

Association Between COVID-19, Sleep Quality and Sleepiness in Medical Students

Associação Entre COVID-19, Qualidade do Sono e Sonolência em Estudantes de Medicina
Asociación Entre COVID-19, Calidad del Sueño y Somnolencia en Estudiantes de Medicina

RESUMO

Objetivo: Analisar a qualidade do sono e a sonolência de estudantes de medicina de uma universidade privada do Nordeste do Brasil, e associações com a pandemia de covid-19. **Método:** Estudo transversal com questionário virtual contendo o Índice da Qualidade do Sono de Pittsburgh e a Escala de Sonolência de Epworth. Verificou-se a associação entre sonolência e fatores pandêmicos. **Resultado:** Participaram 85 alunos, majoritariamente mulheres e matriculados no quinto período. Apenas 18% apresentaram boa qualidade de sono, enquanto 82% apresentaram qualidade ruim. Quanto à sonolência, 46% exibiram padrão normal, 13% níveis médios e 41% sonolência anormal. Notou-se piora do sono ao longo da graduação. **Conclusão:** A qualidade do sono dos estudantes é predominantemente ruim, com alta sonolência diurna. A pandemia esteve associada a mudanças no padrão sono, sugerindo a necessidade de apoio institucional para a manutenção de hábitos saudáveis.

DESCRIPTORIOS: Qualidade do sono; Educação Médica; COVID-19.

ABSTRACT

Objective: To analyze the sleep quality and sleepiness of medical students at a private university in Northeastern Brazil, and associations with the COVID-19 pandemic. **Method:** Cross-sectional study using a virtual questionnaire containing the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale. The association between sleepiness and pandemic factors was verified. **Result:** 85 students participated, mostly women and enrolled in the fifth period. Only 18% showed good sleep quality, while 82% demonstrated poor quality. Regarding sleepiness, 46% exhibited a normal pattern, 13% had average levels, and 41% had abnormal sleepiness. A worsening of sleep throughout graduation was noted. **Conclusion:** Students' sleep quality is predominantly poor, with high daytime sleepiness. The pandemic was associated with changes in sleep patterns, underscoring the need for institutional support to maintain healthy habits.

DESCRIPTORS: Sleep quality; Medical education; COVID-19.

RESUMEN

Objetivo: Analizar la calidad del sueño y somnolencia de estudiantes de medicina de una universidad privada del Nordeste de Brasil, y asociaciones con la pandemia de covid-19. **Método:** Estudio transversal con cuestionario virtual que incluye el Índice de Calidad del Sueño de Pittsburgh y la Escala de Somnolencia de Epworth. Se verificó la asociación entre la somnolencia y los factores pandémicos. **Resultado:** Participaron 85 alumnos, mayoritariamente mujeres, del quinto período. Solo 18% presentó buena calidad de sueño; el 82% demostró mala calidad. Sobre la somnolencia, el 46% presentó patrón normal, el 13% niveles medios y el 41% somnolencia anormal. Se notó un empeoramiento del sueño durante la graduación. **Conclusión:** La calidad del sueño estudiantil es predominantemente deficiente, con alta somnolencia diurna. La pandemia fue asociada a alteraciones en los patrones de sueño, lo que evidencia la necesidad de apoyo institucional para mantener hábitos saludables.

DESCRIPTORIOS: Calidad del sueño; Educación Médica; COVID-19.

RECEIVED: 03/05/2026 APPROVED: 04/08/2026

How to cite this article: Matos YMT, Duarte LJP, Abreu GL, Melo MCRM, Azevedo MFA, Costa LB. Association Between COVID-19, Sleep Quality And Sleepiness in Medical Students. Saúde Coletiva (Brazilian Edition) [Internet]. 2026 [cited year month day];17(107):19950-19971. Available from: DOI: 10.36489/saudecoletiva.2026v17i107p19950-19971

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INTRODUCTION

Sleep is an essential physiological process for human health, playing a fundamental role in maintaining physical, mental, and emotional well-being. An adequate sleep pattern is directly related to memory consolidation, sensorimotor integration, attention, and various executive cognitive functions^(1,2). Assessing sleep quality is a complex process that encompasses the individual's subjective perception and the impact of nighttime difficulties on their daytime functioning⁽³⁾, and is frequently measured using standardized instruments such as the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS)^(4,5).

Sleep disorders are highly prevalent in contemporary society, with an estimated 30% of the adult population exhibiting some symptom of insomnia⁽⁶⁾. Among undergraduate medical students, however, these rates are considerably higher. Studies indicate that approximately 51% of medical students in the United States have poor sleep quality⁽⁷⁾, while in Brazil, this prevalence may exceed 60%⁽⁸⁾.

Several factors contribute to the vulnerability of this specific population. Notable among these are the extensive course load across all shifts, the overload of content and extracurricular activities—such as academic societies, internships, teaching assistantships, and research projects—the high social and academic pressure to achieve results, and frequent exposure to emotionally

stressful situations^(9,10). Another factor is the high prevalence of mental disorders in this population. A systematic review with meta-analysis, published in 2017, showed that approximately 30% of Brazilian medical students have a depressive disorder⁽¹¹⁾.

This scenario of chronic vulnerability was exacerbated by the COVID-19 pandemic. Social distancing measures and the abrupt transition to remote learning led to behavioral changes, such as increased screen time, which negatively affected sleep architecture⁽¹²⁾. More recently, evidence has pointed not only to the indirect impacts of the pandemic but also to the direct effects of the viral infection. Post-COVID-19 syndrome (or *Long COVID*) has been associated with persistent neurological manifestations, including chronic fatigue, brain fog, and wakefulness disorders, which can persist for months after the acute phase of the disease^(13,14).

Given the need to understand how these multiple variables interact in the daily lives of future physicians, the present study aims to investigate sleep quality and daytime sleepiness among medical students at a private university in northeastern Brazil. Specifically, we seek to analyze differences in sleep patterns across different stages of the program and assess possible associations between these patterns and variables related to the COVID-19 pandemic, such as history of infection and perceived changes in sleep quality.

METHOD

This is an observational, cross-sectional study with a quantitative approach. The target population consisted of medical students regularly enrolled at a private university located in northeastern Brazil. The initial sample size was calculated at 291 students, considering a total population of 1,200 students, with a 95% confidence level and a 5% margin of error. We used the free *online* tool OpenEpi for the calculation. Data collection took place between March and May 2023.

The inclusion criteria were: students of both genders, over 18 years of age, and regularly enrolled in the medical program at the aforementioned institution. Participants who did not complete the questionnaire in full or who did not agree to the Informed Consent Form (ICF) were excluded.

Data collection was conducted remotely using a structured form on the *Google Forms* platform. Participants were recruited through a public call for participants conducted virtually and promoted on social media. The data collection instrument was , consisting of three sections: 1) Sociodemographic profile and lifestyle habits (age, sex, marital status, household income, number of household members, weight, height, physical activity, and questions related to COVID-19 infection and perceived changes in sleep); 2) Pittsburgh Sleep Quality Index (PSQI); and 3) Epworth Sleepiness Scale (ESS).

The Pittsburgh Sleep Quality Index (PSQI) is a validated instrument

that assesses sleep quality over the past month. The PSQI consists of 24 questions, in which sleep is evaluated across seven components: subjective sleep quality, latency, duration, efficiency, related disturbances, medication use, and daytime dysfunction. The PSQI is interpreted based on the score for each of the seven components, which ranges from 0 to 3. The maximum total score, therefore, is 21 points: scores above 10 points indicate a sleep disorder; scores from 6 to 10 points indicate poor sleep quality; and scores from 0 to 5 points indicate good sleep quality. The Portuguese-validated version of the PSQI (PSQI-BR) was used.¹⁵ To reduce *response* time and participant fatigue when faced with a lengthy online questionnaire, we chose to administer an adapted version of the instrument, omitting the items on “pain” and “bad dreams.” The overall score was calculated using the remaining variables, maintaining the classic cutoff point, where scores > 5 indicate poor sleep quality and ≤ 5 indicate good sleep quality.

The Epworth Sleepiness Scale (ESS) is a self-administered questionnaire that assesses the likelihood of dozing off in everyday situations, with scores ranging from 0 (none) to 3 (high likelihood of dozing off). A score above 10 is the cutoff point for identifying individuals with EHS. Scores above 16 indicate severe sleepiness. The final version of the scale in Brazilian Portuguese, known as ESE-BR⁽⁵⁾, was used. We chose to apply a shortened version of the ESE-BR,

consisting of 6 of the 8 original items, excluding the situations “lying down to rest in the afternoon” and “sitting and talking with someone,” as they were considered less applicable to the participants’ academic routine. The internal consistency of the 6-item version was verified by Cronbach’s alpha coefficient (alpha = 0.69), indicating acceptable reliability. Due to this adaptation, the maximum possible score became 18 points (instead of 24). The authors proportionally adjusted the cutoff scores to classify daytime sleepiness into: normal sleep (1 to 6 points), moderate sleepiness (7 to 8 points), and abnormal sleepiness (9 to 16 points).

The data were tabulated using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA), and statistical analysis was performed using Stata software, version 18 (StataCorp LLC, College Station, TX, USA). Categorical variables were described using absolute and relative frequencies. Continuous variables were described by mean and standard deviation (SD) or by median and interquartile range (IQR), depending on the normality of the distribution, assessed using the Shapiro-Wilk test.

For inferential analysis, associations between categorical variables were assessed using Pearson’s chi-square test or Fisher’s exact test (when expected frequencies were less than 5). The comparison of nonparametric continuous variables between two independent groups was performed using the Mann-Whitney test, while the comparison between

three or more groups (course phases) was performed using the Kruskal-Wallis test, followed by Dunn’s post-hoc test with Bonferroni correction. The significance level adopted for all tests was $p < 0.05$.

The study was approved by the Research Ethics Committee (CEP) of the University of Fortaleza, under Opinion No. 5,901,660 and CAAE 67199423.4.0000.5052, in accordance with the guidelines of Resolution No. 466/2012 of the National Health Council.

RESULTS

The final sample consisted of 85 medical students, representing 29.2% of the initially calculated sample size. The mean age of the participants at the time of data collection was 22.2 years (SD = 3.9), ranging from 18 to 39 years. There was a slight predominance of females (52.9%; $n=45$), and the vast majority reported being single (90.6%; $n=77$).

The median family income was 14 minimum wages (IQR 10–20). Regarding anthropometric profile, the mean Body Mass Index (BMI) was 24.3 kg/m² (SD = 3.97), and most students (78.8%; $n=67$) reported engaging in regular physical activity, with a median of 4 times per week. There was a concentration of participants enrolled in the 5th semester of the program (41.2%; $n=35$), as detailed in Table 1.

Table 1. Sociodemographic and lifestyle profile of medical students at a private university. Northeast Brazil, 2023.

	N = 85
Age (years)	22,2 ± 3,9
Gender	
Female	45 (52,9)
Male	40 (47,1)
Marital status	
Married	5 (5,9)
Single	77 (90,6)

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Common-law marriage	3 (3,5)	
Household income (as a whole number, multiple of minimum wages)	14 (10; 20)	
How many people do you live with		
0	4 (4,7)	
1	8 (9,4)	
2	16 (18,8)	
3	22 (25,9)	
4	20 (23,5)	
5	13 (15,3)	
6	2 (2,4)	
What is your height (m)	1,69 ± 0,09	
What is your weight (kg)	69,9 ± 15,9	
Do you engage in physical activity?		
No	18 (21,2)	
Yes	67 (78,8)	
If yes, when do you engage in physical activity?		
Morning	14 (16,5)	
Afternoon	10 (11,8)	
Evening	42 (49,4)	
No record	19 (22,4)	
If yes, how many times a week?		4 (3; 5)
In which semester (term) are you currently enrolled in medical school?		
Semester 1	5 (5,9)	
Semester 2	9 (10,6)	
Semester 3	7 (8,2)	
Semester 4	8 (9,4)	
Semester 5	35 (41,2)	
Semester 6	3 (3,5)	
Semester 7	7 (8,2)	
Semester 8	9 (10,6)	
Internship (semesters 9 through 12)	2 (2,4)	

Source: Prepared by the authors. Categorical data expressed as absolute counts and percentages in parentheses. Quantitative data expressed as mean ± standard deviation or as median and interquartile range in parentheses.

Regarding sleep habits, 42.4% (n=36) of the students reported sleeping 6 hours per night, and 29.4% (n=25) reported sleeping 7 hours per night. The mean latency to sleep onset was 24.9 minutes (SD = 20.5). Subjectively, 51.8% (n=44) rated their sleep quality over the past month as “good,” and 37.6% (n=32) as “poor.” When asked how they rated

their sleep before the pandemic, the majority (42.4%; n=36) considered it “normal,” followed by “good” (18.8%; n=16) and “poor” (17.6%; n=15).

The objective assessment, using the adapted Epworth Sleepiness Scale (ESS), revealed a mean score of 7.5 points (SD = 3.5). The sleepiness pattern was classified as normal in 45.9% (n=39) of the students, while 12.9% (n=11) exhibited moderate sleepiness and 41.2% (n=35) showed abnormal sleepiness.

Among the six situations assessed

by the Epworth Sleepiness Scale, the highest probability of dozing off was reported in the situation “sitting quietly after lunch without alcohol” (mean 1.79; 62.4% reported a moderate or high probability), followed by “ly watching TV” (mean 1.67; 56.5% with moderate or high probability). On the other hand, the situation “in a car stopped in traffic for a few minutes” showed the lowest likelihood of dozing off (mean 0.41; 68.2% reported never dozing off in this situation). The mean overall ESE score

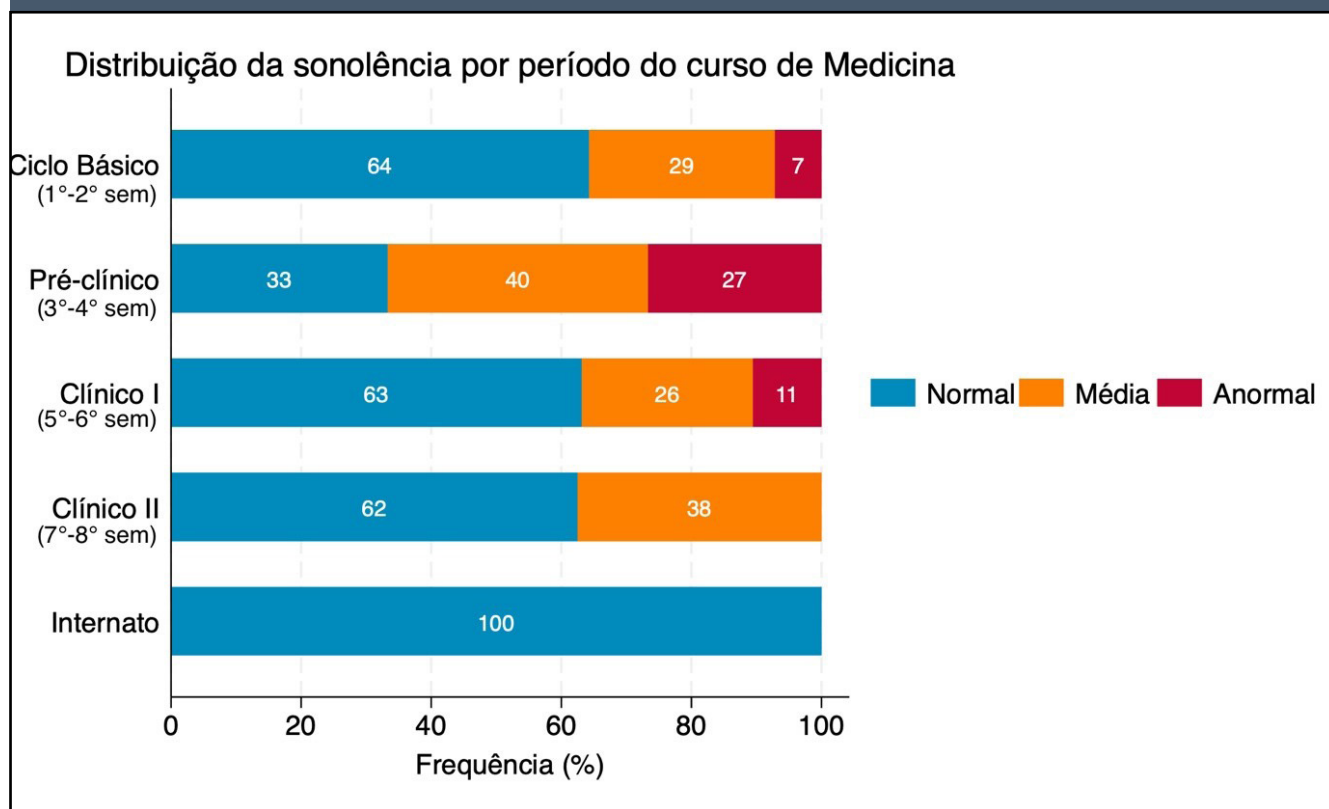
was 7.5 points (SD = 3.5; median = 7.0), ranging from 1 to 16. According to the cut-off points adapted for the 6-item version, 45.9% (n=39) had normal sleepiness, 12.9% (n=11) had moderate sleepiness, and 41.2% (n=35) had abnormal sleepiness

Of the total participants,

42.5% of women and 50% of men had normal sleepiness; 13% of women and 12.5% of men had moderate levels of sleepiness, similar to the 44.5% of women and 37.5% of men who had abnormal sleepiness. Regarding the course period, a higher prevalence of abnormal sleepiness

was observed among students in the 3rd (71.4%) and 4th (62.5%) semesters. First-semester students mostly exhibited moderate sleepiness (60%), while fifth-semester students mostly exhibited normal sleepiness (57.1%) (Figure 1).

Figure 1. Distribution of daytime sleepiness (ESS) according to the stage of the medical school program. Northeast Brazil, 2023.



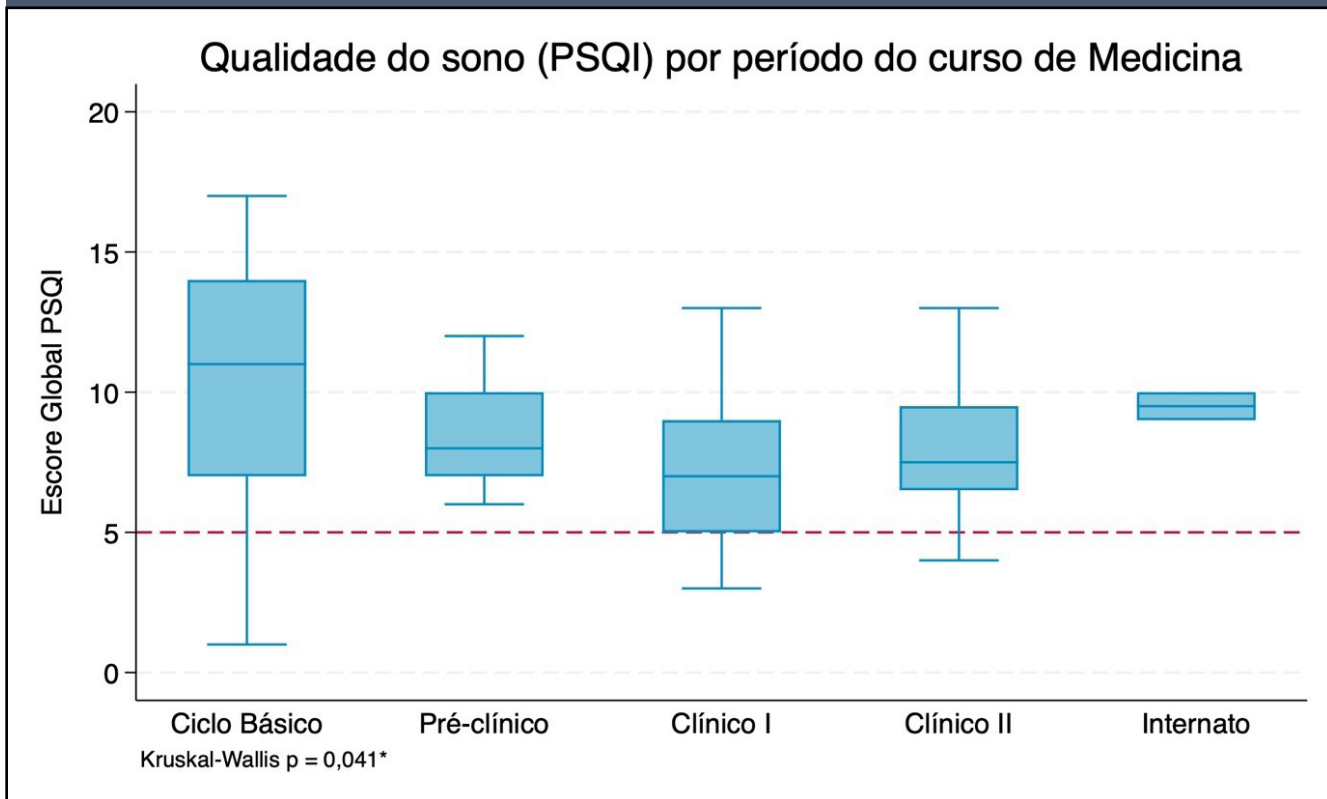
Source: Prepared by the authors.

Analysis of sleep quality using the Pittsburgh Sleep Quality Index (PSQI) showed a mean overall score of 8.0 points (SD = 2.9). Only 17.6% (n=15) of the students reported good sleep quality (score ≤ 5), while 82.4% (n=70) reported poor sleep quality (score >5). Habitual sleep efficiency (Component 4) was, on average, 93% (SD = 10%), indicating that, although overall quality is poor, the proportion of time spent sleeping relative to time in bed remains high.

It was observed that 17.6% of participants had severe sleep disturbances (PSQI total score above 10). Most students go to sleep at 11:00 PM (20%) and wake up at 6:00 AM (25.9%). The median time participants took to fall asleep at night was 15 minutes (IQR: 20). Most (78.8%) participants take up to 30 minutes to fall asleep. Regarding sleep duration (PSQI component 4), 57.6% sleep between 5 and 6 hours per day; 35.3% between 6 and 7 hours; and 4.7% less than 5 hours. In terms of self-percep-

tion (PSQI component 6), 51.8% of participants rated their sleep as good, 37.6% as poor, 7.1% as very good, and 3.5% as very poor. It is noteworthy that 16.47% of participants used medications, whether prescribed or self-administered, at least once a week to help them sleep. Additionally, 17 students reported other reasons for sleep problems (item j of component 10 of the PSQI); of these, 7 reported anxiety. Figure 2 shows the distribution of the PSQI according to the stage of the medical school program.

Figure 2. Sleep quality (PSQI) compared across phases of the medical school program. Northeast Brazil, 2023.



Fonte: Elaborado pelos autores.

Ao comparar a qualidade do sono e a sonolência diurna entre as diferentes fases do curso médico (Tabela 2), o teste de Kruskal-Wallis revelou diferença estatisticamente significati-

va no escore do PSQI ($H = 6,372$; $p = 0,041$). O pós-teste de Dunn indicou que os alunos do ciclo básico (1º e 2º semestres) apresentam escores de PSQI significativamente piores (mediana = 11) do que os alunos do ciclo

clínico (mediana = 7) ($U = 662$; $p = 0,028$). Não houve diferença significativa na sonolência (ESE) entre as fases do curso ($p = 0,709$).

Table 2. Comparison of sleep quality (PSQI) and daytime sleepiness (ESE) scores according to the phase of the medical school program. Northeast Brazil, 2023.

Stage of medical school	n	PSQI Median (IQR)	Poor sleep quality n (%)	ESE Median (IQR)	Abnormal sleepiness n (%)
Basic cycle (1st–2nd)	14	11 (7–14)*	12 (85.7%)	8 (6–10)	5 (35.7%)
Clinical cycle (3rd–8th)	69	7 (6–9)	56 (81.2%)	7 (4–9)	30 (43.5%)
High School (9th–12th)	2	10 (9–10)	2 (100.0%)	6 (6–7)	- (0%)
p-value		0.041	-	0.709	-

Source: Prepared by the authors. Kruskal-Wallis test. * $p < 0.05$ in the comparison between Basic Cycle and Clinical Cycle (Dunn's post-hoc test).

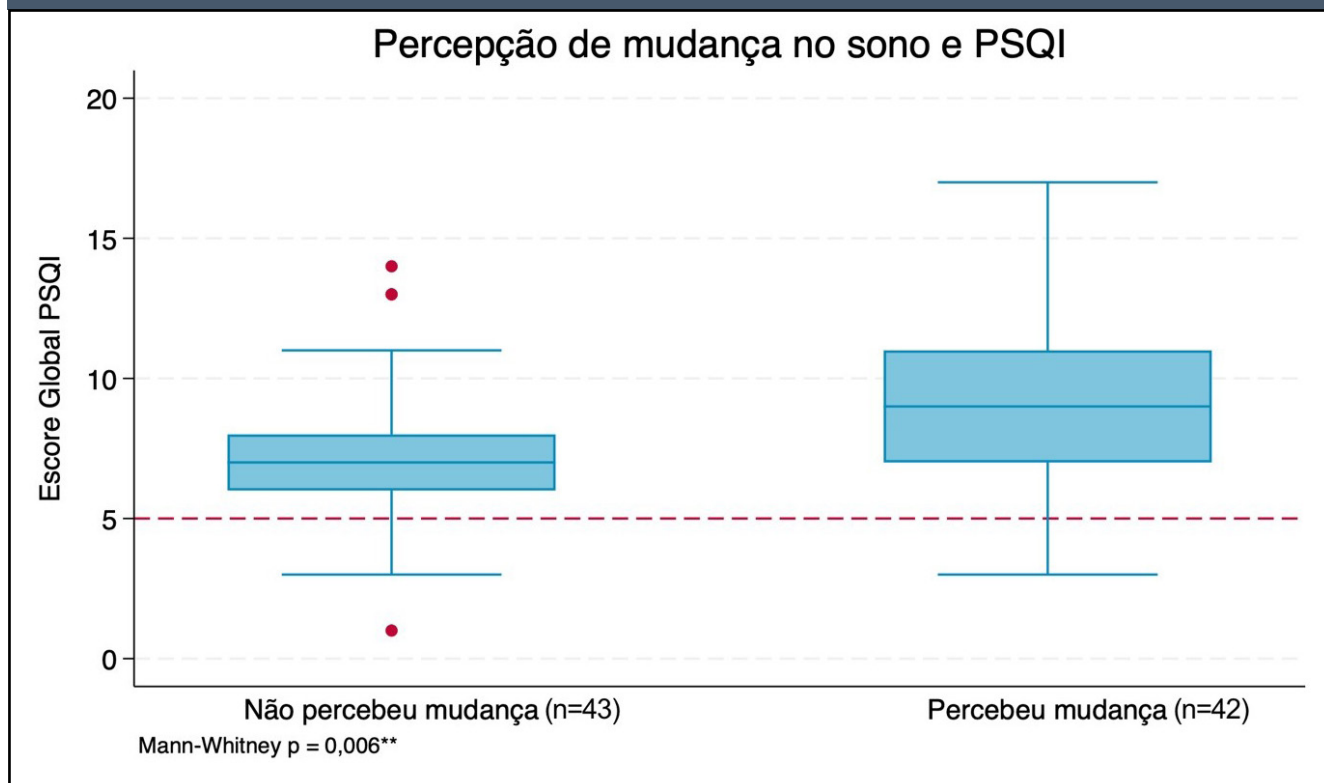
Regarding the pandemic context, 67.1% (n=57) of the students reported having been infected with the virus that causes COVID-19, and 84.7% (n=72) lived with someone who had been infected. An increase in screen time compared to the pre-pandemic period was reported by 75.3% (n=64)

of the sample.

About half of the students (49.4%; n=42) stated that they felt there had been a change in the quality of their sleep following the pandemic period. Statistical analysis confirmed this perception: students who reported a change in sleep after the pandemic

had significantly worse overall PSQI scores (median = 9; IQR 7–11) than those who did not report a change (median = 7; IQR 6–8), as confirmed by the Mann-Whitney test (U = 596; p = 0.006) (Figure 3).

Figure 3. Sleep quality scores (PSQI) according to perceived changes in sleep following the COVID-19 pandemic. Northeast Brazil, 2023.



Source: Prepared by the authors.

Table 3 presents the association, using the chi-square test, between responses to

questions related to the COVID-19 pandemic and the degree of sleepiness measured by the ESE-BR. It is observed that

there was a significant association only between having previously had COVID-19 and abnormal sleepiness (p<0.05).

Table 3. Association between variables related to the COVID-19 pandemic and the degree of daytime sleepiness (ESE). Northeast Brazil, 2023.

	SLEEPINESS			p ^a
	Normal sleep (n=39)	Moderate sleepiness (n=11)	Abnormal sleepiness (n=35)	
How would you rate your sleep before the pandemic?				
Very good	6 (15,4)	3 (27,3)	4 (11,4)	0,844
Good	7 (17,9)	2 (18,2)	7 (20)	
Average	17 (43,6)	3 (27,3)	16 (45,7)	
Poor	6 (15,4)	3 (27,3)	6 (17,1)	
Very poor	3 (7,7)	0 (0)	2 (5,7)	

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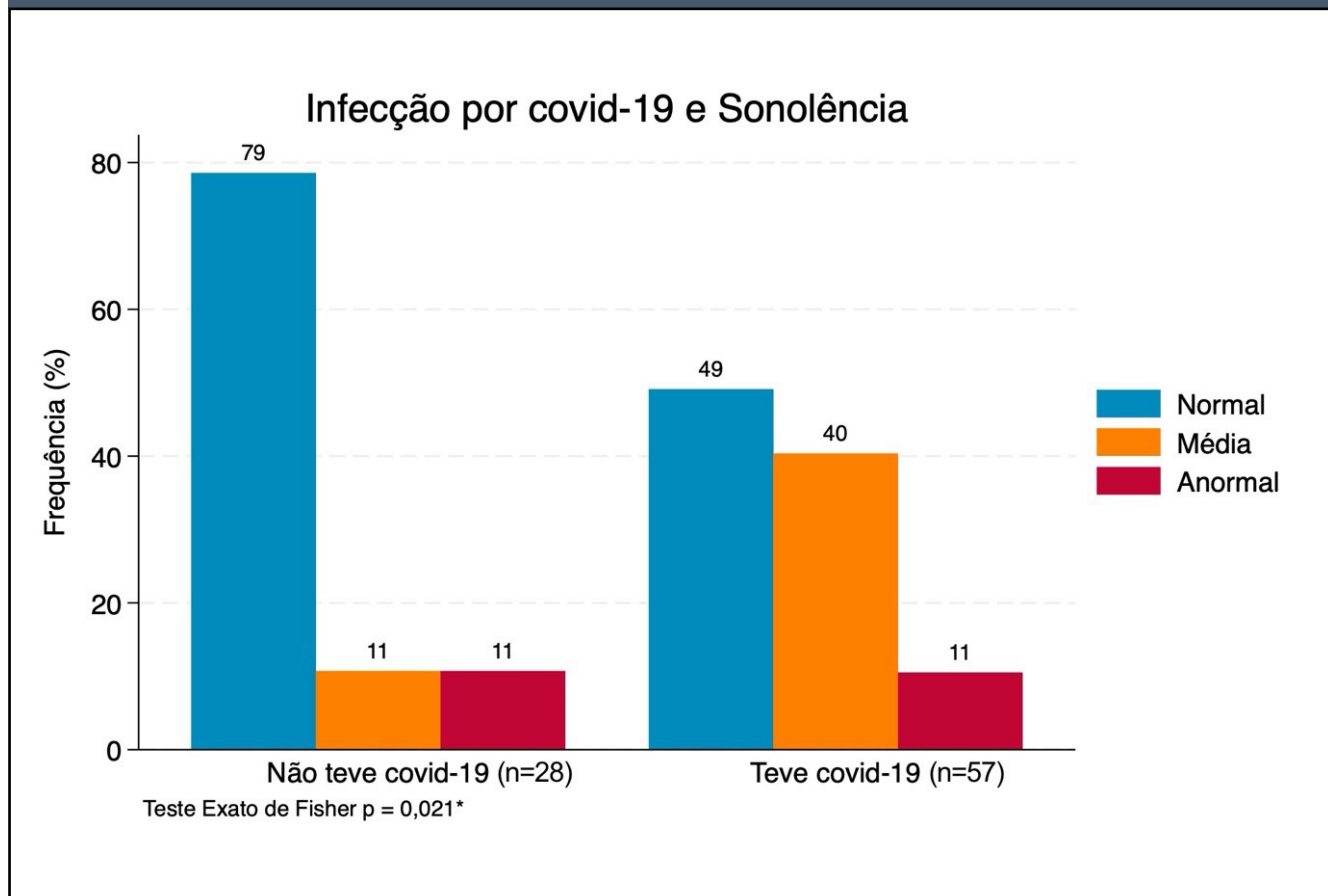
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Do you feel that there has been a change in the quality of your sleep after this period?				
No	22 (56,4)	5 (45,5)	16 (45,7)	0,613
Yes	17 (43,6)	6 (54,5)	19 (54,3)	
Have you ever had COVID-19?				
No	18 (46,2)	4 (36,4)	6 (17,1)	0,029
Yes	21 (53,8)	7 (63,6)	29 (82,9)	
Has anyone living with you been infected with the COVID-19 virus?				
No	6 (15,4)	4 (36,4)	3 (8,6)	0,082
Yes	33 (84,6)	7 (63,6)	32 (91,4)	
Do you feel that your screen time has increased compared to the period before the pandemic?				
No	9 (23,1)	2 (18,2)	5 (14,3)	0,623
Yes	28 (71,8)	9 (81,8)	27 (77,1)	
I don't know	2 (5,1)	0 (0)	3 (8,6)	

Source: Prepared by the authors. *Categorical data expressed as absolute counts and percentages in parentheses. The chi-square test was used.

Figure 4 shows the distribution of daytime sleepiness patterns among those who did and did not have COVID-19.

Figure 4. Distribution of daytime sleepiness (ESE) according to history of COVID-19 infection. Northeast Brazil, 2023.



Source: Prepared by the authors.

Table 4 presents the associations between a history of COVID-19 infection and patterns of sleepiness and sleep quality. Due to the presence of expected frequencies below 5, the sleepiness categories were grouped into Normal vs. Altered for the ap-

plication of Fisher's Exact Test. It was observed that having been infected with COVID-19 () was significantly associated with a higher probability of altered sleepiness (OR = 3.09; $p = 0.021$). There was no significant association between having had

COVID-19 and poor sleep quality as measured by the dichotomized PSQI (OR = 2.04; $p = 0.237$). Increased screen time also had no statistically significant impact on PSQI scores ($p = 0.067$).

Table 4. Association between history of COVID-19 infection, daytime sleepiness (ESE), and sleep quality (PSQI). Northeast Brazil, 2023.

Variable	Had COVID-19 (n=57)	Never had COVID-19 (n=28)	Statistical Test	p
Sleepiness Scale (ESE)				
Normal sleep	21 (36,8%)	18 (64,3%)	Exato de Fisher	0,021*
Altered sleepiness (Moderate/Abnormal)	36 (63,2%)	10 (35,7%)	OR = 3,09	
Sleep Quality (PSQI)				
Good quality (≤ 5)	8 (14,0%)	7 (25,0%)	Exato de Fisher	0,237
Poor quality (> 5)	49 (86,0%)	21 (75%)	OR = 2,04	

Significance level $p < 0.05$.

DISCUSSION

The results of this study indicate a high prevalence of poor sleep quality and excessive daytime sleepiness among medical students, corroborating consistent findings in the national and international literature. The proportion of students with inadequate sleep quality (82.4%) was higher than that described in previous studies conducted in Brazil, which report prevalences between 60% and 75%^(8,19,22), suggesting a possible worsening of the problem in the context investigated or methodological and sampling differences.

The high frequency of abnormal daytime sleepiness observed is also consistent with multicenter studies involving medical students, in which prevalences close to 40% to 50% have been identified⁽⁸⁾. This finding reinforces the hypothesis that chronic sleep deprivation and irregular sleep patterns constitute structural elements of medical education, possibly related to the heavy academic workload, pressure to perform, and the coexistence of multiple extracurricular activities^(9,10).

Analysis by course periods revealed significant differences in sleep quality (PSQI), with students in the basic cycle (1st and 2nd semesters) presenting significantly worse scores than those in the clinical cycle ($p = 0.041$). This finding may reflect the shock of the transition and the difficulty in adapting to the heavy academic workload at the beginning of medical school, differing from studies that identify the internship phase as the period of greatest sleep deprivation^(18,20,21). It is worth noting that there was no statistically significant difference in daytime sleepiness (ESE) between the phases, suggesting that poor nighttime sleep quality affects students generally during the day, regardless of the semester.

The discrepancy observed between the subjective assessment of sleep and the scores obtained by the PSQI is noteworthy. Despite the high proportion of objectively measured poor sleep quality, a significant portion of the participants rated their sleep as good. This finding suggests a possible low perception among students regarding the severity of their own condition, a phenomenon already described in the literature, which may hinder the adop-

tion of self-care behaviors and the pursuit of appropriate interventions^(3,19).

In the context of the COVID-19 pandemic, a notable finding was the significant association between prior infection with the virus and daytime sleepiness. Students who reported having contracted COVID-19 were three times more likely to experience altered sleepiness (OR = 3.09; $p = 0.021$). This result aligns with the growing literature on "Long COVID," whose neurological and systemic manifestations include chronic fatigue, brain fog, and sleep disturbances, which may persist for months after acute infection^(13,14).

In addition, about half of the students reported feeling changes in sleep quality after the pandemic period. Statistical analysis corroborated this self-perception: individuals who reported a change had significantly worse overall PSQI scores ($p = 0.006$) than those who did not notice a change. The increase in screen time, reported by 75.3% of the sample, showed a trend toward association with worse PSQI scores ($p = 0.067$), reinforcing the impact of hyperconnectivity imposed by social isolation and remote learning on sleep architecture^(12,23,24,25).

Physical activity was reported by the majority of participants, predominantly in the evening. Recent evidence suggests that regular physical activity may be associated with improved sleep quality and mood, although its effects vary depending on the intensity and timing of the activity^(16,17). However, the present study did not analytically assess this relationship, which limits the interpretation of the possible protective effect.

This study has important limitations. Notable among these are the smaller-than-estimated sample size and convenience sampling, with a concentration of participants in the 5th semester, which restricts the generalizability of the findings. Furthermore, data collection via self-administered questionnaires is subject to recall bias. Fundamentally, it should be considered that modifications made to the original instruments—such as the exclusion of PSQI items to avoid response fatigue and the use of a 6-item ESE instead of an 8-item version, requiring proportional adjustment of the cutoff scores—impact the direct comparability of the results with oth-

er studies and limit the validity of the standardized measures⁽¹⁵⁾. Finally, the cross-sectional design precludes causal inferences.

Despite these limitations, the findings reinforce the magnitude of sleep disorders among medical students and point to the need for institutional strategies aimed at promoting student health and well-being. Interventions that consider curriculum organization, course load, psycho-pedagogical support, and health education can contribute to improving sleep patterns and, consequently, the academic performance and quality of life of these students.

CONCLUSION

The sleep quality of the medical students investigated was predominantly poor (82.4%), with particular emphasis on students in the basic cycle, who had significantly worse PSQI scores compared to the clinical cycle ($p = 0.041$). Previous COVID-19 infection was associated with a threefold higher risk of altered daytime sleepiness (OR = 3.09; $p = 0.021$), and students who

perceived a change in sleep after the pandemic had poorer sleep quality ($p = 0.006$).

These findings suggest that both the educational phase and the pandemic context may influence sleep patterns in this population, although the cross-sectional design and sampling limitations preclude causal inferences. Modifications to the original instruments (6-item ESE and abbreviated PSQI) also limit direct comparability with other studies.

The results reinforce the need for institutional attention to students' sleep health through strategies that consider curriculum organization, psycho-pedagogical support, and the promotion of healthy habits, especially in the early semesters of the program.

We recommend conducting longitudinal studies with representative samples and fully validated instruments to deepen our understanding of the factors associated with sleep disorders in medical students and to assess the long-term impact of the COVID-19 pandemic on this population.

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