ORIGINAL ARTICLE

Association between Orthodontic Treatment and Temporomandibular Disorders among Adult Patients in Saudi Arabia: A Cross-Sectional Study

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Abstract

Introduction: Patients receiving orthodontic treatment frequently have temporomandibular disorders (TMDs). However, because it depends on the symptoms of patients, the relationship between TMDs and orthodontic therapy is still up for debate. **Objectives:** The objective of the study was to evaluate whether orthodontic treatment in adult patients is associated with TMD symptoms in Saudi Arabia. **Materials and Methods:** A cross-sectional study was conducted between July 2025 and January 2026 across various regions of Saudi Arabia. Data were collected from 384 participants aged 18 years old and above who undergo orthodontic treatment or finished from the treatment within <1 year using Fonseca Anamnestic Index questionnaire. The severity of TMD was assessed and divided into mild, moderate, and severe. **Results:** Among 285 eligible respondents, 67.4% were female, and 68.1% had a bachelor's degree. The mean Fonseca Anamnestic Index (FAI) score was 29.4 ± 19.2 (median 30; range 15–45). No participant reported prior TMJ disease, major jaw trauma, rheumatoid arthritis, or recent muscle relaxant use, limiting confounding. Overall, 67.0% screened positive for TMD symptoms: 37.2% mild, 29.5% moderate, and 0.4% severe; 29.8% met criteria for moderate/severe TMD. Commonly endorsed symptoms/behaviors were headaches (54.7% yes/sometimes), chewing-related muscle pain (52.3%), TMJ clicking (40.7%), clenching/grinding (59.0%), and self-reported tension (59.2%). TMD severity differed significantly by education level ($P = 0.0001$) and region of residence ($P = 0.025$), but not by gender ($P = 0.244$). Orthodontic variables were also associated with severity: moderate/severe TMD was higher among participants currently under treatment (41.4%) or within <1 year of completion (45.2%) than those 1–3 years post-treatment (21.0%) ($P = 0.0001$). By treatment duration, moderate/severe TMD was highest with <1 year of treatment (46.5%), intermediate with >2 years (35.9%), and lowest with 1–2 years (22.6%) ($P = 0.0001$). **Conclusion:** TMD symptoms were common among orthodontic-experienced adults, with greater severity clustering during active treatment and early post-treatment. Routine screening and biopsychosocial counseling during orthodontic care may be warranted; longitudinal studies using clinical diagnostic criteria are needed to clarify temporality.

Key words: Fonseca questionnaire, orthodontic treatment, Saudi Arabia, temporomandibular disorder, temporomandibular disorder symptoms

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INTRODUCTION

The term "temporomandibular disorders" (TMDs) refers to a diverse set of conditions that affect the temporomandibular joints (TMJs), masticatory muscles, and related tissues.[1] The most common symptoms include TMJ pain, cranial and facial muscle fatigue, restricted or erratic mandibular mobility, disc displacements, and articular clicking.[2] Many variables, such as family history, psychological factors, and unstable occlusion, have been suggested as causes of TMD.[3]

TMD is a prevalent condition that affects between 26% and 46% of young adults.[4] The prevalence of TMD is found in 20% to 50% of humans, differences in the population's race, the method of sampling, and the criteria followed might all be relevant for the prevalence's variation.[5] A systematic review conducted in 2021 by Yap *et al.* reported a high prevalence of TMD symptoms among prospective orthodontic patients in Southeast Asia, with 66.7% of participants affected. Approximately 20% of them experienced moderate to severe TMD.[6]

In 2018, Hwang *et al.*, conducted a study among adults in South Korea and found that an increased incidence of TMJ problems may be related to an orthodontic treatment experience.[7] On the other hand, in 2019, Sim *et al.* conducted a study investigating the association between orthodontic treatment and TMJ pain and dysfunction in the South Korean population and discover that there was no correlation between orthodontics and TMJ dysfunction.[3] In 2020, Al-Shamrery *et al.*, conducted a study in Saudi Arabia to evaluate the perception of the relationship between temporomandibular dysfunction and orthodontic treatment; the study found no significant statistical relationship between TMD and orthodontic treatment.[8]

In a 2022 study by Youssef *et al.*, the findings suggested that active orthodontic treatment was found to had no significant effect on TMD.[9] These findings across studies have varied regarding the direct impact on the TMJ, as it is largely influenced by patients' subjective symptoms perception and individual level of awareness.

This study was conducted due to the inconsistent findings in previous literature regarding the association between TMJ disorders and orthodontic treatment. In addition, there is a lack of sufficient studies addressing this topic specifically within the Saudi population.

Objectives

This research aims to investigate whether there is any relationship between orthodontic treatment and the prevalence of TMD symptoms, particularly within the Saudi population.

MATERIALS AND METHODS

Study design and setting

A cross-sectional study conducted between July 2025 and January 2026 across various regions in Saudi Arabia. The study included male and female participants aged 18 years and above from various regions of Saudi Arabia.

Subject: Participants, recruitment, and sampling procedure

This observational study was conducted from July 2025 to January 2026across various regions in Saudi Arabia. Data were collected using a validated questionnaire based on the Fonseca Anamnestic Index (FAI) to assess TMD symptoms. Eligible participants were those who had either been undergoing orthodontic treatment for a minimum duration of 6 months or had completed orthodontic treatment within the past 12 months.

Sample size

The sample size was determined by Raosoft, Inc., considering the standard deviation for 95% confidence, and margin of error that can be accepted is 5% the calculated minimum sample size required for this study is 384 participants.

Inclusion and exclusion criteria

The inclusion criteria for this study were as follows: Male and female participants adults aged 18 years old and above from various regions of Saudi Arabia, who had either been undergoing orthodontic treatment for a minimum duration of 6 months, or had completed orthodontic treatment within the past 12 months. This study did not include children under the age of 18 years old, individuals who have had orthodontic treatment for <6 months, or those who have removed their orthodontic appliances for more than 1 year before participation. In addition, Patients with pre-existing TMJ pathologies (malignant or benign lesions) or a history of severe trauma to the condylar joint or the mandibular body, patients with severe systemic conditions (rheumatoid arthritis) that may affect the TMJ function, and patients recent use of medications that may mask the symptoms of TMD (painkillers, muscle relaxants) were excluded.

Method for data collection, instrument

The FAI was selected as the primary assessment tool to evaluate the presence and severity of TMJ disorder (TMD) among participants who had previously undergone or were currently undergoing orthodontic treatment.[2]

The FAI is a validated and reliable screening tool for assessment of TMDs. In addition, it depends on the patient

symptoms without clinical examination. It has been widely used due to ease of administration, low cost, and ability to categorize the severity of TMD symptoms in a large population.

A well-structured questionnaire was provided to the participants, and their responses were used to collect the study data. The questionnaire is a validated screening instrument consisting of 10 closed-ended questions. The questionnaire was structured into three sections: a demographic section, which included participants' age, gender, place of residence, marital status, and educational level. Second, orthodontic treatment and TMJ disease history. Third, prevalence and associated risk include the presence of TMD symptoms and risk factors.

Participants responded to each question using one of three options: "Yes," "Sometimes," or "No."

Each response was assigned a specific score: "Yes" = 10 points, "Sometimes" = 5 points, and "No" = 0 points. The total score was calculated by summing the values of all responses.

The severity of TMD was categorized based on the following score ranges:

0–15: No TMD, 16–40: Mild TMD, 41–65: Moderate TMD, 66–100: Severe TMD.

Pilot test

The survey was sent to 20 participants, who were instructed to complete it. The purpose of this was to examine the study's viability and the ease of use of the questionnaire. The pilot study's data were not included in the study's final analysis.

Analyzes and entry method

Data were entered on a computer using Microsoft Office Excel software (Windows version 2021). Afterward, the data were analyzed using the SPSS application, version 20 (IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY: IBM Corp.). Descriptive statistics were used to summarize numerical variables for baseline characteristics. For categorical variables, frequencies and percentages were calculated. The Chi-square test was applied to identify associations between categorical variables.

RESULTS

A total of 285 eligible adult participants who had undergone orthodontic treatment completed the questionnaire [Table 1]. Females represented roughly two-thirds of the sample (192, 67.4%), while males accounted for 93 (32.6%). With respect to educational attainment, the sample was predominantly university educated (University/Bachelor's: 194, 68.1%), followed by postgraduate qualifications (36, 12.6%); smaller proportions reported secondary education (23, 8.1%), intermediate education (16, 5.6%), or a diploma (16, 5.6%). Marital status was almost evenly split between married (138, 48.4%) and single participants (135, 47.4%), with a few divorced (8, 2.8%) or widowed individuals (4, 1.4%). Participants were drawn from all Saudi regions, with the highest representation from the Southern Region (113, 39.6%), followed by the Western Region (85, 29.8%) and Central Region (59, 20.7%).

Table 1: Sociodemographic characteristics of participants (*n*=285)

Parameter	No.	Percent
Gender		
Female	192	67.4
Male	93	32.6
Educational level		
University (Bachelor's)	194	68.1
Postgraduate	36	12.6
Secondary (high school)	23	8.1
Diploma	16	5.6
Intermediate	16	5.6
Marital status		
Single	135	47.4
Married	138	48.4
Divorced	8	2.8
Widowed	4	1.4
Region of residence		
Central Region	59	20.7
Western Region	85	29.8
Eastern Region	16	5.6
Northern Region	12	4.2
Southern Region	113	39.6

Table 2 summarizes orthodontic-treatment history. All respondents reported having received orthodontic treatment (100%), which means that the analysis primarily reflects variation in treatment timing and duration rather than a treated vs. untreated comparison. Most participants had completed treatment 1–3 years earlier (167, 58.6%), while 87 (30.5%) were currently under treatment, and 31 (10.9%) had completed treatment within the past year. Treatment duration was most commonly 1–2 years (164, 57.5%), followed by more than 2 years (78, 27.4%) and <1 year (43, 15.1%) [Figure 1]. Notably, no participant reported a previous diagnosis of TMJ disease, major jaw trauma, rheumatoid arthritis, recent use of muscle relaxants, or other listed medical conditions (100% "no medical conditions"), reducing confounding from pre-existing TMJ pathology in this dataset.

Table 2: History of orthodontic treatment among participants (*n*=285)

Parameter	No.	Percent
Have you ever received orthodontic treatment?		
Yes	285	100.0
When did you complete your orthodontic treatment?		
Currently under treatment	87	30.5
<1 year ago	31	10.9
1–3 years ago	167	58.6
Duration of orthodontic treatment was		
<1 year	43	15.1
1–2 years	164	57.5
More than 2 years	78	27.4
Have you ever been diagnosed with any of the following conditions?		
No medical conditions	285	100.0

Item-level prevalence of TMD symptoms and associated risk factors assessed using the FAI is shown in Table 3. For functional limitation, difficulty opening the mouth was uncommon as a definite complaint (Yes: 6.0%), though 28.4% reported it sometimes. Difficulty moving the mandible side-to-side was the least endorsed symptom overall (Yes: 5.6%; Sometimes: 17.2%). Pain-related items showed substantial symptom reporting: headaches were reported as Yes by 16.5% and Sometimes by 38.2% (combined 54.7%), while tiredness/muscular pain during chewing was reported by nearly half of participants at least sometimes (Yes: 9.8%; Sometimes: 42.5%). Clicking of the TMJ was reported by 12.6% (Yes) and 28.1% (Sometimes). Risk-related behaviors and perceptions were also frequent: Clenching/grinding was endorsed by 17.2% (Yes) and 41.8% (Sometimes), and feeling tense/nervous was endorsed by 19.6% (Yes) and 39.6% (Sometimes). Overall, 60.7% of participants reported at least one symptom as "Yes", and 94.0% reported at least one symptom "Yes" or "Sometimes", underscoring the high symptom burden captured by this screening tool.

Based on the FAI scoring system (Yes = 10, Sometimes = 5, No = 0), the mean total score was 29.4 ± 19.2 (median 30, range 15–45). As summarized in Table 4, one-third of participants were classified as having no TMD (94, 33.0%), whereas two-thirds had some degree of TMD symptoms (191, 67.0%). Mild TMD was the most common category (106, 37.2%), followed by moderate TMD (84, 29.5%); severe TMD was rare (1, 0.4%). When moderate and severe categories are combined, nearly one in three participants met criteria for moderate/severe TMD (85, 29.8%), reflecting a clinically relevant level of symptom severity [Figure 2].

Associations between sociodemographic characteristics and TMD severity categories are presented in Table 5 (moderate and severe collapsed for inferential testing due to sparse severe counts). No statistically significant relationship was detected between gender and TMD severity ($P = 0.244$). Educational level showed a statistically significant association with TMD severity ($P = 0.0001$), with markedly higher moderate/severe proportions among participants with a diploma (68.8%) or secondary education (60.9%) compared with those holding a university degree (20.6%). Region of residence was also significantly associated with TMD severity ($P = 0.025$); moderate/severe TMD was proportionally more common in the Northern (50.0%), Central (39.0%), and Southern regions (35.4%) than in the Western (16.5%) and Eastern regions (12.5%). Marital status did not reach conventional statistical significance ($P = 0.063$), though married participants showed a slightly higher moderate/severe proportion (33.3%) than single participants (28.1%).

Table 6 shows relationships between orthodontic-treatment history variables and TMD severity. Timing since orthodontic-treatment completion was significantly associated with TMD severity ($P = 0.0001$). Participants who

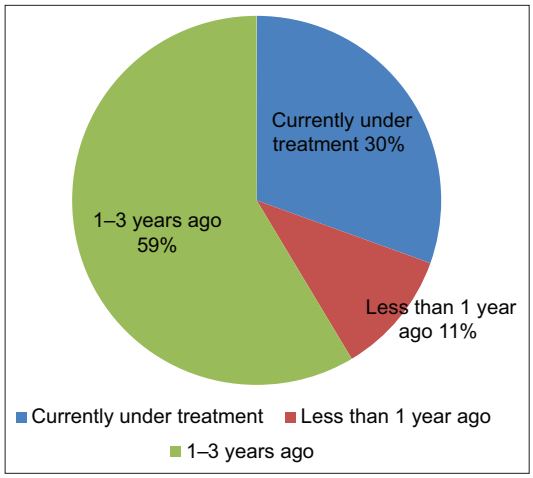

Figure 1: Orthodontic-treatment completion status among participants (*n* = 285)

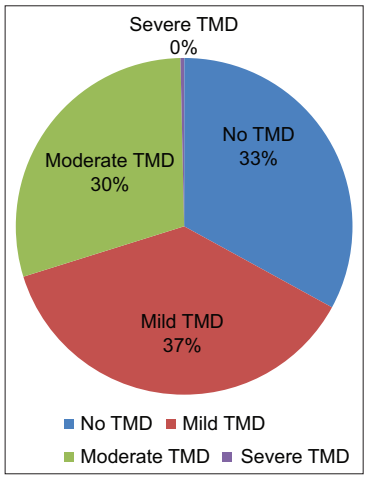

Figure 2: Distribution of participants by temporomandibular disorder severity (*n* = 285)

Table 3: Prevalence and associated risk (FAI items) among participants (*n*=285)

Parameter	No.	Percent
1. Is it difficult for you to open your mouth?		
Yes	17	6.0
Sometimes	81	28.4
No	187	65.6
2. Is it hard for you to move your mandible from side to side?		
Yes	16	5.6
Sometimes	49	17.2
No	220	77.2
3. Do you get tired/muscular pain while chewing?		
Yes	28	9.8
Sometimes	121	42.5
No	136	47.7
4. Do you have frequent headaches?		
Yes	47	16.5
Sometimes	109	38.2
No	129	45.3
5. Do you have pain on the nape or stiff neck?		
Yes	28	9.8
Sometimes	68	23.9
No	189	66.3
6. Do you have earaches or pain in TMJs?		
Yes	32	11.2
Sometimes	76	26.7
No	177	62.1
7. Have you noticed any TMJ clicking while chewing or when you open your mouth?		
Yes	36	12.6
Sometimes	80	28.1
No	169	59.3
8. Do you clench or grind your teeth?		
Yes	49	17.2
Sometimes	119	41.8
No	117	41.1
9. Do you feel your teeth do not articulate well?		
Yes	80	28.1
Sometimes	83	29.1
No	122	42.8
10. Do you consider yourself a tense (nervous) person?		
Yes	56	19.6
Sometimes	113	39.6
No	116	40.7

FAI: Fonseca Anamnestic Index, TMJ: Temporomandibular joints

Table 4: Distribution of TMD severity according to FAI score (*n*=285)

Category	Frequency	Percent
No TMD	94	33.0
Mild TMD	106	37.2
Moderate TMD	84	29.5
Severe TMD	1	0.4
Total	285	100.0

FAI: Fonseca Anamnestic Index, TMJ: Temporomandibular joints

were still under treatment (moderate/severe: 41.4%; mean FAI = 35.7) or who had completed treatment <1 year earlier (45.2%; mean FAI = 37.1) had higher symptom severity than those who completed treatment 1–3 years earlier (21.0%; mean FAI = 24.7). Treatment duration was also significantly associated with TMD severity (P = 0.001); the moderate/severe proportion was highest among those treated for <1 year (46.5%; mean FAI = 36.4), intermediate among those treated for more than 2 years (35.9%; mean FAI = 32.9), and lowest for those treated for 1–2 years (22.6%; mean FAI = 25.9). Chi-square testing could not be performed for "ever received orthodontic treatment" and for the medical-diagnosis item because all participants selected the same response option, limiting variability in these predictors.

DISCUSSION

The present cross-sectional study aimed to evaluate whether orthodontic treatment status and treatment history are associated with temporomandibular disorder (TMD) symptoms among adults in Saudi Arabia using the Fonseca Anamnestic Index (FAI). Among 285 adults with current or previous orthodontic treatment experience, 67.0% were classified as having TMD symptoms, with mild symptoms most frequent (37.2%) and nearly one-third meeting criteria for moderate/severe TMD (29.8%). This distribution suggests a substantial burden of self-reported TMD-related complaints in orthodontic-experienced adults and provides a basis for interpreting how symptom patterns vary with treatment timing and demographic factors.

The overall prevalence observed in the present study is consistent with prior reports that TMD symptoms are frequent among individuals seeking or receiving orthodontic care, although estimates vary by setting and measurement. In a prospective study of orthodontic patients, Yap *et al*. reported that approximately two-thirds of participants had TMD symptoms and that a meaningful minority experienced moderate-to-severe levels.[6] At the evidence-synthesis level, Coronel-Zubiate *et al*. concluded from a systematic review and meta-analysis that orthodontic treatment is not associated with a higher occurrence of TMD overall, supporting the prevailing view that orthodontics is not a consistent long-term etiologic factor for TMD.[10,11] Similarly, Michelotti and

Table 5: Association between sociodemographic characteristics and TMD severity categories (*n*=285)

Parameters	TMD severity			Total (*n*=285)	*P* value*
	No TMD	Mild TMD	Moderate/ Severe TMD		
Gender					
Female	69	66	57	192	0.244
	73.4%	62.3%	67.1%	67.4%	
Male	25	40	28	93	
	26.6%	37.7%	32.9%	32.6%	
Educational level					
Intermediate	5	7	4	16	0.0001
	5.3%	6.6%	4.7%	5.6%	
Secondary (high school)	6	3	14	23	
	6.4%	2.8%	16.5%	8.1%	
Diploma	2	3	11	16	
	2.1%	2.8%	12.9%	5.6%	
University (Bachelor's)	71	83	40	194	
	75.5%	78.3%	47.1%	68.1%	
Postgraduate	10	10	16	36	
	10.6%	9.4%	18.8%	12.6%	
Marital status					
Single	42	55	38	135	0.063
	44.7%	51.9%	44.7%	47.4%	
Married	50	42	46	138	
	53.2%	39.6%	54.1%	48.4%	
Divorced	2	6	0	8	
	2.1%	5.7%	0.0%	2.8%	
Widowed	0	3	1	4	
	0.0%	2.8%	1.2%	1.4%	
Region of residence					
Southern Region	36	37	40	113	0.025
	38.3%	34.9%	47.1%	39.6%	
Western Region	30	41	14	85	
	31.9%	38.7%	16.5%	29.8%	
Central Region	17	19	23	59	
	18.1%	17.9%	27.1%	20.7%	
Eastern Region	8	6	2	16	
	8.5%	5.7%	2.4%	5.6%	
Northern Region	3	3	6	12	
	3.2%	2.8%	7.1%	4.2%	

TMJ: Temporomandibular joints

Iodice emphasized that most pain-related TMD presentations are not adequately explained by occlusal factors alone and should be interpreted within a broader biopsychosocial framework.[12] In this context, the high symptom prevalence in our cohort likely reflects the multi-factorial nature of TMD and the fact that orthodontic patients are commonly exposed to stressors and behaviors that may influence symptom reporting, rather than indicating a direct causal effect of orthodontic treatment.

At the symptom level, headaches and chewing-related muscular fatigue were common in our sample (54.7% and 52.3% reporting these at least sometimes). Joint noises were also frequent, with TMJ clicking reported at least sometimes

Table 6: Association between orthodontic-treatment history and TMD severity categories (*n*=285)

Parameters	TMD severity			Total (*n*=285)	*P* value*
	No TMD	Mild TMD	Moderate/ Severe TMD		
When did you complete your orthodontic treatment?					
Currently under treatment	15	36	36	87	0.0001
	16.0%	34.0%	42.4%	30.5%	
<1 year ago	7	10	14	31	
	7.4%	9.4%	16.5%	10.9%	
1–3 years ago	72	60	35	167	
	76.6%	56.6%	41.2%	58.6%	
Duration of orthodontic treatment was					
<1 year	5	18	20	43	0.0001
	5.3%	17.0%	23.5%	15.1%	
1–2 years	69	58	37	164	
	73.4%	54.7%	43.5%	57.5%	
More than 2 years	20	30	28	78	
	21.3%	28.3%	32.9%	27.4%	

*P value was considered significant if ≤ 0.05. TMJ: Temporomandibular joints

by 40.7% of participants. Contemporary headache literature underscores that TMD and headache disorders often co-occur and can mutually amplify pain via shared nociceptive pathways and central sensitization, making comorbidity clinically meaningful for diagnosis and management.[13] From a clinical perspective, frequent headache reporting may increase perceived jaw-related disability, influence pain attribution during orthodontic treatment, and contribute to healthcare utilization. The frequent reporting of chewing muscle fatigue may also reflect functional adaptation demands and increased attention to jaw sensations in individuals undergoing active dental treatment.

Behavioral and psychosocial correlates were prominent: 59.0% reported clenching or grinding at least sometimes and 59.2% described themselves as tense or nervous at least sometimes. These findings align with the biopsychosocial model of TMD and reinforce the view that behavioral and psychological factors are intertwined with symptom reporting and persistence.[12] Sleep-related factors may also contribute. A systematic review of adults found associations between TMD and sleep disorders, including sleep bruxism and obstructive sleep apnea, while emphasizing the need for higher-quality longitudinal evidence and careful consideration of confounding.[14] In practical terms, the high prevalence of parafunctional behaviors and perceived stress in our cohort supports the importance of incorporating behavioral counseling (e.g., awareness of daytime clenching, stress management) and, when indicated, sleep-related screening into patient-centered care rather than focusing solely on occlusal explanations.

With respect to orthodontic-treatment history, our results suggest that symptom severity is temporally patterned around active treatment and the early post-treatment period. Participants currently under orthodontic treatment and those who completed treatment within the previous year had higher proportions of moderate/severe TMD (41.4% and 45.2%) compared with those who completed treatment 1–3 years earlier (21.0%). This pattern is clinically plausible because active tooth movement, transient occlusal interferences, and the initial adaptation to appliances and retainers can affect jaw function and increase symptom awareness. Importantly, the observed reduction among those 1–3 years post-treatment is consistent with the broader conclusion that orthodontics is not a persistent driver of TMD symptoms for most patients.[11,12] It also suggests that symptom peaks may be more likely during periods of greater functional and psychosocial load, including the active and early retention phases.

Population studies have reported mixed associations between orthodontic experience and TMD symptoms, and our timing-related pattern may help reconcile these findings. Using a representative adult South Korean dataset, Hwang and Park reported that orthodontic treatment experience was associated with TMJ symptom reporting.[7] In contrast, Sim *et al*., also analyzing national survey data, reported no meaningful association between orthodontic treatment and TMD pain/dysfunction after adjustment for relevant covariates.[3] A plausible interpretation is that cross-sectional associations may reflect selection effects, symptom awareness, or time-varying discomfort rather than a stable causal relationship.

Long-term prospective evidence also supports a neutral long-term effect: A 20-year prospective study reported that malocclusion and orthodontic treatment did not appear to drive adverse longitudinal trends in TMJ disorder symptoms at the population level.[1] Together with our findings, this supports the view that clinicians should distinguish between transient symptom fluctuations around treatment periods and the broader evidence base indicating no consistent long-term causation.

Treatment duration was also associated with severity in the present study, with the highest proportion of moderate/severe TMD among those treated for less than one year (46.5%), intermediate levels among those treated for more than two years (35.9%), and the lowest among those treated for 1–2 years (22.6%). Although treatment duration is often viewed as a proxy for clinical complexity, the direction observed here may also reflect early-phase discomfort and adaptation, interruption or discontinuation among symptomatic individuals, or unmeasured treatment characteristics (such as appliance type, mechanics, and elastics). Because the present study did not measure baseline symptoms prior to starting orthodontics or collect detailed orthodontic variables, this association should be interpreted cautiously. Nevertheless, it highlights the need for longitudinal designs that measure pre-treatment status, follow symptoms across defined treatment phases, and account for psychosocial and behavioral factors that may modify symptom trajectories.

Sociodemographic analyses showed significant associations between education level and region of residence with TMD severity, while gender was not significantly associated. Prospective evidence from the Orofacial Pain: Prospective Evaluation and Risk Assessment (OPPERA) study indicates that sociodemographic predictors of first-onset TMD can be nuanced and that sex differences in incidence may be modest compared with prevalence differences often reported cross-sectionally.[15] Moreover, a systematic review and meta-analysis reported that economic inequalities are associated with TMD occurrence, supporting the plausibility that social determinants contribute to pain vulnerability, stress exposure, and healthcare access patterns.[16] In our sample, regional and education differences may therefore reflect broader contextual factors, including differences in stressors, health literacy, care pathways, and symptom reporting practices. These findings warrant further investigation using representative sampling and models that include socioeconomic and psychosocial variables as potential confounders or effect modifiers.

Several limitations should be acknowledged. The cross-sectional design precludes causal inference and cannot establish whether symptoms preceded orthodontic treatment or were influenced by it. Outcomes were assessed using the FAI, which is practical for screening but does not replace standardized clinical diagnosis such as the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD).[17] In addition, psychometric work suggests that the full FAI can be multidimensional and that scoring properties can vary across populations, which may affect severity classification.[18] The sample relied on self-report, and included only orthodontic-experienced adults without an untreated comparator group; detailed data on malocclusion severity, appliance type, and clinical diagnoses were not available. Despite these limitations, the findings provide useful signals that symptom burden is high in orthodontic-experienced adults and that symptom severity may cluster during active treatment and the first year after completion, supporting the clinical value of screening and addressing behavioral and psychosocial contributors in tandem with orthodontic care.

CONCLUSION

In this Saudi Arabian cross-sectional survey of 285 adults with current or prior orthodontic treatment, 67.0% screened positive for TMD symptoms using the FAI, with mild TMD most common and 29.8% classified as moderate/severe. Severity differed by orthodontic timing and duration: Moderate/severe TMD was more common among participants under treatment (41.4%) or within 1 year of completion (45.2%) than 1–3 years after treatment (21.0%), and highest with treatment <1 year (46.5%). These findings support routine symptom screening and biopsychosocial counseling during orthodontic care and early follow-up. Future prospective studies should measure baseline symptoms and appliance variables to clarify temporality.

ACKNOWLEDGMENTS

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ETHICAL APPROVAL

The study was fully explained to all participants, and it was emphasized that participation was voluntary. Written informed consent was obtained from each participant before enrollment. All collected information was securely stored and used exclusively for research purposes.

INFORMED CONSENT

Written informed consent was obtained from all study participants.

DATA AND MATERIALS AVAILABILITY

All data generated or analyzed during this study are included in this published article.

REFERENCES

1. Myllymäki E, Heikinheimo K, Suominen A, Evälahti M, Michelotti A, Svedström-Oristo AL, *et al.* Longitudinal trends in temporomandibular joint disorder symptoms, the impact of malocclusion and orthodontic treatment: A 20-year prospective study. J Oral Rehabil 2023;50:739-45.
2. Zivkovic M, Milenkovic M, Amanovic M, Simic A, Stratimirovic D. Prevalence and severity of TMD in orthodontic patients. Stomatol Glas Srb 2022;69:125-31.
3. Sim HY, Kim HS, Jung DU, Lee H, Han YS, Han K, *et al.* Investigation of the association between orthodontic treatment and temporomandibular joint pain and dysfunction in the South Korean population. Korean J Orthod 2019;49:181-7.
4. Al-Groosh DH, Abid M, Saleh AK. The relationship between orthodontic treatment and temporomandibular disorders: A dental specialists' perspective. Dental Press J Orthod 2022;27:e2220406.
5. Shaik JA, Reddy RK. Review article prevention and treatment of white spot lesions in orthodontic patients. Contemp Clin Dent 2017;8:11-9.
6. Yap AU, Chen C, Wong HC, Yow M, Tan E. Temporomandibular disorders in prospective orthodontic patients. Angle Orthod 2021;91:377-83.
7. Hwang SH, Park SG. Experience of orthodontic treatment and symptoms of temporomandibular joint in South Korean adults. Iran J Public Health 2018;47:13-7.
8. Al Shammery D, Alfayez H, Al Bukairi M, Al Otaibi M, Al Eidan S, Al Sinani Y, *et al.* Perception of the relationship between temporomandibular dysfunction and orthodontic treatment among Saudi population. Int J Community Med Public Health 2020;7:4250-5.
9. Youssef MS, Tarabaih A, Osman A. Prevalence of temporomandibular disorders among orthodontic patients (cross-sectional clinical survey). BAU J Health WellBeing 2022;4:1.
10. Ahmad Ersheidat A, Izzeddin Aldalalah A, Mahmoud Albatayneh A, Abdul Al Karim A, Yaseen Bani Salman M, Mohammad Hasan Ababneh M. Temporomandibular disorder symptoms and orthodontic treatment: A cross - sectional study. Int J Sci Res 2024;13:1228-33.
11. Coronel-Zubiate FT, Marroquín-Soto C, Geraldo-Campos LA, Aguirre-Ipenza R, Urbano-Rosales LM, Luján-Valencia SA, *et al.* Association between orthodontic treatment and the occurrence of temporomandibular disorders: A systematic review and meta-analysis. J Clin Exp Dent 2022;14:e1032-43.
12. Michelotti A, Rongo R, D'Antò V, Bucci R. Occlusion, orthodontics, and temporomandibular disorders: Cutting edge of the current evidence. J World Fed Orthod 2020;9:S15-8.
13. Romero-Reyes M, Klasser GD. Temporomandibular disorders and headache: Shared mechanisms and clinical considerations. Curr Pain Headache Rep 2023;27:627-36.
14. Bloomfield A, Chan N, Fryml L, Horace R, Pyati S. Ketamine for chronic pain and mental health: Regulations, legalities, and the growth of infusion clinics. Curr Pain Headache Rep 2023;27:579-85. Available from: https://link.springer.com/content/pdf/10.1007/s11916-023-01150-5.pdf. [Last accessed on 2026 Apr 25]. https://medicaljournalssweden.se/actaodontologica/article/view/42960/49700
15. Slade GD, Sanders AE, Bair E, Brownstein N, Dampier D, Fillingim RB, *et al.* Preclinical episodes of orofacial pain symptoms and their association with sociodemographic and psychosocial factors: The OPPERA prospective cohort study. J Pain 2013;14 12 Suppl: T17-27.
16. Minervini G, Franco R, Marrapodi MM, Cervino G, Fiorillo L, Cicciù M. Association between economic inequalities and temporomandibular disorders: A systematic review and meta-analysis. J Oral Rehabil 2023;50:715-23.
17. Schiffman E, Ohrbach R, Truelove E, Look J, Anderson G, Goulet JP, *et al.* Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for clinical and research applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group. J Oral Facial Pain Headache 2014;28:6-27.
18. Yap AU, Gunardi I, Lee DZ, Marpaung C. Dimensionality of the Fonseca Anamnestic Index and validation of its short-form derivative. Acta Odontol Scand 2025;84:137-44.
19. Al-Jewair TS, Shibeika D, Ohrbach R. Temporomandibular disorders and their association with sleep disorders in adults: A systematic review. J Oral Facial Pain Headache 2021;35:41-53.

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