Section: Miscellaneous

Original Research Article

EXPLORING THE RELATIONSHIP BETWEEN CHRONOTYPE AND EXAM PERFORMANCE AMONG FIRST PROFESSIONAL MBBS STUDENT

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ABSTRACT

This study investigates the relationship between chronotype and academic achievement among MBBS students, aiming to elucidate the impact of circadian rhythms on learning outcomes in medical education. This study was conducted on a cross-sectional analysis of 173 MBBS students of the 2019 and 2020 grade at AIIMS Gorakhpur. In order to determine the chronotype preferences that the participants belonged to, the Morningness Eveningness Questionnaire (MEQ) was used, classifying the participants by the evening type, intermediate type, and the morning type. Scenario based chronotype analysis was used to categorise the five chronotypes into three. Percentage marks earned by the respondents in their first-year professional examinations, which included courses such as Anatomy, Physiology and Biochemistry were used to measure the academic achievements.

As reflected in the results, the relationship between academic and Chronotype is highly statistically significant in MBBS students. When analysed by a Kruskal-Wallis test, the results achieved are statistically significant (28.362, df =2 $p < 0.001$) showing that there was a difference between the percentage marks of the different chronotype categories. These differences are further explained by pairwise comparisons where it is visibly evident that the average percentage marks of the evening chronotypes take lower marks when compared to those of the morning and intermediate chronotypes. No distinction however was revealed between morning and intermediate chronotypes thus indicating no difference in the performance of students in morning and intermediate chronotypes.

Such findings provide a strong argument to take into account interpersonal variance in the circadian rhythm within the school. Personalized interventions and assistance plans could be required in case of various chronotypes of students.

INTRODUCTION

Circadian rhythm is the light/dark or wake/sleep cycle that is typically 24 hours long but differs between species. From completely diurnal to nocturnal species, the range encompasses varied adaptations to environmental signals.[1-3] For humans, this variability is expressed as variability in the time of day when activities are normally performed, referred to as chronotypes, where "morning types" are early risers and "evening types" are late risers.[4] Morning individuals, or larks, are most active in the early part of the morning. They are able to wake early with no difficulty and possess greater mental and physical efficiency and alertness, but tire earlier in the evenings. Evening individuals, or owls, struggle to wake early and take longer to reach peak mental functioning. The majority of individuals fall between

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these extremes, characterized as intermediate types.[5-7]

Individual morningness and eveningness have a circadian rhythm foundation and contribute to maximizing many aspects of life, such as work timing, sports performance, and school performance.[8] In school environments, the timing of lectures and classes can impact school performance based on whether they coincide with the biological rhythm of an individual. For example, early morning school start times may advantage night owls to the disadvantage of early risers and subsequently their efficiency and grade point average (GPA).[9-11]

In addition, the discrepancy between one's optimal sleep-wake cycle and that imposed by external circumstances, especially among individuals who are evening types and are forced to work earlier shifts, can lead to sleep problems that, in turn, impact academic performance.[12]

While some studies have reported associations between irregular sleep-wake cycles and shorter sleep durations with poorer academic outcomes, others have found inconclusive evidence regarding the relationship between sleep quality and academic performance.[10]

While a lot of research has been done on the effect of circadian rhythms on all areas of life, from academic achievement to athletic performance, very little has been found regarding the effect of chronotype, in particular, on the academic achievement of medical students. The reason for this study, therefore, is to fill this gap by carrying out a study on the correlation between the Morningness-Eveningness Questionnaire (MEQ) score, an indicator of chronotype, and academic achievement among medical students. The study also seeks to establish whether variations in chronotype influence academic achievement among students with morning and evening types in this group. Through this investigation, we aim to contribute to a deeper understanding of how individual differences in circadian rhythms may shape the academic experiences and outcomes of medical students. By elucidating the relationship between chronotype and academic performance, this study may inform educational practices and interventions tailored to optimize learning outcomes in medical education.

MATERIALS AND METHODS

This non-funded intramural study, within the subject area of Chronomedicine, employed a cross-sectional design to thoroughly investigate the potential relationship between chronotype and academic achievement among MBBS students. The target group of study population included students of MBBS who were passing the years in 2019 and 2020. Students who had passed their first-year professional examination were sampled such that the sample was homogenous in that, this is at a critical stage in the medical education process.

The study identified 173 students as a comprehensive sample size after careful selection to take part in the research. This sample had 49 students of the 2019 batch and 124 students of the 2020 batch, so that the sample covered a number of different cohorts and academic years. This broad but focused recruitment enabled a sound study into the possible role of chronotype in the academic performance, considering the possibility of any time or cohort-related differences.

Chronotype Classification

The key method of evaluating the preferences of the participants in the chronotype was the Morningness Eveningness Questionnaire (MEQ), a well-validated series of questionnaires with extensive research heritage. The MEQ was developed by Horne and Ostberg (1976) and later translated into Turkish by Punduk, Gur and Ercan (2005). It consists of 19 well-designed questions with the aim of investigating the participants in terms of their sleep/wake behaviour and habits. Based on their MEQ scores, this thorough evaluation allowed for a more detailed grouping of individuals into five different chronotype categories: definitely evening (DE), moderately evening (ME), intermediate (IM), moderately morning (MM), and definitely morning (DM).

Scenario-Based Chronotype Analysis

To complement the detailed five-category analysis and to provide a more generalized framework for understanding the practical implications of chronotype, the scenario-based analysis was also conducted subsequently using a simplified three-group classification. The five chronotype categories were grouped into three broader chronotype categories to simplify the analysis:

1. **Morning Chronotype:** Included subjects classified as "Definite Morning" and "Moderate Morning" chronotypes.
2. **Intermediate Chronotype:** Remaining consistent with the "Intermediate" category from the five-group classification.
3. **Evening Chronotype:** Incorporated subjects categorized as "Moderate Evening" and "Definite Evening" chronotypes.

The study provides a robust and detailed understanding of chronotype's effect on the outcome variables by performing base case as well as scenario analysis. To measure achievement at academics, a score of MBBS students in their first-year professional examinations was carefully noted and examined. The exam in question is a top qualification test (involving objective and subjective questions covering both practical and theory of Anatomy, Physiology, and Biochemistry) and thus worked as a powerful indicator of an academic robustness and the knowledge of the basics of medicine in participants. Three hours of standardized time guaranteed hardly any inconsistency in the examinations, reducing the number of possible confounders that may affect the measure of academic success and made it more valid. SPSS version 27, a popular statistical software known to be both versatile and capable of powerful

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analysis was used in the analysis of data. Data was represented by descriptive statistics such as percentages as well as frequencies which allowed achieving a subtle comprehension of the interaction of chronotype and academic success in MBBS students.

The required ethical clearance was obtained from Institutional Human Ethics Committee (IHEC). All the participants of the research gave written informed consent to participate voluntarily and to be aware of the purposes and procedures of the study.

RESULTS

The null hypothesis, stating that the distribution of percentage marks is the same across categories of chronotype, was tested using the Kruskal-Wallis test. The significance level was set at 0.05. The test yielded a highly significant result ($\chi^2 = 28.362$, df = 2, $p < 0.001$), leading to the rejection of the null hypothesis. This indicates that there is a statistically significant difference in the distribution of percentage marks among the categories of chronotype.

Pairwise comparisons were conducted to further explore the differences in percentage marks between different chronotype categories.

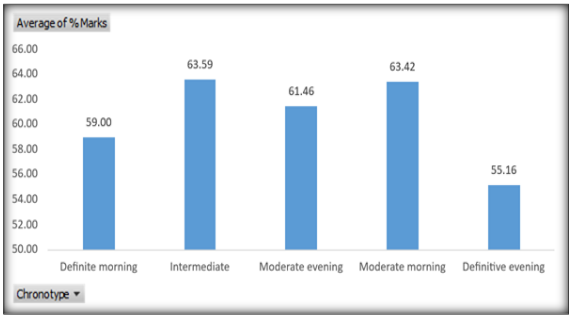

Figure 1: Showing average percentage of marks with respect to different chronotypes

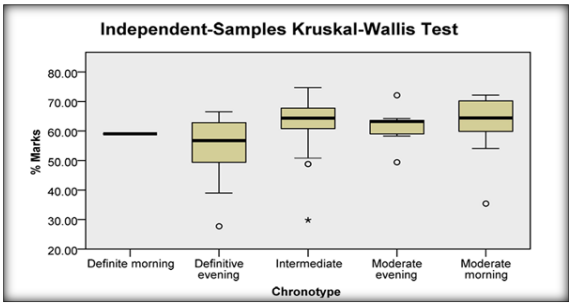

Figure 2: Showing Box and Whisker plot for % of marks with individual chronotype

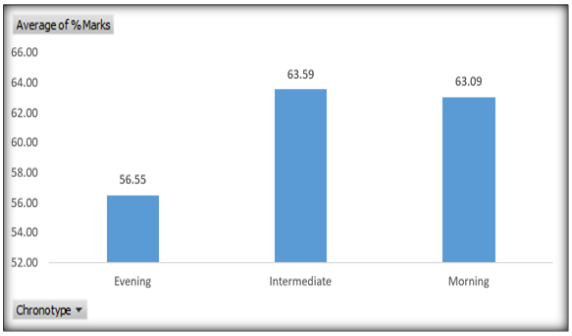

Figure 3: Showing percentage of marks with chronotype with individual chronotype (Scenario-Based Chronotype Analysis)

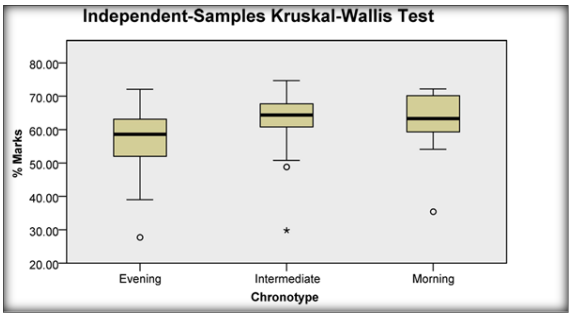

Figure 4: Showing Box and Whisker plot for average percentage of marks with individual chronotype (Scenario-Based Chronotype Analysis)

1. **Evening vs. Morning**:

- The average rank of percentage marks for the evening chronotype group was 56.55% as shown in figure 3.
- The test statistic for the comparison between evening and morning chronotypes was -41.526, with a standard error of 11.961 and a significance level of $p = 0.001$. This indicates a statistically significant difference in percentage marks between evening and morning chronotype groups, with the evening chronotype group scoring lower on average compared to the morning chronotype group.

2. **Evening vs. Intermediate**

- The average rank of percentage marks for the evening chronotype group was 56.55% as shown in figure 3.
- The test statistic for the comparison between evening and intermediate chronotypes was -45.501, with a standard error of 8.734 and a significance level of $p < 0.001$. This suggests a statistically significant difference in percentage marks between evening and intermediate chronotype groups, with the evening chronotype group scoring lower on average compared to the intermediate chronotype group.

3. **Morning vs. Intermediate**

- The average rank of percentage marks for the morning chronotype group was 63.09% as shown in figure 3.
- The test statistic for the comparison between morning and intermediate chronotypes was

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3.975, with a standard error of 10.910 and a significance level of p = 0.716. This indicates no statistically significant difference in percentage marks between morning and intermediate chronotype groups, with both groups scoring similarly on average.

Interpretation

There is significant correlation between chronotype and academic performance among MBBS students as shown by results of Kruskal-Wallis test. In particular, evening chronotypes have a lower average percentage marks than those who are morning and intermediate chronotypes.

These findings are emphasized in the two-way comparison and demonstrate that there is a strong difference between the percentage marks of evening chronotype with morning and intermediate chronotypes. Difference in morning and intermediate types was not significant, i.e., the two types were exceptions equal in their academic performance.

These findings are highly persuasive to suggest that the gap that exists between academic performance and chronotype should be addressed. It may also be required to implement some interventions and care regimes that are specially tailored to address the most probable challenges which are experienced by those students who possess evening chronotypes and simultaneously maximize academic performance on all chronotype types.

DISCUSSION

Chronotype as intrinsic predisposition to time of daily functions influences physiological and behavioural rhythms of individuals in a significant manner. The research question of the study was to determine whether chronotype and academic achievements among MBBS students are associated or not. The findings showed that there was a significant difference in academic performance among the chronotype types, proving that on an academic setting, individual differences in the circadian rhythm needs to be considered.

The result of the research corroborates with other studies that showed the impact of chronotype on academic achievements in different scales. These findings are consistent with other studies, which found that patients having an evening chronotype also displayed lesser academic performance than their morning patients or intermediate patients.[13,14] Such results can be explained by multiple factors connected with evening chronotypes including sleep deprivation, lower level of mental abilities in the morning and disproportion between biological and social timetables.

The significant gap in performance prevalent across chronotype types further establishes the necessity of interventions and approaches to various requirements of students with varying circadian preferences. As an example, schools can think of introducing a flexible schedule policy that would meet the demands of both morning and evening chronotypes. Studies have indicated that school start time changes to ensure they suit the biologic rhythm of the students would bring about some improvements in academic life and the whole well-being.[4,15]

Furthermore, sleep hygiene and time management skills interventions could be helpful to day evening chronotypes students who tend to have adverse sleeping habits and are more prone to cognitive malfunctions at the peak hours. A study revealed that cognitive behavioral therapy of insomnia (CBT-I) has been found to effectively enhance sleep and academic performance of students with evening chronotypes.[16] On the same note, strategies to develop effective time management and studying process can assist day night students to balance their academic life and get the best of their learning ability.

It should be mentioned that although the present study involved the particular group of MBBS students, the results can be applied to medical education in general. It is thus necessary to understand how chronotype plays a role in academic performance among medical students to enable sufficient education planning and assist the students through to the end of the medical training.

Besides having practical implications, this study adds to the theoretical interpretation of complex interaction between circadian rhythms and academic performance. The results provide support to believe that the connection between chronotype and academic performance should be taken into account in educational research and practice because it is essential to take into consideration individual differences in biological rhythms. Moreover, the study contributes to current literature, noting the importance of the circadian rhythms in different fields, such as education or health.

Nevertheless, this study does not go without limitations notwithstanding its contributions. Cross-sectional design does not allow to draw causal assumption, and longitudinal research is required in order to determine the direction of the identified relationship between chronotype and academic performance. Furthermore, it classifies by relying on self-reported variables of chronotype and academic performance that can lead to the addition of bias and measurement error. Subsequent studies can be improved with the introduction of objective forms of assessment of circadian rhythms. It can either be actigraphy data or biomarkers of sleep quality to get a more realistic picture of the chronotype and its association with academic performance.

To sum up, the study is of great use regarding the relationship between chronotype and academic achievement in the MBBS students. The results reflect the importance of considering subjective variations in circadian rhythms in designing education programs and offer targeted interventions aimed at assisting students with different chronotypes. Through understanding of the role of circadian rhythms in academic achievement, the present study will make a contribution to the creation

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of evidence-based practices in improving academic performance in medical education and beyond.

CONCLUSION

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Conflict of Interest:
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