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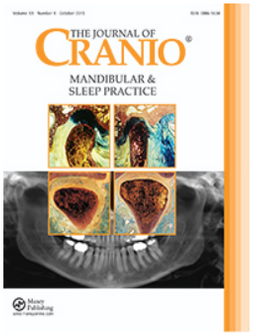

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The association between sleep quality, depression, anxiety and stress levels, and temporomandibular joint disorders among Turkish dental students during the COVID-19 pandemic

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ABSTRACT

Objective: This study aimed to examine the association between sleep quality, depression, anxiety and stress levels, and the frequency of temporomandibular disorders in a sample of Turkish dental students during the COVID-19 pandemic.

Methods: The current cross-sectional study was conducted with 699 dental university students during the COVID-19 pandemic. Fonseca Anamnestic Index (FAI), Pittsburgh Sleep Quality Index (PSQI), and Depression Anxiety Stress Scale-21 (DASS-21) were used in the present study.

Results: The incidence of temporomandibular joint disorders in the present study was found to be 77.5%. Female students' FAI scores were found to be statistically significantly higher than males ($p < 0.05$). Additionally, higher depression and anxiety and stress levels caused increased PSQI and FAI scores.

Conclusion: During the COVID-19 pandemic, increased temporomandibular joint disorders were observed with increased impaired sleep quality and higher depression, anxiety and stress levels among dental university students.

KEYWORDS
COVID-19; pandemics; temporomandibular joint disorders; depression; sleep

Introduction

Novel Corona Virus Disease (COVID-19; Wuhan, China) has resulted in a worldwide emergency. The virus has rapidly infected people [1]. The pandemic has resulted in a big worldwide problem, not only for the loss of life but also the social and economic impacts. The COVID-19 pandemic caused changes in people's daily routines, causing concerns about their health and well-being. In Turkey, as in other countries, social distancing, travel bans, closure of schools, and changes in business practices have affected daily life significantly. The COVID-19 pandemic can also cause negative changes in health attitudes, such as smoking, alcohol use, physical activity, and sleep patterns. Due to the pandemic, after the restriction of physical distancing, common areas such as gyms, park areas, and beaches, where people are physically active, are prohibited. Several studies have shown that low physical activity negatively affects individuals' psychology [2,3]. In addition, higher levels of depression, stress, and anxiety have been associated with poorer sleep quality [4].

Temporomandibular joint disorder (TMD) is characterized commonly by pain in the temporomandibular area and related masticatory muscles, limitations in jaw function, and temporomandibular joint (TMJ) sounds during jaw movement [5,6]. Several studies in different populations show a wide-ranging variation in TMD prevalence and TMD symptoms. This may be caused by different study designs, measurement instruments, and different methods to determine the presence of TMD. Fonseca's Anamnestic Index (FAI) is commonly used to diagnose TMD in a non-patient population because it is reliable and easy to apply. The etiology of TMD is known as multifactorial. Studies have indicated that poor posture, stress and anxiety levels, and sleep disorders are among the risk factors for TMD [7,8]. Patients' health status and quality of life can be affected by poor sleep quality, which can be an etiological factor in TMD patients [9,10]. Several studies have reported a relationship between TMD and sleep disorders [11,12]. The Pittsburgh Sleep Quality Index (PSQI) is mainly used to evaluate subjective sleep quality [13,14]. This survey has been proven to be a reliable method for

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determining the nature and severity of sleep disturbance [13,15].

Stress and psychological factors also have a powerful role on TMD. Academic work, personal problems, environment, time, and economic situations cause stress in university students. In the current situation, during the COVID-19 pandemic, worries about becoming infected, increase in the number of cases, fear of death, lack of belief in the health system, lack of information, and misinformation have created a more stressful environment that may even affect sleep quality and daily activities [16,17]. Moreover, quarantined individuals especially may experience loneliness and anger more dominantly due to losing their social connections [18]. High levels of stress and anxiety also occur in healthcare professionals, mostly females [17,19]. It is well established that there is a positive correlation between psychological disturbances and temporomandibular disorders [20,21].

The specific aims of this study were to characterize the effect of the COVID-19 pandemic on the change in sleep quality, stress and anxiety levels, and their relationship with temporomandibular disorders in dental students.

Materials and methods

The study was approved by Istanbul Medipol University Local Ethics Committee (2020/400). The current cross-sectional study was carried out on 735 randomly selected dental student volunteers from Beykent University School of Dentistry and Medipol University School of Dentistry from May 2020 to July 2020. After exclusion, 699 dental students were included in the present study. All of the volunteers provided written consent to participate in the study. In the present study, 35.3% (n = 247) of participants were male, and 64.7% (n = 452) were female. The average age was 21.31 ± 1.89. The Fonseca Anamnestic Index (FAI) was used to diagnose temporomandibular disorders. A Turkish version of the Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality; a Turkish version of the Depression Anxiety Stress Scale-21 (DASS-21) was used to assess depression, stress, and anxiety levels.

Fonseca Anamnestic Index (FAI)

The FAI was developed to diagnose TMD according to individuals' signs and symptoms. This index consists of 10 questions with three response options: "yes" (10 points), "sometimes" (5 points), and "no" (0 points). The score is determined for the following classifications: absence of signs and symptoms of TMD (0–15 points), mild TMD (20–45 points), moderate TMD (50–65 points), and severe TMD (70–100 points) [5,22].

Pittsburgh Sleep Quality Index (PSQI)

The PSQI includes seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction [6]. The Turkish-language version of the PSQI was used in the present study. The score for each subgroup ranges from 0 to 3. The sum of these scores yields one global score of subjective sleep quality (range: 0–21). The sleep quality of those with a total score of ≤5 is considered "good" and those >5 is "poor" [13,23].

Depression Anxiety Stress Scale-21 (DASS-21)

The DASS-21 scale, developed by Lovibond and recommended by the Australian Psychological Association, consists of three self-report scales designed to measure the emotional states of depression, anxiety, and stress [24]. Each of the three scales contains 7 items, divided into subscales with similar content. This scale is used to determine the level of negative emotional states specified. Psychometric properties of the DASS-21 scale and other suitability with tests has been demonstrated [25]. The Turkish language version was used in this study [26] and applied to all patients to reveal their psychological status during the COVID-19 pandemic.

Statistical analysis

The IBM Statistical Package for Social Sciences (SPSS) version 22 (IBM Corp., Armonk, NY, USA) software program was used for this study. The Shapiro Wilks test was used for evaluating the relevance of the parameters to normal distribution. While evaluating the study data, the Kruskal Wallis test was used for both comparing the descriptive statistical methods (mean, standard deviation, frequency) and the parameters that did not show a normal distribution. The Mann Whitney U test was used for the comparison of the quantitative data and comparisons of non-normally distributed parameters between two groups. Pearson's correlation analysis was used to examine the relationships between parameters that are compatible with normal distribution, and Spearman's rho correlation analysis was used to evaluate the relationships between parameters that do not show normal distribution. The significance was evaluated as $p < 0.05$.

Results

In this study, a survey was collected from 735 dental students. Thirty-six (4.9%) students with systemic diseases were excluded from the study; therefore, the study was conducted with 699 dental students. The demographic characteristics are shown in Table 1. The results of the frequency of anxiety, stress, depression, temporomandibular joint disorders, and sleep quality in dental students are shown in Table 2. The correlations between all scores (anxiety, depression, stress, FAI, and PSQI results) are shown in Table 3. Anxiety, depression, and stress scores of female students were found to be statistically significantly higher than male students ($p < 0.05$). Although, female students' FAI scores were found to be statistically significantly higher than males, ($p < 0.05$), there was no statistically significant difference between PSQI scores according to gender ($p > 0.05$) (Table 4). When the results of all scores were evaluated according to age, a statistically significant correlation was found between age and stress scores (p: 0.010; $p < 0.05$) (Table 5).

There was a statistically significant difference between the grades of students in terms of anxiety scores (p: 0.000; $p < 0.05$). As a result of the comparisons, the anxiety levels of 5th grade students were significantly higher than 1st grade, 2nd grade, 3rd grade, and 4th grade students ($p1$: 0.000; $p2$: 0.031; $p3$: 0.003; $p4$: 0.039).

Table 1. Descriptive demographics of dental students.

Gender	Male	247 (35.3%)
	Female	452 (64.7%)
Age (Mean ± SD)		21.31 ± 1.89
Civil status	Single	695 (99.4%)
	Married	4 (0.6%)
Grade	1	149 (21.3%)
	2	205 (29.3%)
	3	149 (21.3%)
	4	87 (12.4%)
	5	109 (15.6%)

Table 2. The frequency of depression, anxiety, stress, temporomandibular disorders, and sleep quality in dental students during the COVID-19 pandemic.

		Dental Students
		n (%)
DASS-21 Anxiety	Normal	488 (69.8%)
	Mild	69 (9.9%)
	Moderate	106 (15.2%)
	Severe	33 (4.7%)
	Extremely Severe	3 (0.4%)
DASS-21 Depression	Normal	509 (72.8%)
	Mild	112 (16%)
	Moderate	68 (9.7%)
	Severe	10 (1.4%)
DASS-21 Stress	Normal	619 (88.6%)
	Mild	51 (7.3%)
	Moderate	29 (4.1%)
TMD	Absent	157 (22.5%)
	Slight	308 (44.1%)
	Moderate	153 (21.9%)
	Severe	81 (11.5%)
PSQI	Good sleep quality	685 (98%)
	Poor sleep quality	14 (2%)

DASS-21: Depression, Anxiety, Stress Scale-21; TMD: Temporomandibular joint disorders; PSQI: Pittsburgh Sleep Quality Index.

Table 3. The correlations between total scores.

		Anxiety	Depression	Stress	FAI	PSQI
Anxiety	r	1.000	0.510	0.532	0.238	0.108
	p	.	0.000*	0.000*	0.000*	0.004*
Depression	r	0.510	1.000	0.603	0.217	0.130
	p	0.000*	.	0.000*	0.000*	0.001*
Stress	r	0.532	0.603	1.000	0.272	0.100
	p	0.000*	0.000*	.	0.000*	0.008*
FAI	r	0.238	0.217	0.272	1.000	0.162
	p	0.000*	0.000*	0.000*	.	0.000*
PSQI	r	0.108	0.130	0.100	0.162	1.000
	p	0.004*	0.001*	0.008*	0.000*	.

Spearman's Rho correlation analysis *$p < 0.05$; FAI: Fonseca Anamnestic Index; PSQI: Pittsburgh Sleep Quality Index.

Table 4. Evaluation of DASS-21, FAI, and PSQI scores according to gender.

	Male	Female	
	Mean ± SD (median)	Mean ± SD (median)	*p*
DASS-21 Depression	6.26 ± 4.45 (6)	7.5 ± 5.25 (7)	0.009*
DASS-21 Anxiety	4.91 ± 3.98 (4)	6.44 ± 4.36 (6)	0.000*
DASS-21 Stress	8.22 ± 4.5 (8)	9.79 ± 4.65 (10)	0.000*
FAI	29.49 ± 20.11 (25)	38.56 ± 23.45 (35)	0.000*
PSQI	0.87 ± 1.65 (0)	0.7 ± 1.27 (0)	0.912

Mann Whitney U Test *$p < 0.05$; SD: Standard deviation; DASS-21: Depression, Anxiety, Stress Scale-21; FAI: Fonseca Anamnestic Index; PSQI: Pittsburgh Sleep Quality Index.

Table 5. Evaluation of DASS-21, FAI, and PSQI scores according to grade of dental students.

	Anxiety	Depression	Stress	FAI	PSQI
Grade	Mean ± SD (median)	Mean ± SD (median)	Mean ± SD (median)	Mean ± SD (median)	Mean ± SD (median)
1	5.05 ± 3.69 (4)	6.26 ± 4.89 (5)	8.53 ± 4.49 (9)	32.05 ± 22.1 (30)	0.99 ± 1.55 (0)
2	5.95 ± 4.16 (5)	6.7 ± 4.46 (6)	9.05 ± 4.31 (8)	35.15 ± 23.75 (25)	0.75 ± 1.38 (0)
3	5.6 ± 4.44 (5)	7.07 ± 5.32 (6)	8.59 ± 4.8 (9)	34.68 ± 20.23 (30)	0.77 ± 1.47 (0)
4	5.7 ± 4.21 (5)	7.05 ± 4.25 (7)	9.6 ± 4.38 (10)	35.69 ± 22.13 (30)	0.45 ± 1.02 (0)
5	7.53 ± 4.73 (7)	8.84 ± 5.91 (8)	11.14 ± 5.03 (12)	40.92 ± 24.62 (40)	0.71 ± 1.45 (0)
p	0.000*	0.004*	0.000*	0.028*	0.027*

Kruskal Wallis Test *$p < 0.05$; SD: Standard deviation; DASS-21: Depression, Anxiety, Stress Scale-21; FAI: Fonseca Anamnestic Index; PSQI: Pittsburgh Sleep Quality Index.

When depression scores were statistically analyzed between grades of students, the depression levels of 5th grade students were significantly higher than 1st and 2nd grade students ($p1$: 0.002; $p2$: 0.036). But there was no significant difference between the other grades in terms of depression scores ($p > 0.05$) (Table 5). The stress levels of 5th grade students were found to be significantly higher than 1st, 2nd, and 3rd grade students ($p1$: 0.000; $p2$: 0.000; $p3$: 0.000). There was no significant difference between the other grades in terms of stress scores ($p > 0.05$). Although 5th grade students' FAI scores were higher than all other grades, they were found to be statistically significantly higher than 1st grade students ($p1$: 0.013; $p < 0.05$). When PSQI scores were evaluated statistically, 1st grade students' PSQI scores were significantly higher than 4th grade students, ($p1$: 0.015; $p < 0.05$) (Table 5).

Discussion

The current study investigated the effect of the COVID-19 pandemic on sleep quality, stress, anxiety and depression levels, and frequency of TMD in Turkish dental students. Several studies have reported that patients with TMD suffer from poor sleep quality [27–29]. Patients with higher Pittsburgh sleep quality have been reported to have increased frequency of TMD [27]. However, these studies examined only individuals with TMD. The results in the present study provide epidemiological evidence for an association between TMD, sleep quality and depression, anxiety, and stress levels during the pandemic. The combined effect of changes in habitual behaviors, lockdown, impaired sleep quality, and increased depression, anxiety and stress levels associated with the COVID-19 pandemic may have significant negative impacts on sleep [30], especially evident in healthcare workers, who have to work for long hours in highly stressful environments [31,32].

During lockdown, individuals' sleep patterns have markedly changed, with people going to bed and waking up later, and spending a lot of time in bed. The impaired sleep behavior and sleep difficulties cause a higher level of depression, anxiety, and stress. Cellini et al. [4] measured sleep quality with PSQI and measured depression, anxiety and stress levels with the DASS-21 scale in their study during the pandemic process, reporting that they encountered poor sleep quality due to restrictions. Although they observed that there were individuals with poor sleep quality up to 52.4%, they did not observe any difference between students and employees. Similar to the current study, the researchers stated that individuals with a high PSQI global score, especially students, had an increased DASS-21 score. Xiao et al. [32] reported that more socializing efforts reduced anxiety and stress levels, which provides improved sleep quality during the COVID-19 virus pandemic. Roy et al. [1] reported that during the COVID-19 pandemic, sleep difficulties occurred in 12.5% of the participants, and problems related to social media occurred in 36.4% of the participants. In addition, the researchers pointed out the importance of the need of mental healthcare in the pandemic time course by stating that mental health should be maintained in a high proportion of participants. Stanton et al. [33] stated that they did not find a significant difference between 1491 male and female individuals for depression and anxiety during the COVID-19 pandemic period. However, in the present study, females had significantly higher DASS-21 scores compared to males. Also, the researchers determined that younger individuals had higher levels of depression, anxiety, and stress than the elderly ones, and similarly, these values were higher in single participants compared to other relationship status [33]. The present study was conducted with mostly single, young university students with higher depression, anxiety, and stress scores, which supports previous study results.

In the literature, studies using the the FAI report the TMD rate between 42% and 73% [7,34]. The variability in prevalence may be due to factors such as the variability of the number of samples used in the studies and the period in which the study was conducted. Özdinç et al. [35] examined the relationship between stress level, sleep quality, and TMD in university students; the study results reported that the prevalence of TMD among university students was 60.50%, and TMD was observed more in females than males. Similiar to the previous study, Çebi [36] reported that the majority of TMD appeared in young and adult females more often than males. In the current study, the frequency of TMD among dental university students was found to be 77.5%, which was higher than the previous study. The higher result in the current study may be due to the COVID-19 pandemic and the specific study population in the present study. In addition, in the present study, the frequency of TMD in females was found to be higher than in males, which was supported by a previous study. Also, Özdinç et al. [35] demonstrated that PSQI scores and perceived stress scores were increased in individuals with TMD and argued that sleep quality and perceived stress are important risk factors for TMD. Unlike the previous study results, the current study evaluated the TMD frequency, sleep quality, and DASS-21 score during the COVID-19 pandemic. However, similar results were found with the previous study.

There are several limitations of the present study. First, this survey was conducted in only Turkish dental

students. Therefore, these results may not be generalizable to other populations. Second, TMD symptoms (clicking, tenderness, and reduced jaw mobility) were not diagnosed clinically. Therefore, it is hard to explain the relationship between sleep quality, depression, anxiety and stress levels, and all TMD symptoms. Third, in the current study, national survey data was used, and temporomandibular joint structures and disc position were not diagnosed by radiographs.

Conclusion

The results in the current study showed that TMD tended to be more prevalent in dental students, especially females, with increased depression, anxiety and stress levels, and poor sleep quality during the COVID-19 pandemic. Both DASS-21 scores and PSQI scores may be considered risk factors of TMD. However, well-controlled prospective studies are needed to examine the causal relationships between sleep quality, depression, anxiety and stress levels, and TMD, and their results should be compared with the results of the studies carried out during the pandemic.

Disclosure statement

The authors have no conflicts of interests to declare in connection with this article.

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