Original Research

The Disadvantages of Normal Circadian Chronotype in Medical Students during the Most Demanding Sections of the Objective Structured Clinical Examination (OSCE)

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Abstract

Background and Objective: Previous studies had examined the effect of learning in young adults with generally worse results in cases with the delayed sleep-wake phase disorder. In this study, the relationship between circadian rhythm preferences and objective structured clinical examination (OSCE) results was examined in medical students.

Materials and Methods: This study was conducted during the OSCE for clinical license in medical students who were graduation candidates. The reduced form of the Horne and Ostberg Morningness-Eveningness Questionnaire was used to estimate their circadian chronotype. The OSCE consisted of 12 stations, which evaluated different clinical skills, as well as participant's medical knowledge. The effect of morningness-eveningness preference of each participant on score was evaluated within each station of OSCE.

Results: In total, 78 students participated out of a total of 114 clinically competent candidates (aged 25-34 years) were evaluated. In terms of sex, 56% of the students were girl, who obtained significantly higher grades in three stations ($P < 0.05$). The grades of students with delayed sleep-wake chronotypes were higher in most of the stations; however, the difference was statistically significant in only one station ($P = 0.045$), which was the most difficult station of the exam. Nevertheless, the delayed sleep-wake chronotype was associated with excessive daytime sleepiness ($P = 0.002$).

Conclusion: Contrary to other similar studies in medical students, normal circadian chronotype was associated with poorer outcome in the OSCE; which may be explained by unusual student training hours during shifts, and the resultant available time for undisturbed study.

Keywords: Circadian rhythm; Objective structured clinical examination; Medical students; Morningness; Eveningness

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Introduction

The objective structured clinical examination (OSCE) grades are often used as a tool for qualifying graduation from medical school, and are thus among the most important graduation criteria for medical students (1).

A large amount of studies have shown that sleep is important for memory functions (2, 3). Circadian rhythmicity, together with sleep homeostasis, shapes the timing and structure of the sleep-wake cycle in young and older people, as well as in men and women (4, 5). Environmental cues to which circadian clocks adjust themselves are zeitgebers (6). Light is considered the most important zeitgeber for humans' circadian system (7, 8), with variations in response intensity to light entrainment resulting in different "chronotypes" (7).

Chronotypes of young adults are later compared to all other age groups, thus, they have later sleep times (9). Accordingly, early starts of classes lead

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to chronic sleep deprivation of medical students (10-12). Chronic sleep deprivation related to early starts of work or classes and late sleep onset is defined as social jetlag (13). Social jetlag is mismatch between internal and external time (13). Increased social jetlag is contributed to lower academic achievements (14, 15). Late chronotypes has lower grades compared to early types (16-20).

Time of taking examinations also influences academic performance of students, since students' cognitive functions, e.g. attention, changes during the day (15, 18, 21, 22).

In this study, OSCE grades performed at 08:15 and 12:00 a.m. were collected and assessed, to determine how medical student's performance depended on internal time. To the authors' knowledge, this was the first detailed description of chronotype-dependent fluctuations in Iranian medical school grades.

Materials and Methods

This study was performed among 114 candidates being assessed by the OSCE for a clinical competence license. The OSCE was performed in clinical skill laboratory at the Tehran University of Medical Sciences, Tehran, Iran. Grades were collected from candidates who filled in the questionnaire before taking the OSCE in August 2019. The protocol was approved by the institutional Human Research Committee, and written informed consent was obtained from the medical school principal and all participants. Based on national regulations, the study was not invasive to participants' integrity, and it was performed during regular medical school exam hours.

The exam consisted of 12 different stations, which evaluated different aspects of students' medical knowledge and clinical skills, and which was used to approve their clinical license at the end of their general physician program. Medical students had to answer questions at each station in 5 minutes. The evaluation and scoring for each station was performed by an expert rater in the relevant field, and scored from 0 to 20.

Information on different circadian chronotypes was collected using the reduced form of Horne and Ostberg Morningness-Eveningness (23). This questionnaire assesses chronotype by using simple and short questions about morningness and eveningness. It contains 19 questions about individual rising and bed times, preferred time for physical and mental performance, and alertness after rising and before going to bed. The subjects are categorized with scores from high to low into the following sub-types: Morning types (M-types), Intermediate or Neither types (N-types), and Evening types (E-types). The standardized form of questionnaire was used in this study (23). The questionnaire consists of 5 multiple choice questions about circadian preferences.

The original reduced Horne questionnaire was translated and adapted in accordance with the cultural differences of the Iranian population by two sleep medicine fellowships. The validity of the questionnaire was confirmed by five expert translators.

The following classifications were used for three preference groups: M-types: score 18-25, N-types: score 12-17, and E-types: 4-11. The de-identified data was used for further analysis. The collected participants' characteristics included: age, sex, body mass index (BMI), past medical history, taking hypnotics, taking wake-stimulating medications, snoring, excessive daytime sleepiness, apnea, hypertension, bedtime, sleep latency, sleep time, wake time, circadian score, circadian type, and the score of each station.

Later, the 5 items in the reduced Morningness-Eveningness questionnaire were analyzed according to multiple correspondences and clusters. Statistical analysis was done using SPSS software (version 23.0, IBM Corporation, Armonk, NY, USA). For evaluation of the association of morningness-eveningness effect on each station score, the nonparametric Kruskal-Wallis test was used. For evaluation of the mutual effects of categorical items, the chi-square test was used.

The relationship between the OSCE score of each station and chronotype grade was investigated by subdividing the population into three chronotype groups: M-types, N-types, and E-types. Then the achieved grades were compared between the three chronotype groups.

The relationship between excessive daytime sleepiness and BMI was evaluated by Mann-Whitney U test.

Results

The number of medical students who agreed to participate in the research was 78. The minimum age was 24 and the maximum was 34, and the mean was 26.3 years [standard deviation (SD) = 1.4]. The data on the content and scores of each station is shown in table 1.

Table 1. Content and scores of each station of objective structured clinical examination (OSCE)

OSCE station	Minimum	Maximum	Mean ± SD
Hand washing	14.00	20.00	19.14 ± 1.61
Red eye evaluation	4.00	17.00	11.40 ± 3.24
Depression management	9.00	19.00	14.04 ± 1.89
Psoriasis diagnosis	6.00	20.00	14.44 ± 3.28
Icterus evaluation	8.50	20.00	15.67 ± 2.43
Cardiology physical examination	5.00	20.00	15.53 ± 2.17
Rectal examination	6.00	20.00	14.65 ± 2.63
Atrial fibrillation management	12.00	20.00	17.10 ± 2.31
Pap smear	13.00	20.00	18.22 ± 1.58
Knee examination	6.00	20.00	15.95 ± 3.70
Tension pneumothorax radiology	0.00	15.50	10.17 ± 3.68
Failure to thrive evaluation	10.00	18.00	13.92 ± 1.56

SD: Standard deviation

In terms of sex, 49% of the subjects were girl, and they obtained significantly higher grades on the fourth (P = 0.047), sixth (P = 0.008), and ninth (P = 0.002) stations (Table 2). The mean score (SD) for the morningness-eveningness questionnaire was 13.4 (3.4), and the range was from 7 to 23.

Effect of chronotypes on students' grades performance was assessed in each station. Except for the third, fourth, and twelfth stations, E-types performed better than M and N-types in each station. Grades from the 11th station were significantly higher in E-types compared to the grades from the same station taken from M and N-types (P = 0.04) (the most difficult with the lowest average scores). The average of grades obtained for other stations used in the analysis were not significantly different (Table 3).

The frequency of each circadian type was 22.8 for E-type, 69.6 for N-type, and 7.6 for M-type. Excessive daytime sleepiness was significantly associated with eveningness (P < 0.01) (Table 4). There was no statistically significant association among snoring, apnea, and BMI with excessive daytime sleepiness.

Discussion

The results showed that late chronotypes typically show better performance in the station with a higher difficulty level. Sleep deficiency is prevalent in adolescents, especially in late chronotypes (12, 24). Previous studies have shown that sleep deficiency and being a late chronotype negatively affect school achievement (16, 25). However, the effect of task difficulty on performance of different chronotypes and academic achievements has received limited attention. Haraszti et al. showed that compared to early chronotypes, late chronotypes underperformed only when tested at early times of the day (15).

In this study, the relationship between external, internal time (chronotype) and performance (examination grades) was studied throughout an OSCE, from 08:15 to 12:00 a.m., showing significant differences between the early and late chronotype groups. While late types performed significantly better in the difficult station, early and intermediate types performed indistinguishably in the other stations.

Table 2. The sex-specific scores of each station

OSCE station	Boy (n = 30)	Girl (n = 38)	P-value*
	Mean ± SD	Mean ± SD	
Hand washing	19.07 ± 1.55	19.16 ± 1.72	0.500
Red eye evaluation	10.93 ± 3.66	11.80 ± 2.95	0.530
Depression management	13.80 ± 2.28	14.26 ± 1.54	0.280
Psoriasis diagnosis	13.52 ± 3.33	15.22 ± 3.16	0.047*
Icterus evaluation	15.30 ± 2.68	16.12 ± 1.92	0.360
Cardiology physical examination	14.85 ± 2.51	16.18 ± 1.69	0.008*
Rectal examination	14.97 ± 2.57	14.71 ± 2.35	0.510
Atrial fibrillation management	17.23 ± 2.03	17.11 ± 2.53	0.920
Pap smear	17.77 ± 1.76	18.76 ± 1.00	0.020*
Knee examination	15.67 ± 3.67	16.37 ± 3.69	0.280
Tension pneumothorax radiology	10.28 ± 3.57	10.43 ± 3.55	0.880
Failure to thrive evaluation	13.83 ± 1.58	13.97 ± 1.60	0.720

*Mann-Whitney U test
SD: Standard deviation

Table 3. The scores of each station according to the circadian chronotype

OSCE station	Circadian type			P-value
	Eveningness	Intermediate	Morningness	
	Mean ± SD	Mean ± SD	Mean ± SD	
Hand washing	19.29 ± 1.21	19.06 ± 1.76	19.33 ± 1.63	0.890
Red eye evaluation	12.50 ± 2.75	11.23 ± 3.25	9.58 ± 3.95	0.140
Depression management	13.94 ± 1.48	14.21 ± 2.02	13.00 ± 1.79	0.430
Psoriasis diagnosis	13.74 ± 4.06	14.86 ± 2.79	13.17 ± 4.36	0.500
Icterus evaluation	15.97 ± 2.03	15.77 ± 2.62	14.08 ± 1.43	0.130
Cardiology physical examination	15.29 ± 1.21	15.63 ± 2.47	15.50 ± 2.07	0.590
Rectal examination	14.82 ± 1.94	14.64 ± 2.97	14.33 ± 1.63	0.900
Atrial fibrillation management	17.41 ± 1.97	16.89 ± 2.36	17.83 ± 2.93	0.430
Pap smear	18.24 ± 1.75	18.21 ± 1.53	18.33 ± 1.75	0.880
Knee examination	16.56 ± 2.93	15.79 ± 4.08	15.58 ± 2.62	0.730
Tension pneumothorax radiology	11.71 ± 3.77	9.51 ± 3.67	11.00 ± 2.32	0.045*
Failure to thrive evaluation	13.65 ± 1.17	14.11 ± 1.58	13.33 ± 2.34	0.460
Total	15.26 ± 0.78	14.99 ± 1.13	14.60 ± 1.06	0.640

*Kruskal-Wallis test
SD: Standard deviation

Table 4. Relationship between circadian chronotype and excessive daytime sleepiness (EDS)

Circadian type	EDS		n (%)
	No (%)	Yes (%)	
Eveningness	22.2	77.8	18 (22.8)
Intermediate	54.7	45.3	54 (69.6)
Morningness	100	0	6 (7.6)

P = 0.002 by Pearson chi-square test
EDS: Excessive daytime sleepiness

The lower observed grades in the 2nd and 11th stations might be a result of additional differential effects of sleepiness in early and late chronotypes, with late chronotypes performing exceptionally in station 11. This effect may be more in late chronotypes who gave their exams too early in their internal body daytime. These findings oppose those of Haraszti et al. (15).

The findings of the present study indicate that students' chronotype should be considered in performance assessments. This is supported by data demonstrating an endogenous circadian rhythm in sleep inertia of cognitive performance, with the worst impairment upon awakening during the biological night and little impairment during the biological day (26). In addition, a misalignment between internal and external time (social jetlag) significantly influences students' health (13, 27-29).

Contrary to other similar studies among medical students (15, 16), normal circadian chronotypes were associated with poorer outcomes in the OSCE, which may be explained by unusual student training hours during shifts, and the resultant available times for undisturbed study.

Conclusion

Unlike other similar studies among medical students, normal circadian chronotypes were associated with bad outcomes in the OSCE. Our study indicated that late chronotype students' perform better at stations that are more difficult to work with. Further studies with larger sample group are suggested on this topic to conclude crucial results.

Conflict of Interests

Authors have no conflict of interests.

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