 | 31.1 |
| > 60 minutes | 1 | 2.2 |
|  |  |  |
| **Sleep duration** |  |  |
| > 7 hours | 21 | 46.7 |
| 6 to 7 hours | 10 | 22.2 |
| 5 to 6 hours | 9 | 20.0 |
| < 5 hours | 5 | 11.1 |
|  | | |
| **Habitual sleep efficiency** | |  |
| > 85% | 1 | 2.2 |
| 75 a 84% | 27 | 60.0 |
| 65 a 74% | 16 | 35.6 |
| < 65% | 1 | 2.2 |
|  |  |  |
| **Sleep disorders** |  |  |
| Not once | 31 | 68.9 |
| Less than once/week | 9 | 20.0 |
| 1 to 2 times/week | 4 | 8.9 |
| 3 times/week or more | 1 | 2.2 |
|  |  |  |
| **Use of sleeping medication** | |  |
| Not once | 37 | 82.2 |
| Less than once/week | 5 | 11.1 |
| 1 to 2 times/week | 2 | 4.4 |
| 3 times/week or more | 1 | 2.2 |
|  |  |  |
| **Dysfunction during the day** | | |
| *Difficulty staying awake in the past month* |  |  |
| Not once | 7 | 15.6 |
| Less than once/week | 20 | 44.4 |
| 1 to 2 times/week | 17 | 37.8 |
| 3 times/week or more | 1 | 2.2 |

The assessment of students' cardiorespiratory fitness, carried out using the UMTT Track Running Test, revealed that most participants were classified as having average performance (40.0%), followed by poor performance (37.8%). Lower percentages were observed in the good (15.6%) and very good (6.7%) classifications, indicating a predominance of lower levels of cardiorespiratory fitness among the students evaluated, as shown in Table 5. This predominance of low classifications suggests a possible lack of regular practice of aerobic physical activity among students, which may negatively impact their general health and psychological well-being.

**Table 5 – Classification of students’ cardiorespiratory fitness according to the UMTT Track test.**

|  |  |  |
| --- | --- | --- |
| **CLASSIFICATION** | **N** | **%** |
| Weak | 17 | 37.8 |
| Regular | 18 | 40.0 |
| Good | 8 | 17.8 |
| Excellent | 2 | 4.4 |

The correlation analysis between depression scores, sleep quality, chronotype and cardiorespiratory fitness of university students revealed a single statistically significant association. A moderate negative correlation was observed between depression scores and sleep quality (r = -0.524; p = 0.0002), indicating that the higher the levels of depressive symptoms, the lower the sleep quality perceived by participants, as shown in Table 6. This finding reinforces the scientific literature that points to a bidirectional relationship between sleep and mental health, especially in contexts of high cognitive and emotional demand, such as university studies.

**Table 6 – Correlation between depression scores, sleep quality, chronotype and cardiorespiratory fitness of university students.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **IMC** | **Chronotype** | **Sleep Quality** | **Depression** |
| **VO2max** | r = 0.0051  p = 0.9734 | r = 0.174  p = 0.253 | r = -0.029  p = 0.8498 | r = 0.0415  p = 0.7867 |
| **Depression** | r = 0.0635  p = 0.6786 | r = 0.2047  p = 0.1772 | **r = -0.524\***  **p = 0.0002** |  |
| **Sleep Quality** | r = 0.0533  p = 0.7282 | r = 0.0647  p = 0.673 |  |  |
| **Chronotype** | r = -0.027  p = 0.8603 |  |  |  |

\*Significant (p<0.05).

**4. DISCUSSION**

The data found in this study reinforce a scenario that has already been widely discussed in the literature about the strong relationship between the evening chronotype, poor sleep quality and increased depressive symptoms in university students. This combination has a direct impact on both mental and physical health, affecting not only well-being but also daily habits and behaviors.

Studies such as that of Zhou et al. (23) show that people with a nighttime chronotype tend to have less healthy routines, including difficulties in maintaining a balanced diet and less physical activity. This, combined with poor sleep quality, contributes to a higher risk of being overweight, obese and having emotional problems. This cycle ends up affecting both mental and physical health, creating a worrying situation, especially in the university context.

In our survey, we observed that, although most students have a Body Mass Index within the range considered normal (55.6%), a significant number are overweight (31.1%) or obese (6.7%). These numbers directly corroborate studies such as that of Castillo et al. (24), which show how poor eating habits and depressive symptoms feed off each other. In other words, people eat worse when they are depressed, and this poor eating pattern, in turn, worsens the depressive condition.

Similar results were found in a study conducted with urban adults in Malaysia, which analyzed the relationship between chronotype, mental health, and eating behaviors (25). Among women, an increase in BMI was associated with both emotional and uncontrolled eating, as well as lower dietary restraint in those with higher depression scores. Among men, BMI was associated only with emotional eating, and higher anxiety scores were linked to uncontrolled eating. The study also observed that men with higher chronotype scores showed greater cognitive restraint and a lower tendency toward uncontrolled eating—an association not observed among women. These findings highlight important sex differences in psychobehavioral profiles.

Regarding mental health, the data is equally alarming. The use of the Beck Depression Inventory (BDI) revealed that almost half of the participants (46.7%) had some degree of depression. Of these, 35.6% had mild to moderate depression and 11.1% had moderate to severe depression. These numbers are consistent with other studies conducted in Brazil and other countries, such as a survey in São Paulo, which found 56% of university students with depressive symptoms (26), and a study in Colombia, which also showed high rates (27).

When we look at sleep, the scenario is not much different. Even though many students subjectively report that they sleep well (57.8% say they sleep well and 22.2% say they sleep very well), the objective data tell a different story. According to the Pittsburgh Sleep Quality Index (PSQI), 75.5% of participants are classified as having poor sleep quality. And this is reflected in their daily lives, with 44.4% reporting drowsiness or difficulty staying awake throughout the day, which harms not only their academic performance, but also their physical and mental health.

This discrepancy between what students think about their sleep and what the data reveal is quite common and has already been observed in other studies, such as that of Primadani et al. (28) in Indonesia, where 86.1% of university students also presented poor quality sleep. Similar results were found in India (29) and in other contexts. Among the main associated factors are excessive use of screens before bed, high academic demands and lack of routine, as pointed out by Javed, Qureshi and Latif (30). All of this ends up affecting not only sleep, but also increasing the risk of stress, anxiety and depression.

Given this situation, it is essential to also look at cardiorespiratory fitness, which, according to the literature, is directly linked to both mental health and sleep quality. Studies show that students with better physical fitness tend to have lower levels of stress and depression and better quality sleep (31, 32). Therefore, when we find some participants with low cardiorespiratory fitness, this cannot be seen in isolation, but rather as part of a cycle that involves poor sleep, unregulated lifestyle habits and mental suffering.

When analyzing the data, we observed a moderate and significant relationship between depressive symptoms and sleep quality (r = -0.524; p = 0.0002). In practice, this shows that the higher the depressive symptoms, the worse the perception of sleep quality tends to be, something already well documented in the literature. This finding becomes even more important when we consider the impact that sleep has on mental health, especially in the university environment.

However, we did not find a significant association between cardiorespiratory fitness and the other variables. This may be related to the small sample size, which compromises statistical power, or even to the small variation in the participants' fitness level. It is also impossible to ignore the influence of individual factors, such as exercise habits or personal characteristics that were not measured. Still, it is important to remember that previous studies have already indicated that both poor sleep quality and higher levels of depressive symptoms can impair physical fitness (32), which reinforces the need to further discuss this issue in future research.

Among the limitations of this study, the lack of a significant correlation between cardiorespiratory fitness and the other variables investigated stands out. This finding may be partly attributed to the small sample size and its low heterogeneity, factors that compromise the statistical power of the analyses, as well as possible limitations in the methodological design adopted. To overcome these barriers, future studies may benefit from the use of factorial designs, as suggested by Oliveira (33), which allow for the testing of interactions between multiple variables, such as sleep quality and physical exercise, even with a smaller number of participants.

Furthermore, there is strong support in the literature that sleep quality is a key factor in the relationship between evening chronotype and depressive symptoms (34,35). People with this profile often have difficulty aligning their biological clock with the demands of the day, which leads to sleep deprivation, constant fatigue and greater emotional vulnerability.

Overall, our findings reinforce that poor sleep, depressive symptoms, and low cardiorespiratory fitness are not isolated problems, but rather part of the same scenario, especially among individuals with an evening chronotype. Therefore, educational institutions need to look at this context more closely. Investing in programs that promote physical activity, stress management, sleep guidance, and psychological support is not only desirable, but essential to take care of students' well-being and academic performance.

**5. CONCLUSION**

The results of this study demonstrate a significant relationship between depressive symptoms, eveningness, and poor sleep quality in college students, indicating that these factors are interconnected and negatively impact mental health, well-being, and academic performance. Although no statistical association with cardiorespiratory fitness was identified, the observed picture reinforces the importance of interventions that promote healthy habits, stress management, and improved sleep quality. Limitations such as the cross-sectional design and the use of subjective instruments suggest the need for future studies with longitudinal designs and objective measures, aiming to broaden the understanding of these interactions. It is concluded that mental health care in the university context should be an institutional priority.

**Ethical Approval and Consent:**

The study was approved by the Research Ethics Committee of the University of Gurupi, under opinion no. 6,900,688, and all participants electronically signed the Free and Informed Consent Form (FICF), in accordance with the principles of the Declaration of Helsinki.

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**Disclaimer (Artificial intelligence)**

The authors declare that generative artificial intelligence technology, specifically **ChatGPT (model GPT-4, developed by OpenAI)**, was used during the writing and revision process of this manuscript.

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