The Relationship Between Chronotype and Impulsivity, Attention-Deficit Disorder, Internet, Social Media, and Smartphone Addiction

ABSTRACT

Background: The aim of our study is to investigate the relationship between chronotypes and impulsivity, attention-deficit disorder and smartphone, social media, and internet addiction in a sample of university students.

Method: The study was conducted at our university from May to July 2021. A total of 255 subjects were recruited in the study among the students from the medical faculty and the faculty of health sciences (departments of nutrition and dietetics, nursing, and physiotherapy and rehabilitation) of our university who received face-to-face education in 2020-2021. Sociodemographic data form, the Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale, Morningness–Eveningness Questionnaire, Barratt Impulsiveness Scale-11 Short Form, Young’s Internet Addiction Scale, Social Media Addiction Scale–Adult Form, and Smartphone Addiction Scale–Short Version were administered by the study investigators through face-to-face interviews.

Results: Among the students, the intermediate type was most common (n = 157) and the evening type was least common (n = 44). The chronotypes differed in terms of the time spent daily on smartphone and internet (P = .001 and P < .001). The evening types showed significantly higher mean scores on the Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale, Morningness–Eveningness Questionnaire, Barratt Impulsiveness Scale-11 Short Form, Young’s Internet Addiction Scale, Social Media Addiction Scale–Adult Form, and Smartphone Addiction Scale–Short Version when compared with other chronotypes. Female and male students showed comparable scores on all scales. Chronotypes were not different between genders.

Conclusions: The results of our study showed a greater frequency of smartphone, internet, and social media addiction among the evening types than in the other chronotypes. Greater impulsivity and attention problems as observed in the evening types may be predisposing these individuals to develop addiction to smartphone, internet, and social media.

Keywords: Chronotype, eveningness, internet addiction, social media addiction, smartphone addiction

Introduction

The biological activities of all organisms follow a certain rhythm. Chronobiology is the study of biological rhythms in many aspects, from the molecular level to their clinical manifestations. Humans have 2 chronotypes, namely morningness and eveningness, that differ in biological and behavioral rhythms such as sleep-wake cycle and timing of cortisol and melatonin secretion. While morning types go to bed and wake up earlier and perform better early in the morning hours, evening types sleep late and prefer evening hours for their activities.1 There is a phase difference of about 2 hours between the 2 chronotypes in terms of the onset of secretion of hormones including melatonin and cortisol and body temperature.2

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It has been found that morning types generally make healthier choices and are more satisfied with life overall than evening types. Additionally, certain chronotypes have been associated with mental disorders. Mood disorders have been reported to occur less commonly in morning types than in evening types. As such, morningness was suggested to be a protective factor against mental illnesses in general. A meta-analysis has found a higher rate of depressive symptoms among evening types compared to other chronotypes. Eveningness has also been associated with impulsivity and suicidal behavior. In another study, eveningness was more common in patients diagnosed with adult attention-deficit/hyperactivity disorder compared to controls.

The relationship between chronotypes and addiction has been known for many years. Evening types have been shown to have a greater tendency to smoke, consume alcohol, and use illegal substances. In recent studies, a higher prevalence of smartphone, Facebook, and internet addiction was reported in evening types than morning types. In the current study, the primary aim was to investigate the possible relationship of chronotypes with smartphone, Facebook, and internet addiction. The first hypothesis tested in the study was that technology addiction would be more common among the evening types than other chronotypes. Thus, we sought to contribute to the relevant literature by gaining further insight into the association of chronotypes and 3 types of technology addiction in a Turkish sample and to obtain regional data from Turkey, which is currently limited. The second hypothesis of the study was that evening types would be more impulsive and have greater attention and hyperactivity problems than other chronotypes, making them more prone to technology addiction.

On the other hand, it has been suggested that preferences for technology use may differ between genders. Females may be more prone to smartphone addiction. Facebook and internet addiction may be more common in males than in females. Unlike previous studies that focused on individual addictions, the present study aimed to reveal possible differences between genders by examining the relationship of chronotypes with internet, social media, and smartphone addiction in the same sample.

**Methods**

Approval was obtained from the ethics committee of SANKO University for this cross-sectional survey study (no. 2021/12-2, April 19, 2021). This study was conducted from May to July 2021 in SANKO University. A total of 298 university students receiving face-to-face education between 2020 and 2021 were contacted, and among them, 255 students from the medical faculty and the faculty of health sciences (departments of nutrition and dietetics, nursing, and physiotherapy and rehabilitation) who fully completed the questionnaires were included in the study (response rate 85%). Informed consents were obtained from all participants. Sociodemographic data form, the Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale (ASRS), Morningness–Eveningness Questionnaire (MEQ), Barratt Impulsiveness Scale–11 Short Form (BIS-11-SF), Young’s Internet Addiction Scale, Social Media Addiction Scale–Adult Form (SMAS-AF), and Smartphone Addiction Scale–Short Version (SAS-SV) were administered by the study investigators through face-to-face interviews. The students taking antidepressants or antipsychotics for any reason, as identified on face-to-face interviews, were excluded from the study. In addition, the students diagnosed with attention deficit hyperactivity disorder (ADHD) who were taking methylphenidate or atomoxetine and those who were diagnosed with bipolar disorder and psychotic disorder were also excluded.

The details namely age, gender, educational status, medical history, smoking status, and the patterns of smartphone and internet use of the participants were obtained using the sociodemographic data form generated by the study investigators.

Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale (ASRS): The ASRS is one of the scales that was developed by the World Health Organization to screen mental disorders. The scale consists of parts A and B. Part A contains 6 questions demonstrated to better predict ADHD symptoms and part B contains 12 questions. The questions intend to determine how often each symptom has occurred in the last 6 months and are scored from 0 to 4 points. Reliability and validity of a Turkish version of the scale have been demonstrated.

Morningness–Eveningness Questionnaire (MEQ): The MEQ is a self-report scale consisting of 19 items that question individuals about their lifestyles, sleep–wake patterns, and performance. Total scores range from 16 to 86; scores between 16 and 41 indicate “eveningness,” scores between 42 and 58 denote “intermediate types,” and scores between 59 and 86 indicate “morningness.” Validity and reliability of the MEQ have been demonstrated in the Turkish population.

Barratt Impulsiveness Scale–11 Short Form (BIS-11 SF): The BIS was developed by Barratt in 1995 and BIS-SF was generated by Spinella. The scale consists of 15 items and each item is assigned a score ranging from 1 to 4 points. The BIS-11-SF contains 3 subscales: non-planning impulsiveness, motor impulsiveness, and attentional impulsiveness. A Turkish adaptation of the scale was developed in 2013, with internal consistency reliability coefficients (Cronbach’s alpha) of 0.82 for the overall scale, 0.80 for non-planning impulsiveness, 0.70 for motor impulsiveness, and 0.64 for attentional impulsiveness.

Young’s Internet Addiction Scale: It is a 20-item, Likert type scale developed by Young to establish whether the respondent suffers from internet addiction and scores range between 0 and 5 points. Higher scores indicate greater internet addiction. The scale was adapted to the Turkish population by Bayraktar et al who reported a Cronbach alpha coefficient of 0.91.

**MAIN POINTS**

• This study investigated the relationship of chronotype characteristics impulsivity, attention-deficit disorder and smartphone, social media and internet addiction in a sample of university students.

• The results of our study showed a greater frequency of smartphone, internet, and social media addiction among the evening types than in the other chronotypes.

• Greater impulsivity and attention problems as observed in the evening types may be predisposing these individuals to develop addiction to smartphone, internet, and social media.

• The findings of the current study showed no difference between genders in terms of chronotypes. Daily duration of smartphone and internet use was also similar in both genders. There were no gender-related differences in internet, smartphone, and social media addiction.
Social Media Addiction Scale-Adult Form (SMAS-AF): The SMAS-AF was developed by Şahin and Yağcı (2017) with the aim to measure the social media addiction levels of adults. It is a 5-point Likert scale, consisting of 20 items. The lowest possible score is 20 and the highest possible score is 100. Factor analyses have shown that factor loadings of the scale range between 0.61 and 0.87.

Smartphone Addiction Scale-Short Version (SAS-SV): The SAS-SV was developed to measure the addiction of individuals to their smartphones. The tool is a 6-point Likert scale, consisting of a total of 10 items. Reliability and validity of a Turkish version of the scale have been demonstrated. The SAS-SV has a single factor structure and the scores range from 0 to 60 points. Higher scores indicate a greater risk for smartphone addiction. Overall, the scale was shown to have an internal consistency coefficient of 0.87.

Statistical Analysis
Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM SPSS Corp.; Armonk, NY, USA) was used to analyze the study data. For descriptive statistics, continuous quantitative variables were summarized as mean and standard deviation (minimum–maximum values), and frequency and percentage values were presented for qualitative variables. Whether the continuous variables followed a normal distribution was assessed using the Kolmogorov–Smirnov test. For comparisons among independent groups, the independent samples t-test and one-way analysis of variance (ANOVA) were used for continuous quantitative variables. For comparisons showing significant results on ANOVA, the groups were compared using Tukey’s multiple comparison test. The chi-square test was used to compare qualitative variables among the groups. The relationship between 2 continuous variables was evaluated using Pearson correlation analysis. A P value <.05 was considered statistically significant in all analyses.

Results
A total of 255 undergraduate students receiving face-to-face education at our university participated in this study on a voluntary basis. Of the participants, 135 (52.94%) were female, the mean age of the sample was 22.86 (1.93) years (min. 18 and max. 27), and 84 (32.94%) participants were current smokers. The average duration of daily internet use was 4.04 (2.12) hours (min. 1 and max. 12) and the average time spent on smartphone per day was 4.68 (2.24) hours (min. 1 and max. 14). A total of 151 (59.21%) students reported that their smartphone use affected their academic performance negatively. Among the students, 247 (96.86%) reported using their smartphones to browse internet, 231 (90.58%) to listen to music, 225 (88.23%) to visit social media platforms, 191 (74.90%) for their academic studies, 175 (68.62%) to watch movies, and 120 (47.05%) to play games.

Based on their responses to MEQ, 44 (17.25%) students were identified as evening types, 54 (21.17%) as morning types, and 157 (61.56%) as intermediate types. The data from all scales administered to the participants are presented in Table 1.

When the participants were divided into 3 groups according to their chronotypes, they differed in terms of time spent on smartphone and internet per day (P = .001 and P < .001). Analysis of variance analysis showed statistically significant differences among the chronotypes in ASRS, MEQ, SMAS-AF, BIS-11 SF, SAS-SV, and Young’s Internet Addiction Scale scores (P < .001) (Table 2). On “post hoc” analysis, the evening types showed significantly higher scores than the morning types and intermediate types on all scales (P < .001). Similarly, intermediate types showed significantly higher scores than morning types on all scales (Table 2). Statistically, smoking was significantly more common among evening types compared to other chronotypes (P = .008).

The associations between the students’ ASRS and BIS-11 SF scores and their SMAS-AF, SAS-SV, Young’s Internet Addiction Scale scores were examined according to the chronotypes. A positive correlation was found between ASRS and BIS-11 SF scores and SMAS-AF, SAS-SV, and Young’s Internet Addiction Scale scores in the intermediate and morning types (Table 3). A similar correlation was observed between ASRS scores and Young’s Internet Addiction Scale scores in the evening types. Additionally, BIS-11 SF scores were positively correlated with SAS-SV and Young’s Internet Addiction Scale scores in the evening types (Table 3).

There was no difference between male and female students in terms of chronotype characteristics (P = .965) (Table 4). Male students showed a significantly higher prevalence of smoking (P < .001). The duration of daily smartphone and internet use was not different between genders. No significant gender-related differences were found in the mean scores of ASRS, MEQ, SMAS-AF, BIS-11 SF, SAS-SV, and Young’s Internet Addiction Scale (Table 5).

Discussion
In this study, the relationship between individual chronotypes and attention-deficit disorder, impulsivity, and social media, smartphone and internet addiction were examined in undergraduate students. Of the participants, 44 (17.25%) were identified as evening types, 54 (21.17%) as morning types, and 157 (61.56%) as intermediate types. Thus, the most common chronotype in our sample was intermediate type. This finding is in line with the results of another study examining chronotype features of Turkish university students, which showed that the intermediate type was most common and the evening type was least common. In addition, similar to the data from the same study, the distribution of chronotypes was not different between males and females in the present study.

Our study showed that chronotypes are correlated with ASRS mean scores. The mean ASRS scores of the evening types were significantly higher when compared with those of morning and intermediate types. Likewise, the mean ASRS scores of the intermediate types

| Table 1. Mean Scores of the Scales Used in the Study | Mean (SD) | Minimum | Maximum |
|---|---|---|---|
| ASRS | 27.00 (9.99) | 0 | 66 |
| MEQ | 50.00 (9.61) | 21 | 71 |
| BIS-11 SF | 28.60 (7.09) | 15 | 54 |
| Young’s Internet Addiction Scale | 33.38 (17.28) | 0 | 83 |
| SMAS-AF | 37.57 (12.18) | 20 | 80 |
| SAS-SV | 28.14 (11.47) | 10 | 60 |

ASRS, Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale; MEQ, Morningness-Eveningness Questionnaire; BIS-11 SF, Barratt Impulsiveness Scale-11 Short Form; SMAS-AF, Social Media Addiction Scale-Adult Form; SAS-SV, Smartphone Addiction Scale-Short Version
were significantly higher than those of morning types. In one study involving 180 adult patients presenting to a psychiatry clinic for the first time and 33 healthy subjects, the prevalence of eveningness was found to be significantly higher in patients diagnosed with ADHD than in patients without ADHD and healthy controls. In another study, 27 individuals with adult ADHD were evaluated in terms of chronotypes. Delayed melatonin secretion in the pathophysiology of ADHD is thought to be associated with signs of hyperactivity and shifts in the circadian cycle.

In our study, the evening types showed higher impulsivity scores compared to other chronotypes. At the same time, the intermediate types showed greater impulsivity than the morning types. This finding closely matches the data from other studies reporting greater impulsivity in the evening types. In a study on 1000 subjects, of whom 500 were male, a negative correlation was found between mean MEQ and BIS-11 SF scores. Sleep disorders are prevalent in evening types. In a Finnish study analyzing survey data from 6858 individuals for the assessment of chronotypes and sleep patterns, evening types in both genders were reported to experience symptoms of insomnia and have nightmares more commonly compared to other chronotypes. Thus, sleep disturbances experienced by evening types may be the reason for their greater impulsivity. On the other hand, it is known that certain genes that are thought to be related to circadian rhythm (e.g., CLOCK, PER1, PER2, and PER3) can also affect the activity and levels of monoaminergic neurotransmitters. Some monoamines, such as serotonin, are associated with impulsivity. Therefore, eveningness may be directly correlated with impulsivity.
Addiction Scale scores were investigated by chronotype in this study. Impulsivity was correlated with smartphone, social media, and internet addiction in the morning and intermediate types. However, impulsivity was associated with smartphone and internet addiction but not with social media addiction in the evening types. The small number of evening types in our sample may have hindered our ability to detect a possible relationship between social media addiction and impulsivity in those individuals.

The evening types showed higher mean scores on ASRS than other chronotypes in our study. It is known that alcohol and substance use disorders and smartphone addiction are common in individuals with ADHD. Adolescents with attention problems were found to spend more time on smartphone. The presence of both attention problems and hyperactivity in the evening types may explain their tendency to develop addiction to internet, smartphone, and social media. In this study, the correlation of ASRS scores with SMAS-AF, SAS-SV, and Young’s Internet Addiction Scale and scores was investigated according to chronotype. As a result, ASRS scores were found to be correlated with internet, smartphone, and social media addiction in the intermediate and morning types. However, in the evening types, ASRS scores were correlated with internet addiction but not with social media and smartphone addiction. Again, the small number of evening types in our sample might have precluded our ability to determine a possible correlation between ASRS scores and social media and smartphone addiction in these subjects. The findings of our study indicate that the evening types are more impulsive, experience attention problems more commonly, and therefore, are more prone to smartphone, internet, and social media addiction. On the other hand, the evening types experience social jetlag. These individuals may be spending a lot of time on technological devices because they stay awake longer at night and cannot find people around them to socialize at nighttime and this may lead to a predisposition to social media, internet, and smartphone addiction among evening types. It is considered that the evening types develop mental disorders more commonly due to the frequent occurrence of sleep disturbances in these people. Increased prevalence of smartphone addiction is observed in certain mental disorders including depression. Increased occurrence of psychiatric disorders due to sleep disturbances may be creating a tendency for addiction in the evening types. On the other hand, decreased activation of medial prefrontal cortex in response to reward observed in the evening types may suggest a neural mechanism associated with addiction.

It is believed that preferences for technology use and related addiction may differ between genders. Women are considered to be more prone to smartphone addiction. There are some studies suggesting that Facebook addiction and internet addiction are more common among men than women. The findings of the current study showed no difference between male and female students in terms of chronotype. Daily duration of smartphone and internet use was also similar in both genders. ADHD and impulsivity levels were not different between female and male students. In contrast with the data from previous studies, no gender-related differences were found in internet, smartphone, and social media addiction.

A number of limitations should be noted for our study. First, we were not able to contact all of the students of our university due to the restrictions imposed by the pandemic and only the students receiving face-to-face education were included in the study. Second, given the fact that eveningness increases the susceptibility to mental disorders, the lack of a mental state assessment that would have been performed for the participants is an important limitation of the study. Alcohol and substance use were not questioned in the study and this can be regarded as a limitation considering the possible association between chronotypes and addiction. Lastly, the study was conducted only on university students and this prevents extrapolation of the study results to the general population.

Despite these limitations, we believe that this study adds valuable data to the relevant literature because (1) there are only 3 studies from Turkey examining chronotype-technology addiction relationship (one study each for smartphone, Facebook, and internet addiction) in different samples and this is the first study to investigate these 3 types of addiction in a single sample; (2) for the first time, gender-related differences in 3 types of addiction were also sought in this study in a single sample; and (3) this study showed that impulsivity and attention-deficit disorder occur more commonly in the evening types, and therefore, eveningness may increase the likelihood for developing technology addiction; this is the first study to also take into account attention-deficit disorder.

In conclusion, the data obtained from the present study suggest that chronotype should be evaluated individually for persons seeking assistance.
treatment for addiction to internet, social media, or smartphone (or all 3) and considered as a factor in treatment decisions. The study findings may contribute to the literature by providing regional data, which is scarce in Turkey, on chronotype and its relationship with technology addiction. Evidence from published studies suggests that technology addiction differs between genders. This was not confirmed by our study and needs to be assessed in large samples from different backgrounds and cultures, possibly allowing generalization of the data to the general population.

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