

CRANIO®

The Journal of Craniomandibular & Sleep Practice

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ycra20

Temporomandibular disorder prevalence and its association with oral parafunctions, neck pain, and neck function in healthcare students: A cross-sectional study

Gul Oznur Karabicak & Zeynep Hazar Kanik

To cite this article: Gul Oznur Karabicak & Zeynep Hazar Kanik (2023) Temporomandibular disorder prevalence and its association with oral parafunctions, neck pain, and neck function in healthcare students: A cross-sectional study, CRANIO®, 41:1, 9-15, DOI: 10.1080/08869634.2020.1862581

To link to this article: https://doi.org/10.1080/08869634.2020.1862581

Published online: 24 Dec 2020.

Submit your article to this journal

Article views: 407

View related articles

View Crossmark data

Citing articles: 7 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=ycra20

CRANIO®: THE JOURNAL OF CRANIOMANDIBULAR & SLEEP PRACTICE
2023, VOL. 41, NO. 1, 9–15
https://doi.org/10.1080/08869634.2020.1862581

Taylor & Francis
Taylor & Francis Group

TMJ

Check for updates

Temporomandibular disorder prevalence and its association with oral parafunctions, neck pain, and neck function in healthcare students: A cross-sectional study

Gul Oznur Karabicak PhD, PT[a] and Zeynep Hazar Kanik PhD, PT[b,c]

[a]Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Adnan Menderes University, Emniyet Mahallesi, Muammer Yasar Bostanci Cad. No:16 Besevler, Aydin, Turkey; [b]Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University, Ankara, Turkey; [c]Department of Neurobiology, Harvard Medical School, Boston, MA, USA

ABSTRACT

Objective: To determine the temporomandibular disorder (TMD) prevalence in female students and to assess its association with oral parafunctions, neck pain, and function.

Methods: One hundred forty-four participants were included. The severity of TMD was assessed with Fonseca's Anamnestic Index (FAI). The oral parafunctions were self-reported with the Oral Behaviors Checklist (OBC). Neck pain and neck function were recorded with the Core Outcome Measure Index (COMI). The Spearman correlation analysis was used for statistical analysis.

Results: Seventy participants (48.6%) had mild TMD. All participants had a positive OBC score, which indicated an oral parafunction. A moderate correlation between TMD and oral parafunctions ($p < 0.001$) was detected.

Discussion: TMD is common in female healthcare students, and its presence is associated with oral parafunctions, neck pain, and function. It is recommended to evaluate oral health habits and neck pain and function in females with TMD.

KEYWORDS
Temporomandibular disorder; oral health; neck pain; prevalence; female

Introduction

Temporomandibular disorder (TMD) is a collective term that comprises various clinical problems, including the masticatory muscles, the temporomandibular joint, and associated structures [1]. TMD has a multifactorial etiology related to parafunctional habits, emotional and psychological factors, trauma, posture, and other musculoskeletal or rheumatic disorders [2]. Symptoms of TMD may include temporomandibular joint pain and clicks, headache, myofascial pain, decreased mandibular range of motion, masticatory muscle fatigue, limitation of mouth opening, pain when chewing, tinnitus, neuralgia, and bruxism [2,3]. The severity of symptoms is related to the age and gender of the patients. Women in an age range between 20 and 40 years showed a higher prevalence of TMD symptoms, with proportions varying from two to six women for each man [4]. The distribution of age and gender in TMD suggests a possible link between its pathogenesis and the female sexual hormone (estrogen) or between TMD and the mechanisms of pain modulation, as women show more sensitivity to most of the pain modalities [4,5]. Epidemiologic studies showed that TMD prevalence in students ranged from 50% to 77% [6–8]. Several studies have reported that the prevalence of TMD ranges from 47% to 81% in Turkish student populations [9–14]. However, in some cases, especially in students, the presence of TMD is asymptomatic. Therefore, the diagnosis of early symptoms and signs of TMD is crucial in preventing or minimizing TMD signs and symptoms [10].

Several studies have also examined the association between TMD and oral parafunctions in students.

Oral parafunctions, such as bruxism, chewing gum, foreign objects biting, and prolonged nail-biting may increase the risk of TMD [15]. Several studies have also examined the association between TMD and oral parafunctions in students [16–18]. However, still more studies are needed to identify which oral behaviors cause TMD [19]. In this regard, understanding the TMD symptoms in association with the oral parafunctions could provide different perspectives and help in the development of an efficient treatment program [16].

Neck pain is often considered a significant risk factor for TMD. Previous studies have shown anatomic and physiologic mechanisms to explain the association between TMD and neck pain [20–22]. Therefore, assessment of TMD and

CONTACT Zeynep Hazar Kanik zhazar@gazi.edu.tr Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University, Emniyet Mahallesi, Muammer Yasar Bostanci Cad. No:16 Besevler, Ankara 06500, Turkey.

This article has been republished with minor changes. These changes do not impact the academic content of the article.

© 2020 Taylor & Francis Group, LLC

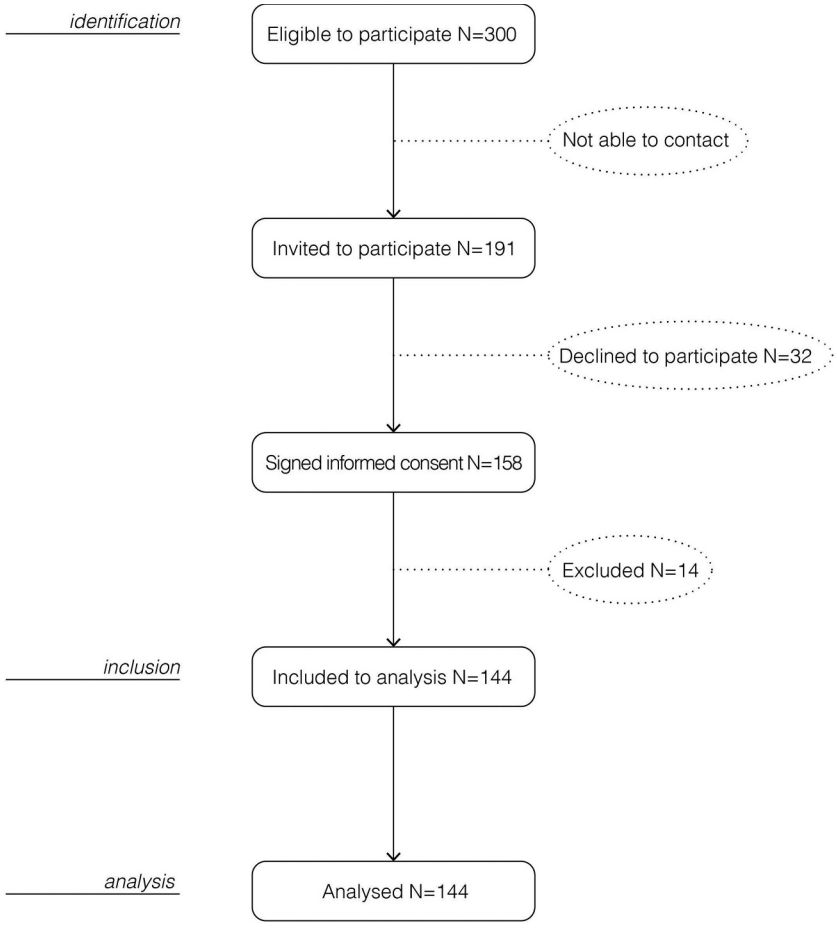


Figure 1. Flow diagram of the subjects.

the cervical spine was recommended in the literature because TMD can affect neck pain and function reciprocally [23]. However, there are also contradicting results showing that neck disability does not have an association with TMD [24,25]. Despite all these described mechanisms, more clarification regarding this relationship is still needed for health professionals to better assess and treat TMD [26].

There is no study about TMD prevalence in female healthcare students and its association with oral parafunctions, neck pain, and function. The aims of this cross-sectional study were the following: (1) to assess the TMD prevalence in female healthcare students and (2) to determine the association of TMD severity with oral parafunctional habits and neck pain and function.

Materials and methods

Study design

This is a descriptive cross-sectional study with a quantitative approach.

Subjects

This study was carried out at Adnan Menderes University, Faculty of Health Sciences in a group of 144 female students in 2019 and 2020. Inclusion criteria required subjects to be a female student at Adnan Menderes University, Faculty of Health Sciences within an age range of 18–35 years and to consent to participate in the study. Subjects with a recent trauma to the head or face, history of systematic diseases or neurological disorders, and those who were receiving a then-current ongoing orthodontic treatment were excluded from the study.

The participants were provided with a written and verbal explanation regarding the study procedures, and informed consent was obtained from each subject prior to testing. This study was approved by the Institutional Review Board of Adnan Menderes University, Faculty of Health Sciences (Number: E.69971; Date 11.11.2019). The Fonseca's Anamnestic Index (FAI) [6], Oral Behaviors Checklist (OBC) [27], and Core Outcome Measure Index (COMI) [28] were used to evaluate the

presence and severity of TMD, oral parafunction, and neck pain and function, respectively.

Sample size calculation

The sample size was calculated with the G* Power program (Version 3.0.10 Universität Düsseldorf, Düsseldorf, Germany). The estimated desired sample size was calculated to be 138 subjects, assuming a correlation of 0.30 [29] between TMD and oral parafunctions, an alpha level of 0.05, and the desired power of 95%.

Outcome measures

Temporomandibular disorders

The Fonseca Anamnestic Index (FAI) was used to evaluate the severity of TMD. It was proposed as a low-cost and easy-to-apply alternative and has been in use in screening of TMD in non-patient populations [6]. It has 10 3-point Likert scale items: "yes (10 points)," "sometimes (5 points)," and "no (0 points)." The total score of the FAI is determined by the sum of the scores of all items, providing the following classifications: no signs and symptoms of TMD (0–15 points), mild TMD (20–45 points), moderate TMD (50–65 points), and severe TMD (70–100 points) [30].

Oral parafunction

The Oral Behaviors Checklist is a self-report questionnaire for determining the frequency of oral parafunctional behaviors, which are any abnormal behavior or functioning of the oral structures and associated muscles in the previous one month. The original checklist consists of 21 items: 2 items for oral behaviors during sleep and 19 items for oral behaviors during awake hours. In this study, the questionnaire was modified, and two of the questions were extracted: singing and playing a musical instrument that involves the use of mouth or jaw (for example, woodwind, brass, string instruments), per the study of Hayek et al. [27]. Each item is scored from 0–4 based on the frequency of the activity performed: 0 = never; 1 = rarely; 2 = sometimes; 3 = frequently, and 4 = always. The score range is 0–76 [19]. The sum of the score has the following scheme: none = 0, low = 1–16, and high = 17–76 [27].

Neck pain and function

The COMI-neck is a simple, self-administered outcome instrument consisting of just seven items to assess five dimensions: pain, neck-related function, symptom-specific well-being, the general quality of life, and disability (social and work) [31,32]. The two pain items use a 0–10 visual rating scale, and all other items use a 5-point Likert scale. For the COMI final score, each of the domain scores is transformed to a 0–10 scale. They are then averaged to obtain a score ranging from 0 to 10, with higher scores indicating a worse status [33].

Statistical analysis

All statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (SPSS) Statistics software (Version 20.0. IBM Corporation; Armonk, NY, USA). The normal distribution of the variables was analyzed with the Kolmogorov-Smirnov test. Descriptive statistics (minimum-maximum, median, and percentages) were used to determine the participant's characteristics. The chi-square test was used to analyze the distribution of the TMD score between the participants' programs and levels.

Spearman correlation analysis was used for determining the relationship between temporomandibular disorders, oral parafunction, and neck pain and functions. The correlation coefficient was classified as negligible (0–0.10), weak (0.10–0.39), moderate (0.40–0.69), strong (0.70–0.89), and very strong (0.90–1.00) [34]. The statistical significance level was $p < 0.05$.

Results

One hundred forty-four female students from Adnan Menderes University, Faculty of Health Sciences participated in the present study (Table 1). The study population consisted of 29 females from the Nutrition and Dietetics Program (20.13%), 75 females from the Nursing Program (52.09%), and 40 females from the Child Development Program (27.78%). The median

Table 1. Demographics of the subjects.

	Program of Nutrition and Dietetics (n = 29) Median (min-max)	Program of Nursing (n = 75) Median (min-max)	Program of Child Development (n = 4 0) Median (min-max)	Total (n = 144) Median (min-max)
Age (years)	22 (20–34)	20 (17–28)	21 (20–34)	20 (17–34)
Height (cm)	163 (153–173)	165 (152–180)	163 (150–176)	164 (150–180)
Weight (kg)	55 (44–72)	55 (43–85)	58 (43–90)	55.50 (43–90)

Table 2. Prevalence of temporomandibular disorders in the participants.

FAI	Program of Nutrition and Dietetics (n = 29)	Program of Nursing (n = 75)	Program of Child Development (n = 40)	Total (n = 144)
TMD-no (n/%)	7/24.14	23/30.67	9/22.50	39/27.08
TMD-mild (n/%)	12/41.38	35/46.67	23/57.50	70/48.61
TMD-moderate (n/%)	6/20.69	13/17.33	7/17.50	26/18.05
TMD-severe (n/%)	4/13.79	4/5.33	1/2.50	9/6.25

FAI: Fonseca Anamnestic Index; TMD: Temporomandibular disorder.

Table 3. Comparison of temporomandibular disorder severity based on Fonseca Anamnestic Index (FAI) and oral parafunctions based on Oral Behavior Checklist (OBC) classification (n = 144).

OBC checklist	Total (n = 144)	TMD classification based on FAI	
		With moderate to severe dysfunction (50–100) n = 116	Without dysfunction/mild dysfunction (0–45) n = 28
No parafunction	0	0	0
Low (1–16)	18 (20.4%)	18 (12.5%)	0
High (17–76)	126 (80.6%)	98 (68.1%)	28 (19.4%)

age was 20 years. The prevalence of TMD diagnosis, according to the Fonseca Anamnestic Index, was 48.6%, with mild as the most frequently seen grade (Table 2). It was found that 72.9% of the participants had temporomandibular disorders (n = 105) of varying severity.

Out of 116 participants with a high OBC score, TMD was observed in 98 (68.1%), and TMD was observed in all participants with a low OBC score. None of the participants reported the absence of the OBC (Table 3).

A positive and moderate correlation was detected between temporomandibular disorders and oral parafunctions (Spearman's rho = 0.505; $p < 0.001$) (Table 4). The correlation between the OBC score for each item and the Fonseca total score was also calculated (Table 5). Items 2 (Spearman's rho = 0.407, $p < 0.001$) and 6 (Spearman's rho = 0.534, $p < 0.001$) had a moderate and significant correlation with TMD severity.

There was a positive moderate correlation between TMD severity and the COMI-pain sub-parameter evaluating neck pain (Spearman's rho = 0.482; $p < 0.001$). Similarly, there was a positive weak correlation with TMD severity and COMI-total score (Spearman's rho = 0.398; $p < 0.001$) (Table 4).

Table 4. Relationship between temporomandibular disorder and Oral Behaviors Checklist, and neck pain and function.

	R	*p*
FAI-OBC	0.505	<0.001
FAI-COMI		
COMI-Pain	0.482	<0.001
COMI-Total	0.398	<0.001
OBC- COMI		
COMI-Pain	0.397	<0.001
COMI-Total	0.461	<0.001

FAI: Fonseca Anamnestic Index; OBC: Oral Behaviors Checklist; COMI: Core Outcome Measures Index.

There was also a positive weak correlation between oral parafunctions and the COMI-pain sub-parameter evaluating neck pain (Spearman's rho = 0.397; $p < 0.001$, and there was a positive moderate correlation between oral parafunctions and the COMI-total score (Spearman's rho = 0.461; $p < 0.001$) (Table 4).

Discussion

The authors conducted this study to determine the prevalence of TMD and to determine the relationship between TMD and oral parafunctions and neck pain and function in female healthcare students. This cross-sectional study detected the prevalence of TMD in healthcare students according to the Fonseca Anamnestic Index as 72.2%. One of the most significant findings of this study was that all participants had at least one oral parafunction. In addition, the study showed that TMD is correlated with oral parafunctions and neck pain and function in female healthcare university students.

The FAI provides valuable data for the diagnosis and early detection of TMD in a short time and is a low-cost evaluation tool. The frequency of TMD detected by the FAI varies between 37% and 81% in similar studies conducted in students [10–14,27]. Mild TMD (48.6%) was the most prevalent level of TMD in the population assessed in this study. This result agrees with the results reported by Pedroni et al. [2], Dekon et al. [34], and Karthik et al. [7], all of whom used the FAI to evaluate TMD. In a Turkish population, Özdinç et al. [13] and Dervis et al. [9] (47.3%) reported a prevalence similar to the current study. On the other hand, Türken et al. [10] (79%) reported higher TMD prevalence than the one reported in the present study. These results may be due to differences in the populations, such as gender

Table 5. Mean-SD scores of the individual OBC items, and their Spearman's rho correlations with Fonseca Total Score (n = 144).

	Mean (SD)	Correlation coefficient	*p*-value
Clench or grind teeth when asleep, based on any information you may have	0.973 (1.13)	0.399*	<0.001
Sleep in a position that puts pressure on the jaw	0.796 (1.08)	0.407	<0.001
Grind teeth together during waking hours	0.243 (0.63)	0.183*	0.024
Clench teeth together during waking hours	0.828 (1.01)	0.66*	0.001
Press, touch, or hold teeth together other than while eating	1.598 (1.24)	0.158	0.052
Hold, tighten, or tense muscles without clenching or bringing teeth together	0.697 (0.86)	0.534	<0.001
Hold or jut jaw forward or to the side	0.348 (0.71)	0.231*	0.008
Press tongue forcibly against teeth	1.185 (1.11)	0.223*	0.006
Place tongue between teeth	0.861 (1.02)	.278*	0.001
Bite, chew, or play with your tongue, cheeks or lips	0.486 (0.79)	0.118	0.148
Hold jaw in rigid or tense position, such as to brace or protect the jaw	0.717 (1.29)	0.218*	0.007
Hold between the teeth or bite objects such as hair, pipe, pencil, pens, fingers, fingernails	1.046 (1.13)	0.194*	0.016
Use chewing gum	2.059 (0.87)	0.181*	0.026
Play musical instrument that involves use of mouth or jaw	0.230 (0.68)	−0.032	0.699
Lean with your hand on the jaw, such as cupping or resting the chin in the hand	2.052 (1.22)	0.239*	0.003
Chew food on one side only	1.953 (1.12)	0.223*	0.006
Eating between meals (that is, food that requires chewing)	2.32 (1.03)	0.159*	0.050
Sustained talking (for example, teaching, sales, customer service)	1.677 (1.19)	0.060	0.460
Hold telephone between your head and shoulders	2.105 (1.16)	0.073	374
Yawning	2.66 (0.81)	0.214	0.08

SD: Standard deviation; OBC: Oral Behaviors Checklist; *Statistically significant but weak correlations. Correlation coefficients that are moderate are bolded in the table.

distribution or sociodemographic characteristics. In addition, since all the participants in the present study were students, stress-related psychological factors caused by school-related factors and busy class schedule, or anxiety about the possibility of failure may cause variations in TMD severity [11,35].

In the present study, the OBC was used to evaluate oral parafunctions. The OBC is a self-administered tool designed to evaluate oral activities (e.g., grinding and other oral parafunctions) during sleep or awake hours [17,36]. This current study shows that increasing oral parafunctional habits assessed with the OBC were associated with TMJ problems. In addition to this result, a moderate correlation was found between the severity of TMD and "sleeping with tense unilateral jaw joint" and "keeping the mouth closed with tense muscles without clenching," which are among the oral parafunctional habits evaluated in the OBC. These results are similar to the results reported by Yeler et al. [12], who showed that temporomandibular dysfunction is associated with unilateral chewing and bruxism. In addition, Karthik et al. [7] reported that the symptoms of TMD were more common in university students who defined themselves as tense. Moreover, in a study conducted in Nepalese students, Royaka et al. [35] detected that 20% of the participants showed grinding. Similarly, Lövgren et al. [17] found that oral parafunctional habits were more prevalent in students diagnosed with TMD in a study involving dentistry students, and suggested that this result was associated with bruxism, which was frequently observed in participants [17].

Due to the biomechanical interactions between TMJ and the cervical region, the relationship between the cervical region and TMJ dysfunction has been investigated in many studies in the literature. Grossi et al. [37] conducted a study in female students to assess neck pain and TMD severity and reported that TMD accompanied neck pain and symptoms, but TMD symptoms or pain did not increase neck complaints, which also indicates that TMD predates neck problems. They also reported that cervical signs and symptoms can be defined as persistent factors for TMD. In a study conducted in women with TMD, restricted cervical region mobility due to neck pain and decreased flexor extensor muscle endurance were observed [38]. Thus, Ferreira et al. [38] highlighted the importance of performing functional tests in the cervical region in patients with TMD. In the present study, functional loss and quality of life parameters related to the neck were examined along with the neck pain severity using the COMI. The current study found that neck pain and functions were associated with TMD, which is consistent with the current literature.

The present study has several limitations. First, the study population consisted of only female subjects, which limits any generalization of the findings beyond this gender. However, it is also emphasized in the literature that TMD is often seen in the female gender. Therefore, this study provides additional supportive data by focusing only on females within a specific age group. Second, the study did not assess postural alterations and hormonal phases, which may be strongly related to TMD disorders and pain sensations [39]. Another important limitation of this study is the use

of questionnaires for evaluation. Although it is thought that the use of objective measurement tools would be more beneficial, this limitation can be ignored because the validity and reliability of all the questionnaires used in the present study have been established.

Conclusion

The present study detected a 72.2% TMD prevalence in female healthcare students. In addition to this result, TMD severity is correlated with oral parafunctions and neck pain and function in female healthcare university students. All participants had at least one parafuctional habit, according to OBC score. The authors believe that this study highlights the association between TMD and neck pain, neck function, and oral parafunction, which are frequently seen in students.

Disclosure statement

The authors declare that there is no conflict of interest.

Funding

No funding was received for this study.

Human and animal rights statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

ClinicalTrials.gov ID: NCT04495777

References

[1] De Stefano AA, Guercio-Monaco E, Uzcátegui A, et al. Temporomandibular disorders in Venezuelan and Italian adolescents. CRANIO®. 2020;1–7. DOI:10.1080/08869634.2020.1801013.

[2] Pedroni CR, De Oliveira AS, Guaratini MI. Prevalence study of signs and symptoms of temporomandibular disorders in university students. J Oral Rehabil. 2003 Mar;30(3):283–289. DOI:10.1046/j.1365-2842.2003.01010.x.

[3] Kuć J, Szarejko KD, Sierpińska T. Evaluation of orofacial and general pain location in patients with temporomandibular joint disorder—myofascial pain with referral. Front Neurol. 2019 May 29;10:546. DOI:10.3389/fneur.2019.00546.

[4] Schmid-Schwap M, Bristela M, Kundi M, et al. Sex-specific differences in patients with temporomandibular disorders. J Orofac Pain. 2013;27(1):42–50.

[5] Nekora-Azak A, Evlioglu G, Ceyhan A, et al. Estrogen replacement therapy among post-menopausal women and its effects on signs and symptoms of temporomandibular disorders. CRANIO®. 2008 Jul;26(3):211–215. DOI:10.1179/crn.2008.028.

[6] Nomura K, Vitti M, de Oliveira AS, et al. Use of the Fonseca's questionnaire to assess the prevalence and severity of temporomandibular disorders in Brazilian dental undergraduates. Braz Dent J. 2007;18(2):163–167.

[7] Karthik R, Fathima Hafila MI, Saravanan C, et al. Assessing prevalence of temporomandibular disorders among university students: A questionnaire study. J Int Soc Prev Community Dent. 2017 Jun;7(Suppl 1):S24–S29. DOI:10.4103/jispcd.JISPCD_146_17.

[8] Lung J, Bell L, Heslop M, et al. Prevalence of temporomandibular disorders among a cohort of university undergraduates in Australia. J Investig Clin Dent. 2018 Aug;9(3):e12341. DOI:10.1111/jicd.12341.

[9] Emel Dervis N. Prevalence of temporomandibular disorder in Turkish university students: a questionnaire study. Balk J Dent Med. 2019;23(2):80–87. DOI:10.2478/bjdm-2019-0015.

[10] Türken R, Büyük SK, Yaşa Y. Diş Hekimliği Fakültesi Öğrencilerinde Temporomandibular Eklem Rahatsızlıklarının ve Ağız Sağlığı Alışkanlıklarının Değerlendirilmesi. Acıbadem Üniversitesi Sağlık Bilim Derg. 2020;11(2):208–213. DOI:10.31067/0.2018.83.

[11] Tanhan A, Yıldız A, Demirbüken İ, et al. Sağlık Bilimleri Öğrencilerinde Temporomandibular Eklem Disfonksiyon Riskinin Araştırılması. Sak Med J. 2019. DOI:10.31832/smj.490740.

[12] Yalçın Yeler D, Yılmaz N, Koraltan M, et al. A survey on the potential relationships between TMD, possible sleep bruxism, unilateral chewing, and occlusal factors in Turkish university students. CRANIO®. 2017;35(5):308–314.

[13] Özdinç S, Ata H, Selçuk H, et al. Temporomandibular joint disorder determined by Fonseca anamnestic index and associated factors in 18- to 27-year-old university students. CRANIO®. 2018. DOI:10.1080/08869634.2018.1513442.

[14] Ayalı A, Ramoğlu S. KUZEY KIBRIS'TA DİŞ HEKİMLİĞİ FAKÜLTESİ ÖĞRENCİLERİNDE TEMPOROMANDİBULER EKLEM DİSFONKSİYONU'NUN PREVALANSI. Atatürk Üniversitesi Diş Hekim Fakültesi Derg. 2015;24(3). DOI:10.17567/dfd.91850.

[15] Oliveira LK, Almeida G de A, Lelis ÉR, et al. Temporomandibular disorder and anxiety, quality of sleep, and quality of life in nursing professionals. Braz Oral Res. 2015;29(1):S1806–83242015000100265.

[16] Chatzopoulos GS, Sanchez M, Cisneros A, et al. Prevalence of temporomandibular symptoms and parafunctional habits in a university dental clinic and association with gender, age, and missing teeth. CRANIO®. 2019;37(3):159–167.

[17] Lövgren A, Österlund C, Ilgunas A, et al. A high prevalence of TMD is related to somatic awareness and pain intensity among healthy dental students. Acta Odontol Scand. 2018;76(6):387–393.

[18] Paduano S, Bucci R, Rongo R, et al. Prevalence of temporomandibular disorders and oral parafunctions in adolescents from public schools in Southern Italy. CRANIO®. 2018;1–6. DOI:10.1080/08869634.2018.1556893.

[19] Leketas M, Šāferis V, Kubilius R, et al. Oral behaviors and parafunctions: comparison of temporomandibular dysfunction patients and controls. J Craniofac Surg. 2017;28(8):1933–1938.

[20] Häggman-Henrikson B, Eriksson PO. Head movements during chewing: relation to size and texture of bolus. J Dent Res. 2004;83(11):864–868.

[21] Grondin F, Hall T, Laurentjoye M, et al. Upper cervical range of motion is impaired in patients with temporomandibular disorders. CRANIO®. 2015;33(2):91–99.

[22] Flores HF, Ottone NE, Fuentes R. Analysis of the morphometric characteristics of the cervical spine and its association with the development of temporomandibular disorders. CRANIO®. 2017;35(2):79–85.

[23] von Piekartz H, Pudelko A, Danzeisen M, et al. Do subjects with acute/subacute temporomandibular disorder have associated cervical impairments: A cross-sectional study. Man Ther. 2016;26:208–215.

[24] Packer AC, Dibai-Filho AV, De Souza Costa AC, et al. Relationship between neck disability and mandibular range of motion. J Back Musculoskelet Rehabil. 2014;27(4):493–498.

[25] Thorp J, Willson J. The neck disability index is not correlated with some parameters of temporomandibular disorders: a cross-sectional study. J Oral Facial Pain Headache. 2019;33(1):39–46.

[26] Balthazard P, Hasler V, Goldman D, et al. Association of cervical spine signs and symptoms with temporomandibular disorders in adults. JBI Evid Synth. 2020;18(6):1334–1340. DOI:10.11124/jbisrir-d-19-00107

[27] Al Hayek SO, Al-Thunayan MF, AlGhaihab AM, et al. Assessing stress associated with temporomandibular joint disorder through Fonseca's anamnestic index among the Saudi physicians. Clin Exp Dent Res. 2019;5(1):52–58.

[28] Karabicak GO, Bek N, Tiftikci U. Short-term effects of kinesiotaping on pain and joint alignment in conservative treatment of hallux valgus. J Manipulative Physiol Ther. 2015;38(8):564–571.

[29] Melchior M de O, Mazzetto MO, de Felício CM. Temporomandibular disorders and parafunctional oral habits: an anamnestic study. Dental Press J Orthod. 2012;17(2):83–89.

[30] Bevilaqua-Grossi D, Chaves TC, De Oliveira AS, et al. Anamnestic index severity and signs and symptoms of TMD. CRANIO®. 2006;24(2):112–118.

[31] Mannion AF, Porchet F, Kleinstück FS, et al. The quality of spine surgery from the patient's perspective. Part 1: the core outcome measures index in clinical practice. Eur Spine J. 2009. DOI:10.1007/s00586-009-0942-8.

[32] Mannion AF, Porchet F, Kleinstück FS, et al. The quality of spine surgery from the patient's perspective: part 2. Minimal clinically important difference for improvement and deterioration as measured with the core outcome measures index. Eur Spine J. 2009. DOI:10.1007/s00586-009-0931-y.

[33] Karabicak GO, Hazar Kanik Z, Gunaydin G, et al. Reliability and validity of the Turkish version of the core outcome measures index for the neck pain. Eur Spine J. 2020;29(1):186–193.

[34] Schober P, Schwarte LA. Correlation coefficients: appropriate use and interpretation. Anesth Analg. 2018;126(5):1763–1768.

[35] Rokaya D, Suttagul K, Joshi S, et al. An epidemiological study on the prevalence of temporomandibular disorder and associated history and problems in Nepalese subjects. J Dent Anesth Pain Med. 2018;18(1):27.

[36] Kaplan S, Ohrbach R. Self-report of waking-state oral parafunctional behaviors in the natural environment. J Oral Facial Pain Headache. 2016;107–119. DOI:10.11607/ofph.1592

[37] Bevilaqua-Grossi D, Chaves TC, De Oliveira AS. Cervical spine signs and symptoms: perpetuating rather than predisposing factors for temporomandibular disorders in women. J Appl Oral Sci. 2007;15(4):259–264. DOI:10.1590/S1678-77572007000400004.

[38] Ferreira MP, Waisberg CB, Conti PCR, et al. Mobility of the upper cervical spine and muscle performance of the deep flexors in women with temporomandibular disorders. J Oral Rehabil. 2019;46(12):1177–1184.

[39] Carvalho GF, Chaves TC, Florencio LL, et al. Reduced thermal threshold in patients with temporomandibular disorders. J Oral Rehabil. 2016;43(6):401–408.