

The Association of Chronotype with Depressive Symptoms and Sleep Quality in Undergraduate Medical Students

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Abstract:

Background: An individual's natural inclination towards the time of the day, when they prefer to sleep or to be active, can be known by their chronotype. It is important for the circadian rhythm and influences the physical and psychological well-being. Our study focuses on assessing the chronotype and its relationship with depressive symptoms and sleep quality in the undergraduate medical students.

Methodology: It is a cross-sectional study, done in 290 students between 18-25 years of age, studying first and final year MBBS. They completed the Morningness-Eveningness Questionnaire (MEQ), Quick Inventory of Depressive symptomatology (QIDS) and Pittsburgh Sleep Quality Index(PSQI). Individual scores for each scale were taken and compared between both groups. The effect of chronotype and its association with depressive symptoms and sleep quality was assessed in both the groups.

Results: Among first years, 11% had evening-chronotype, 28.7% -moderate, 25.4% -severe depression and 44.5% had significant sleep disturbances. Among final years, 11.8% had evening-chronotype, 34% -moderate, 22.3% -severe depression and 33.3% had significant sleep disturbances. There was a significant negative correlation between chronotype and sleep quality in both groups. No statistically significant difference was found between both groups.

Conclusion: Our study showed that students with evening-chronotype had poorer sleep quality. Although students with evening chronotype scored higher on depressive scale, it was not statistically significant. A prospective study is necessary to understand the temporal relationship of chronotype with sleep and depressive symptoms.

Keywords: Chronotype, Morningness Eveningness Preferences, Depression, Sleep Quality.

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Introduction

All the human beings are endogenously controlled by a circadian clock, which also synchronizes with the external environment in which they live. This circadian clock is necessary for the daily activities and various physiological processes right from gene expressions to the sleep wake cycle.[1] The circadian rhythm is taken from the word 'circadian' in which circa is - about, and diem is - day or 24 hours and, refers to the functions whose cycle is around the 24 hours.[13]

There are individual differences in this circadian clock's synchronization with the environmental rhythm, which occur due to a phenomenon called 'Chronotype'. Chronotype is defined as individual preferences of daily activity and sleep timing

during the day. [1] It is divided broadly into 3 types. They are the morning type, intermediate type and evening type. Of these, the morning type also called the "larks" and the evening type also called the "owls" are considered the extreme types.[2] People with morning type wake up early in the morning and are more active in the morning time, whereas people with evening type will have their peak circadian activity in the later hours of the day.[2]

Chronotype not only explains an individual's preferred time of waking up, falling asleep, or increased physical and intellectual activity, it also gives a reflection of circadian pattern of the person at the psychological, physiological, and

biochemical levels.[14] The factors that commonly determine the chronotype of a person include age, sex, environmental conditions, external conditions, and social aspects. In the recent times, study of chronotype in relation to psychopathology has gained much required attention. A special attention is given particularly to the evening chronotype, as it was reported that evening chronotype is associated with a higher prevalence of depressive symptoms, poor sleep quality and also more prone to use alcohol.[3]

Few studies which have explored the relationship between chronotype and depression stated that, eveningness was significantly associated with depressive symptoms.[4] In a study done on patients diagnosed with Major Depressive Disorder, it was found that those with evening chronotype reported higher suicidal ideation than the morning type.[5] A cross sectional study showed that behavioral activation mediates the relationship between chronotype and depressive symptoms, and that the evening chronotype was associated with lower behavioral activation and consequently more depressive symptoms.[5] Patients with depressive disorders were often reported to have a later chronotype and severe sleep disturbances.[6] A study done in adolescents also revealed that depressive states were comparatively higher in evening chronotype.[7] A recent prospective study done in children and adolescents also showed that, evening chronotype longitudinally predicted increase in depressive symptoms and the onset of a depressive episode during 1 year period, even when the prior depression was controlled.[8] With several evidences proving the link between depression with individual functions of circadian rhythms, it is important to target the risk factors and preventive factors of depression in youth.[9]

Sleep quality refers to the subjective perception of the duration and effectiveness of sleep.[14] Sleep disturbances have been proposed to play a mediating role in the association between eveningness and depressive symptoms. Having an evening chronotype is associated with sleep disturbances, including shorter sleep duration, poorer sleep quality and insufficient sleep.[10] Insufficient sleep in turn also leads to worsened mood and decreased ability to regulate negative emotions.[10] Evening chronotypes also should adapt their sleep preferences to social requirements more than larks. Professional activity also forces them to get up early. In combination with falling asleep late, sleep deficiency is significant.[11] Evening types tend to self-report poor sleep quality.[12]

It is important to determine the possible association of chronotype to prevent the risk of depressive symptoms and poor sleep quality especially in

medical students. It is extremely important because this can also compromise their quality of living, hinder their studies and affect their long-term career goals and can have wide and detrimental consequences on society as a whole. So, the purpose of this study is to find out the influence of chronotype on the depressive symptoms and sleep quality in Undergraduate Medical students.

Aim: To find the association of chronotype with depressive symptoms and sleep quality in undergraduate medical students.

Methodology

Participants and Procedure: The current study is a cross sectional study done in undergraduate medical students of Andhra Medical College. Appropriate permission was taken from the college authority for conducting the present study. Institutional Ethics committee of Andhra Medical College approved the study. Data was collected from a total of 290 undergraduate medical students of age between 18 to 25 years, studying first and final year MBBS in Andhra Medical College, Visakhapatnam. Both males and females were included in the study after explaining the purpose of the study and taking a written and valid informed consent from them. Students with history of any psychiatric illnesses, chronic medical illnesses, any alcohol dependence or known sleep disorders or any recent stressors were excluded from the study. Students with any self-reported use of medications affecting the autonomic physiology like beta-blockers, tricyclic antidepressants, clozapine, thioridazine etc., were also excluded from the study.

146 students of first year MBBS and 144 students of final year MBBS fulfilled the criteria and were enrolled in the study as two groups. The socio-demographic details including name, age, gender and the year of their course were taken with the help of a structured proforma. Then the students were asked to fill the self - reported questionnaires, which include

1. Morningness Eveningness Questionnaire (MEQ- SA): This is a valid and reliable self-assessment questionnaire used widely for the assessment of chronotype. This has 19 questions in total regarding the preferences for activity, sleep, planning the day etc. Each question has a number of points and the total score ranges from 16 to 86. Score below 41 indicates 'evening type', score of 42 to 58 indicates an 'intermediate type' and score above 59 indicates 'morning type'. A further subset of definite morning type and definite evening type is also given if the score is above 70 and below 16 respectively. Internal consistency is high with Cronbach α coefficient=0.83 and high test-retest reliability.

2. Quick Inventory of Depressive Symptomatology

ogy (QIDS-SR 16): This is a 16 item self-report measure scale for the assessment of depressive symptoms. This correlates with the nine DSM-IV symptom criterion domains including: Sleep disturbance (initial, middle, and late insomnia or hypersomnia) (Q1-4), Sad mood (Q5), Decrease/increase in appetite/weight (Q6-9), Concentration (Q10), Self-criticism (Q11), Suicidal ideation (Q12), Interest (Q13), Energy/fatigue (Q14), Psychomotor agitation/retardation (Q15-16). Severity of depression can be judged based on the total score, which ranges from 1 to 27.

The categories given are 1-5 is no depression, 6-10 is mild depression, 11-15 is moderate, 16-20 is severe and 21-27 is very severe depression. Internal consistency for this scale is high with Cronbach's $\alpha=0.86$ and has high concurrent validity and test-retest reliability.

3. Pittsburgh Sleep Quality Index (PQSI) for the sleep quality: This is a self-reported questionnaire that contains a combination of Likert type and opens ended questions, which are then converted to scaled scores using provided guidelines.

Each of the questionnaire's 19 self-reported items belongs to one of seven subcategories: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Scores for each question range from 0 to 3, with higher scores indicating more acute sleep disturbances.

A cut off score of 5 for the global scale was taken

as it correctly identified 88.5% of the patient group in the original validation study, with score of 5 or below 5 indicating good sleep and score above 5 indicating significant sleep disturbances. This scale has an internal reliability of $\alpha=0.83$, a test-retest reliability of 0.85 for the global scale, a sensitivity of 89.6%, and a specificity of 86.5%.

Once the students filled all the questionnaires, individual scores for each scale were taken in both the groups and comparison between the two groups of students was done. The effect of chronotype on depressive symptoms and on sleep quality was analysed in both the groups individually and a comparative analysis between both the groups was done.

Statistical Analysis: Statistical analysis was done using Statistical Package for Social Sciences (SPSS) software version 25.0. Data was expressed as mean (standard deviation) for continuous variables and frequency (percentage) for categorical variables. Chi square test and correlation analysis done.

Results:

Demographic Profile: In our current study, 290 undergraduate medical students of 18 to 25 years were included. Of them 146 (N) were first year students with 43.8% Males and 56.2% Females (table 1), with mean age of 18.6 years and a standard deviation of 0.729 (table 2). There were 144 (N) final year students with 53.4% Males and 46.6% Females (table 1), with mean age of 21.74 years and a standard deviation of 0.939 (table 2).

Table 1: summarizes the gender distribution between both the groups.

Gender	Males	Females	Total
First Year	64(43.8%)	82(56.2%)	146(100%)
Final Year	77(53.4%)	67(46.6%)	144(100%)

Table 2: summarizes the mean age and standard deviation in both groups

Descriptive Statistics (AGE)		
	First Year (N=146)	Final Year (N=144)
Mean	18.60 Years	21.74 Years
Median	18.00	22.00
Std. Deviation	.729	.939
Minimum	18	20
Maximum	21	25

Chronotype Assessment

For the chronotype assessment, a self-assessment questionnaire called the Morningness Eveningness Questionnaire (MEQ-SA) was used. This has 19 questions in total regarding the preferences for activity, sleep, planning the day etc. In our current sample, 11% (n=16) of first year and 11.8% (n=17) of final year students have an Evening chronotype (figure.1) and, 14.4% (n=21) of first year and

17.4% (n=25) of final year students have a Morning chronotype (figure.1). Majority of them have an intermediate type which is the common type seen in general population.

Chi square test was performed to compare the results between the two groups and analysis revealed no significant difference seen in the chronotype and MEQ scores between two groups, with Chi square value of 0.59 and P value of 0.74.

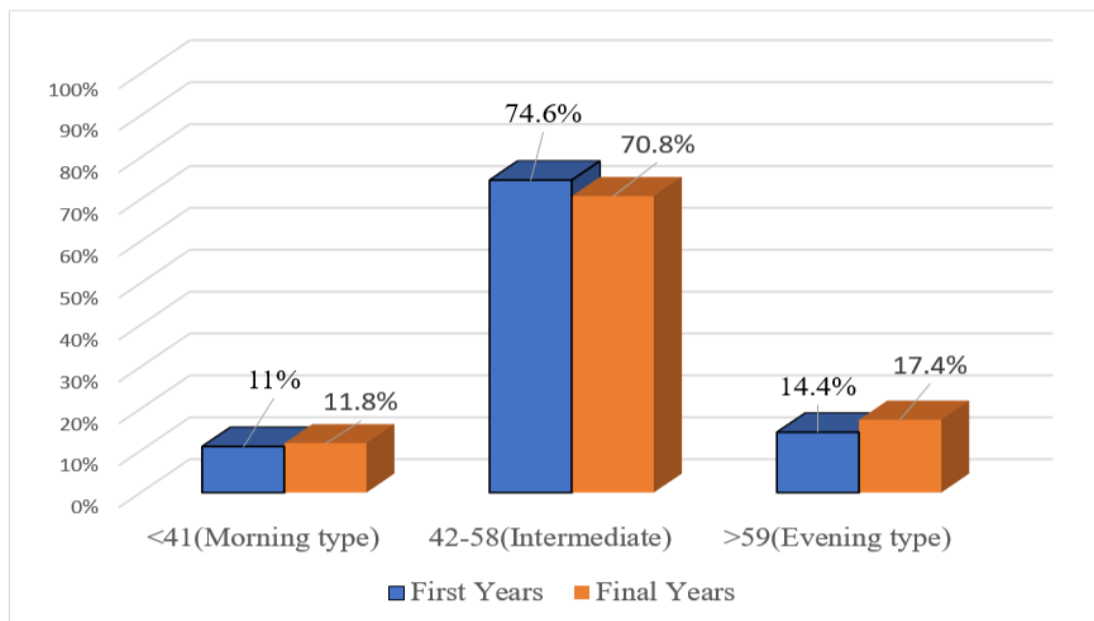


Figure 1: Shows the percentages of students with different chronotypes and no significant difference between the MEQ score in both groups. Chi square = 0.59, df=2, p value=0.74. Mean 1st year- 50.56, Mean final year- 51.14

Depressive Symptoms

To assess the depressive symptoms among the students, a 16 item self-reported questionnaire namely Quick Inventory for Depressive Symptomatology (QIDS-SR16) correlating with the nine symptom domains of DSM IV was used. In the current sample, 45.9% (n=67) of first years and 43.7% (n=63) of final years have no to mild depression, 28.7%

(n=42) of first years and 34% (n=49) of final years have moderate depression. And lastly, 25.4% (n=37) of first years and 22.3% (n=32) of final years (figure 2) have severe to very severe depression.

There was no statistically significant difference in the levels of depression between two groups on performing the analysis with p value of 0.60.

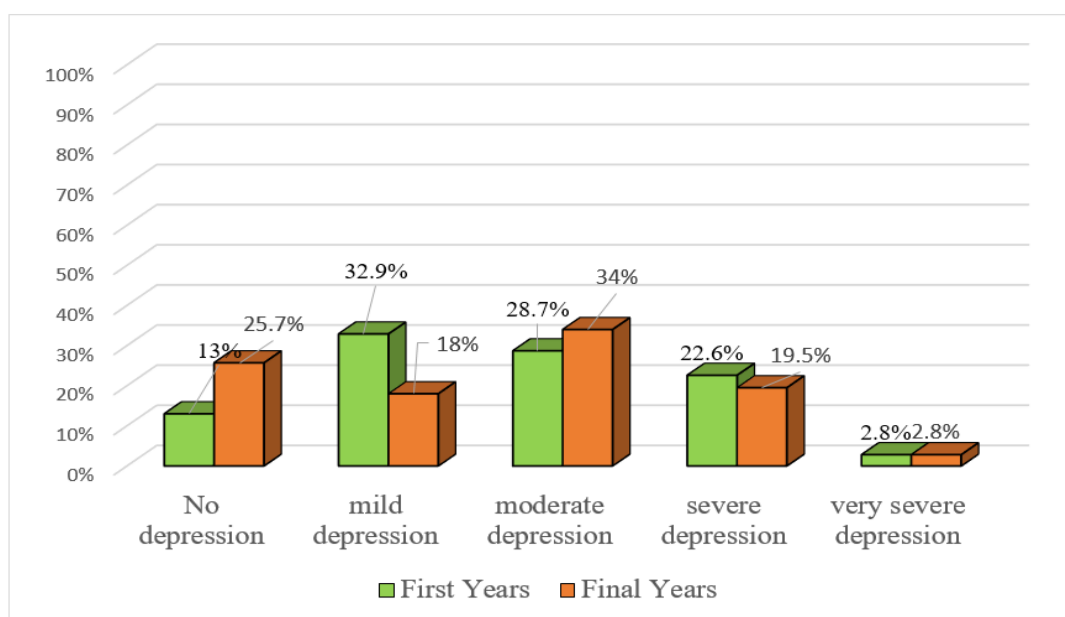


Figure 2: Shows severity of depression in both groups given in percentages, with no statistically significant difference between the levels of depression. Chi square value = 1.010 df = 2 p value = 0.60. Mean 1st year-11.51 Mean final year – 10.85.

Sleep Quality

To understand the sleep quality among the students, Pittsburgh Sleep Quality Index (PQSI) questionnaire was used.

In our study 55.4% (n=81) of first years and 62.7% (n=94) of final years (figure 3) have a score of 5 or below indicating they are good sleepers, 44.7%

(n=65) of first years and 33.3% (n=50) of final year (figure 3) students have a score of above 5 indicating significant sleep disturbances. Chi square test analysis revealed a better sleep quality among final year students compared to first year students but it was not statistically significant.(p value=0.11)

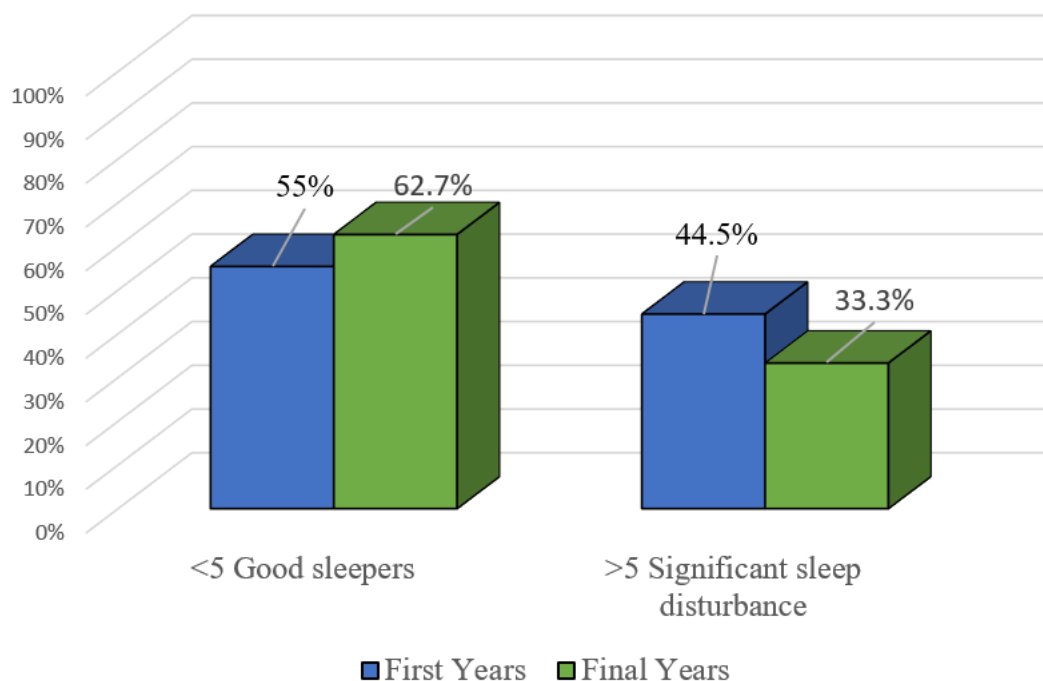


Figure 3: Shows the percentage of students with good sleep and with sleep disturbances. No statistically significant difference was found between the PSQI scores of both groups. Chi square value=2.5 df=1 p value = 0.11, Mean^{1st} – 5.01 Mean^{final} – 4.71

Association of Chronotype with Depressive Symptoms and Sleep Quality:

After the analysis of individual scale scores in both first and final year students, the association of chronotype with depressive symptoms and sleep quality was assessed by correlation analysis. Among the first year students there was no statistically significant association between chronotype and depressive symptoms present (r=0.19, p value >0.05) (table 3),

however, there was a statistically significant correlation between chronotype and sleep quality (figure 4).

The chronotype was negatively correlated to the sleep quality, indicating that those with evening chronotype and score more towards evening type had poorer sleep quality with PSQI score of above 5 compared to the morning chronotype. (r=0.25, p value<0.002)

Table 3: correlation between chronotype and depression is not significant in first year students. r=0.19, p value >0.05

		chronotype	depression
Chronotype	Pearson Correlation	1	.019
	Sig. (2-tailed)		.820
	N	146	146
Depression	Pearson Correlation	.019	1
	Sig. (2-tailed)	.820	
	N	146	146

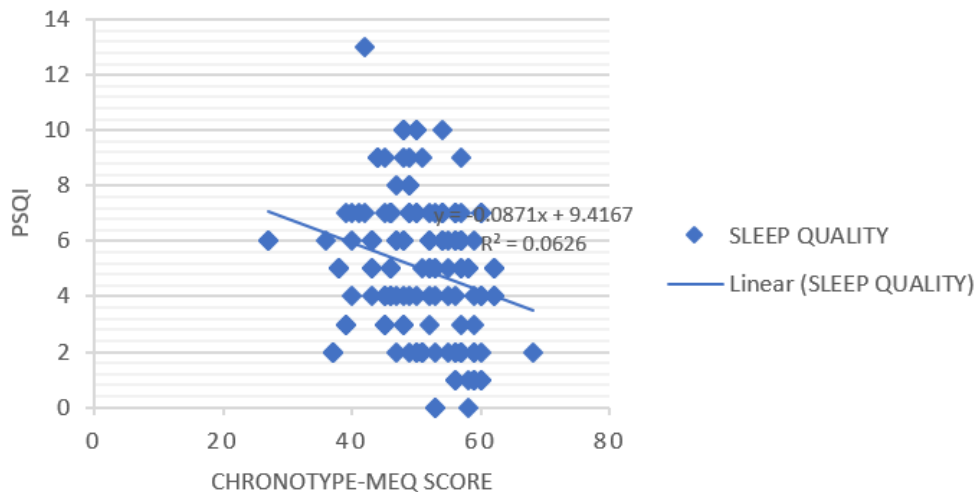


Figure 4: Scatter plot showing the association between chronotype (MEQ score) and sleep quality (PQSI score) in first year students. $r=-0.25$, p value <0.002 Negative correlation with $y= -0.0871x + 9.4167$, $R^2 = 0.0626$

Among the final year students as well, there was no statistically significant association found between the chronotype and depressive symptoms ($r= 0.19$, $p >0.05$). (Table 4). But students with evening chronotype scored higher on the QIDS scale with an average of 12.2 compared to the average of 10.5 in the total sample. A statistically significant asso-

ciation was present between the chronotype and sleep quality in the students (figure 5). Chronotype was negatively correlated to sleep quality, indicating that those with evening chronotype and score more towards evening type had poorer sleep quality compared to the morning chronotype.

Table 4: correlation between chronotype and depressive symptoms is not significant in final year students. ($r= 0.19$, $p >0.05$)

Correlations			
		Chronotype	Depression
Chronotype	Pearson Correlation	1	.019
	Sig. (2-tailed)		.823
	N	144	144
Depression	Pearson Correlation	.019	1
	Sig. (2-tailed)	.823	
	N	144	144

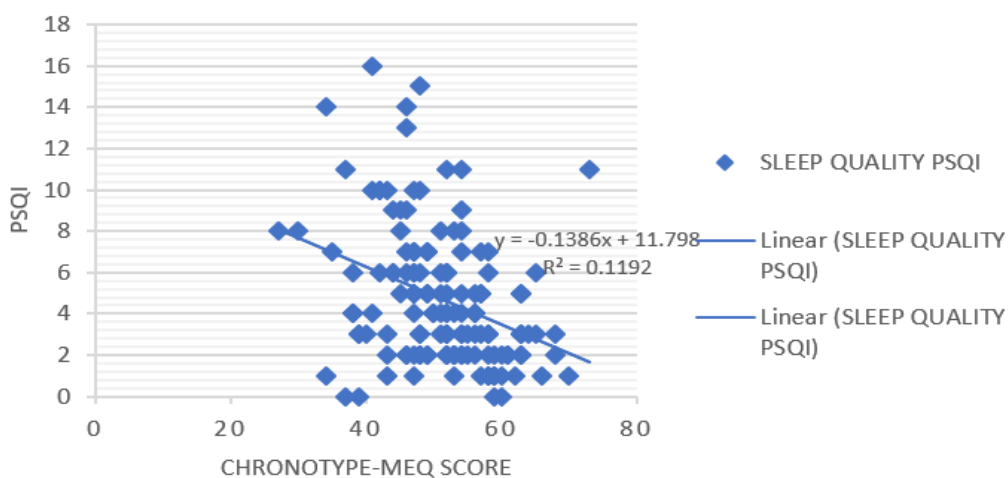


Figure 5: Scatter plot showing the association between chronotype (MEQ score) and sleep quality (PQSI score) in final year students with $r= -0.34$, p value <0.00 . Negative correlation with $y= -0.1386x + 11.798$, $R^2= 0.1192$

Discussion

The purpose of this study is to find out the influence of chronotype on the depressive symptoms and sleep quality in students. In this cross sectional study, two hundred and ninety students studying first and final year MBBS were analysed firstly for their chronotype, presence of depressive symptoms and sleep quality in them. Then, the association of chronotype on these depressive symptoms and sleep quality was established.

Our results indicated that chronotype measured through the MEQ questionnaire revealed 'Intermediate type' as the most common type seen in majority of the students, 74.6% in first years and 70.8% in final years, which is consistent with previous studies done in Chinese college students (Yingying Zhu, Jiahao Huang and Minqi Yang., et al. 2022). The prevalence of Eveningness in our study is 14.4% in first years and 17.4% in final years, which is also consistent with previous study done in Taiwan (Wen-Hsuan Chiu, Hao-Jan Yang et.al, 2017, Yingying Zhu et al, 2022). Whereas, the prevalence of morningness in our study is around 11%, which is less than the prevalence range of 15.2%-30.9%, given in previous studies. (Wen-Hsuan Chiu et al., 2017, Gau et al., 2007; Giannotti et al., 2002).

The effect of chronotype on depression was studied in multiple research articles in the recent times and a significant correlation was established between them. Studies reported that people with evening chronotype are at increased risk of experiencing emotional problems, including depressive symptoms both cross-sectionally and prospectively. A cross-sectional study showed that behavioral activation mediates the relationship between chronotype and depressive symptoms (Hasler et al. 2010), with eveningness being associated with lower behavioral activation and consequently more depressive symptoms. In our study, even though students with evening chronotype had higher scores on the QIDS scale, it was not statistically significant to establish a correlation between chronotype and depressive symptoms. This was not consistent with previous studies done in Amsterdam, Rotterdam etc, which reported a significant association between evening chronotype with depressive symptoms (Julia F. Van den Berg, Liia Kivelä & Niki Antypa et al, 2018.) This could have been due to a comparatively smaller sample size and a possible information bias in self-reporting of either depressive symptoms or the chronotype. A prospective study with higher sample size could establish a better correlation between chronotype and depressive symptoms.

Sleep quality is another important variable studied in relationship with the chronotype in the recent times and a significant negative correlation was

established between the two. Evening types reported poorer subjective sleep quality, as given in multiple prior literatures (Kitamura et al. 2010; Martin et al. 2012; Roeser et al. 2012; Rique et al. 2014; Yun et al. 2015). Another study conducted in Leiden, The Hague, Delft, also reported a poorer self-rated subjective sleep quality, longer sleep onset latency, shorter sleep duration and higher daytime dysfunction in people with evening chronotype. (Julia F. Van den Berg et al.,2017). The same was replicated in our study, where a statistically significant negative correlation between evening chronotype and sleep quality was established both in first and final year students. Students with evening chronotype reported a poorer quality of sleep with significant sleep disturbances as seen in the scores of PSQI scale. Our understanding is that poor sleep-wake behaviors, delaying bedtime at night will undoubtedly lead to shorter sleep duration and sleep insufficiency, which in turn causes a decline in the quality of sleep.

Conclusion

The main conclusion of our study is that the chronotype has significant negative correlation with the sleep quality in the students. Although students with evening chronotype scored higher on depressive scale, it was not statistically significant. Sleep problems have become more prominent among youth in the recent decade with technology advancement and lifestyle changes. For medical students aiming to develop into health professionals, it is important to determine the possible association of chronotype to prevent the risk of depressive symptoms and a poor sleep quality in them. This is because it can also compromise their quality of living, hinder their studies and impact their long-term career goals and can have wide and detrimental consequences on society as a whole.

Limitations

1. Our study was done using self-reported questionnaires, which may be susceptible to information bias and so our results may not be able to be generalized. However, self-report questionnaire remains the most widely used assessment tool in large-scale surveys.
2. This study is a cross sectional design and the causal relationship between these variables could not be established.
3. Finally, this study did not consider the use of stimulants like coffee etc, which can affect the sleep quality and could be a confounding factor.

Future Recommendations

This study is focused on undergraduate medical students, but more studies involving heterogeneous

samples are needed to further explore the influence of chronotype on depression and sleep, and to generalize the results in a wider population. More longitudinal studies with greater sample size are required to understand the temporal association of chronotype with that of depressive symptoms and sleep quality.

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