



Effect of Online Learning During the COVID-19 Pandemic on Tension-Type Headache, and Anxiety Among Medical Students

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Abstract

Aim: Screen exposure can lead to numerous health problems, such as headaches, in students. This study aimed to investigate the impact of online learning on tension-type headache (TTH) and its association with anxiety among medical students who attended online classes during the novel coronavirus disease-2019 pandemic.

Methods: This cross-sectional study was conducted between June 1 and 15, 2021, among preclinical medical students at the Ataturk University Faculty of Medicine in Erzurum. The data were collected via an online survey. Sociodemographic features and characteristics of online classes and headaches were collected. Anxiety levels were measured using the generalized anxiety disorder test-7 (GAD-7) scale. Questions for the preliminary diagnosis of TTH were prepared based on the International Classification of Headache Disorder Diagnosis.

Results: The mean age of the participants was 20.6 ± 3.0 years, and 52.2% ($n=297$) were women. Tension-type headaches affected 323 (56.8%) students, while 246 (43.2%) had no headaches. In addition, 41.3% ($n=135$) of the participants with TTH reported experiencing headaches after online classes, and 47.1% ($n=154$) of those with TTH stated that their headache intensity increased after online classes. The mean GAD-7 score was 11.2 ± 5.2 among the participants with TTH, compared to 8.7 ± 5.2 among those with no headache ($p < 0.01$). Significant differences were observed between the groups in terms of daily screen time ($p = 0.019$), GAD-7 score ($p < 0.001$), and gender ($p < 0.001$).

Conclusion: The study findings indicate that TTH is common in medical students during online learning. Efforts should be made to educate students on screen use, and stress reduction programs should be included in the curriculum.

Keywords: Online learning, tension-type headache, medical student, screen time, anxiety

Introduction

The novel coronavirus disease-2019 (COVID-19) caused a global pandemic in March 2020 (1). Millions were infected and died during the pandemic, and COVID-19 poses a serious worldwide threat to public health (2). The COVID-19 pandemic has also led to radical changes in global education systems. As educational institutions closed down, the severe acute respiratory syndrome Coronavirus-2 pandemic resulted in the imposition of e-learning in medical education. Many countries have

resorted to online classes to reduce the rate of transmission of the virus (3).

Clinical rotations were canceled or replaced during the pandemic, and exams were temporarily suspended or conducted online. The epidemic quickly transformed traditional face-to-face teaching into an online classroom activity. While university courses were held online, educational activities, including meetings, continuous professional development activities, congresses, assignments, projects, presentations, and exams, were also moved to the online platform (4,5). This new training



system resulted in additional time spent in front of a digital device. In our previous study, 94% of medical students reported that the time they spent in front of the screen increased during the pandemic (5).

Prolonged exposure to these devices can lead to numerous health problems in students, such as headaches, eye strain, anxiety, neck and back pain, and sleep disorders (6). Perez-Dominguez et al. (7) concluded that while screen time differed across the countries surveyed, students' mental and physical health was adversely impacted (backache, eye fatigue, etc.). One of the health-related consequences of online learning is headache. The most common type in the general population is tension-type headache (TTH), the second most common disease worldwide (8).

Stress and posture are known causal factors, while modern living conditions also impact headaches. The increased use of digital technologies has also recently been linked to headaches (9). Patients with TTH typically suffer from mild or moderate bilateral compression-type pain attacks with no worsening caused by physical activity, lasting from 30 minutes to seven days. No nausea or vomiting occurs, although autophobia or phonophobia may be present. According to the IHS, patients experiencing at least 10 headache episodes with these characteristics are diagnosed with TTH. Tension-type headaches occurring once or less per month are classified as sparse episodic, and TTH occurring on more than one but fewer than 15 days a month are classified as frequent episodic. Chronic TTH is defined as headaches on 15 or more days a month (10).

Tension-type headaches adversely affect mental skills such as memory, attention, concentration, and reading (11). Factors affecting TTH development include mental stress, sleep problems, hormonal fluctuation, postural tension, and forward head posture (12). Headache-related absenteeism from the workplace on several occasions a year is reported in 10% of individuals with TTH (13).

During the COVID-19 pandemic, lockdowns, restrictions, and quarantine aimed at preventing the spread of the disease, the closure of university campuses and public areas such as cinemas, gymnasiums, and cafes, the transition from face-to-face education to distance education, and students continuing their education from home prevented them from socializing and resulted in stress and anxiety. Both the use of distance courses and students' quest for self-learning, knowledge, and socialization on social media and online platforms have led to an unprecedented use of technological devices and an inevitable increase in screen time (4). Spending extended periods in front of screens due to online learning, which became mandatory in medical schools with the COVID-19 pandemic, can contribute to the development of TTH

by causing postural abnormalities, sleep problems, and stress. Understanding the relationship between medical students' online education experiences and headaches will allow the development of preventive strategies. To the best of our knowledge, no previous studies in Turkey have investigated the frequency of TTH in online learning among medical students.

This study investigated the impact of online learning on TTH and the association with anxiety among medical students who attended online classes during the COVID-19 pandemic.

Methods

Ethics Approval and Consent to Participate

Ethical permission for the study was obtained from the Ataturk University Faculty of Medicine Ethical Committee (IRB number B.30.2.ATA.0.01.00/250-03/26 dated 15.04.2021). The study was conducted following the principles of the Declaration of Helsinki. All participants in this study signed an informed consent form.

Study Design

This cross-sectional study was conducted between June 1 and 15, 2021, among preclinical medical students at the Ataturk University Faculty of Medicine in Erzurum, Turkey. The study population consisted of 930 preclinical students at the Ataturk University Faculty of Medicine.

Medical training in Turkey lasted six years, the first three of which are known as the preclinical period. As of June 2021, preclinical semester student education was provided solely online. No face-to-face educational activities were held, such as theoretical courses, laboratory and practical applications, exams, assignments and projects, student congresses, meetings, or elective courses. Only preclinical semester students who took all relevant courses online were included in the study. Students in the clinical period who attended face-to-face courses were excluded.

Participants and Data Collection

The students were informed about the aim of the study and were then invited to participate. One hundred twenty-eight students did not respond. Thus, data were collected from 802 students, with a survey response rate of 86.2%. Of these, 54 forms were excluded from the analysis because they were incomplete or left unfinished. One hundred seventy-nine participants with migraine symptoms and other types of headaches were also excluded. All the excluded students with migraines and other types of headaches were referred to a neurologist. The final analysis thus involved complete data from 569 students (Figure 1).

The data was collected via a web-based survey created using Google Forms. The survey questions were prepared by the researchers based on previous literature.

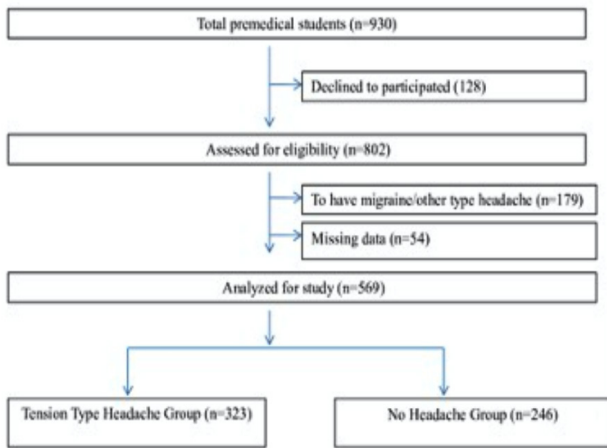


Figure 1. Flow chart of the participants

The survey was piloted with 20 students before being finalized. The students were invited to participate in the study through WhatsApp® groups. The survey link was shared with the students via WhatsApp® groups specific to preclinical students. Participation was entirely based on voluntary consent. The students were allowed two weeks to respond to the survey. Two reminder messages were sent during that time on a weekly basis. No questions required any personal information to be given. The first item in the survey was “I voluntarily consent to participate in the study”, and students could not move on to the questions without responding. Online consent was thus obtained. The data collection was terminated after two weeks.

The data collection tool consisted of four parts: (1) socio-demographic features; (2) questions about online classes; (3) questions about headaches; and (4) the generalized anxiety disorder test-7 (GAD-7).

The sociodemographic questions consist of concerning age, gender, class, the online class linking tool employed, the device screen size, and daily screen time.

To establish a preliminary diagnosis of TTH, students were asked whether they experienced headaches and, if so, when these headaches started, their frequency, character, and duration, the severity of the pain, and accompanying findings. Questions for the preliminary diagnosis of TTH were based on the International Classification of Headache Disorder Diagnosis (10).

The GAD-7 measured the participants’ anxiety levels. This valid and reliable tool for scaling generalized anxiety disorder was developed in 2006 by Spitzer et al. (14). It was subsequently adapted to Turkish by Konkan et al. (15). Generalized anxiety disorder test-7 investigates participants’ symptoms related to anxiety over the past two weeks. It is answered and scored on a 4-point Likert-type scale (0=almost nothing, 3=almost

every day). Possible scores ranged between 0 and 21. At a cut-off score ≥ 10 , the GAD-7 has 89% sensitivity and 82% specificity in determining generalized anxiety disorder (14). The Cronbach’s alpha value in this study was 0.86.

Each student was allowed to complete the questionnaire only once. No questions required the students to identify themselves. The data were checked by two researchers following online collection.

Statistical Analysis

Statistical Package for the Social Sciences version 20.0 software (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Numerical variables are expressed as the mean and standard deviation, and categorical variables are expressed as numbers and percentages. Numerical data were analyzed for the normal distribution using skewness. The independent sample t-test and chi-square test were used to analyze the differences between the two groups in terms of outcome measurements. P-values < 0.05 were regarded as statistically significant.

Results

Five hundred and sixty-nine preclinical medical students were included in the study. The participants’ mean age

Table 1. Descriptive characteristics of the study group	
Characteristics	n (%)
Gender	
Female	297 (52.2%)
Male	272 (47.8%)
Electronic device used for online classes	
Laptop computer	341 (59.9%)
Desktop computer	52 (9.1%)
Smartphone	144 (25.3%)
Tablet	32 (5.6%)
Daily screen time	
1-3 hours	115 (20.2%)
4-7 hours	161 (28.3%)
8-10 hours	180 (31.6%)
>10 hours	113 (19.9%)
Headache type	
TTH	323 (56.8%)
No headache	246 (43.2%)
GAD-7 Score	
Anxiety	296 (52%)
No anxiety	273 (48%)
	Mean \pm SD
Age (years)	20.6 \pm 3.0
GAD-7 Score	10.1 \pm 5.3
GAD-7: General anxiety disorder-7, TTH: Tension-type headache	

was 20.6 ± 3.0 years, and 52.2% (n=297) were female. Additionally, 52.4% (n=298) were in year 1, 3.5% (n=20) were in year 2, and 44.1% (n=251) were in year 3.

Tension-type headaches were reported in 323 (56.8%) students, while 246 (43.2%) reported no headaches. In addition, 41.3% (n=135) of the participants with TTH reported headaches after online classes. A further 47.1% (n=154) of the participants with TTH reported worsening the intensity of their headaches after online classes. Other descriptive characteristics, including headache symptoms and anxiety scores, are summarized in Table 1.

A comparison of the TTH group and the headache group is presented in Table 2. Statistically significant differences were observed between the groups in terms

of daily total screen time, GAD-7 scores, and gender ($p < 0.05$). The mean GAD-7 score was 11.2 ± 5.2 in the participants with TTH and 8.7 ± 5.2 among those with no headache ($p < 0.01$).

The relationship between daily screen time and TTH is shown in Table 3. When the groups were compared in themselves, TTH was significantly higher in students with daily screen times of 8-10 hours or over 10 h ($p = 0.001$ and $p = 0.006$, respectively).

Discussion

Long-term screen use is a known trigger factor in the emergence of headaches (16). More than half

Table 2. Comparison of the TTH and non-TTH groups in terms of different variables

Characteristics	TTH (n=323) n (%)	No headache (n=246) n (%)	p (χ^2)
Academic year			
1	180 (60.4%)	118 (39.6%)	0.96
2	13 (65%)	7 (35%)	
3	130 (51.8%)	121 (48.2%)	
Electronic device used for online classes			
Laptop	205 (60.1%)	136 (39.9%)	0.116
Desktop	23 (44.2%)	29 (55.8%)	
Smartphone	76 (52.8%)	68 (47.2%)	
Tablet	19 (59.4%)	13 (40.6%)	
Screen size			
4-7 inches	75 (54.4%)	62 (45.6%)	0.188
8-11 inches	25 (51%)	24 (49%)	
12-14 inches	90 (63.8%)	51 (36.2%)	
15-18 inches	114 (57.3%)	85 (42.7%)	
>18 inch	20 (45.5%)	24 (54.5%)	
GAD-7 Score			
Anxiety	193 (65.2%)	103 (34.8%)	<0.001*
No anxiety	130 (47.6%)	143 (52.4%)	
Gender			
Female	201 (67.7%)	96 (32.3%)	<0.001*
Male	122 (44.9%)	150 (55.1%)	

GAD-7: General anxiety disorder-7, TTH: Tension-type headache, * $p < 0.05$

Table 3. Relationships between students' daily screen times and TTH

Characteristics	TTH (n=323) n (%)	No headache (n=246) n (%)	p-value (one sample χ^2)	p-value (χ^2)
Daily total screen time				
1-3 hours	64 (55.7%)	51 (44.3%)	0.225	0.019*
4-7 hours	76 (47.2%)	85 (52.8%)	0.478	
8-10 hours	112 (62.2%)	68 (37.8%)	0.001**	
>10 hours	71 (62.8%)	42 (37.2%)	0.006**	

TTH: Tension type headache, **One sample χ^2 test (< 0.05); * χ^2 (< 0.05)

(60%) of the students in this study had TTH. Symptoms commenced after online education in 41% of students, and the intensity of existing TTH also worsened after online learning in 47%. Anxiety was also high among preclinical medical students. This percentage is quite high and indicates that TTH and anxiety are prevalent among students. Our findings are consistent with the results of studies focusing on the relationship between screen time and headaches (17-19).

The global use of computers and the internet is increasing rapidly. However, excessive screen use has been shown to cause different types of headaches, fatigue, sleep problems, dizziness, neck and back pain, memory and learning difficulties, social isolation, depression, anxiety, and internet addiction (20).

Previous studies in the pediatric age group have reported that computer use (gaming, social media use, and internet use) is one of the primary triggers of recurrent headaches in children (21). On the other hand, a recent study has shown that online education may be more effective and has numerous advantages for medical students. In recent years, there have been an increasing number of recommendations for online education in undergraduate medical programs (22). However, it is important to note that these recommendations also imply that health problems associated with excessive computer use may become significant in the coming years. Therefore, while online education offers several benefits, it is crucial to address potential health concerns and implement strategies to mitigate the negative effects of prolonged computer use on medical students' well-being.

Smartphone use exceeding three hours has increased headaches by causing secondary insomnia and fatigue at night. Playing on computers for more than four hours a day was associated with headaches in a study of adolescents in Brazil. The results of this study showed that more than 80% of students reported any type of primary headache that is related to excessive use of electronic devices and video games (23).

A study from China found that computer use exceeding 8 hours per day was associated with headaches. This cross-sectional study revealed a high prevalence of TTH among information technology staff, and the prevalence of TTH was higher than in the general Chinese population. In conclusion, excessive computer use was identified as a significant risk factor for TTH (24). These findings highlight the importance of addressing the impact of computer use on a person's health and implementing measures to mitigate the risk of TTH in this population.

No significant relationship was determined between the type of electronic device used for connecting to online learning, the size of the screen, and TTH in the present

study. However, an important relationship was found between screen time and TTH. Tension-type headaches were significantly higher in students with daily screen times of 8-10 hours or over 10 hours. Similar results were obtained in previous studies evaluating the relationship between screen time and headaches. A study from Iceland found a significant correlation between screen time and headaches in a large pediatric age group sample. In this study, the risk of headaches increased in students with a screen time exceeding two hours, and the risk increased 1.6-2 times when the screen time exceeded four hours (25). A study of 2276 students in nine countries found that students spent 8.7 hours a day in front of screens. Physical health symptoms such as back pain, irritability, and emotional imbalance also occurred or increased in these students (7). In the study by Abou Hashish et al. (19) with 353 students from the Saudi University medical, nursing, and health college, it was determined that there was a positive and significant relationship between the duration of screen exposure and headache. In the same study, it was also shown that more than half of the participants had a high screen exposure time, and students who were not satisfied with the online learning environment had more headaches (19).

A quarter of the students in this study used smartphones to connect to online learning. Due to their multifunctional features, smartphones are currently used for internet access, participation in social networks, and digital gaming rather than simply making phone calls. Smartphones can lead to problems such as headaches, neck and shoulder pain, posture and musculoskeletal problems, eye problems, and anxiety. A clinical study among adolescents reported that greater smartphone use was associated with more sleep problems and higher levels of depressive symptoms (26).

Tension-type headaches are a common neurological condition found to be associated with sleep dysfunction. Numerous studies have provided evidence for the connection between TTH and various sleep disturbances (27). In our previous study, symptoms of insomnia were found to be present in 24% of medical students during the pandemic (28). Although we did not evaluate sleep problems, phone use was also high in the current study.

In a study involving 549 students from 31 public medical schools in Germany, Michaeli et al. (29) reported headaches in 33% of students who studied online during the pandemic, with a prevalence of anxiety of 48%. The prevalence of anxiety in their research was similar to that in this study. However, the frequency of headaches was much higher than that in this study. They reported a significant relationship between daily screen time and headache and that each additional hour spent in front of the screen increases the likelihood of headaches by

1.09 times. Preclinical students also experienced more headaches than clinical training students (29).

Our study involved only preclinical students, and no difference was observed between the three academic years in terms of TTH. Rafi et al. (30), in their study with 2352 university students, showed that high screen time and anxiety were risk factors for headache.

It has been shown that reasons such as internet connection problems, distraction due to the learning environment, sleep problems, and a lack of communication in online learning cause stress in students (17,31,32).

More than half of the students in this study had anxiety symptoms. In our previous studies conducted in the early stages of the pandemic, we found the frequency of anxiety to be 70% in medical students and 40% in the general population (5,33).

In the current study, GAD-7 scores were significantly higher in students with TTH than in non-headache groups. Studies have reported significantly higher anxiety scores in individuals with TTH than in control groups (34). Anxiety increases the perception of pain, while pain causes anxiety (35). While social distancing and restrictions have increased anxiety in the COVID-19 pandemic, increased screen time has also been identified as a factor exacerbating the risk of anxiety (36). Approximately 80% of the students in this study spent more than four hours a day in front of their screens. Long screen times and restrictions imposed due to the pandemic may have also had an impact on our students' anxiety scores.

Study Limitations

There are some limitations to this study. First, it was conducted with preclinical students at a single medical school. The results cannot be generalized to all medical school students. Face-to-face interviews with the students were impossible because of the pandemic, and the data were therefore collected via a web-based survey. However, the online sampling technique can cause under- or over-reporting compared to self-selection and other methods. The GAD-7 scale, which evaluates anxiety, is also a self-assessment tool, and the results are based on the students' self-reports. Finally, since there was no control group in our study, the causality between online learning and TTH cannot be interpreted definitively. Nonetheless, this study demonstrates a relationship between TTH and online education among medical students, a subject that has not been previously studied.

Conclusion

The results of this study suggest that online education during the COVID-19 pandemic may cause TTH in medical students and that there is a potential association between online learning and the exacerbation of TTH symptoms.

Considering the relationship between headaches and screen time, keeping online lesson times short, interrupting classes at appropriate intervals, and resting the eyes regularly may be beneficial. Taken together, these findings underscore the need for targeted interventions and support mechanisms to mitigate the negative impact of online learning on the well-being of medical students. The results of this study may guide remedial interventions in the prevention and reduction of headaches due to screen exposure in online learning environments. Future research should explore the underlying mechanisms linking online classes, TTH, and anxiety to inform the development of effective strategies for promoting student health and academic success in the context of remote education.

Ethics

Ethics Committee Approval: Ethical permission for the study was obtained from the Ataturk University Faculty of Medicine Ethical Committee (IRB number B.30.2.ATA.0.01.00/250-03/26 dated 15.04.2021).

Informed Consent: All participants in this study signed an informed consent form.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Concept: E.C.T., N.B., Y.C., Design: E.C.T., N.B., Y.C., Data Collection or Processing: E.C.T., Y.C., Analysis or Interpretation: Y.C., Literature Search: E.C.T., N.B., Y.C., Writing: E.C.T., N.B., Y.C.

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