

## Evaluation of Daily Rhythm in High School Children

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### ABSTRACT

**Background:** Regular night's sleep, which is among the most fundamental needs of human beings, is accepted as one of the most important factors of health and quality of life at all ages. Daily rhythm patterns effect one's attention, memory, problem solving skills, work, and academic performance. This research study was planned to determine daily rhythm awareness among adolescents. Considering the psychological and physiological factors brought about by the adolescent age, it is considered that it is more important to evaluate this age group in terms of daily rhythm awareness. The aim of this study was to determine the daily rhythm pattern of adolescent age group by applying the Circadian Rhythm Assessment Scale to high school children.

**Method:** The study was performed in the Pediatric Clinics of Tepecik Training and Research Hospital after approvals from the local ethics committee of the hospital, and provincial national education directorate ethics committee were obtained. The students who were between the ages of 14-18 and continuing their high school education in Izmir constituted the study population. Undersigned consent forms were obtained from children who agreed to participate in the study. The sample size was calculated as 2144 participants with a margin of simple random sampling, 0.2 error margin, 0.80 power value, and 95% confidence interval.

**Results:** Questionnaire forms were distributed to a total of 2144 accessible high school students, and 1953 students answered the question inquiring their grades. Accordingly, the students were in the 9th (42%), 10th (29.4%), 11th (15.9%), and 12th (3.8%) grades, while 57.3% of the study group consisted of female students. When the relationship between total scale score and gender was evaluated, it was seen that boys obtained statistically significantly higher scores than girls ( $p=0.000$ ). There was no significant difference between the scale scores and the grades of the students ( $p=0.452$ ). When the relationship between the grades and the survey questions was evaluated, it was seen that in higher grades c and d options of the 4th question were ticked, in other words the evening hours were more frequently preferred in higher grades ( $r=0.086$ ,  $p=0.000$ ).

**Conclusion:** This study will raise awareness on the concept of morningness/eveningness and the factors affecting it, especially in adolescents and also it will contribute to the literature.

**Key words:** Daily rhythm, adolescent

### INTRODUCTION

Human is a biological entity. The biological and chemical dimensions of human beings effect daily life, bodily, mental and spiritual health by regulating their social and psychological structures. Sleep and wakefulness are important parts of a healthy life and a process necessary for the sustainability of health (1). Problems related to sleep during adolescence cause various physical and related health problems and psychological impairment (2, 3). Even without performing an extensive scientific research, we know the presence of night people (evening people) and early people (morning people) around us in terms of daily rhythm. Depending on factors such as age, pubertal development, and potential sociocultural differences, there may be gender

differences in terms of morningness / eveningness (M / E), but any significant difference is not seen in later ages. It is thought that eveningness, in which late- wake is frequently observed, occurs due to intrinsic circadian phase delay due to natural developmental changes in adolescents. Circadian rhythm pattern effects one's attention, memory and problem solving skills, work and academic performances. It is also known that increased frequency of eveningness is often associated with delayed sleep phase disorder leading to developmental pathologies (4). Researches have shown that when sleep is qualitatively and quantitatively impaired, attention / memory disorders, emotional variability, even hallucinations and delusions can be seen, and

normal working efficiency is reduced (5,6). The aim of this study was to evaluate high school children who are thought to be under the biological, psychological and social effects of adolescence. regarding morningness/eveningness.

## MATERIAL and METHODS

The study was performed in the Pediatric Clinics of Tepecik Training and Research Hospital after approvals from the local ethics committee of the hospital, and provincial national education directorate ethics committee were obtained. There are 240,202 high school students in İzmir. (TURKSTAT, <https://biruni.tuik.gov.tr/ilgosterge/?locale=tr>) The students who were between the ages of 14-18 and continuing their high school education in İzmir constituted the study population. Undersigned consent forms were obtained from children who agreed to participate in the study. The sample size was calculated as 2144 participants with a margin of simple random sampling, 0.2 error margin, 0.80 power value, and 95% confidence interval.

### Data collection

For data collection, Morningness / Eveningness Scale for Children formulated by Carskadon et al. in 1993 was used. This scale consisting of 10 questions with 5 options each aiming to determine daily rhythm translated and adapted by Önder İ et al. to Turkish language was applied to the participants (7, 8). The questions of the scale were related to the time to start the day, subjective assessments of both getting out of bed in the morning, and of the high achievement targeted in physical education course or exams which require physical and mental performance in terms of time during the day, high energy- times during the day, determining the bedtime with the parents, the feelings of the participants about getting up in the morning or always having to wake up early. Besides, age, gender and grade of the cases were noted.

### Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS for Windows, 24.0). Kolmogorov -Smirnov test was used to evaluate the fitness of variables (numerical data) to the normal distribution Numerical variables with normal distribution were expressed as mean +/- standard deviation, and numerical variables without normal distribution as median (25.-75. percentiles). Intergroup differences as for normally distributed numerical data, Student's t-test, one-way analysis of variance (ANOVA) and Tukey's multiple comparison test, and for non-normally distributed numerical variables Mann-Whitney U test, Kruskal Wallis one-way analysis of variance and Dunn's multiple comparison test were used. Fisher's exact chi-square test was used to determine the correlations between categorical variables.

## Results

Questionnaire forms were distributed to a total of 2144 accessible high school students, and 1953 students answered the question inquiring their grades. Accordingly, the students were in the 9th

(42% ),10th (29.4%), 11th (15.9%), and 12th (3.8%) grades, while 57.3% of the study group consisted of female students (Table 1). Accordingly, the mean total score was  $18.51 \pm 3.6$ . (range: 7-28) points). The highest mean score was obtained by the answer to the last question (How long does it take for you to feel fully awake after you get up in the morning?). A total of 2135 people answered this question and 35.1% of the cases indicated a delay of more than 40 minutes. When the relationship between total scale score and gender was evaluated, it was seen that boys obtained statistically significantly higher scores than girls ( $p = 0.000$ ). Table 2 shows the rate of the most common answers to the questions. When the gender and the questions were correlated one by one it was found that boys marked c and d options more significantly in the first, third, seventh, eighth and ninth questions, and girls significantly marked c and d options in the second question. Table 3 shows the relationship between gender and answers. There was no significant difference between the scale scores and the grades of the students ( $p = 0.452$ ). When the relationship between the grades and the survey questions was evaluated, it was seen that in higher grades c and d options of the 4th question were ticked, in other words the evening hours were more frequently preferred in higher grades ( $r = 0.086, p = 0.000$ ). Still in higher grades as responses to the 8th question (When your body starts to warn you that it is time to go to sleep?) more frequently a and b options (between 8 and 10 o'clock in the evening) were ticked ( $r=-0.065, p = 0.004$ ) (Table 4).

**Table 1.** Demographical features of patients

Feature	N (%)
<b>Class</b>	N=1953
9	900 (42%)
10	631 (29.4%)
11	340 (15.9%)
12	82 (3.8%)
<b>Age</b>	N=2112
14	211 (9.8%)
15	981 (95.7%)
16	565 (26.4%)
17	290 (13.5%)
18	56 (2.6%)
19	8 (0.4%)
20	1 (0.0%)
<b>Gender</b>	N=2123
F	1229 (57.3%)
M	894 (41.7%)

**Table 2.** The highest response rates given to the questions

Question number	Answers	N
Q1	"b"	813/2137 (%37.9)
Q2	"b"	823/2133 (%38.4)
Q3	"c"	794/2131 (%37)
Q4	"c"	1050/2130 (%49)
Q5	"b"	614/2118 (%28.6)
Q6	"c"	1014/2083 (%47.3)
Q7	"b"	1023/2128 (%47.7)
Q8	"c"	1097/2125 (%51.2)
Q9	"a"	921/2144 (%43)
Q10	"d"	753/2135 (%35.1)

**Table 3.** The relationship between gender and answers

Questions	p	Correlation coefficient	Commentary
1	0.000	0.139	Boys indicated more "c and d" options than girls
2	0.000	0.124	Boys indicated more "c and d" options than girls
3	0.000	0.180	Boys indicated more "c and d" options than girls
7	0.017	0.052	Boys indicated more "c and d" options than girls
8	0.005	-0.061	Boys indicated more "a and b" options than girls
9	0.001	0.074	Boys indicated more "c and d" options than girls

**Table 4.** Relationship between classes and answers

Question	p	Correlation coefficient	Commentary
4	0.000	0.086	More "c and d" options as the class grows
8	0.004	- 0.065	More "a and b" options as the class grows

## DISCUSSION

Circadian rhythm is a fundamental biological process that prepares the organism against predictable changes in the environment that occur during the twenty-four-hour process (9). The chronotype expresses the individual differences in circadian rhythm and effects the individual's quality of life which is being shaped by its significant impact on psychosocial and geographic factors, which are experienced in the form of morningness and eveningness stemming from endogenous biological rhythm (10, 11). In the population, morningness people sleep early, wake up early and show their maximum performance early in the day, whereas eveningness people go to bed late, wake up late and show their performance late in the day (12). Although clinical methods and questionnaire studies are being used in the determination of chronotype, the use of scale offers the opportunity to evaluate individuals from different aspects. The information, attitude and behavior scales used for the determination are being employed to quantify and then measure some subjective characteristics that can not be measured directly. The present study was performed to determine the awareness in the adolescent age group on the way to becoming an adult individual. Youth is the period of transition from childhood to adulthood with stages of rapid growth, development and maturation in terms of physical, biochemical, psychological and social aspects. In today's societies, young people face many biological and psychosocial health problems. The mismatch between this biological and social time in evening people is called social jetlag and leads to changes in health behaviors (13). In a study with 530 participants from 10 countries, ME was evaluated and morning types were significantly older, woke earlier, did their test earlier in the day (14) Increasing age was associated with reduced sleep time, waking earlier (15) For this reason, it seems more likely to detect eveningness in

studies conducted on the adolescent and young population. Especially in evening people, obesity, hypercholestoremia, Type 2 DM, hypertension and cardiovascular diseases are among the top ranked disorders, which are among important public health problems. Therefore, the study group was selected from high school students that are in the adolescent age group. In our study, it was seen with the answer given by the volunteers to the last question that evening is an important problem in this population. In a study, eveningness was associated with greater daytime sleepiness, greater depressive mood and more frequent substance use in university students, with sleep characteristics acting as important mediators in these relationships (12) The sleep problem in these cases is the most important problem. Three types of sleep disorders are described: sleep depth, poor sleep quality and weekend bedtime delay. In our study, the patients stated that they felt awake for more than 40 minutes when they woke up in the morning. Although the delayed sleep pattern is a behavioral condition in young people, it is known that they change the circadian rhythm and also disrupt the weekly sleep pattern (16). According to researches, when compared with morning people, evening people more frequently have smoking, and unhealthy eating habits, depressive mood, more stress, higher rates of type 2 diabetes, hypertension, LDL cholesterol, lead an inactive sedentary, and also irregular life style, and consume more often alcohol, caffeinated drinks. However, they have lower scores in health-related quality of life indicators such as asthma, ADHD, risk of cardiovascular disease, self control, and emotional stability (1). In another study conducted on adolescents, it has been shown that there is a positive relationship between physical health, mental health, self-esteem, family relationships and school-related works in morning people (17). In a study conducted on 280 adolescents aged 14-16 years where the effect of health-related quality of life which is a multidimensional structure consisting of physical, emotional, mental, social and behavioral components on chronotype was investigated, significantly higher health-related quality of life scores were noted in morning people (18) There are no clear decisive factors effective on the correlation between gender and daily rhythm (19). In our study, it was found that boys are prone to eveningness than girls and complain about waking up early when they go to school, and they say that they woke up in the morning with difficulty . Morningness is affected by gender and age in different ways. The most important reason for gender differences is the interaction of biological and socio-psychological factors. Circadian rhythm characteristics differ between boys and girls. (20) For example, when looking at the gender difference in circadian rhythm, eveningness causes more severe disorders in women. (21). In some studies, it has been reported that gender differences occur due to factors such as age, pubertal development and possible sociocultural differences. Age is a more important factor than sex (22). The impact of M / E increases with age, in men in their fourth decade of life, morningness is more common. In this study, it was observed that performances increased later in the day with age and tendency to go to bed early with age increased. In adolescent girls, higher rates of eveningness are observed, which are thought to be related to earlier pubertal development. The habit of eveningness decreases

at the end of the adolescent period, ie at the age of 18-20, and a shift to morningness is seen in youth and middle age (7). In higher grades, morningness becomes more prominent. Morning people are older and believe that they will be more successful if they do the tests earlier in the day and suffer from insomnia less frequently. With aging, sleep time decreases and working times prolong (15). Accordingly, sleepiness and fatigue are strongly associated with higher rates of earlier rise times (23, 24, 14). The study has some limitations. Because it was performed in a specific geographical region, its results can not be generalized to the whole country. Cultural differences are thought to be important. In addition, the lack of research on the body weights, life habits, physical activities and health status of these adolescents causes us to evaluate the physical and health implications of the concept of morningness/eveningness. These limitations may have led to conclusions different from those mentioned in the literature. However, the fact that the questions in the survey were answered individually by adolescents is an important detail and is thought to have a positive effect on the results of the study.

In conclusion, this study will raise awareness on the concept of morningness/eveningness and the factors affecting it, especially in adolescents and also it will contribute to the literature. Evening chronotype are independently associated with the risk of having emotional and behavioural problems in adolescents, intervention and prevention strategies should be directed to target both sleep and circadian factors.

**Informed Consent:** From the volunteer himself

**Compliance with Ethical Standards:** The research was carried out after approval from the Tepecik Training and Research Hospital Ethics Committee (No:2019/18-37, Date: 09.10.2019)

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept - DO, KE; Design - KE; Supervision - DO, KE; Fundings - KE; Materials - KA; Data Collection and/or Processing - DO, KE; Analysis and/or Interpretation - DO, KE; Literature Search - DO; Writing Manuscript - DO; Critical Review - DO, KE

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