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Influence of circadian rhythm habit on academic performance and body mass index among the medical students in Qassim University, Saudi Arabia

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ABSTRACT

Objective: Based on the significance of sleep quality on academic performance among medical students, this research was conducted to determine the influence of sleep circadian rhythm categories and their impact on the academic performance of medical students and relationship to body mass index (BMI).

Methods: A cross-sectional self-administered questionnaire was conducted from September to October 2018 at the College of Medicine in Qassim University. The survey was designed to assess their circadian rhythm habit, academic performance and Body mass index (BMI). The circadian rhythm habit was evaluated using the morningness-eveningness questionnaire (MEQ).

Results: The analysis of the BMI with MEQ scores revealed a significant relationship between circadian rhythm habit and BMI (p -value 0.016). The majority of normal weight students fall in intermediate category (71%). Among overweight category 20.5% of the participants fall in moderate evening while 10.3% of the students fall in moderate morning. All the definite morning participant were underweight. There were 126 (62.1%) male students, and 77 (37.9%) female students. For academic performance there were 80 students (39.4%) who had "high" performance, 64 students (31.5%) had "good" performance, 32 students (15.8%) had "normal" performance and 2 students (1%) had "low" performance.

Conclusion: This study revealed several sleep dimensions such as sleep-wake schedules, and individual circadian rhythms characteristics may be associated to the deranged BMI and academic results achieved by university students.

1. Introduction

We all tend to feel the ebb and flow of existence, the daily rhythms that form our days. The foremost basic daily rhythm we tend to live by is the sleep-wake cycle. It is well reported that the daily life routine including learning are well correlated with sleep-dependent memory consolidation¹ and sleep deprivation was found to be one of the major factors responsible for the onset of impaired neurocognitive and psychomotor performance.² Sleep-wake and alternative daily activities are ruled by the body's internal biological clock, housed deep within the brain. Sleep is not only important in providing a buffer by coping with the stress events we face in routine life but it is also vital to maintain our circadian rhythm which is also termed generally as a 'biological clock'. Research findings have reported that the body's biological clock is accountable for quite simply sleep and wakefulness. Alternative systems, like hunger, mental alertness, mood, stress, heart performance, and immunity also operate on a daily rhythm.³ Medical students are prone to be affected by sleep deprivation due to their academic commitments and stressful lifestyle which leads to disturbances in the circadian rhythm leading to negative results on the body's functioning. Studies conducted on the association of disturbed circadian rhythm with health related issues revealed that affected individuals are susceptible to obesity, diabetes type 2 and heart diseases.⁴ Another study conducted by medical students identified a novel cluster of young adults whose educational commitments and manner impacted on their sleep habits mainly causing sleep deprivation.⁵ They found that the continuous educational demand facing medical college students results in an irregular sleep/wake patterns and poor sleep quality, which can successively

have a negative impact on their performance.⁶ Moreover, the daily variation in sleeping time each night due to academic commitments and assignments as well as late sleeping and early waking up to match the college attendance timings also has a negative impact on the 'body clock' resulting in an appalling impact on cognitive function among medical students.⁷

Based on the significance of sleep quality on academic performance among medical students, this research was conducted to determine the influence of sleep on the circadian rhythm and its effect on the academic performance of medical students in college of Medicine, Qassim University.

2. Methods

A cross-sectional self-administered questionnaire was conducted online through the College email from September to October 2018 at the College of Medicine in Qassim University. We targeted both male and female medical students who were from first, second and third year academic classes. All students had the same academic schedule for studying in the medical college, starting at 8 a.m. in morning to 3 p.m. in evening. The total number of students in the first three academic years was 432 students (62% males, 38% Females). We used a stratified random sampling technique, which resulted in a target group of 203 students, with 95% Confidence level. The objectives of the study were explained to the participants, they responded to a self-administered questionnaire.

The survey was designed to assess their circadian rhythm habit, academic performance and BMI (Body mass index). The circadian rhythm habit was evaluated using the morningness-eveningness questionnaire (MEQ).⁸ The morningness-eveningness questionnaire

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was comprised of 19 questions, each with a number of points. Score range from 16-86. Scores of 41 and below indicate "evening types." Scores of 59 and above indicate "morning types." Scores between 42 to 58 indicate "intermediate types". Academic performance was based on the self-reported GPA (grade point average), which is a known method to define academic performance.⁹The academic performance was stratified as high (4.50-5.00), good (GPA 3.75-4.49), normal (GPA 2.75-3.74) and low (2.00-2.74). BMI was categorized as "underweight", "normal weight", "overweight" and "Obese"

The questionnaires were collected from the participants. SPSS V.23 program was used to enter and analyze the data. Categorical variables were expressed as cross tables, and continuous variables were expressed as frequencies ± mean and standard deviation (SD). The chi-square test was used to compare categorical data. The results were considered statistically significant when $p \leq 0.05$. Participation was voluntary, anonymous and unpaid. The study protocol was approved by the college of medicine institutional review board. All procedures were performed only with the consent of the participants and all information was used solely for this research. Those who did not give their consent to participate were excluded.

3. Results

Of the 203 questionnaires distributed, all questionnaires were returned. There was no missing questionnaires. However there were incompleteness with some participant, missing GPA (n=26) and missing BMI (n=23). There were 126 (62.1%) of them male students, and 77 (37.9%) of them female students. the academic performance were 80 students (39.4%) had "high" performance, 64 students (31.5%) had "good" performance, 32 students (15.8%) had "normal" performance and 2 students (1%) had "low" performance. The mean of BMI was 23.9 (SD 5.5). The majority of our population were under intermediate category of morningness-eveningness questionnaire (MEQ) score (Table 1).

Table 1: Demographic characteristics and other study variable

Variables	No. (%)
Sex	
Male	126 (62.1%)
Female	77 (37.9%)
Academic year	
First	71 (35%)
Second	68 (33.5%)
Third	64 (31.5%)
GPA	
High	80 (39.4%)
Good	64 (31.5%)
Normal	32 (15.8%)
Low	2 (1%)
BMI	
Underweight	19 (9.4%)
Normal weight	101 (49.8%)
Overweight	39 (19.2%)
Obesity	23 (11.3%)
MEQ score	
Definite evening	7 (3.4%)
Moderate evening	38 (18.7%)
Intermediate	136 (67%)
Moderate morning	17 (8.4%)
Definite morning	2 (1%)

There was a slight increase in the percentage of students who were obese in third year students compared to first and second year student. The majority of our population were normal weight. While the smallest category in our population were underweight (Figure 1).

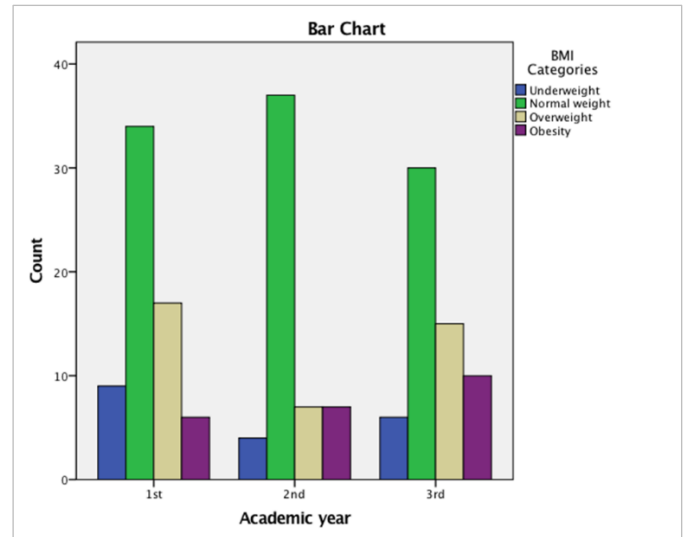


Figure 1: Frequency count distribution of each academic year according to their BMI.

The analysis of the BMI with morningness-eveningness questionnaire (MEQ) scores revealed a significant relationship between circadian rhythm habit and BMI (p -value 0.016). The majority of normal weight students were in the intermediate MEQ category (71%). Among overweight participants, 20.5% were categorized as moderate-evening, while 10.3% were in moderate-morning. All the definite morning participants were underweight. In contrast, in the definite evening category, no one was underweight. The majority of definite evening participants were classified as overweight (50%) (Table 2).

Table 2: Scores * BMI Categories Cross tabulation. Caption: Of 203 participantmissing BMI (n=23). BMI: Body mass index

		BMI Categories				Total	
		Underweight	Normal weight	Overweight	Obesity		
Scores	definite evening	Count	0	2	3	1	6
		% within BMI Categories	0.0%	2.0%	7.7%	4.3%	3.3%
	moderate evening	Count	1	20	8	3	32
		% within BMI Categories	5.6%	20.0%	20.5%	13.0%	17.8%
	intermediate	Count	13	71	24	17	125
		% within BMI Categories	72.2%	71.0%	61.5%	73.9%	69.4%
	moderate morning	Count	2	7	4	2	15
		% within BMI Categories	11.1%	7.0%	10.3%	8.7%	8.3%
	definite morning	Count	2	0	0	0	2
		% within BMI Categories	11.1%	0.0%	0.0%	0.0%	1.1%
Total		Count	18	100	39	23	180
		% within BMI Categories	100.0%	100.0%	100.0%	100.0%	100.0%

The mean BMI of participants was significantly lower in the evening category compared to morning. Those who were definite evening had the highest BMI (mean 25.5), whereas those who were definite morning had the lowest BMI (mean 17.1) (Table 3). The correlation analysis of GPA with MEQ scores revealed that there was no significant relationship (p -value 0.94). However, moderate evening students were more likely to have a high GPA (19%) compared to moderate morning students (7.6%) (Table-4).

Table 3: Mean +/- SD of BMI according to categories of morningness-eveningness (MEQ questionnaire)

MEQ score	BMI	
	Mean	Std. Deviation
definite evening	25.5560	5.74123
moderate evening	23.9511	3.91807
Intermediate	24.1470	6.03735
moderate morning	22.9916	4.35235
definite morning	17.1153	0.65452
Total	23.9793	5.56443

Table 4: MEQ score * GPA Cross tabulation. Caption of 203 participant missing GPA (n = 26). GPA: grade point average

		GPA				Total	
		Low	Normal	Good	High		
Scores	Definite evening	Count	0	2	3	1	6
		% within GPA	0.0%	6.3%	4.7%	1.3%	3.4%
	Moderate evening	Count	0	6	12	15	33
		% within GPA	0.0%	18.8%	18.8%	19.0%	18.6%
	Intermediate	Count	2	22	40	56	120
		% within GPA	100.0%	68.8%	62.5%	70.9%	67.8%
	Moderate morning	Count	0	2	8	6	16
		% within GPA	0.0%	6.3%	12.5%	7.6%	9.0%
	Definite morning	Count	0	0	1	1	2
		% within GPA	0.0%	0.0%	1.6%	1.3%	1.1%
	Total	Count	2	32	64	79	177
		% within GPA	100.0%	100.0%	100.0%	100.0%	100.0%

4. Discussion

Our research was about the comparison of the influence of circadian rhythm habit on academic performance and BMI. BMI is an important tool to detect the healthiness of a person.¹⁰ The simple explanation is that it represents an index of a person's level of obesity. Also, it has been widely identified as a risk factor for the occurrence of, or the prevalence of various health related issues.¹¹ Similarly, sleeping is a normal human behaviour which is essential in restoring our bodies and also for overall performance, especially in cognitive functions including learning and understanding.^{12,13} Sleep deprivation or poor sleep quality not only affect our 'body clock' but also affects the level of our learning. Consequently, student's academic performance gradually declines with sleep deprivation, resulting in poor grades and increases in absenteeism in teaching institutes. In our study, we expected that the majority of students with good academic performance and normal BMI tend to have a non-disturbed circadian rhythm habit. We found a strong significant relationship between BMI and circadian rhythm habit. However, we did not detect any significant relationship between the academic performance and the circadian rhythm habit. This may be due to the teaching strategy used in college of Medicine in Qassim University which is problem based learning. The teaching strategy includes active participation of every student; hence, students gain knowledge by active and passive learning by presenting an academic topic themselves as well as participating in discussion in an interactive session. As a result, students understand basic concepts and fundamentals of the topic.

We found a significant relationship between circadian rhythm and BMI (*p-value* 0.016). The mean BMI of students was highest in evening types decreased across categories to lowest in morning types. Moreover, definite evening students had highest BMI (mean 25.5), whereas definite morning students had the lowest BMI (mean 17.1). The majority of definite evening participants was lower in the overweight category (50%). In our opinion, these findings are likely to be attributable to many factors. One of them is due to the decrease of physical activity. Most probably, the evening person tend to have a more sedentary lifestyle and less social activities. On the other hand, medical students tend to have stressful academic demands which lead to less sleep time hours. Furthermore, among overweight category 20.5% of the participants fell in moderate evening while 10.3% of the students fell in moderate morning. Possibly the evening students were not aware about the effect of disturbed circadian rhythm habit on their lifestyle. However, most of evening students were satisfied with their circadian rhythm habit because their academic performance was higher (Table 4), regardless of the risk of BMI changes. All the definite morning population in our study were underweight. We suggest this surprising finding could be related to low number of students were categorized into definite morning category. However, the majority of

normal weight students were in intermediate category (71%). Maybe this suggests that an intermediate ME category is the healthiest regular circadian rhythm habit.

On the other hand, there was no significant relationship between academic performance and circadian rhythm habit (*p-value* 0.94). These findings are in disagreement with another study conducted at the College of Medicine, King Saud University that revealed that there is significant correlation between academic performance and sleep habit.¹⁴ However, in our study population, we found that moderate evening students were more likely to have a high GPA (19%) compared to moderate morning students (7.6%). This could be due to an increase in study hours in the first group compared to the other group or different teaching strategies. In addition, it could be influenced by the other variables not measured in our study such as daytime activity. Various studies have revealed that changing the sleeping habits for a few days before the exam also showed positive effect on student's grades. Duration of sleep the night prior to an exam was found to be linked with better academic performance as measured by course grades and semester GPA.¹⁴ This finding is in consistent with a study conducted by Medeiros et al. who revealed that sleeping for a longer duration was associated with higher scores achieved in examinations.¹⁵ Sleep deprivation among students is a serious issue and needs more attention from faculty members and administrators of teaching institutes. Besides causing daytime fatigue, poor academic performance and impaired cognitive skills, various studies revealed that sleep deficits results in various health related complications such as diabetes and cardiovascular disease.¹⁶⁻¹⁹

5. Conclusion

This study has demonstrated that there is a significant relationship between circadian rhythm habit and BMI. Disturbed BMI can lead to serious health issues including obesity and cardiovascular disease. Further, more studies are required to determine the influence of circadian rhythm habit on academic performance which include more co-variables such as daytime activity and have larger sample sizes.

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