# Comparison of the Relationship between Temporomandibular Disorder and Oral Habits or Quality of Life in Dentistry Students in Different Years of Education

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**Objective:** *To evaluate the prevalence of temporomandibular disorder (TMD) in dental faculty students in different years of education and investigate the relationship between TMD and oral habits or quality of life.*
**Methods:** *The Fonseca Anamnestic Index (FAI) questionnaire was used to determine the prevalence and severity of TMD, the Oral Behaviors Checklist (OBC) questionnaire served to determine the severity of harmful oral habits/parafunctions and the Oral Health Impact Profile-14 (OHIP-14) questionnaire was used to evaluate the quality of life in a total of 452 dentistry students (269 women and 183 men) in different years of education.*
**Results:** *With regard to incidence of TMD, a total of 215 women had TMD (215/269, 79.9%), which was significantly higher than that in men (87/183, 47.5%) ($P < 0.001$). According to the OBC and OHIP-14 questionnaire results, harmful oral habits and quality of life showed a low to moderately significant correlation with TMD ($P < 0.05$).*
**Conclusion:** *The Fonseca, OHIP-14 and OBC questionnaires allow early and inexpensive determination of oral habits that increase the prevalence of TMD. The prevalence of TMD in dentistry students at the clinical education stage is higher than those who have not progressed to the clinical education stage.*

**Key words:** *Fonseca questionnaire, oral behaviours checklist, oral health impact profile-14, temporomandibular disorder*
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The temporomandibular joint (TMJ) is a part of the chewing system, which fulfils important functions such as chewing, speaking, swallowing, tasting and breathing[1]. The TMJ is anatomically and biomechanically different from other movable joints in the body. It is the only movable joint among those that make up the head and neck system. The TMJ is located between the hood of the mandible of the mandibular condyle and the mandibular fossa of the temporal bone and consists of the condyle in the lower jawbone, the mandibular fossa in the temporal bone, and the joint disc that separates these two bone surfaces from each other[2,3].

Although there are several definitions of TMJ dysfunction, or temporomandibular disorder (TMD), it is commonly expressed as a combination of problems related to the masticatory muscles, the TMJ and related structures[2,4-6]. Malocclusion, trauma, bruxism, parafunctional habits, pathophysiology of the masticatory

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muscles, emotional stress, psychosocial factors, age and sex are implicated in the aetiologies of TMD[4-10].

Symptoms indicative of TMD include TMJ pain when chewing and clicking and popping sounds in the TMJ[11,12]. TMJ pain, one of the most common symptoms, limits jaw movements and causes joint sounds, as well as symptoms such as headache, earache, tinnitus, toothache and vertigo[13]. These symptoms can be observed alone or together[9].

Results from different clinical trials have shown that more reliable tools are needed to determine the severity of TMD in the population. The determination of aetiological factors and the role of several factors in TMD help prevent the standardisation of samples[6]. Due to the need for widely valid and simple evaluation procedures that standardise research samples including TMD patients, questionnaires have been developed that identify the main clinical findings of TMD and classify patients according to their severity level[14].

One of the indices used to diagnose TMD patients in the healthy population is the Fonseca Anamnestic Index (FAI). The low cost and easy applicability of the FAI make it preferable for the diagnosis of TMD in patients. The FAI is a questionnaire consisting of 10 questions that determine the presence of pain in the head and back regions, pain on chewing, parafunctional habits, limitation of movement, clicking sounds, malocclusion and emotional stress[14].

The Oral Behaviours Checklist (OBC) indicates oral activities such as chewing, swallowing and speaking. Oral parafunctional habits, on the other hand, reflect other sorts of habits, such as gnashing teeth while awake or sleeping; activities like chewing gum or biting the lips, cheeks, nails or a pen; or playing a wind instrument, all of which create a load on the arches[15,16].

Parafunctional habits affect the masticatory system at various levels owing to repetitive trauma. These factors are considered critical during the onset of TMD strongly related to TMJ pain. Additionally, significant psychosocial stress can cause TMD, and it may be related to chronic TMJ pain[17,18].

This study evaluates the prevalence of TMD, oral habits and quality of life using the FAI, OBC and Oral Health Impact Profile-14 (OHIP-14) questionnaires applied to dentistry students and revealing the relationship between severity of TMD, oral habits and quality of life.

## Materials and methods

This observational cross-sectional study was conducted among students of the Faculty of Dentistry at Erciyes University, Kayseri, Turkey, and approved by the Erciyes University Clinical Research Ethics Committee (approval no. 2021/87). Informed consent was obtained from all participants included in the study. At the beginning of the study, 650 students were sent questionnaires, 120 could not be contacted and 78 declined to answer the questions. A total of 452 volunteer dentistry students (mean age 21.18 ± 2.08 years, mean height 169.40 ± 12.50 m, mean weight 65.74 ± 13.68 kg, mean body mass index [BMI] 23.49 ± 7.09 kg/m$^2$) participated in the study. Of these, 103 were men (mean age 21.14 ± 2.42 years, mean height 178.57 ± 6.35 m, mean weight 77.03 ± 12.32 kg, mean BMI 24.11 ± 3.38 kg/m$^2$) and 269 were women (mean age 21.20 ± 1.82 years, mean height 169.78 ± 13.23 m, mean weight 58.05 ± 8.08 kg, mean BMI 23.59 ± 3.70 kg/m$^2$). The online questionnaire was created using Google Forms (Mountain View, CA, USA) and emailed to the registered students in the dentistry faculty student office database. Before the questionnaire was administered, the purpose of the study and the questions were explained, and informed consent was obtained from all participants.

### *FAI*

Various questionnaires have been conducted to date for the classification of TMD[14]. In the early 1990s, Fonseca et al developed a questionnaire that was easy to apply and understand, thus allowing a simple classification of TMD[5]. In the present study, a questionnaire designed by Fonseca was used to classify the severity of TMD. This questionnaire was used due to its ability to collect epidemiological data. It comprises 10 questions that provide a versatile assessment of the presence of pain on chewing, parafunctional habits, limitation of movement, joint sounds, malocclusion and emotional stress in the joint area, head and neck. The participants could only provide one of the following answers (without any time limitation) to the questions: yes (10 points), sometimes (5 points) and no (0 points). After adding up the scores, the participants were classified into four categories: TMD-None (0 to 15 points), Mild-TMD (20 to 40 points), Moderate-TMD (45 to 60 points) and Severe-TMD (70 to 100 points).

### *OBC*

The OBC is a self-reporting questionnaire used to determine any parafunctional disorder of the oral structures and associated muscles. Like in previous studies[19,20], two questions on singing and playing a musical instrument in the original 21-question OBC checklist were

removed, and the checklist was changed. Thus, a 19-question questionnaire was used for evaluation[19,20]. The participants answered each item according to the frequency of complaints (4 = always, 3 = most of the time, 2 = sometimes, 1 = several times or 0 = none). The total score for the OBC was used for analysis. The overall score can range from 0 to 76. A total of three groups (0 points = none; 1 to 16 points = low; 17 to 76 points = high OBC group) were formed for all patients according to the total score obtained from the OBC[19].

*OHIP-14*

The OHIP is one of the instruments used to assess quality of life related to oral or dental health. The instrument was developed by Slade and Spencer[21]. Its validity and reliability have been demonstrated, and it is commonly used in dentistry.

The OHIP-14, which consists of 14 items (two for each of seven dimensions) and is shorter than the original OHIP, was then developed. The answers to the items were assessed on a Likert-type scale as follows: no = 0, rarely = 1, occasionally = 2, often = 3 and always = 4.

Fourteen questions were asked regarding functional activity, disability, pain, psychological state and physical dimension, as well as social insufficiency, and the aim was to measure oral functional disorders or limitations extensively[22]. The lowest score for the OHIP-14 was 0, whereas the highest was 56. As the score reached the maximum, oral health and quality of life decreased[23].

To determine the awareness of the individuals participating in the study about possible TMD or previous treatments they received, the following three questions were asked by the researchers: "Do you think you have a problem with the jaw or jaw joint?" "Have you been to the dentist for jaw joint pain within the last year?" and "Have you had any treatment (mouthpiece, exercise, medicine, etc.)?" They were asked to answer the three questions with a "yes" or "no".

*Sample size calculation*

According to the study by Karaman and Sapan24, considering the OHIP-14 scores that varied with different years of education and the power analysis performed, using GPower software (v 3.1.9.4, Heinrich Heine Universität Düsseldorf, Düsseldorf, Germany)25 at 90% power, for alpha = 0.05, d = 0.54 (large) effect value, it was determined that we should recruit 60 participants at least for each education year in the present study.

*Statistical analysis*

The data for the obtained results were stored and processed using Microsoft Excel (Microsoft Office 365, Microsoft, Redmond, WA, USA). Statistical analysis of the data was carried out using SPSS (v 24.0, IBM, Armonk, NY, USA). Chi-square and Fisher exact tests were used to examine the relationship between sex and classes of distribution of the TMD score, and a Mann-Whitney U test was used to compare the OBC scores by sex and class. A Kendall tau-b correlation test was used to evaluate the relationship between the OBC, OHIP-14 and FAI. The strengths of the correlation between the variables were defined as follows: 0.00 to 0.10, negligible; 0.10 to 0.39, weak; 0.40 to 0.69, medium; 0.70 to 0.89, strong; and 0.90 to 1.00, very strong[26]. $P < 0.05$ denoted statistical significance.

## Results

It was determined that 66.8% of the students participating in the questionnaire had TMJ problems at any level (Table 1). The proportion was found to be 77.9% for women and 47.5% for men. The OBC questionnaire scores and BMI values were more statistically significant in women than men (Table 1).

The total score for the FAI was significantly higher in women than in men (Table 2; $P < 0.001$). The prevalence of TMD differed significantly in first-, second-, third-, fourth- and fifth-year students ($P = 0.017$). It was determined that the FAI scores for the individuals in the fourth ($P = 0.027$) and fifth ($P = 0.045$) years were significantly higher than those for the individuals in the first year. At the same time, the OBC ($P < 0.001$) and OHIP-14 ($P = 0.002$) scores were found to be significantly higher in women than in men (Table 2). The BMI scores did not have a statistically significant effect on the total scores obtained from the FAI ($P = 0.52$), OHIP-14 ($P = 0.17$) and OBC ($P = 0.85$) questionnaires (Table 2). When the FAI scores were evaluated according to year of education, there was a statistically significant difference (Table 3; $P = 0.008$). A statistical relationship could not be established between the groups based on the OBC ($P = 0.32$) and BMI ($P = 0.61$) scores as well as the years of education (Table 3).

A statistically significant relationship was established between the groups based on the FAI results and the groups based on the BMI scores (Table 4; $P = 0.028$). There was no statistically significant relationship between the groups based on the OBC and BMI scores (Table 4; $P = 0.15$).

**Table 1** Distribution and comparison of FAI, OBC and BMI scores according to sex.

| Score | | Female, n (%) | Male, n (%) | Total | *P* value |
|---|---|---|---|---|---|
| FAI | TMD-None | 54 (20.1) | 96 (52.5) | 150 (33.2) | < 0.001* |
| | TMD-Mild | 149 (55.4) | 74 (40.4) | 223 (49.3) | |
| | TMD-Moderate | 42 (15.6) | 10 (5.5) | 52 (11.5) | |
| | TMD-Severe | 24 (8.9) | 3 (1.6) | 27 (6.0) | |
| OBC | None | 1 (0.4) | 3 (1.6) | 4 (0.9) | 0.002** |
| | Low | 42 (15.6) | 50 (27.3) | 92 (20.4) | |
| | High | 226 (84.0) | 130 (71.0) | 352 (78.8) | |
| BMI group | Underweight | 29 (10.8) | 4 (2.2) | 33 (7.3) | < 0.001* |
| | Normal | 210 (78.1) | 117 (63.9) | 327 (72.3) | |
| | Overweight | 28 (10.4) | 54 (29.5) | 82 (18.1) | |
| | Obese | 2 (0.7) | 8 (4.4) | 10 (2.2) | |

*Pearson chi-square test.
**Fisher exact test.
The level of statistical significance was set at $P < 0.05$.

**Table 2** Comparison of FAI, OBC and OHIP-14 total scores among the education years and genders.

| Group | | FAI total | OBC total | OHIP-14 |
|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ± SD |
| Year of education | First year (n = 123) | 24.59[a] ± 16.30 | 25.73 ± 10.45 | 8.22 ± 5.99 |
| | Second year (n = 60) | 27.17[a,b] ± 16.03 | 25.20 ± 8.70 | 9.00 ± 6.72 |
| | Third year (n = 72) | 29.93[a,b] ± 20.97 | 23.14 ± 9.68 | 9.31 ± 8.14 |
| | Fourth year (n = 88) | 34.55[b] ± 24.10 | 25.72 ± 11.68 | 10.25 ± 7.34 |
| | Fifth year (n=109) | 33.39[b] ± 21.99 | 26.22 ± 12.23 | 8.83 ± 6.80 |
| | *P* value* | 0.017* | 0.565* | 0.421* |
| Sex | Female | 35.54 ± 20.89 | 27.60 ± 10.58 | 9.77 ± 6.95 |
| | Male | 21.48 ± 16.62 | 22.08 ± 10.38 | 7.97 ± 6.78 |
| | *P* value | < 0.001** | < 0.001** | 0.002** |
| BMI group | Underweight (n = 33) | 38.03 ± 28.67 | 27.97 ± 8.18 | 11.48 ± 10.78 |
| | Normal (n = 327) | 29.13 ± 18.87 | 25.09 ± 10.55 | 8.92 ± 6.62 |
| | Overweight (n = 82) | 29.33 ± 22.25 | 25.38 ± 12.63 | 8.51 ± 6.25 |
| | Obese (n = 10) | 30.50 ± 20.61 | 25.70 ± 12.23 | 9.30 ± 5.60 |
| | *P* value | 0.518* | 0.165* | 0.848* |
| Total | | 29.85 ± 20.46 | 25.36 ± 10.83 | 9.04 ± 6.93 |

*Kruskal–Wallis test.
**Mann-Whitney U test.
SD, standard deviation.
The level of statistical significance was set at $P < 0.05$.

**Table 3** Distribution and comparison of FAI, OBC and BMI scores according to education years.

| Score | | Year group, n (%) | | | | | | *P* value |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total | |
| FAI | TMD-None | 49 (39.8) | 19 (31.7) | 23 (31.9) | 28 (31.8) | 31 (28.4) | 150 (33.2) | 0.008* |
| | TMD-Mild | 66 (53.7) | 34 (56.7) | 37 (51.4) | 36 (40.9) | 50 (45.9) | 223 (49.3) | |
| | TMD-Moderate | 5 (4.1) | 7 (11.7) | 8 (11.1) | 15 (17.0) | 17 (15.6) | 52 (11.5) | |
| | TMD-Severe | 3 (2.4) | 0 (0.0) | 4 (5.6) | 9 (10.2) | 11 (10.1) | 27 (6.0) | |
| OBC | None | 0 (0.0) | 0 (0.0) | 2 (2.8) | 1 (1.1) | 1 (0.9) | 4 (0.9) | 0.323** |
| | Low | 22 (17.9) | 8 (13.3) | 18 (25.0) | 21 (23.9) | 23 (21.1) | 92 (20.4) | |
| | High | 101 (82.1) | 52 (86.7) | 52 (72.2) | 66 (75.0) | 85 (78.0) | 352 (78.8) | |
| BMI group | Underweight | 5 (4.1) | 6 (10.0) | 6 (8.3) | 11 (12.5) | 5 (4.6) | 33 (7.3) | 0.614** |
| | Normal | 93 (75.6) | 41 (68.3) | 50 (69.4) | 61 (69.3) | 82 (75.2) | 327 (72.3) | |
| | Overweight | 23 (18.7) | 11 (18.3) | 13 (18.1) | 15 (17.0) | 20 (18.3) | 82 (18.1) | |
| | Obese | 2 (1.6) | 2 (3.3) | 3 (4.2) | 1 (1.1) | 2 (1.8) | 10 (2.2) | |

*Pearson chi-square test.
**Fisher exact test.
The level of statistical significance was set at $P < 0.05$.

**Table 4** Distribution and comparison of FAI and OBC scores according to BMI group.

| Score | | BMI group, n (%) | | | | | *P* value |
|---|---|---|---|---|---|---|---|
| | | Underweight | Normal | Overweight | Obese | Total | |
| FAI | TMD-None | 10 (30.3) | 107 (32.7) | 29 (35.4) | 4 (40.0) | 150 (33.2) | 0.028* |
| | TMD-Mild | 11 (33.3) | 173 (52.9) | 36 (43.9) | 3 (30.0) | 223 (49.3) | |
| | TMD-Moderate | 6 (18.2) | 32 (9.8) | 11 (13.4) | 3 (30.0) | 52 (11.5) | |
| | TMD-Severe | 6 (18.2) | 15 (4.6) | 6 (7.3) | 0 (0.0) | 27 (6.0) | |
| OBC | None | 0 (0.0) | 2 (0.6) | 2 (2.4) | 0 (0.0) | 4 (0.9) | 0.149* |
| | Low | 2 (6.1) | 70 (21.4) | 17 (20.7) | 3 (30.0) | 92 (20.4) | |
| | High | 31 (93.9) | 255 (78.0) | 63 (76.8) | 7 (70.0) | 352 (78.8) | |

*Fisher exact test.
The level of statistical significance was set at $P < 0.05$.

**Table 5** Scores for the individual OBC items and their Spearman rho correlations with the total FAI score and OHIP-14 score.

| Item | Score, mean ± SD | FAI | OHIP-14 |
|---|---|---|---|
| | | Correlation coefficient | Correlation coefficient |
| 1. Clench or grind teeth when asleep based on any information you may have | 1.21 ± 1.27 | 0.513** | 0.138** |
| 2. Sleep in a position that puts pressure on the jaw | 1.19 ± 1.23 | 0.483** | 0.169** |
| 3. Grind teeth during waking hours | 0.55 ± 0.93 | 0.286** | 0.105* |
| 4. Clench teeth during waking hours | 1.15 ± 1.08 | 0.382** | 0.166* |
| 5. Press, touch or hold teeth together other than while eating | 1.83 ± 1.16 | 0.366** | 0.146** |
| 6. Hold, tighten or tense muscles without clenching or bringing teeth together | 1.03 ± 1.16 | 0.555** | 0.229** |
| 7. Hold or jut jaw forward or to the side | 0.59 ± 0.95 | 0.243** | 0.176** |
| 8. Press tongue forcibly against teeth | 1.31 ± 1.22 | 0.186** | 0.174** |
| 9. Place tongue between teeth | 0.86 ± 1.10 | 0.093* | 0.093* |
| 10. Bite, chew or play with your tongue, cheeks or lips | 0.62 ± 0.92 | 0.093* | 0.038 |
| 11. Hold jaw in rigid or tense position, such as to brace or protect the jaw | 2.04 ± 1.28 | 0.091* | 0.066 |
| 12. Hold between the teeth or bite objects such as hair, pipe, pencil, pens, fingers or fingernails | 0.89 ± 1.05 | 0.066 | 0.089 |
| 13. Use chewing gum | 1.64 ± 1.02 | 0.060 | 0.001 |
| 14. Lean with your hand on the jaw, such as cupping or resting the chin in the hand | 2.07 ± 1.17 | 0.312** | 0.133** |
| 15. Chew food on one side only | 1.93 ± 1.11 | 0.321** | 0.236** |
| 16. Eating between meals (food that requires chewing) | 2.31 ± 1.09 | 0.209** | 0.185** |
| 17. Sustained talking (for example teaching, sales or customer service) | 0.98 ± 1.00 | 0.147** | 0.146** |
| 18. Yawning | 2.23 ± 0.94 | 0.158** | 0.089 |
| 19. Holding telephone between head and shoulders | 0.95 ± 1.11 | 0.023 | 0.001 |

*Correlation is significant at the $P < 0.05$ level (2-tailed).
**Correlation is significant at the $P < 0.01$ level (2-tailed).
SD, standard deviation.
Correlation coefficients were Kendall tau-b correlation coefficients.

Significant correlations were found between the questions in the OBC (except for questions 10, 11, 12, 13, 18 and 19), as well as the FAI and OHIP-14 scores (Table 5). While moderate correlations were established between OBC questions 1, 2 and 6, as well as the FAI questionnaire, a low-grade correlation with the OBC questionnaire was found (Table 5; $P < 0.01$).

Various correlations were found between the responses to the questions in the OHIP-14 questionnaire, as well as the FAI and OBC scores. Notably, a moderate correlation was found between the response to question 6 of the OHIP-14 and the FAI and OBC scores (Table 6; $P < 0.01$).

When the bivariate correlations among the FAI, OHIP-14 and OBC questionnaire total scores were examined, a moderate correlation was found between the FAI and OBC questionnaire scores, although there were significant correlations between them (Table 7; $P < 0.01$). When stratified by education, a moderate correlation was found between the FAI and OBC questionnaire scores, except for first-year students (Table 7; $P < 0.05$). In addition, only a moderate correlation was

**Table 6** Scores for the individual OHIP-14 items and their Spearman rho correlations with the total FAI score and OBC score.

| Item | Score, mean ± SD | FAI | OBC |
|---|---|---|---|
| | | Correlation coefficient | Correlation coefficient |
| 1. Have you had trouble pronouncing any words because of problems with your mouth or dentures? | 0.31 ± 0.59 | 0.103* | 0.100* |
| 2. Have you felt that your sense of taste has worsened because of problems with your mouth or dentures? | 0.15 ± 0.45 | 0.015 | 0.084 |
| 3. Have you had painful aching in your mouth? | 0.91 ± 0.97 | 0.337** | 0.265** |
| 4. Have you found it uncomfortable to eat any foods because of problems with your mouth or dentures? | 0.67 ± 0.86 | 0.206** | 0.171** |
| 5. Have you felt self-conscious because of your mouth or dentures? | 1.73 ± 1.18 | 0.018 | 0.012 |
| 6. Have you felt tense because of problems with your mouth or dentures? | 1.12 ± 1.06 | 0.427** | 0.322** |
| 7. Has your diet been unsatisfactory because of problems with your mouth or dentures? | 0.49 ± 0.81 | 0.147** | 0.073 |
| 8. Have you had to interrupt meals because of problems with your mouth or dentures? | 0.50 ± 0.74 | 0.083 | 0.039 |
| 9. Have you found it difficult to relax because of problems with your mouth or dentures? | 0.51 ± 0.78 | 0.330** | 0.297** |
| 10. Have you felt a bit embarrassed because of problems with your mouth or dentures? | 0.73 ± 0.99 | 0.039 | 0.046 |
| 11. Have you been a bit irritable with other people because of problems with your mouth or dentures? | 0.57 ± 0.84 | 0.241** | 0.169** |
| 12. Have you had difficulty doing your usual job because of problems with your mouth or dentures? | 0.53 ± 0.81 | 0.158** | 0.156** |
| 13. Have you felt that life in general was less satisfying because of problems with your mouth or dentures? | 0.66 ± 0.93 | 0.197** | 0.141** |
| 14. Have you been totally unable to function because of problems with your mouth or dentures? | 0.17 ± 0.44 | 0.096* | 0.085 |

*Correlation is significant at the $P < 0.05$ level (2-tailed).
**Correlation is significant at the $P < 0.01$ level (2-tailed).
SD, standard deviation.
Correlation coefficients were Kendall tau-b correlation coefficients.

found between the OHIP-14 and FAI for the third-year students (Table 7; $P < 0.05$). When evaluated according to BMI groups, strong correlations were observed between the Fonseca and OBC questionnaires in individuals whose scores were not within normal values (Table 7; $P < 0.05$).

## Discussion

The present study assessed the impact of oral habits, both in terms of the joints and quality of life, on TMD in 452 dental students. With this cross-sectional study, it was determined that the prevalence of TMD in dentistry students was 66.8%. One of the most important findings was that all students had at least one oral parafunction and 16 of the 19 questions correlated with their FAI score.

The FAI provides valuable data for the early detection and low-cost evaluation of TMD. Ayali and Ramoglu[27] conducted a study on 409 dentistry students and found that 38.6% had mild TMD, 13.4% had moderate TMD and 4.4% had severe TMD. Habib et al[28] administered the FAI to 400 people and found that 36.1% had mild TMD, 9.6% had moderate TMD and 1.1% had severe TMD. Among the 452 students in the present study, 33.2% did not have TMD, whereas 49.3% had mild TMD, 11.5% had moderate TMD and 6.0% had severe TMD. Considering the distribution of years of education, the fourth and fifth-year students' average FAI TMD scores were significantly higher than those for other years (especially the first-year students). Similarly, Karaman and Sapan[24] found that the prevalence of TMD was higher among senior students in the faculty of dentistry.

The frequency of TMD detected by the FAI varies between 37% and 81% in similar studies conducted on students[19,20,27-31]. Mild TMD (49.3%) was the most prevalent level of TMD in the population assessed in

**Table 7** Relationship between FAI, OBC and OHIP-14 scores by year group, sex and BMI group.

| Variable | | FAI–OBC | FAI–OHIP-14 | OBC–OHIP-14 |
|---|---|---|---|---|
| Year group | First year | 0.327** | 0.146 | 0.192* |
| | Second year | 0.436** | 0.282* | 0.316* |
| | Third year | 0.505** | 0.514** | 0.352** |
| | Fourth year | 0.706** | 0.348** | 0.293** |
| | Fifth year | 0.567** | 0.347** | 0.185 |
| Sex | Female | 0.551** | 0.327** | 0.282** |
| | Male | 0.311** | 0.249** | 0.137 |
| BMI group | Underweight | 0.848** | 0.759** | 0.691** |
| | Normal | 0.428** | 0.264** | 0.211** |
| | Overweight | 0.691** | 0.290** | 0.292** |
| | Obese | 0.740* | 0.022 | 0.061 |
| Total | | 0.517** | 0.318** | 0.249** |

*$P < 0.05$; **$P < 0.01$.
The data presented are Kendall tau-b correlation coefficients.

the present study. This is in line with the results reported by Pedroni et al[32] and Karthik et al[33], all of whom used the FAI to evaluate TMD. In a Turkish population, Özdinç et al[31] and Emel Dervis[34] reported a prevalence similar to the current study (47.3%). On the other hand, Türken et al[29] reported a higher prevalence of TMD (79%) than that reported in the present study. These results may be due to differences in the populations, such as varying sex 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 like busy class schedules and anxiety about the possibility of failure may have caused variations in severity of TMD[35].

A study conducted by Ahuja et al[36] with 450 students studying at faculties of dentistry indicated that women suffer from joint disorders more than men. Minghelli et al[37] studied Portuguese children aged between 5 and 19 years and found that the prevalence of TMD was higher in females. Karaman and Buyuk[38] found that females' mean FAI TMD scores were significantly higher than males'. Hongxing et al[39], Karibe et al[40] and Kim et al[41] found that symptoms of masticatory disorders were more frequent among women in comparison to men. Wieckiewicz et al[42] and Kim et al[41] stated that this frequency arose from biological differences, including hormonal and psychosocial factors. Poveda et al[43] and Nomura et al[5] noted that this higher prevalence of TMD among women could be related to their physiological characteristics, hormonal variations and structures in connective tissues and muscles. Landi et al[44] indicated that the serum value of 17-beta-estradiol among TMD patients was higher than that in patients who did not suffer from TMD. This study indicated that the prevalence of TMD in women was significantly higher than its prevalence in men (77.9% vs 47.5%)[44], which was in line with the findings of previous studies.

Ingle et al[45] reported that the OHIP-14 score was higher among women. Gonzales-Sullcahuamán et al[46] found no statistically significant relationship between OHIP-14 score and year of academic education, and no difference between the sexes. Karaman and Buyuk[38] found that the mean OHIP-14 score for women was significantly higher than that for men. This study suggests that the OHIP-14 score is higher in women than men, and there was no statistically significant relationship between years of education and OHIP-14 score[38].

In the present study, the OBC was used to evaluate oral parafunctions. The OBC is a self-administered tool designed to evaluate oral activities such as grinding and other oral parafunctions during sleep or awake hours[47,48]. Perrotta et al[49] aimed to explain the relationships between parafunctional habits and TMD and reported a relationship between them. Van der Meulen et al[50] found no significant difference regarding total OBC scores between male and female participants. Chow and Cioffi[51] reported that women's OBC scores were higher than those of men. Karaman and Buyuk[38] stated that mean OBC scores were higher for women than men. Paduano et al[52], meanwhile, found no relationship between sex and oral parafunctions. A moderately significant relationship was found between the FAI questionnaire results and OBC scores[52]. The OBC scores for female participants were statistically higher than those for male participants, and there was no significant relationship between academic year and OBC score[52].

According to Jordani et al[53], obesity and a sedentary lifestyle were not found to be associated with TMD pain

in adolescents. Rhim et al[54] found TMD to be associated with low BMI and abdominal obesity in women, whereas BMI was not associated with TMD in men, and they stated that further prospective studies are required to determine the causal relationship and mechanism between TMD and obesity. In Turkish society, individuals of normal weight have more joint problems[55]. The same was found to be true in the present study; it would therefore be incorrect to conclude that severity of TMJ disorders increases in overweight and obese people. The reason for this may be because the number of people in those groups was fewer than the number of individuals of a normal weight.

The present study found that increasing oral parafunctional habits assessed with the OBC were associated with TMJ problems. In addition, a moderate correlation was found between severity of TMD and responses to the following questions related to oral parafunctional habits evaluated by the OBC questionnaire: "Do you clench or grind your teeth while sleeping?", "Do you put pressure on your jaw while sleeping?" and "Is there pain or tension in your jaw muscles while awake?" These results are similar to those reported by Yeler et al[30], who showed that TMD is associated with unilateral chewing and bruxism. In addition, Karthik et al[33] reported that TMD symptoms were more common in university students who defined themselves as tense. Moreover, in a study on Nepalese students, Royaka et al[35] detected that 20% of the participants exhibited grinding. Similarly, Lövgren et al[47] found that oral parafunctional habits were more prevalent in students diagnosed with TMD in a study involving dentistry students, and they suggested that this result was associated with bruxism, which was frequently observed in participants.

A moderate correlation was found between the response to question 6 in the OHIP-14 questionnaire ("Do you feel tension due to problems with your teeth, mouth or prosthesis?") and the FAI and OBC questionnaire scores. This shows that the high results obtained from the FAI and OBC questionnaires can be interpreted as representative of the high level of tension in the person.

When evaluated according to BMI groups, there were strong correlations between the FAI and OBC questionnaires in individuals whose scores were not normal. The existence of problems, such as those related to eating habits, in individuals whose scores were not normal may cause a difference between oral parafunction and an increase in TMD severity in these groups.

An early diagnosis of TMD and the factors that cause it (occlusal factors developed because of oral parafunctions) is vital in dentistry. Early diagnosis and treatment of problems prevents them from progressing further and becoming complicated and thus improves individuals' quality of life. These questionnaire studies, which seem simple, will increase the chance of treating individuals early by increasing the prevalence, awareness and early diagnosis of TMD in this respect.

### *Limitations*

An important limitation of this study is the use of questionnaires for the evaluation. Although 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. Only specific subclinical symptoms related to TMJ problems can be obtained when only one questionnaire is used. Considering the data obtained, it is necessary to diagnose TMD precisely based on clinical and radiological examination, followed by prompt treatment. This study involved only students in the dentistry faculty. The proportions of students differed by sex; however, the literature shows that the prevalence of TMD is higher in women. This situation may have affected the results of the study and made it difficult to generalise the results. It is therefore necessary to evaluate TMJ problems and clinical and radiological examinations in future studies with similar but more participants, and various student populations should be involved.

## Conclusion

This study revealed that the prevalence of TMD was higher among fourth- and fifth-year students of the dentistry faculty, especially compared with the first-year students. Additionally, prevalence of TMD was higher among the female students than the male students. TMD, quality of life and oral habits were related to each other. Necessary measures should be taken in the dental education system to improve students' quality of life, improve joint disorders and eliminate detrimental oral habits.

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## Conflicts of interest

The authors declare no conflicts of interest related to this study.

## Author contribution

Dr Ravza ERASLAN contributed to the study conceptualisation, methodology, data collection and writing (original draft and editing) and Dr Taner OZTURK contributed to the methodology, statistical analysis and writing (reviewing and editing).

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