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Original Article

Official Journal of Erciyes University Faculty of Medicine

DOI: 10.14744/cpr.2026.15629
J Clin Pract Res 2026;48(3):0–0

# Relationship Between Functionality and Pain, Range of Motion, Neck Disability, and Quality of Life in Individuals with Temporomandibular Joint Disorders: A Cross-Sectional Study

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**Cite this article as:**
Tütüneken YE, Kabasakal E. Relationship Between Functionality and Pain, Range of Motion, Neck Disability, and Quality of Life in Individuals with Temporomandibular Joint Disorders: A Cross-Sectional Study. J Clin Pract Res 2026;48(3):0–0.

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**Submitted:** 19.01.2026
**Revised:** 06.04.2026
**Accepted:** 18.05.2026
**Available Online:** 18.06.2026

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



## ABSTRACT

**Objective:** This study investigated the associations between functional status, pain, mandibular range of motion (ROM), neck disability, and quality of life (QoL) in individuals with temporomandibular joint disorders (TMDs).

**Materials and Methods:** This study included 54 adults previously diagnosed with TMD. Mandibular function was assessed using the Mandibular Function Impairment Questionnaire (MFIQ), and pain intensity was rated using the Visual Analog Scale (VAS). Mandibular ROM was measured with digital calipers. Neck-related functional limitation was assessed using the Neck Disability Index, and participants' QoL was evaluated using the World Health Organization Quality of Life-BREF (WHOQOL-BREF) instrument. Statistical analysis was performed using Pearson correlation coefficients, with the significance level set at $p<0.05$.

**Results:** MFIQ scores showed a strong correlation with pain intensity ($r=0.87$, $p<0.001$) and neck disability ($r=0.71$, $p<0.001$), and a moderate correlation with mandibular ROM ($r=-0.65$, $p<0.001$). Mandibular dysfunction was also correlated with all WHOQOL-BREF domains, particularly physical health ($r=-0.78$, $p<0.001$) and psychological health ($r=-0.69$, $p<0.001$). These findings indicate that greater functional impairment is associated with increased pain, reduced mandibular mobility, greater neck disability, and diminished overall QoL.

**Conclusion:** Mandibular dysfunction in TMD is closely associated with pain severity, neck disability, and poor QoL. These findings emphasize the functional and biomechanical interdependence between the temporomandibular and cervical regions. Comprehensive management strategies addressing both musculoskeletal and psychosocial components may optimize rehabilitation outcomes and improve the well-being of individuals with TMD.

**Keywords:** Disability evaluation, mandible, pain, quality of life, temporomandibular joint disorders.

## INTRODUCTION

The temporomandibular joint (TMJ) is considered one of the most complex synovial joints in the body because of its role in both mastication and verbal communication, as well as its anatomical proximity to neighboring musculoskeletal structures. Temporomandibular disorders (TMDs) comprise a multifaceted spectrum of conditions characterized by functional and structural impairments of the TMJ and related anatomical structures.[1] Epidemiological findings suggest that TMDs affect nearly one-third of adults and approximately one-tenth of children and adolescents, with females having twice the prevalence observed in males.[2,3]

Clinically, TMDs typically manifest as pain, joint sounds, and restricted mandibular mobility. Among these manifestations, pain is the most frequently reported symptom and may radiate to the ear, temporal region, forehead, or cervical area through interconnected neuromuscular and fascial pathways.[4,5] These symptoms frequently lead to compensatory motor adaptations during mastication, resulting in functional limitations and increased muscle tension.[6,7]

The anatomical and functional relationship between the cervical region and the TMJ has received increasing attention in recent years. Postural deviations, including forward head posture, reduced atlanto-occipital movement, and muscular imbalance in the craniocervical region, are thought to contribute to the development and persistence of TMDs.[8–10] Accordingly, these findings emphasize the importance of evaluating cervical alignment and mobility as an integral part of TMD assessment and treatment planning.[11]

Beyond physical impairment, TMD is associated with psychosocial consequences, including stress, depression, and anxiety, which collectively exacerbate pain perception and disability.[12] This multidimensional impact supports the biopsychosocial framework for understanding chronic musculoskeletal pain. Pain intensity and cervical dysfunction are known to correlate with functional limitations and reduced quality of life (QoL).[13,14]

Although previous studies have examined the relationships among pain, mandibular function, cervical impairment, and QoL in individuals with TMDs, comprehensive evaluations of these factors together remain limited.[13–16] A comprehensive understanding of these factors is essential for developing holistic and effective rehabilitation strategies. Therefore, this study aimed to examine the relationships among mandibular function, pain, mouth opening, cervical disability, and QoL in individuals with TMDs.

### KEY MESSAGES

- Mandibular dysfunction in individuals with temporomandibular joint disorders is strongly associated with increased pain intensity, reduced mandibular range of motion, greater neck disability, and poorer quality of life.
- The close relationship between temporomandibular and cervical dysfunction supports the concept of regional interdependence, emphasizing the need for comprehensive assessment and multidisciplinary management in TMD rehabilitation.
- Addressing both musculoskeletal and psychosocial components is essential for optimizing functional outcomes and improving overall well-being in individuals with temporomandibular joint disorders.

## MATERIALS AND METHODS

### Study Design

A single-blind, cross-sectional design was employed between June and October 2025 at the Istinye University Physiotherapy and Rehabilitation Application and Research Center (ClinicalTrials.gov Identifier: NCT06937502). Ethical approval was obtained from Istinye University Human Research Ethics Committee (Protocol Number: 2025-132, Date: 20.05.2025). Written informed consent was obtained from each volunteer after they were thoroughly informed about the study procedures.

### Participants

Participants with a previous diagnosis of TMD established by a dentist using the Diagnostic Criteria for Temporomandibular Disorders were included in the study.[17] G*Power software was used to perform an a priori power analysis. Sample size requirements were determined based on an anticipated effect size derived from the findings of Akdag and Aydin (r=0.466).[18] With the type I error set at 0.05 and the type II error minimized to 0.05, the power analysis yielded a target enrollment of 54 participants. Therefore, recruitment continued until this minimum sample size was reached, and 54 eligible participants were included.

The inclusion criteria were as follows: voluntary participation and the ability to provide informed consent; age between 18 and 55 years, selected to minimize the potential influence of age-related degenerative changes and comorbidities on TMJ function, cervical mobility, and pain perception; a confirmed diagnosis of TMD with at least one of the three primary clinical findings: jaw pain, restricted mouth opening, and/

or TMJ sounds; a Mini-Mental State Examination score of ≥24; and TMJ pain intensity of ≥3 on the Visual Analog Scale (VAS).[19] Participants were excluded if they had a history of complex head or neck surgery, trauma, chemoradiotherapy, or tumor; ongoing use of analgesic, anti-inflammatory, or psychiatric medications; substance dependence; significant tooth loss impairing masticatory function; current use of dental prostheses; ongoing tooth pain; receipt of any TMD-specific treatment before or during data collection; a history of orthodontic treatment; or a diagnosis of nonreducing disc displacement. The study flowchart is presented in Figure 1.

All assessments were conducted by a physiotherapist specializing in musculoskeletal rehabilitation. Data were anonymized and coded by an independent researcher before analysis, ensuring that the data analyst remained blinded to participant identifiers and clinical characteristics. This single-blind design minimized potential bias during statistical evaluation.

## Data Collection

Participants' sociodemographic and clinical characteristics were recorded. Mandibular function was then evaluated using the Mandibular Function Impairment Questionnaire (MFIQ). Pain intensity in the TMJ region was quantified using the VAS. Maximal mouth opening (MMO) was measured with a caliper. Cervical disability was assessed using the Neck Disability Index (NDI), and QoL was determined using the WHOQOL-BREF questionnaire.

## Outcome Measures

### *Assessment of Mandibular Function*

The MFIQ was used to assess mandibular function. The questionnaire comprises 17 items, each evaluated using a 5-point Likert-type response format. Ten items assess chewing-related functions, 5 items address speaking, daily activities, socializing, and work-related issues, and the remaining 2 items assess non-chewing-related functions, such as yawning, daily activities, and kissing. The questionnaire has a total score range of 0–68, with higher scores indicating greater dysfunction.[20,21]

### *Assessment of Maximal TMJ Movement*

MMO was evaluated using a digital caliper. Participants voluntarily opened their mouths until they felt the onset of discomfort. Three separate measurements were obtained, and the mean value was calculated. The distance between the lower and upper central incisors was measured in centimeters, with overbite excluded from the total value.[22]

### *Assessment of Pain Severity*

A 10-cm VAS was used to assess TMJ pain intensity, with 0 representing no pain and 10 indicating the highest level of pain. After receiving standardized instructions, participants marked the point corresponding to the average pain level they had experienced during the previous week. The score was recorded in centimeters, with higher values indicating greater pain intensity.[23]

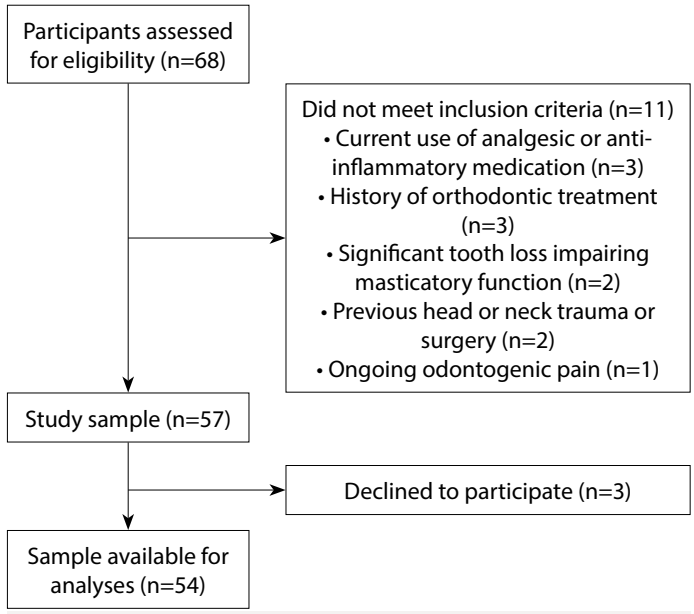


**Figure 1.** Study flow chart.

### *Assessment of Neck Disability*

The NDI was used to evaluate the level of cervical functional limitation in participants. The questionnaire comprises 10 sections addressing daily activities, such as personal care, lifting, pain intensity, headaches, reading, sleeping, and leisure participation. Each section includes six response options that quantify the degree of pain and limitation on a scale from 0 to 5, with a total score ranging from 0 to 50. According to the total score, participants were categorized into the following groups: 0–4, no limitation; 5–14, mild limitation; 15–24, moderate limitation; 25–34, severe limitation; and 35–50, complete limitation.[24,25]

### *Assessment of QoL*

Participants' QoL was assessed using the WHOQOL-BREF questionnaire. The Turkish adaptation of this instrument contains 27 items grouped into five domains: physical health, social relationships, environmental factors, psychological well-being, and national environment. Each item is rated on a 5-point Likert-type scale, with higher scores representing better perceived QoL. Domain scores are converted to a 4–20 scale, and each domain is analyzed individually.[26,27]

### Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize participant characteristics and included frequencies, percentages, means, and standard deviations, as appropriate. The distributional properties of the variables were evaluated using the Shapiro–Wilk test, together with visual examination of histogram plots. For normally distributed variables, associations between measures were examined using Pearson correlation analysis. The magnitude of the correlation coefficients was categorized according to the following criteria: negligible ($r<0.25$), weak ($0.25\leq r<0.50$), moderate ($0.50\leq r<0.70$), strong ($0.70\leq r<0.90$), and very strong ($r\geq0.90$).[28] Statistical significance for all analyses was set at a two-tailed p-value of $<0.05$.

## RESULTS

Sixty-eight individuals were initially evaluated for eligibility. Eleven individuals did not meet the inclusion criteria, and 3 declined to participate. Consequently, 54 participants were included in the final analysis. Most participants were female (61%), with a mean age of 33.02±9.12 years, a mean BMI of 24.85±3.62 kg/m$^2$, and a mean symptom duration of 22.72±12.68 months (Table 1). Table 2 presents the MFIQ scores and other clinical and QoL measures, and Figure 2 shows the Pearson correlation matrix between the variables. MFIQ scores showed a strong positive correlation with pain intensity, as measured by the VAS-P ($r=0.87$, $p<0.001$), and a moderate negative correlation with MMO ($r=-0.65$, $p<0.001$), indicating that greater functional impairment was associated with higher pain levels and reduced mouth opening. A significant correlation was also found between the MFIQ and NDI ($r=0.71$, $p<0.001$), suggesting that increased mandibular dysfunction was associated with higher levels of neck disability. Regarding QoL measures, MFIQ scores were correlated with the physical health domain of the WHOQOL-BREF ($r=-0.78$, $p<0.001$), psychological domain ($r=-0.69$, $p<0.001$), social relationships domain ($r=-0.57$, $p<0.001$), and environmental domain ($r=-0.46$, $p<0.01$). These results indicate that greater mandibular dysfunction was associated with poorer perceived QoL across all assessed domains.

**Table 1.** Descriptive statistics for demographic data (n=54)

| Demographic data | n (%) | SD |
|---|---|---|
| Gender | | |
| Female | 33 (61) | |
| Male | 21 (39) | |
| Age (years) | 33.02 | 9.12 |
| Height (cm) | 169.09 | 9.11 |
| Weight (kg) | 71.50 | 14.33 |
| BMI (kg/m$^2$) | 24.85 | 3.62 |
| Duration of symptoms (month) | 22.72 | 12.68 |

M and SD represent mean and standard deviation, respectively.

## DISCUSSION

This study demonstrates that mandibular function is strongly associated with pain intensity, cervical disability, and QoL in individuals with TMDs. The observed correlations suggest that mandibular dysfunction should not be interpreted as an isolated impairment, but rather as part of an integrated musculoskeletal and functional system involving the craniocervical region. These findings support the concept of regional interdependence and reinforce the need for multidimensional assessment strategies.

Epidemiological evidence indicates that TMD is more prevalent in females, particularly during early and middle adulthood, which has been attributed to hormonal modulation,

**Table 2.** Means, standard deviations, and correlations

| Variables | M | SD | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. MFIQ | 36.28 | 10.32 | | | | | | | | |
| 2. VAS-P | 4.52 | 1.71 | **0.87**** | | | | | | | |
| 3. MMO | 3.76 | 0.41 | **-0.65**** | **-0.62**** | | | | | | |
| 4. NDI | 20.57 | 8.96 | **0.71**** | **0.79**** | **-0.43*** | | | | | |
| 6. WHOQOL-Bref PH | 54.56 | 17.77 | **-0.78**** | **-0.86**** | **0.53**** | **-0.71**** | | | | |
| 7. WHOQOL-Bref P | 58.76 | 16.47 | **-0.69**** | **-0.72**** | **0.47**** | **-0.64**** | **0.71**** | | | |
| 8. WHOQOL-Bref SR | 65.21 | 12.75 | **-0.57**** | **-0.60**** | **0.32*** | **-0.59**** | **0.55**** | **0.63**** | | |
| 9. WHOQOL-Bref E | 73.83 | 6.65 | **-0.46*** | **-0.43*** | **0.47**** | **-0.41*** | **0.35*** | **0.40*** | **0.47**** | |

*: Indicates p<.01; **: Indicates p<0.001; M and SD are used to represent mean and standard deviation, respectively; MFIQ: the Mandibular Function Impairment Questionnaire; MMO: The maximum mouth opening; NDI: The Neck Disability Index; VAS-P: The Visual Analog Scale pain; WHOQOL-Bref: The World Health Organization's Quality of Life.

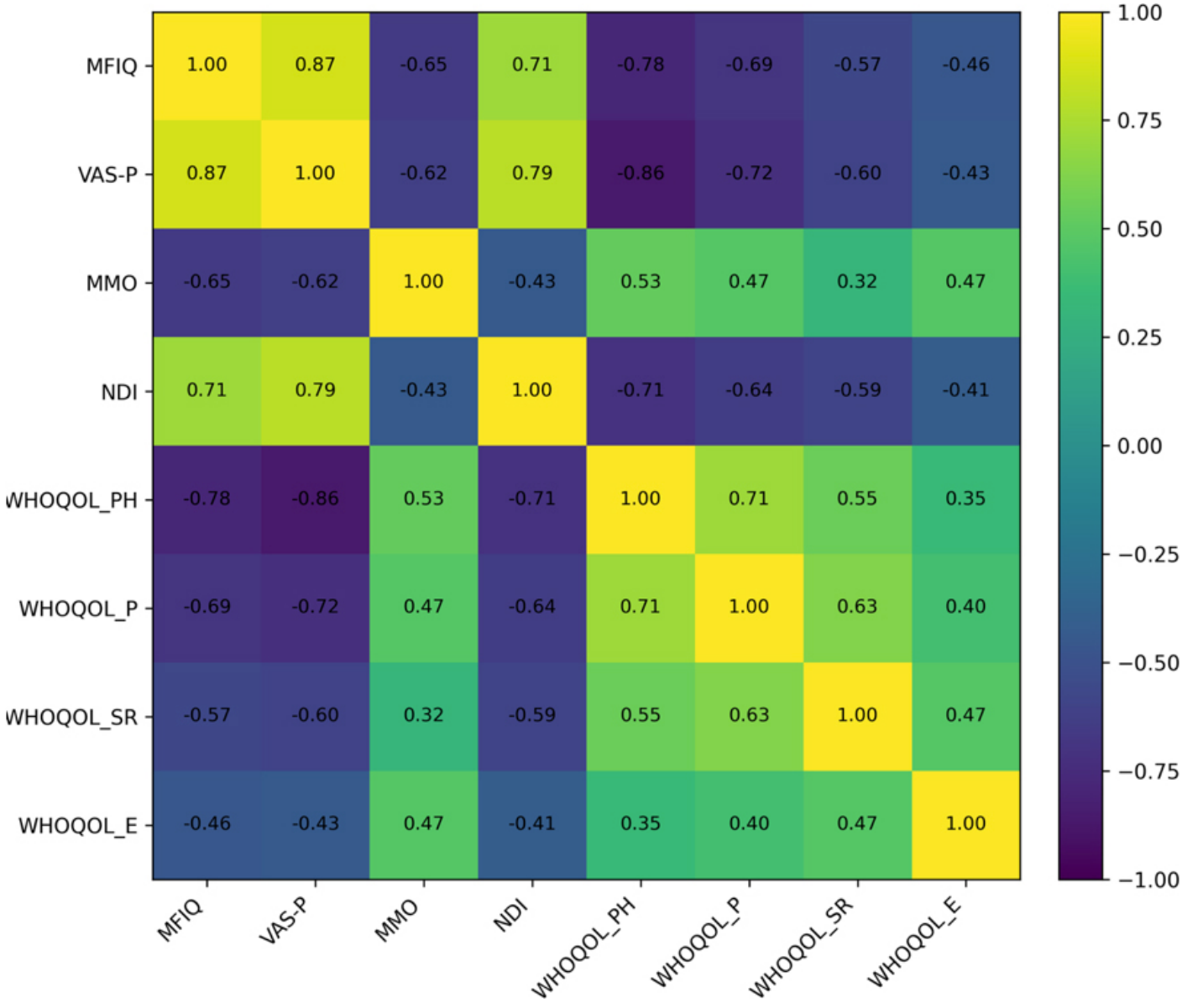


**Figure 2.** Pearson correlation matrix for MFIQ versus other variables.

psychosocial factors, and differences in pain sensitivity.[29,30] The demographic characteristics of the present sample are consistent with this pattern, suggesting that sex-related biological and behavioral factors may contribute to the clinical expression of TMD.

This study identified moderate-to-severe functional limitations based on MFIQ scores. Rather than directly comparing these findings with previous prevalence data, it is important to consider that variability in reported dysfunction levels across studies may arise from differences in diagnostic criteria, population characteristics, and measurement tools. Within this context, our findings indicate that increased pain intensity and cervical disability are associated with reduced mandibular function, highlighting the multifactorial nature of functional impairment in TMD.

Pain remains the primary complaint among individuals with TMD and is a major driver of healthcare utilization.[31,32] Emerging evidence suggests that myofascial TMD is frequently associated with widespread pain distribution and central sensitization mechanisms.[33] In line with these findings, the strong correlation between MFIQ and VAS-P observed in this study indicates that functional limitation and pain are closely

interrelated, potentially through shared neuromuscular and central processing pathways. This relationship underscores the importance of integrating pain modulation strategies into clinical management.

The interaction between the TMJ and the cervical region can be explained by biomechanical, neuromuscular, and neurophysiological mechanisms. Previous studies have shown that alterations in cervical posture, muscle activation patterns, and mobility can influence mandibular function, and vice versa.[15,34–36] The significant association between mandibular dysfunction and neck disability observed in this study provides further support for this bidirectional relationship, suggesting that impairments in one region may contribute to functional deficits in the other.

Evidence indicates that reduced cervical mobility and impaired craniocervical motor control are key features in individuals with TMD.[11,14,36] This perspective aligns with the present findings and supports the inclusion of cervical assessment as a routine component of TMD evaluation. Therefore, the concept of regional interdependence has direct clinical implications, particularly for rehabilitation strategies targeting both the mandibular and cervical systems.

The present findings also demonstrate an association between mandibular dysfunction and reduced QoL across all WHOQOL-BREF domains. Although previous studies have focused on oral health–related QoL, growing evidence indicates that TMD has a broader impact on general QoL, affecting physical functioning, psychological well-being, and social participation.[16,30,37] The consistent relationship observed across multiple QoL domains in this study reinforces the view that TMD should be considered a biopsychosocial condition rather than a localized musculoskeletal disorder.

From a clinical perspective, these results emphasize the importance of adopting a comprehensive and integrative approach to TMD management. The strong interrelationships among mandibular function, pain, cervical disability, and QoL suggest that isolated interventions targeting a single domain may be insufficient. Instead, multidisciplinary strategies incorporating musculoskeletal rehabilitation, pain management, and psychosocial support may be required to achieve optimal outcomes.

### Limitations

Certain limitations of this study should be acknowledged, particularly the limited sample size, which may restrict the generalizability of the findings to the wider TMD population. Second, although a single-blind design was adopted to minimize bias, self-reported measures, such as pain intensity and QoL, may still be influenced by participants' psychological or contextual factors. Additionally, only individuals clinically diagnosed with TMD according to standardized criteria were included; therefore, comparisons with asymptomatic individuals or other orofacial pain groups were not possible. Finally, potential confounders, such as stress, bruxism, and psychosocial variables, were not quantitatively assessed, which may have contributed to the observed variability in pain and function.

## CONCLUSION

This study demonstrates that mandibular dysfunction in individuals with TMDs is strongly associated with increased pain intensity, reduced mandibular mobility, greater cervical disability, and diminished QoL. These findings emphasize the interdependence between the temporomandibular and cervical regions and highlight the importance of a comprehensive, multidisciplinary approach to the clinical management of TMD. Addressing both musculoskeletal and psychosocial components may enhance functional outcomes and improve overall well-being in affected individuals. Future studies with larger sample sizes and longitudinal or interventional designs are needed to clarify causal relationships and support the development of targeted rehabilitation strategies aimed at improving function and QoL in individuals with TMD.

**Ethics Committee Approval:** Ethics committee approval was obtained from Istinye University Human Research Ethics Committee (Protocol Number: 2025-132, Date: 20.05.2025).

**Informed Consent:** Written informed consent was obtained from the participants prior to data collection.

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

**Funding:** The authors declared that this study received no financial support.

**Use of AI for Writing Assistance:** No use of AI-assisted technologies was declared by the authors.

**Author Contributions:** Concept – YET, EK; Design – YET, EK; Supervision – YET; Resource – YET, EK; Materials – YET, EK; Data Collection and/or Processing - YET, EK; Analysis and/or Interpretation – YET; Literature Review – YET, EK; Writing – YET, EK; Critical Review – YET.

**Acknowledgments:** The authors sincerely thank all individuals who voluntarily participated in the study and provided informed consent.

**Peer-review:** Externally peer-reviewed.

**Clinical Trial Registration:** NCT06937502.

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