Official Journal of Erciyes University Faculty of Medicine

DOI: 10.14744/cpr.2023.76486
J Clin Pract Res 2023;45(5):456–62

Temporomandibular Dysfunction Affects Neck Disability, Headache, Anxiety, and Sleep Quality in Women: A Cross-Sectional Study

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ABSTRACT

Objective: Temporomandibular dysfunction (TMD) is associated with the stomatognathic system, encompassing the masticatory muscles, temporomandibular joint, and the craniocervical system. This study aims to compare neck disability, headache, anxiety, and sleep quality between women with TMD and asymptomatic women. Additionally, the research seeks to explore the relationship between symptom severity and jaw pain, neck insufficiency, headache, sleep quality, and anxiety in women with TMD.

Materials and Methods: This cross-sectional study enrolled women aged 18 to 65 years, comprising 83 healthy women and 129 women with TMD. The study is registered as a clinical trial on the Clinical Trials platform with the identifier NCT0494820. TMD assessment utilized the Fonseca Anamnestic Index (FAI) while evaluating TMD severity, jaw pain, neck disability, anxiety, headache, and sleep quality.

Results: It was observed that women in the TMD group exhibited higher occurrences of bruxism and tinnitus. In comparison to the control group, the TMD group demonstrated elevated FAI scores, increased jaw pain, neck disability, headache, and anxiety, along with decreased sleep quality. Within the TMD group, the FAI score exhibited significant associations with jaw pain, neck disability, headache, anxiety, and sleep quality ($p<0.05$).

Conclusion: In summary, when evaluating individuals with TMD, it is imperative for therapists to meticulously examine adjacent structures and consider influential factors from a holistic perspective.

Keywords: Temporomandibular disorders, neck, headache, anxiety, sleep quality.

Cite this article as:
Ünlüer NÖ, Ateş Sarı Y, Baş SS. Temporomandibular Dysfunction Affects Neck Disability, Headache, Anxiety, and Sleep Quality in Women: A Cross-Sectional Study. J Clin Pract Res 2023; 45(5): 456–62.

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Submitted: 28.02.2023
Revised: 05.04.2023
Accepted: 09.08.2023
Available Online: 13.09.2023

Erciyes University Faculty of Medicine Publications - Available online at www.jcpres.com

INTRODUCTION

Temporomandibular dysfunction (TMD) comprises a range of often dysfunctional and/or painful conditions involving the temporomandibular joint (TMJ) and the surrounding muscles.[1] Research indicates that symptoms and signs of TMD exhibit gender-based disparities, with women aged 20–40 years experiencing them at least twice as often as men.[2] This phenomenon is attributed to hormonal fluctuations or muscle tenderness linked to smaller cross-sectional muscle areas and a greater presence of Type-1 muscle fibers in women.[2,3]

The etiology of TMD is recognized as multifactorial. Goldstein[1] defines chronic TMD as a psychophysiological disorder of the central nervous system, characterized by physiological, neuroendocrine and emotional responses, illustrating its diverse nature.

Literature suggests that TMD frequently co-occurs with other symptoms impacting the head and neck area, including cervical spine disorders (e.g., fatigue in cervical-scapular and masticatory muscles) as well as headache and ear-related issues (e.g., tinnitus and otalgia).[4] Drangsholt and LeResche[5] attribute the factors associated with the female gender in TMD to the presence of pre-existing pain and depression. Salameh, Alshaarani, Hamed, and Nassar[6] stated that individuals with TMD have higher levels of stress and depression than healthy individuals. It is also noted that sleep disturbances associated with psychological distress are a risk factor for TMD.[7]

A biomechanical connection between the craniocervical region and the TMJ was reported.[8] While various studies have established a relationship between TMD and cervical region disorders in women, others have argued that no such relationship exists.[4,9] Additionally, whether neck problems cause TMD or cervical region disorders are observed in individuals with TMD remains unclear.[10,11] Moreover, although relationships between headache, neck pain, and TMD have been reported, it is unclear which one acts as a predisposing factor for the others. As sleep disorders and anxiety mutually trigger one another, observing these issues in individuals with TMD underscores the need for a more detailed examination, especially in women. To the extent of the authors' knowledge, no study in the literature examines headache, neck disability, sleep quality, and anxiety in women with TMD. Therefore, this study aimed to investigate these parameters in women with TMD and compare the results with those of asymptomatic women. Another aim was to explore the relationship between symptom severity and jaw pain, neck disability, headache impact, anxiety, and sleep quality in women with TMD. The hypothesis was that:

(1) the parameters evaluated in the present study would demonstrate worse outcomes in the TMD group;

(2) headache, neck disability, and anxiety would increase, and sleep quality would decrease as the severity of temporomandibular disturbance increases in individuals with TMD.

MATERIALS AND METHODS

Study Design

This cross-sectional web-based survey was conducted between November 2020 and January 2021. Ethical approval was granted by the Ankara Yıldırım Beyazıt University Ethical Committee (2020-43). The study was registered on ClinicalTrials.gov (identifier: NCT0494820). The study adhered to the principles outlined in the Declaration of Helsinki throughout. Informed consent was obtained from all participants, with the consent form included on the first page of the questionnaire.

Patient and Data Collection

Volunteer women aged 18–65 years, possessing a Fonseca Anamnestic Index (FAI) score of 45 points or more, and who experiencing a problem for at least six months were included in the TMD group. The control group encompassed women aged 18–65 years with a FAI score of 15 or lower. The FAI, a widely accepted diagnostic tool for TMD, was used for TMD assessments. Exclusion criteria encompassed: (1) history of acute craniocervicofacial trauma; (2) history of temporomandibular surgery; (3) history of dental or orofacial infection; and (4) a FAI score between 20 and 40.

Two groups were categorized based on their FAI scores. Those with an FAI score of 0–15 were assigned to the control group, while those with an FAI score of 45 and above were placed in the TMD group. Both groups' participants' age, height, weight, education level, profession, marital status, dominant side of chewing, presence of tinnitus, and parafunctional habits were documented. Furthermore, symptom severity, jaw pain, neck disability, headache, anxiety, and sleep quality were assessed.

TMD severity was evaluated using the FAI. The FAI, a 10-item scale, yields a total score ranging from 0 to 100. Symptom severity is categorized according to the total score: 0–15 points signify no TMD, 20–45 points indicate mild symptoms, 50–65 points represent moderate symptoms, and 70–100 points correspond to severe symptoms.[12] The severity of jaw pain in women was evaluated using the Numerical Rating Scale (NRS). This scale rates participants' pain on a scale from 0 points, indicating "no pain," to 10 points, indicating "the most severe pain".[13] The Neck Disability Index (NDI), designed to determine the extent of neck disability, is a survey that encompasses pain intensity, daily activities, and leisure pursuits. The higher the score on the 10-item scale, the greater the degree of neck disability.[14] To assess headache symptoms, the Headache Impact Test (HIT-6) was employed. This test, comprising six items, furnishes quantitative insights into migraine and headache based on individuals' self-reports. As the score on the HIT-6 increases, the severity of the headache is observed to escalate.[15]

The General Anxiety Disorder-7 Scale (GAD-7) was used to assess anxiety levels. This 7-item scale evaluates anxiety disorder experienced over the previous two weeks, with scoring ranging from 0 points denoting "none", 1 point representing "several days", 2 points indicating "more than 7 days", and 3 points signifying "almost every day." As the score on the GAD-7 rises, the level of anxiety also increases.[16] Sleep quality was

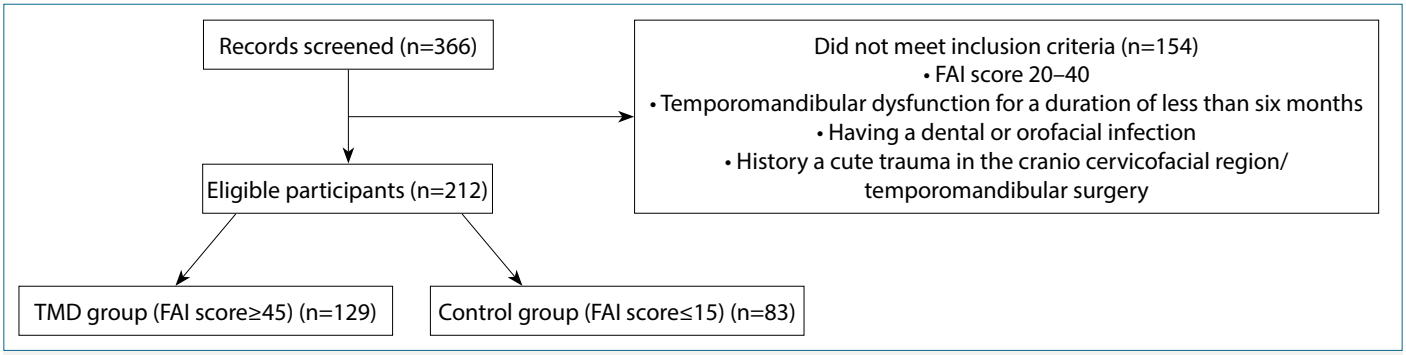

Figure 1. Flow diagram depicting the participant selection process using the Fonseca Anamnestic Index.

evaluated using the Pittsburgh Sleep Quality Index (PSQI). This index assesses sleep quality and disturbances in the preceding month. Comprising 7 sub-parameters of sleep difficulties, higher scores are indicative of poorer sleep quality.[17]

Statistical Analysis

The number of participants was determined using the G*Power software package. Sample size calculation was based on sleep quality research conducted by Benoliel et al. Considering sleep quality as a parameter, it was determined that a sample size of at least 78 participants per group was required to achieve 80% power, with α=0.05 for type I error, d=0.40 for effect size, and β=0.05 for type II error.[18]

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) 22.0 (SPSS Inc., Chicago, IL, USA). Normally distributed data are presented as mean±standard deviation (SD). Non-normally distributed data are presented as median (min–max). Ordinal variables are presented as frequency and percentage. The Chi-Square test and the Mann-Whitney U test were employed to compare clinical and demographic data between the groups. Student's t-test was used for normally distributed parameters, while the Mann-Whitney U test was used for non-normally distributed parameters. Spearman's test was used to ascertain relationships among assessed parameters within the TMD group. A significance level of alpha <0.05 was set for statistical significance.

RESULTS

A total of 366 women were screened for the study, of which 154 did not meet the inclusion criteria. The study was ultimately conducted with 129 women in the TMD group and 83 women in the control group (Fig. 1).

Demographic characteristics, including age and BMI, were comparable between the groups. Both groups exhibited similarity in terms of educational level, marital status, and food chewing side (right/left) (p>0.05). However, disparities were observed in the rates of bruxism and tinnitus. The TMD group demonstrated higher instances of bruxism and tinnitus (p<0.05, Table 1).

When comparing the groups, significant differences were observed in the FAI score (p<0.001), jaw pain (p<0.001), neck disability (p<0.001), anxiety (p<0.001), and headache impact (p<0.001), all of which were higher in the TMD group. Additionally, sleep quality exhibited a decrease (p<0.001) in the TMD group. With respect to the PSQI score, 79.1% of women in the TMD group scored over 5 points, indicating poor sleep quality (Table 2).

Correlation analysis within the TMD group revealed that the FAI score demonstrated a moderate correlation with jaw pain (rho=0.589, p<0.001), headache impact (rho=0.453, p<0.001), anxiety (rho=0.514, p<0.001), and sleep quality (rho=0.467, p<0.001). Furthermore, a strong correlation was identified between neck disability and symptom severity (rho=0.637, p<0.001) (Table 3).

DISCUSSION

This study aimed to compare women with TMD to asymptomatic women in terms of jaw pain, neck disability, anxiety, headache impact, and sleep quality, revealing notable differences between groups. Consistent with the authors' hypothesis, the TMD group exhibited moderate correlations between symptom severity and jaw pain, headache impact, sleep quality, and anxiety. Furthermore, a strong correlation existed between neck disability and symptom severity.

The cervical spine and the temporomandibular joint share a close anatomical relationship. When considering the human body as a whole, a deficiency in one anatomical structure can impact another. A therapist embracing a holistic perspective should not solely evaluate the disorder's structure but also the surrounding structures. In the literature, studies adopting this viewpoint have primarily concentrated on structural

Table 1. Demographic and clinical characteristics of the participants

	TMD group (n=129)		Control group (n=83)		p
	n	%	n	%	
Age, years (Mean±SD), (min–max)	23.96±7.34 (18–50)		24.40±9.09 (18–57)		0.70
BMI, kg/m^2 (Mean±SD), (min–max)	22.45±3.54 (14.20–33.80)		22.08±3.90 (16.30–35.50)		0.47
Educational level					0.69
High school	10	7.8	4	4.8	
University	106	82.2	70	84.3	
Postgraduate	13	10.1	9	10.8	
Marital status					0.68
Married	107	82.9	67	80.7	
Single	22	17.1	16	19.3	
Occupation					0.28
Student	96	74.4	60	72.3	
Working	27	20.9	22	26.5	
Housewife	6	4.7	1	1.2	
Foot chewing side					0.12
Right	92	71.3	67	80.7	
Left	37	28.7	16	19.3	
Bruxism					<**0.001***
Yes	39	30.2	5	6	
No	90	69.8	78	94	
Tinnitus					**0.003***
Yes	48	37.2	15	18.1	
No	81	62.8	68	81.9	

*: P<0.05; TMD: Temporomandibular dysfunction; BMI: Body mass index; SD: Standard deviation.

Table 2. Comparison of FAI, jaw pain, neck disability, headache impact, sleep quality, and anxiety among groups

	TMD group (n=129) Median (min–max)	Control group (n=83) Median (min–max)	p
FAI (score)	55 (45–95)	15 (0–15)	<**0.001***
Jaw pain (score)	2 (0–9)	0 (0–3)	<**0.001***
NDI (score)	11 (2–36)	5 (0–21)	<**0.001***
HIT-6 (score)	59 (36–78)	50 (36–67)	<**0.001***
GAD-7 (score)	8 (0–21)	4 (0–11)	<**0.001***
PSQI (score)	7 (0–16)	4 (0–13)	<**0.001***

*: P<0.05; TMD: Temporomandibular dysfunction; FAI: Fonseca Anamnestic Index; NDI: Neck Disability Index; HIT-6: Headache Impact Test-6; GAD-7: Generalized Anxiety Disorder-7; PSQI: Pittsburgh Sleep Quality Index.

irregularities within the cervical region and/or cervical region pain in individuals with TMD. Coskun Benlidayi et al.[11] suggested that individuals with TMD exhibit postural disorders encompassing the head and neck regions. However, contrasting studies posit that TMD might not influence head and neck abnormalities.[19,20] Moreover, studies have investigated the correlation between neck disability in individuals with TMD, independent of neck posture.[11,21] Coskun Benlidayi et al.[11] demonstrated that individuals with TMD exhibit reduced cervical lordosis with malalignment irrespective of neck pain. Karabicak and Kanik[4] discovered a positive correlation was between TMD and neck pain in female university students. Guarda-Nardini et al.[21] unveiled a positive relationship between TMD and neck dysfunction in females with TMD. Notably, the convergence of trigeminal and upper cervical afferent inputs in the trigeminocervical nucleus establishes neurophysiological connections between the temporomandibular joint and

Table 3. Relationship between FAI with jaw pain, neck disability, headache impact, sleep quality, and anxiety in patients with TMD (n=129)

	Fonseca Anamnestic Index	
	rho	**p**
Jaw pain	0.589	<**0.001***
Neck disability	0.637	<**0.001***
Headache impact	0.453	<**0.001***
Anxiety	0.514	<**0.001***
Sleep quality	0.467	<**0.001***

*: P<0.05; TMD: Temporomandibular dysfunction.

cervical spine.[22] Reports indicate that decreased movement in the upper cervical region among patients with cervicogenic headaches is linked to certain TMD symptoms.[23] The current study's findings support the literature, revealing a substantial correlation between TMD and neck disability. While discrepancies persist in the outcomes of previous studies due to varying perspectives, the current study holds significance as it exclusively focused on women with TMD, effectively eliminating gender differences. Moreover, despite most women in both study groups being students, the discernible posture adopted during studying, known to trigger neck pain, clarifies the disparity between the groups and its impact on TMD.

Understanding the mechanisms that may physiologically link TMD and headache could offer insights into their clinical significance. There has been an assertion of an association between headaches and TMD are associated.[24] Molina et al.[24] identified a correlation between TMD and headache, attributing this connection to oral habits like bruxism. The present study, which aligns with existing literature, is bolstered by the notable statistical divergence in bruxism between the groups, thereby substantiating the study by Molina et al.[24]

Sleep disorders can disrupt the physiological reparative functions that support the homeostasis system, which contributes to growth. Pain-related helplessness and the severity of sleep problems contribute to pain in women with TMD.[25] Considering this information, it is suggested that there is a bidirectional relationship between pain and sleep quality. Pain in TMD also affects the quality of life by causing sleep disorders. Individuals with TMD have lower sleep quality than asymptomatic individuals.[18] The present results strongly support the literature. Additionally, a total score of 5 and above on the index indicates poor sleep quality. Benoliel et al.[18] reported PSQI scores of 5.53±2.85 in the TMD group and 4.41±2.61 in the control group. In the present results, both the median score value of 7 in the TMD group and sleep quality above 5 in 79.1% of the TMD group explain the poor sleep quality, both of which support the literature.

The effect of psychoemotional factors on sleep disorders is well-established. Recently, there has been an exploration of how psychological factors affect sleep quality in TMD. In these studies, negative emotional conditions such as pain, stress, depression, and anxiety, and poor sleep quality have been reported in individuals with TMD.[7,26] Stress, anxiety, and sleep disorders are interlinked in a vicious cycle. It is noted that anxiety acts as an etiological factor in TMD, with its prevalence being higher among TMD patients compared to the general population.[27] Although Fernandes Azevedo et al.[28] reported no relationship between TMD and anxiety in dental students, other studies present differing perspectives. While a strong correlation was identified between anxiety and TMD in a study involving adolescents,[29] another study conducted with undergraduate health students reported a high rate of TMD in students.[30] In this study, consistent with existing literature, a higher anxiety level was observed in the TMD group when compared to the asymptomatic control group.

While dysfunction in the cervical region and pain are evident in patients with TMD, neck issues are frequently reported among individuals with headaches. What holds significance here is the close relationship between these three factors – TMD, headaches, and neck problems. Thus, when assessing TMD, it is essential to delve not only into chewing function and jaw pain but also into the cervical region and headaches, examining them in detail. The moderate correlation between jaw pain and FAI in the present findings further underscores the role of jaw pain in TMD. The factor that connects TMD, jaw pain, neck pain, and headaches is primarily associated with bruxism. Various issues such as psychogenic and/or sleep problems can lead to bruxism, which may indirectly explain TMD. Similarly, a myriad of pain problems and sleep disturbances can contribute to anxiety. From a different perspective, a psychogenic factor causing sleep disorders and bruxism could potentially indirectly explain TMD. Ultimately, an effective and comprehensive evaluation is essential for designing a robust therapy program.

In the light of these findings, the current study exhibits strengths and advantages over existing literature. This study encompasses a large sample group of women, aiming to mitigate gender-related hormonal influences, especially given that TMD is more prevalent among women. Furthermore, a notable strength of this study is its comprehensive examination of all neuropsychological factors (neck pain, anxiety, sleep disturbances, and headaches) and their intricate associations with TMD, all in a versatile and simultaneous manner.

Limitations

This study has some limitations. The first limitation is that the specific type of TMD was not determined. The type of TMD may have an impact on the parameters being investigated. Other limitations include the unknown causes of headaches and the wide age range of individuals included in the study. The headache could potentially be either secondary to TMD or a form of primary headache. A more detailed investigation of this matter is necessary.

CONCLUSION

In this study, it was observed that women with TMD tend to experience higher instances of neck pain, headaches, anxiety, and sleep problems. The precise causal relationship between these factors remains unclear, and a more thorough evaluation of these interconnections is warranted in women with TMD. With this goal in mind, during a holistic evaluation, the therapist should adopt a multidimensional approach to the matter. This involves an examination of neighboring structures and a thorough consideration of the influencing factors. Similarly, it holds paramount importance to offer treatments that encompass not only TMD but also address other associated issues, all within the framework of a holistic approach to treatment. In future studies, TMD, neck pain, headaches, anxiety, and sleep disorders should be assessed post-treatment.

Acknowledgements: Special thanks to individuals who participated and consented to join this study.

Peer-review: Externally peer-reviewed.

Ethics Committee Approval: The Ankara Yıldırım Beyazıt University Clinical Research Ethics Committee granted approval for this study (date: 08.12.2020, number: 43).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Author Contributions: Concept – NÖÜ, YAS, SSB; Design – NÖÜ, YAS, SSB; Supervision – NÖÜ, YAS, SSB; Resource – NÖÜ, YAS, SSB; Data Collection and/or Processing – NÖÜ, YAS, SSB; Analysis and/or Interpretation – YAS; Literature Search – NÖÜ, YAS, SSB; Writing – NÖÜ, YAS, SSB; Critical Reviews – NÖÜ, YAS, SSB.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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