Impact of Morningness-Eveningness Chronotype on Sleep Quality and Test Anxiety Levels among Medical Students at Ahvaz Jundishapur University of Medical Sciences

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Abstract

Background: Circadian rhythms determine individual chronotypes as morning, evening, or intermediate. Evidence shows evening types are more susceptible to sleep disorders and higher levels of anxiety. Sleep quality and test anxiety are issues associated exams' failure.

Objectives: The study aimed to investigate the impact of chronotypes on sleep quality and test anxiety, taking into account the established relationship between general and test anxiety.

Methods: The study included medical students at Ahvaz Jundishapur University of Medical Sciences, who were assessed using demographic information and questionnaires to evaluate test anxiety, morningness-eveningness patterns, and sleep quality. The questionnaires were translated into Persian, and their validity and reliability were previously verified. Significance level was P < 0.05.

Results: The results revealed 23 morning-type, 126 intermediate, and 74 evening-type participants. Regarding sleep quality, 197 participants reported poor sleep, while 26 reported good sleep. The mean test anxiety was 44.13 ± 10.67. Male students exhibited significantly higher test anxiety compared to female students (P =0.041). Test anxiety varied significantly across the chronotype groups (P =0.009). A significant inverse correlation was observed between sleep quality and test anxiety (r =-0.342, p<0.05). This relationship may differ by chronotype, indicating the need to consider individual characteristics in sleep interventions.

Conclusion: Our findings indicated that morning types had higher levels of test anxiety, likely due to incongruence with afternoon exam schedules. Tailoring examination schedules and class timings to accommodate diverse chronotypes highlights the importance of evening courses and adjustments to enhance well-being and academic performance, despite logistical challenges persisting.

Keywords: Moringness-Eveningness Preference; Anxiety; Sleep Quality; Students; Education

Background

Human behavior is significantly influenced by circadian rhythms, resulting in distinct chronotypes. Morning-type individuals tend to prefer early wake times and sleep periods, accompanied by a corresponding decline in daytime alertness. Evening types exhibit the opposite pattern, favoring later wake and sleep times and experiencing increased alertness in the afternoon and evening. Intermediate chronotypes display a moderate circadian phase alignment, reflecting a balance between these two extremes (1, 2). In humans, dysfunction or misalignment of the circadian clock disrupts the sleep-wake cycle, resulting in various circadian rhythm sleep disorders (3).

Sleep quality has deteriorated among adults and adolescents in recent years. While 'sleep quality' lacks a universal definition, it's generally understood as an individual's satisfaction with their sleep, encompassing sleep duration, continuity, and restorative feeling (4). Critically, short sleep duration—less than 9 hours for

children (6-12), 8 for adolescents (13-18), and 7 for adults (18-60)—affects over 50% of the U.S. population. A survey of university students from 26 countries, categorized by income level, found that the combined prevalence of sleep durations less than 6-8 hours and greater than 9 hours was 39.2% in low-income countries, 46.9% in middle-income countries, and 13.9% in high-income countries (4). Socioeconomic factors, including job requirements, housing conditions, access to healthcare services, and social networks, likely play a role in determining sleep duration among countries with varying income levels (4). Sleep health disparities among adolescents are strongly linked to parental socioeconomic indicators. Low parental income, low-income family socioeconomic status, and low parental education are associated with more sleep disorders among adolescents. Lower education levels predict an increased risk of sleep disorders in adults. Low socioeconomic status is associated with high sleep disorders in adults and the elderly. Low income and full-time employment were significantly associated with short sleep among adults and the elderly. As a result, sleep health should be an important public health goal (5).

Studies have reported that poor sleep quality is prevalent among students, affecting over half of the student population (6, 7). Low sleep quality has thus become a significant issue among students (4, 6-8). A confluence of factors contributes to the high prevalence of sleep problems among university students. Academic and social demands, irregular schedules, active social engagement, and the unfettered autonomy of university life, which can promote unhealthy behaviors such as smoking, collectively undermine sleep quality and lead to sleep disorders (4). Factors contributing to reduced sleep quality in students include caffeine consumption, mobile phone addiction, and anxiety (4). Evening chronotypes exhibit greater sleep debt and daytime sleepiness than morning chronotypes, reflecting their increased susceptibility to sleep problems (9). Previous evidence indicates that evening chronotypes exhibit a higher prevalence of unhealthy behaviors, including increased smoking rates, poorer dietary habits, and delayed bedtimes (10). Furthermore, there is a correlation between individuals with different chronotypes and the severity of depression (11).

Attending university can be a full-time stressor for many students, as the healthcare needs of college students have increased dramatically. Young people and students frequently experience sleep disturbances,

which research indicates are strongly correlated with poor mental health (12-14). Anxiety symptoms are prevalent among university students, exhibiting a reciprocal relationship with sleep quality (15, 16). Anxiety has been reported as a factor that affects the sleep-wake cycle, and it appears that university schedules and academic demands contribute to sleep-wake cycle irregularity, which, in turn, may elevate anxiety levels. While low to moderate anxiety can enhance cognitive function, elevated anxiety negatively impacts attention, memory, and problem-solving. Furthermore, a significant correlation exists between sleep disturbances, including abnormal daytime sleepiness and inadequate total sleep hours, and diminished academic performance. Consequently, prioritizing sleep quality and anxiety management is crucial for students' optimal physical, mental, and emotional well-being (17).

Test anxiety is one of the educational challenges that many students find difficult to cope with, which can lead to failure in exams (18). Test anxiety in students is characterized by anxious behaviors that result from procrastination, ineffective study, and a lack of necessary skills to take the exam. This anxiety can be a serious obstacle to students' educational success (19). Test anxiety is a set of emotions accompanied by worry and fear, dissatisfaction with personal thoughts, and physical symptoms that occur during exams. It can be problematic for a large number of students and can have negative effects on the academic abilities of many people who suffer from it (20, 21).

Contributing factors to test anxiety include inadequate preparation, situational discomfort despite content mastery, or misconceptions regarding test-taking strategies (22). A previous study showed that students who experience test anxiety perceive tests as threats, triggering task-irrelevant thoughts and negative emotions such as fear, helplessness, and anticipated failure (22).

Chronotype may influence the relationship between sleep quality and anxiety because individuals whose time preference did not align with their class schedule experienced lower sleep quality and higher anxiety (17). Consequently, test anxiety can hinder the performance of otherwise capable students (22).

Although previous studies have examined general anxiety and sleep patterns in college students, few have specifically examined the predictors and consequences of test anxiety in relation to students' chronotypes. This gap highlights the need for research that examines

differences in test-related anxiety among students with different chronotypes. Therefore, we examined the prevalence of test anxiety, sleep quality, and chronotype (Morningness-Eveningness) among medical students at Ahvaz Jundishapur University of Medical Sciences, and explored the interrelationships between these variables.

Objectives

The study aimed to investigate the impact of chronotypes on sleep quality and test anxiety, taking into account the established relationship between general and test anxiety.

Methods

This descriptive-analytical study involved 223 medical students in their first to fourth semesters (academic year 2023-2024) at the School of Medicine, Ahvaz Jundishapur University of Medical Sciences (AJUMS). The sample size was calculated using the formula ($\bar{x}_1$=39.31, $\bar{x}_2$=42.84, s_1=9.58, s_2=7.41, α=0.05, β=. 0.2) for comparing two means, based on the results of Issazadegan et al. (2011) (23). In their study, the mean and standard deviation of anxiety scores were reported as 39.31 ± 9.58 for morning-type students and 42.84 ± 7.41 for evening-type students. Considering a significance level of α = 0.05 and a statistical power of 80% (β = 0.20), the required sample size for each group was estimated. After accounting for potential attrition, the final sample size was determined (23).

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}}+Z_{1-\beta}\right)^2(\delta_1^2+\delta_2^2)}{(\mu_1-\mu_2)^2}$$

Participants were included if they provided voluntary consent and reported no history of mental illness or current use of psychotropic medications. Informed consent was obtained following a thorough explanation of the study and assurance of data confidentiality. With the endorsement of the Vice-Chancellor for Research, as evidenced by a letter of introduction, and the active participation of officials from the Faculty of Medicine, data collection commenced. Participation was voluntary, and all data were collected anonymously and kept confidential. Participants whose questionnaires were considered incomplete were excluded from the study. A questionnaire was defined as incomplete if more than 10% of the total items were missing or if any of the key scales, including the anxiety and circadian typology scales, were not fully completed. The following

instruments were used to collect the data: 1) a demographic information form (gender, age), and 2) standardized questionnaires measuring test anxiety, Morningness-Eveningness (Horne and Östberg, 1976), and sleep quality.

The questionnaires were made available to students through the Porsline online system. The Morningness-Eveningness Questionnaire (Horne and Östberg, 1976), comprising 19 items, was employed to assess participants' circadian typology. The internal consistency of the questionnaire, as measured by Cronbach's alpha, was 0.77, which is considered acceptable. Recognized for its high validity across numerous studies, it is considered a leading instrument in this domain. Scores ranged from 16 to 86, where higher scores represented a stronger morning preference and lower scores a stronger evening preference (24).

The Pittsburgh Sleep Quality Index (PSQI) was used to assess the sleep quality of the students. PSQI evaluates seven components of sleep, each scored from 0 (no problem) to 3 (severe problem). The sum of these component scores yields a global score, where higher scores indicate poorer sleep quality. A cutoff score of 5 was used to categorize participants, with scores above 5 denoting poor sleep quality and scores below 5 denoting good sleep quality. The PSQI demonstrated strong internal consistency, with a Cronbach's alpha of 0.83 (25).

Test anxiety was assessed by the Friedman and Jacob Test Anxiety Questionnaire. It consists of 23 questions and aims to measure various dimensions of test anxiety. The response spectrum is of the Likert type. The reliability of the questionnaire, as measured by Cronbach's alpha, was 0.91 (26). The questionnaire was administered to students at the end of the term, three weeks before examinations (27). The face validity and reliability of the questionnaires were calculated and confirmed in previous studies on Iranian samples after translation (28-30).

Statistical Analysis: The normality of data distribution was assessed by the Kolmogorov-Smirnov test. As the variables did not conform to a normal distribution, non-parametric tests, including the Chi-Square and Kruskal-Wallis tests, were employed to examine relationships between variables. To examine the linear association between PSQI and test anxiety scores, Spearman's correlation coefficient was employed. The results were indicated as means±standard deviation (SD). All analyses were done in SPSS version 23 at a significance level of p < 0.05.

Results

The study population consisted of 223 medical students, comprising 114 males (51.1%) and 109 females (48.9%). The age of participants varied from 18 to 33 years (mean age: 21 ± 2.74 years). The mean Morningness-Eveningness score was 46.84 ± 9.69. The circadian preference distribution revealed that 23 students (10.3%) had a morning pattern, 126 students (56.5%) had an intermediate pattern, and 74 students (33.2%) had an evening pattern. The most frequent circadian rhythm pattern observed among the students was the intermediate pattern, with 67 female (61.5%) and 59 male students (51.8%) having this pattern. The Morningness-Eveningness pattern in medical students at Ahvaz Jundishapur University of Medical Sciences did not show a statistically significant difference based on student gender (P =0.309).

The mean sleep quality score of the students was 9.24 ± 3.10, with scores ranging from 2 to 18. Table 1 presents the scores for the Pittsburgh Sleep Quality components.

Table 1. Mean Sleep Quality Scores

Components of Sleep Quality	Mean (SD)
Sleep Latency	2.55 (1.67)
Sleep Duration	1.55 (1.12)
Sleep Disturbances	1.08 (0.43)
Use of Sleeping Medication	0.33 (0.77)
Daytime Dysfunction	1.14 (0.9)
Sleep Sufficiency	0.74 (1.18)
Global Sleep Quality	1.21 (0.73)
Total Score	9.24

SD: Standard deviation

Based on PSQI categorization, 88.3% (n= 197) of students reported poor sleep quality, while 11.7% (n = 26) showed good sleep quality. Specifically, poor sleep quality was observed in 89.5% (n = 102) of male students and 87.2% (n = 95) of female students. Sleep quality did not differ significantly across morning, intermediate, and evening circadian preference groups (P = 0.0827) (Table 2).

Participants were nearly equally divided into high (n=111, 49.8%) and low (n=112, 50.2%) test anxiety categories. The overall mean test anxiety score was

44.13 ± 10.67. Male students exhibited a significantly higher mean test anxiety score (45.55 ± 11.42) compared to female students (42.65 ± 9.66; P = 0.041) (Table 3).

Table 2. Differences in Student Sleep Quality Based on Morningness-Eveningness Chronotype

Morningness-Eveningness Chronotype	Poor Sleep Quality Frequency (Percentage)	Good Sleep Quality Frequency (Percentage)	P value
Morning Chronotype	21 (91.3%)	2 (8.7%)	0.827
Intermediate Chronotype	110 (87.3%)	16 (12.7%)	
Evening Chronotype	66 (89.2%)	8 (10.8%)	
Total	197	26	

Table 3. Mean Test Anxiety Scores of Medical Students Based on Gender

Gender	Number	Mean (SD)	P value
Female	109	42.65 (9066)	0.041
Male	114	45.55 (11.42)	
Total	223		

SD: Standard deviation

Differences in test anxiety scores across morning, intermediate, and evening circadian preference groups were assessed using the Kruskal-Wallis test. The mean test anxiety level showed a statistically significant difference among students with morning, evening, and intermediate patterns (H-value=9.32, P =0.009) (Table 4).

Table 4. Mean Test Anxiety Scores of Medical Students Based on Morningness-Eveningness Chronotype

Gender	Number	Mean (SD)	P value
Morning	23	50.69 (9.89)	0.009
Intermediate	126	43.65 (10.93)	
Evening	74	42.91 (42.91)	
Total	223		

SD: Standard deviation

There was a significant difference between morning and intermediate students (Test statistic = 41.33, P =0.014) and between morning and evening students (Test statistic= 45.517, P =0.009) (Table 5).

Table 5. Dunn's Post hoc Test Results for Significant Differences between Groups

Morning	Groups	Mean Difference	SD	95% Confidence Interval		Test Statistic	P-value
				Lower Bound	Upper Bound		
	Intermediate	7.04	2.37	1.43	12.65	41.33	0.014
	Evening	7.77	2.5	1.87	13.68	45.51	0.009

SD: Standard deviation

To investigate the relationship between sleep quality and test anxiety in medical students at AJUMS, Spearman's correlation coefficient (r =-0.342) was used at an error level of 0.05. Sleep quality had a statistically significant inverse relationship with test anxiety in medical students, meaning that as anxiety increased, students' sleep quality decreased (P =0.001) (Figure 1).
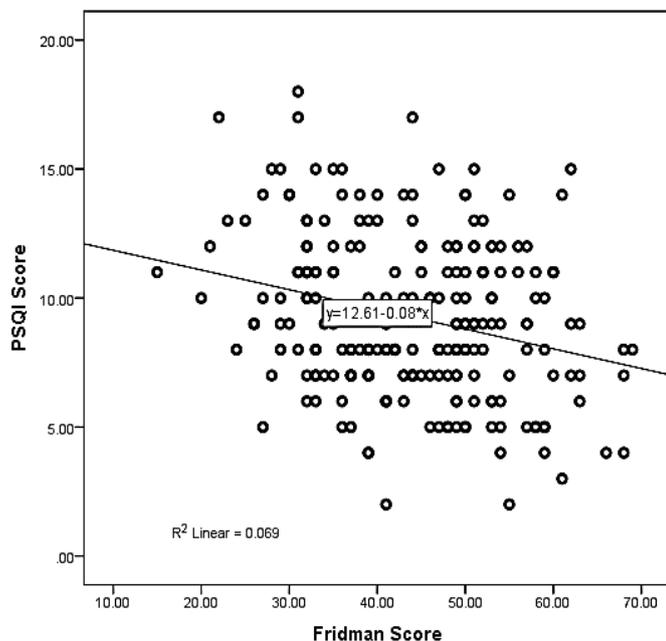

Figure 1. Relationship between Sleep Quality and Test Anxiety

Discussion

Most female (61.5%, n=67) and male (51.8%, n=59) medical students exhibited an intermediate circadian preference. Despite the observed numerical differences, gender had no significant association with Morningness-Eveningness patterns within the student population at AJUMS. Student sleep quality was generally poor, and no significant differences in sleep quality were observed across morning, evening, or intermediate circadian patterns. The study population was nearly evenly distributed between high (49.8%, n=111) and low (50.2%, n=112) test anxiety categories. The overall mean test anxiety score was 44.13 ± 10.67. Significant gender differences were observed in mean test anxiety scores, and scores also varied significantly across morning, intermediate, and evening circadian preference groups. Furthermore, a significant inverse correlation was found between sleep quality and test anxiety among medical students, indicating that higher test anxiety scores were associated with poorer sleep quality. These results indicate that interventions such as sleep hygiene education and stress management help improve students' sleep quality and reduce their anxiety (31).

Furthermore, aligning the timing of classes and exams with students' chronotypes can improve academic performance. Designing and implementing these interventions with gender differences in mind can help promote the mental health and academic performance of medical students (32). Chapell et al. observed an inverse relationship between general anxiety levels (Spielberger) and grade point average (GPA) among undergraduate and graduate students in non-medical fields. Female undergraduate students with low anxiety had higher GPAs compared to female undergraduates with high anxiety. However, male undergraduates with low and high anxiety showed no significant GPA differences. Female graduate students exhibited both higher anxiety and higher GPAs compared to their male counterparts, and a similar pattern was observed among undergraduates (33).

Contrary to the findings of Chapell et al. (33), the present study revealed a higher mean test anxiety score (Friedman and Bandas Jacob) among male students compared to female students. This discrepancy could stem from methodological differences, such as the assessment of test-specific versus general anxiety, cultural field, or variations in the studied academic disciplines. However, aligning with our results, another study reported test anxiety levels among dental students exceeding the average (34).

An interesting finding from the present results was that the mean test anxiety score differed significantly across morning, evening, and intermediate circadian patterns. This significant difference was observed between students with morning and intermediate patterns, as well as between students with morning and evening patterns. Notably, the mean test anxiety score was significantly higher among students with a morning chronotype.

A previous study examining the personality styles of chronotypes reported that both thinking and behavioral styles are associated with Morningness-Eveningness patterns. Specifically, morning individuals are associated with a thinking style that prioritizes trust in direct experience over inference or abstraction, as well as a preference for processing knowledge through logic and analysis rather than emotions and personal values. Therefore, the high test anxiety levels observed in morning chronotype medical students in this study may be attributed to their logical decision-making and behavioral characteristics (33).

Previous studies have shown that personality traits and cognitive styles are related to chronotype, such that

morning-type individuals tend to base their decision-making and information processing on direct experience, logic, and analysis, paying less attention to personal feelings and values (25). Therefore, high test anxiety in morning-type students may stem from their logical behavior and misaligned exam timing (13:00) with their peak cognitive performance. Interventions like stress management and adjusting exam schedules by chronotype may help reduce their anxiety.

Given that examinations at the School of Medicine of AJUMS are scheduled between 12:30 PM and 2:00 PM, the observed higher test anxiety in morning chronotype students may reflect a mismatch between their preferred cognitive performance times and the exam schedule.

In this study, test anxiety was found to be higher in morning-type students compared to intermediate and evening-type students. One possible explanation is that the exams were held between 12:30 and 14:00, which does not align with the peak cognitive performance time for morning-type individuals.

Our data do not provide direct evidence for the role of (logical decision-making style) in explaining this difference. Therefore, we focus on timing mismatch as the most plausible explanation, which aligns with previous research on the impact of circadian rhythm alignment on performance and anxiety. Chronotype studies have shown that morning-type individuals tend to perform best in the early morning, while evening-type individuals perform better in the late afternoon or evening. Therefore, the time of the exam may have contributed to the increased anxiety in morning-type students. These findings have implications for academic planning, suggesting that aligning exam times with students' chronotypes can help reduce test anxiety and optimize performance.

A study at a Brazilian university, where classes started at 7:00 AM, reported higher general anxiety levels in evening chronotype students compared to morning chronotype students (17). This suggests that the timing of academic schedules significantly influences anxiety levels, requiring students to align their biological rhythms with social study cycles. Consequently, the observed higher anxiety in evening chronotype students in that context may result from a desynchronization between their endogenous rhythms and the imposed social schedule (17). Prior research has demonstrated a significant association between chronotype and cognitive performance in student populations. Specifically, individuals tend to exhibit enhanced performance on cognitive tasks, including theoretical and practical assessments, as well as seminar participation, when the timing of these activities aligns with their preferred chronotype (35).

Previous studies have shown that aligning academic activities with students' chronotypes improves performance. A Brazilian study found that evening-type students had more anxiety when classes started at 7:00 AM. These findings highlight the impact of scheduling on anxiety and suggest that future research should investigate adjusted exam times by chronotype. Such interventions could provide a practical solution for reducing chronotype-related anxiety and improving academic performance (17).

This study also assessed student sleep quality, revealing a prevalence of poor sleep among participants.

Our findings showed that 88.3% of medical students have poor sleep quality, which is significantly higher than the rates reported in other regions. Almojali et al. (2017) found that about 57% of medical students had poor sleep quality, citing factors such as lifestyle and academic stress, with a significant association between high stress levels and poor sleep quality. Given the vital role of sleep in cognitive performance, memory consolidation, and mental health, these findings highlight the urgent need for interventions to improve sleep quality among medical students (36).

Notably, we did not find any significant association between sleep quality and Morningness-Eveningness chronotypes. These findings are consistent with Schlarb et al. (37), who also reported low sleep quality in a student population. University students undergo significant life transitions, including leaving home, navigating increased independence and new social environments, and managing academic responsibilities (38). Approximately 90% of university students share living accommodations, and within this group, 41% report nighttime awakenings by noise from their roommates (39). These disruptions, along with the inherent stressors of student life, significantly impact sleep quality. Over half of university students report poor sleep, experiencing issues such as insomnia and nightmares (7, 40). A previous study showed that sleep problems are associated with decreased academic success and lead to lower GPAs (40). Another study found that evening chronotype students had poorer sleep quality and were more prone to psychiatric disorders compared to morning chronotype students (41). A significant finding in this study was the inverse relationship between sleep quality and test anxiety

levels. The significant inverse relationship between sleep quality and test anxiety observed in our study suggests that interventions aimed at improving sleep or reducing anxiety can enhance the overall well-being and academic performance of students. Possible strategies include holding workshops on stress management and anxiety reduction, providing sleep hygiene education and counseling services, and adjusting educational scheduling to accommodate students' chronotypes (42, 43). A study showed that students with poor sleep quality exhibited higher general anxiety levels (44).

Limitations: Some limitations of the present study included a small statistical population due to time constraints, which limited the scope of our conclusions. Moreover, we were unable to examine more diverse samples (students in different levels and fields) and account for several potential confounders of volunteer anxiety, including the impact of academic workload, social isolation, substance use, residential changes, electronic devices, and financial stressors.

In addition to the mentioned limitations, the study's cross-sectional design is also a significant limitation, as it does not allow for the determination of a causal relationship between anxiety and sleep quality. In other words, it is unclear whether anxiety causes poor sleep or poor sleep leads to higher anxiety.

Conclusion

Based on the findings of this study, it is recommended that exam schedules and, to some extent, class timetables be adjusted according to students' different chronotypes. This approach could reduce student anxiety and improve academic performance. Therefore, considering morning and evening preferences as physiological and individual traits is important. Allocating class hours and exam times to cognitive needs during periods that align more closely with students' circadian rhythms, while avoiding challenging classes early in the morning or late in the afternoon, can help reduce anxiety and improve sleep quality. However, implementing such a program in a university setting faces practical constraints and challenges, including coordinating classes and instructors, space limitations, and administrative complexities. Pilot programs, multiple exam sessions, or flexible options could serve as initial steps to assess feasibility and gradually implement this approach. Additionally, incorporating sleep hygiene education and stress management as practical modules into new student orientation programs can raise awareness and promote healthy sleep habits. Ultimately, paying attention to students' chronotypes and morning-evening preferences can guide improvements in academic planning and university management decisions.

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