

Investigation of Factors Associated with Dizziness, Tinnitus, and Ear Fullness in Patients with Temporomandibular Disorders

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Submitted June 24, 2022; accepted September 10, 2022.

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Aims: To determine differences between TMD subtypes in terms of clinical characteristics, dizziness, tinnitus, and ear fullness according to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) and to investigate the clinical conditions associated with dizziness, tinnitus, and ear fullness. **Methods:** Participants having TMDs aged 18 to 45 years were included in this study. They were classified and divided into three groups according to the DC/TMD Axis I criteria: group 1 = pain-related TMDs and headache; group 2 = intra-articular joint disorders; and group 3 = degenerative joint disease. Demographic data and dizziness, tinnitus, and ear fullness were assessed. Maximum mouth opening, opening/closing click, lateral click, fine/coarse crepitation, bruxism, and presence of pain were evaluated by physical examination. **Results:** A total of 129 participants were included: 68 (52.7%) in group 1, 40 (31%) in group 2, and 21 (16.3%) in group 3. In the comparison of all three diagnostic groups, there was a significant difference only in educational level ($P = .013$). The presence of dizziness, tinnitus, or ear fullness was not found to be significantly different among the three groups. When all participants were divided into two groups according to the presence of dizziness, low education levels ($P = .007$), being married ($P = .040$), presence of pain ($P = .002$), tinnitus ($P = .008$), ear fullness ($P = .017$), and presence of thin crepitation ($P = .015$) were related to having dizziness symptoms. In addition, patients with ear fullness ($P = .042$), dizziness ($P = .008$), and female sex ($P = .008$) reported more tinnitus. **Conclusion:** TMD subtype was not associated with dizziness, tinnitus, or ear fullness. Painful conditions were associated with dizziness in participants with TMDs. *J Oral Facial Pain Headache 2023;37:17–24. doi: 10.11607/ofph.3286*

Keywords: aural symptoms, dizziness, ear fullness, temporomandibular disorders, tinnitus

Temporomandibular pain can originate from the temporomandibular joint (TMJ) and neighboring structures. With musculoskeletal system problems such as temporomandibular disorders, patients may not only have symptoms related to the jaw joint, but also aural symptoms such as tinnitus, dizziness, ear fullness, earache, hyperacusis or hypoacusis, toothache, and/or headache.¹

In the literature, the incidence of aural symptoms has been reported to be 85% in TMD patients. The reason aural symptoms are so common in TMDs is controversial. There are theories that aural symptoms may be due to the common embryologic origin and innervation of the TMJ and middle ear, as well as the structures connecting them.² However, it has also been reported that aural symptoms in TMD patients are not always of otologic origin; in some cases, the problem can occur in the TMJ and masseter muscles.³

TMDs are accepted as a condition that causes pain and functional limitation and requires a multidisciplinary treatment approach, the etiology of which has not been fully determined.⁴ In clinical practice, patients present to otolaryngologists due to aural complaints, and TMD-induced aural symptoms are often overlooked.⁵ In a recent review, it was reported that the prevalence of tinnitus in TMD patients was higher than in non-TMD patients.⁶ However, there are very few studies investigating aural symptoms according to TMD subtype, and the DC/TMD criteria

were not used for TMD classification in these studies.⁷ Another recent review reported that there was no consensus on the management of patients with aural symptoms accompanying TMD; therefore, further well-designed studies are needed.⁸

The primary purpose of this study was to determine whether there were differences between TMD subgroups in terms of dizziness, tinnitus, ear fullness, pain, bruxism, gender, and mouth opening according to the DC/TMD. The secondary aim of this study was to evaluate the associations between clinical characteristics and dizziness, tinnitus, and ear fullness.

Materials and Methods

A total of 129 male and female patients aged between 18 and 45 years who applied to the outpatient clinic and were diagnosed with TMDs were included in the study. Patients were classified as having pain-related TMDs and headache (group 1), intra-articular joint disorders (group 2), or degenerative joint disease (group 3) according to the DC/TMD Axis I diagnostic criteria.

The demographic data of all patients participating in the study were collected. Then, maximum mouth opening (MMO), opening and/or closing click, lateral click, fine crepitation and coarse crepitation, popping sound, and bruxism were determined by physical examination. The examinations were performed in accordance with the DC/TMD guidelines. The DC/TMD examination form was used to collect the data from the participants. Section 4A (Pain Free Opening), Section 6 (TMJ Noises During Open & Close Movement), Section 7 (TMJ Noises During Lateral & Protrusive Movements), Section 9 (Muscle & TMJ Pain with Palpation), and Section 11 (Diagnoses) were completed. Tinnitus, ear fullness, and dizziness were assessed. Participants were asked about the presence of pain according to the Diagnostic Criteria Symptom Questionnaire for Temporomandibular Disorders, question 1: Have you ever had pain on any side, in your jaw, temple, inside or front of your ear?⁹

All measurements and physical examinations were performed with the patients sitting upright in an anatomical position in a chair, aiming to prevent spinal movements. All measurements were made by the same physiatrist with 7 years of experience in TMDs (M.D.K.).

For measurement of MMO, patients were asked to open their mouths as wide as possible. The distance between the anterior incisors was measured with the help of a millimeter ruler. MMO is a physical examination method frequently used in clinical practice to determine the motion of the jaw joint. Functional mouth opening is considered to be 35 to 40 mm.²

For evaluating TMJ sound, the TMJ was palpated with the thumb and middle fingers, and any sound when opening or closing the mouth was noted.

Pain levels were evaluated on a 10-point visual analog scale (VAS).¹⁰

The presence of bruxism was determined with physical examination based on the presence of abnormal tooth wear, tooth marks in the buccal region, tooth marks on the tongue, and hypertrophy.

The exclusion criteria were as follows: known psychiatric illness; illiterate; aphasic; lacked the cognitive ability to understand the test instructions; had other systemic diseases that could cause TMDs (cancer, rheumatologic diseases) or diseases that could increase aural symptoms or cause dizziness (neurologic disease, migraine, history of vertigo); and/or history of cervical pain, cervical spondylosis, and/or cervical disc herniation.

Statistical Analysis

SPSS version 23.0 for MacOS was used for the statistical analysis of all data. Descriptive statistics were described as mean (SD) and percentages. Shapiro-Wilk test and histograms were used to check the distribution of the variables. For quantitative variables, one-way ANOVA was used to compare all three groups, and independent sample *t* test was used to compare two groups. For categorical variables, chi-square test was used. After evaluation by univariate analysis, logistic regression analysis was performed. The 95% CI was used, and $P < .05$ was considered to be significant.

Ethical Approval

The study protocol was approved by the Kirsehir Ahi Evran University Ethical Committee (KA EK/2022.03.55) in conformity with the Declaration of Helsinki. All participants were given a signed informed volunteer consent form. This study was registered at clinicaltrials.gov (ID No: NCT05402228).

Results

A total of 129 participants were included in the study. When the participants were evaluated according to the DC/TMD Axis I criteria, 68 participants (52.7%) had pain-related TMDs and headache (group 1), 40 (31%) had intra-articular joint disorders (group 2), and 21 (16.3%) had degenerative joint disease (group 3). When comparing the three diagnostic groups, there was a significant difference only in educational level ($P = .013$). There was no relationship between groups in terms of age, gender, marital status, working environment, dizziness, tinnitus, ear fullness, bruxism, or MMO (Table 1).

Table 1 Comparison of Variables in TMD Subgroups

	Muscular pain (n = 68)	Disc displacement (n = 40)	Joint degeneration (n = 21)	<i>P</i>
Mean (SD) age, y	34.2 (14.1)	34.7 (14.7)	38.5 (13.5)	.471
Sex, n (%)				
Male	12 (17.6)	11 (27.5)	2 (9.5)	.210
Female	56 (82.4)	29 (72.5)	19 (90.5)	
Education level, n (%)				
Primary school	23 (33.8)	15 (37.5)	5 (23.8)	.013*
Central school	6 (8.8)	6 (15)	7 (33.3)	
College	12 (17.6)	11 (27.5)	7 (33.3)	
University	27 (39.7)	8 (20)	2 (9.5)	
Marital status, n (%)				
Married	37 (54.4)	19 (47.5)	15 (71.4)	.201
Single	31 (45.6)	21 (52.5)	6 (28.6)	
Working environment, n (%)				
No stress	26 (38.2)	13 (32.5)	6 (28.6)	.797
Stressed	22 (32.4)	12 (30)	6 (28.6)	
Not working	20 (29.4)	15 (37.5)	9 (42.9)	
Dizziness, n (%)				
No	41 (60.3)	21 (52.5)	14 (66.7)	.276
Yes	27 (39.7)	19 (47.5)	7 (33.3)	
Tinnitus, n (%)				
No	30 (44.1)	22 (55)	10 (47.6)	.550
Yes	38 (55.9)	18 (45)	11 (52.4)	
Ear fullness, n (%)				
No	31 (45.6)	23 (57.5)	11 (52.4)	.480
Yes	37 (54.4)	17 (42.5)	10 (47.6)	
TMJ sound, n (%)				
Yes	42 (61.8)	36 (90)	12 (57.1)	.003*
No	26 (38.2)	4 (10)	9 (42.9)	
Bruxism, n (%)				
Yes	49 (72.1)	26 (65)	11 (52.4)	.238
No	19 (27.9)	14 (35)	10 (47.6)	
Pain, n (%)				
Yes	52 (76.5)	23 (57.5)	14 (66.7)	.116
No	16 (23.5)	17 (42.5)	7 (33.3)	
Mean (SD) VAS, cm	4.3 (2.6)	3.4 (3.2)	4.0 (2.8)	.277
Mean (SD) MMO, mm	36.2 (7.6)	38.1 (8.1)	36.6 (7.1)	.470

* Significant.

When the participants were divided into two groups according to the presence of dizziness, it was found that 53 (41.1%) had complaints of dizziness and 76 (58.9%) did not have such a complaint. Educational level, marital status, presence of pain, tinnitus, ear fullness, and presence of fine crepitation were found to be statistically different between the two groups ($P = .007, .040, .002, .008, .017, \text{ and } .015$, respectively; Table 2).

The participants were also divided into two groups according to the presence of tinnitus. Only gender, dizziness, and ear fullness were found to be statistically different between groups ($P = .008, .008, \text{ and } .042$, respectively).

When the participants were divided into two groups according to the presence of ear fullness, there was a significant difference between groups for the presence of dizziness and tinnitus ($P = .017 \text{ and } .042$, respectively; Table 3).

When the participants were analyzed according to the presence of dizziness, tinnitus, and ear fullness, the VAS value was found to be significantly higher only in participants with dizziness than in those without dizziness (Table 4).

Discussion

Based on the results of the current study, there was no association between TMD subtype and dizziness, tinnitus, or ear fullness. Low educational levels, being married, having TMJ pain, and having aural symptoms such as tinnitus and ear fullness were related to having dizziness symptoms. Patients with ear fullness and dizziness and female patients reported more tinnitus.

Kusdra et al reported that 87% of TMD cases had aural symptoms, and most of these symptoms were tinnitus (42%) and ear fullness (39%).¹¹ In the present

Table 2 Comparison of Clinical and Demographic Characteristics According to the Presence of Dizziness

	Dizziness			P
	Yes (n = 53)	No (n = 76)	Total	
Sex, n (%)				
Male	9 (16.4)	16 (21.6)	25	.455
Female	46 (83.6)	58 (78.4)	104	
Diagnosis, n (%)				
Muscular	27 (49.1)	41 (55.4)	68	.276
Disc displacement	21 (38.2)	19 (25.7)	40	
TMJ degeneration	7 (12.7)	14 (18.9)	21	
Education level, n (%)				
Primary school	25 (45.5)	18 (24.3)	43	.007*
Middle school	11 (20.0)	8 (10.8)	19	
High school	7 (12.7)	23 (31.1)	30	
University	12 (21.8)	25 (33.8)	37	
Marital status, n (%)				
Married	36 (65.5)	35 (47.3)	71	.040*
Single	19 (34.5)	39 (52.7)	58	
Work environment, n (%)				
No stress	21 (32.4)	24 (32.4)	45	.143
Stressful	12 (21.8)	28 (37.8)	40	
Not working	22 (40.0)	22 (29.7)	44	
Economic status, n (%)				
0–5,000 TL	15 (27.3)	15 (20.3)	30	.352
> 5000 TL	40 (72.7)	59 (79.7)	99	
TMJ sounds, n (%)				
Yes	43 (78.2)	47 (63.5)	90	.073
No	12 (21.8)	27 (36.5)	39	
Pain, n (%)				
Yes	46 (83.6)	43 (58.1)	89	.002*
No	9 (16.4)	31 (41.9)	40	
Tinnitus, n (%)				
Yes	36 (65.5)	31 (41.9)	67	.008*
No	19 (34.5)	43 (58.1)	62	
Ear fullness, n (%)				
Yes	30 (40.5)	34 (61.8)	64	.017*
No	44 (59.5)	21 (38.2)	65	
Bruxism, n (%)				
Yes	40 (72.7)	46 (62.2)	86	.208
No	15 (27.3)	28 (37.8)	43	
Opening click, n (%)				
Yes	19 (34.5)	24 (32.4)	43	.801
No	36 (65.5)	50 (67.6)	86	
Closing click, n (%)				
Yes	10 (18.2)	6 (8.1)	16	.086
No	45 (81.8)	68 (91.9)	113	
Lateral click, n (%)				
Yes	7 (12.7)	11 (14.9)	18	.729
No	48 (87.3)	63 (85.1)	111	
Fine crepitation, n (%)				
Yes	2 (3.6)	13 (17.6)	15	.015*
No	53 (96.4)	61 (82.4)	114	
Coarse crepitation, n (%)				
Yes	6 (10.9)	5 (6.8)	11	.404
No	49 (89.1)	69 (93.2)	118	
Popping, n (%)				
Yes	6 (10.9)	9 (12.2)	15	.826
No	49 (89.1)	65 (87.8)	114	

Chi-square test was used for comparison. * $P < .05$ Significant.

Table 3 Comparison of Clinical and Demographic Characteristics According to the Presence of Tinnitus

	Tinnitus		Total	P
	Yes (n = 67)	No (n = 62)		
Sex, n (%)				
Male	7 (10.4)	18 (29)	25	.008*
Female	60 (89.6)	44 (71)	104	
Diagnosis, n (%)				
Pain-related TMDs	38 (56.7)	30 (48.4)	68	.550
Intra-articular JD	18 (26.9)	22 (35.5)	40	
Degenerative JD	11 (16.4)	10 (16.1)	21	
Education level, n (%)				
Primary school	27 (40.3)	16 (25.8)	43	.301
Middle school	8 (11.9)	11 (17.7)	19	
High school	13 (19.4)	17 (27.4)	30	
University	19 (28.4)	18 (29)	35	
Marital status, n (%)				
Married	41 (61.2)	30 (48.4)	71	.144
Single	26 (38.8)	32 (51.6)	58	
Work environment, n (%)				
No stress	25 (37.3)	20 (32.3)	45	.181
Stressful	16 (23.9)	24 (38.7)	40	
Not working	26 (38.8)	18 (29)	44	
Economic status, n (%)				
0–5,000 TL	47 (70.1)	52 (83.9)	99	.065
> 5,000 TL	20 (29.9)	10 (16.1)	30	
TMJ sound, n (%)				
Yes	51 (76.1)	39 (62.9)	90	.102
No	16 (23.9)	23 (37.1)	39	
Pain, n (%)				
Yes	47 (70.1)	42 (67.7)	89	.768
No	20 (29.9)	20 (32.3)	40	
Dizziness, n (%)				
Yes	36 (53.7)	19 (30.6)	55	.008*
No	31 (46.3)	43 (69.4)	74	
Ear fullness, n (%)				
Yes	37 (59.7)	28 (41.8)	65	.042*
No	25 (40.3)	39 (58.2)	64	
Bruxism, n (%)				
Yes	40 (46.5)	46 (53.5)	86	.208
No	15 (34.9)	28 (65.1)	43	
Opening click, n (%)				
Yes	43 (64.2)	43 (69.4)	86	.533
No	24 (35.8)	19 (30.6)	43	
Closing click, n (%)				
Yes	9 (13.4)	7 (11.3)	16	.712
No	58 (86.6)	55 (88.7)	113	
Lateral click, n (%)				
Yes	9 (13.4)	9 (14.5)	18	.859
No	58 (86.6)	53 (85.5)	111	
Fine crepitation, n (%)				
Yes	6 (9)	9 (14.5)	15	.325
No	61 (91)	53 (85.5)	114	
Coarse crepitation, n (%)				
Yes	5 (7.5)	6 (9.7)	11	.653
No	62 (92.5)	56 (90.3)	118	
Popping, n (%)				
Yes	8 (11.9)	7 (11.3)	15	.908
No	59 (88.1)	55 (88.7)	114	

Table 4 Comparison of Clinical and Demographic Characteristics According to the Presence of Ear Fullness

	Ear fullness		Total	P
	Yes (n = 64)	No (n = 65)		
Sex, n (%)				.129
Male	9 (14.1)	16 (24.6)	25	
Female	55 (85.9)	49 (75.4)	104	
Diagnosis, n (%)				.480
Muscular	37 (57.8)	31(47.7)	68	
Disc displacement	17 (26.6)	23 (35.4)	40	
TMJ degeneration	10 (15.6)	11 (16.9)	21	
Education level, n (%)				.603
Primary	24 (37.5)	19 (29.2)	43	
Central	9 (14.1)	10 (15.4)	19	
College	12 (18.8)	18 (27.7)	30	
University	19 (29.7)	18 (27.7)	37	
Marital status, n (%)				.181
Married	39 (60.9)	32 (49.2)	71	
Single	25 (39.1)	33 (50.8)	58	
Work environment, n (%)				.064
No stress	19 (29.7)	26 (40)	45	
Stressful	26 (40.6)	14 (21.5)	40	
Not working	19 (29.7)	25 (38.5)	44	
Economic status, n (%)				.713
0–5,000 TL	50 (78.1)	49 (75.4)	99	
> 5,000 TL	14 (21.9)	16 (24.6)	30	
TMJ sound, n (%)				.527
Yes	43 (67.2)	47 (72.3)	90	
No	21 (32.8)	18 (27.7)	39	
Pain, n (%)				.143
Yes	48 (65)	41 (63.1)	89	
No	16 (35)	24 (36.9)	40	
Dizziness, n (%)				.017*
No	30 (46.9)	44 (67.7)	74	
Yes	34 (53.1)	21 (32.3)	55	
Tinnitus, n (%)				.042*
No	25 (39.1)	37(56.9)	62	
Yes	39 (60.9)	28 (43.1)	67	
Bruxism, n (%)				.106
Yes	47 (73.4)	39 (60)	86	
No	17 (26.6)	26 (40)	43	
Opening click, n (%)				.383
Yes	19 (29.7)	24 (36.9)	43	
No	45 (70.3)	41 (63.1)	86	
Closing click, n (%)				.616
Yes	7 (10.9)	9 (13.8)	16	
No	57 (89.1)	56 (86.2)	113	
Lateral click, n (%)				.859
Yes	8 (12.5)	10 (15.4)	18	
No	56 (87.5)	55 (84.6)	111	
Fine crepitation, n (%)				.808
Yes	7 (10.9)	8 (12.3)	15	
No	57 (89.1)	57 (87.7)	114	
Coarse crepitation, n (%)				.358
Yes	4 (6.3)	7 (10.8)	11	
No	60 (93.8)	58 (89.2)	118	
Popping, n (%)				.392
Yes	9 (14.1)	6 (9.2)	15	
No	55 (85.9)	59 (90.8)	114	

Chi-square test was used for comparison. *P < .05 is considered significant.

Table 5 Comparison of Pain Intensity, MMO, and Age According to Presence of Dizziness, Tinnitus, and Ear Fullness

	VAS, cm			MMO, mm			Age, y		
	Mean (SD)	95% CI	<i>P</i>	Mean (SD)	95% CI	<i>P</i>	Mean (SD)	95% CI	<i>P</i>
Dizziness									
No (n = 74)	3.4 (3.1)		.004*	36.73 (7.3)		.783	33.8 (14.3)		.252
Yes (n = 55)	4.8 (2.1)	(-2.25, -0.45)		37.11 (8.2)	(-3.10, 2.34)		36.7 (13.8)	(-7.87, 2.09)	
Tinnitus									
No (n = 62)	3.9 (2.8)	(-1.08, 0.86)	.826	36.5 (6.8)	(-3.39, 1.94)	.593	34.4 (14.3)	(-6.10, 3.80)	.648
Yes (n = 67)	4.0 (2.8)			37.2 (8.5)			35.6 (14.1)		
Ear fullness									
No (n = 65)	3.9 (3.1)	(-1.08, 0.86)	.825	37.5 (7.7)	(-1.35, 4.02)	.326	34.8 (14.7)	(-5.41, 4.48)	.853
Yes (n = 64)	4.1 (2.4)			36.2 (7.7)			35.3 (13.7)		

Independent *t* test was used for analysis. *P* < .05 was considered significant.

study, 41.1% of the participants had dizziness, 51.9% of them had tinnitus, and 49.6% had ear fullness. These results were found close to those from the previous study results.

Kitsoulis et al evaluated TMD patients by classifying them according to disease severity and reported that there was a correlation between TMD severity and mouth opening, aural symptoms, bruxism, TMJ pain, and hearing loss.²

A relationship between aural symptoms and TMDs has been found in the literature.¹² No correlation was found between the intensity of tinnitus and sleep bruxism in patients with subjective tinnitus complaints accompanying TMDs.¹³ However, in a recent study, both TMDs and bruxism were associated with tinnitus.¹⁴ According to the present study, no relationships with tinnitus, ear fullness, or dizziness were found for TMD subtype or bruxism.

Several studies found a relationship between painful TMDs and tinnitus, and it was reported that tinnitus may be associated with chronic pain mechanisms, sympathetic system relationships, and anatomical causes.^{15,16} In contrast, there was no association between TMJ pain and tinnitus in the present study.

In the literature, it has been reported that postural control is impaired in patients with chronic pain caused by the musculoskeletal system. This impaired control and central hypersensitivity have also been associated with dizziness.¹⁷ TMDs are also one of the central hypersensitivity syndromes.¹⁸ In the present study, participants with dizziness were found to have greater pain intensity. These relationships can be explained by central sensitization.

De Felício et al detected associations of earache, tinnitus, and ear fullness with TMJ pain and joint sounds.³ However, Demirkol et al reported no relationship between joint clicking and tinnitus.¹³ Similarly, joint sounds and pain were not found to be associated with tinnitus or ear fullness in the present study.

It has been reported that tinnitus is more common in female TMD patients than in male TMD patients.¹³ Similarly, the results of the present study showed that female sex was associated with the presence of tinnitus.

Peng reported that ear fullness was seen mostly in muscle-induced TMD patients and was least seen in joint-induced (osteoarthritis, arthralgia) cases.⁵ The results of the current study showed that dizziness, tinnitus, and ear fullness were not associated with TMD subtype.

In clinical practice, when patients present to an otolaryngologist with a complaint of aural symptoms, it should be considered that they may have a temporomandibular problem.⁵ Treatment for TMD symptoms with tinnitus can also address the tinnitus complaint.¹⁹ In a recent review of management of aural symptoms accompanying TMDs, it was reported that aural symptoms could be improved with TMD treatment; however, the level of evidence was also stated to be low.²⁰ According to these studies, TMD symptoms should be assessed in patients who present with aural symptoms.

It was reported in a recent study that dizziness was more common in patients with TMDs compared to healthy volunteers.²¹ It has also been reported that, as the severity of TMD increases, the frequency of otologic and nonotologic symptoms such as headache, neck pain, back pain, and eye pain also increases. However, in the same study, no correlation was reported between the severity of TMDs and dizziness.²² The results of the present study also showed that the presence of dizziness was not related to TMD subtype, but the patients with dizziness reported more pain.

Limitations of this study include that the participants were not tested for hearing loss and the symptoms questionnaire was self-reported. Not reporting the source of the pain can also be considered a limitation. Strengths of the present study include that all

patients were examined by the same physician and classified according to the current DC/TMD Axis I criteria.

Conclusions

Since patients do not consider that aural symptoms are related to the jaw joint, they may not report it during questioning. In patients presenting with a complaint of dizziness, tinnitus, or ear fullness, TMJ examination should also be considered. The management of patients with TMDs requires a multidisciplinary approach.

Highlights

- TMD subtype was not associated with dizziness, tinnitus, or ear fullness.
- Painful conditions were associated with dizziness.
- Dizziness occurred independent of TMD subtype, and patients with dizziness reported more pain.
- Ear fullness, tinnitus, and dizziness were related to each other.
- In clinical practice, the management of patients with TMDs requires a multidisciplinary approach.

Acknowledgments

The authors want to give many thanks to the participants who were involved in this study.

The author contributions are as follows: B.C.K.: concept development, study design and supervision, literature search, data collection/processing, writing of the manuscript, critical review; M.D.K.: concept development, literature search, data collection/processing, statistical analysis/data interpretation, manuscript writing, critical review.

The authors report no conflicts of interest.

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References

1. Kmeid E, Nacouzi M, Hallit S, Rohayem Z. Prevalence of temporomandibular joint disorder in the Lebanese population, and its association with depression, anxiety, and stress. *Head Face Med* 2020;16:19.
2. Kitsoulis P, Marini A, Iliou K, et al. Signs and symptoms of temporomandibular joint disorders related to the degree of mouth opening and hearing loss. *BMC Ear Nose Throat Disord* 2011;11:5.
3. de Felício CM, Melchior Mde O, Ferreira CL, Da Silva MA. Otologic symptoms of temporomandibular disorder and effect of orofacial myofunctional therapy. *Cranio* 2008;26:118–125.
4. Garrigós-Pedron M, Elizagaray-García I, Dominguez-Gordillo AA, Del-Castillo-Pardo-de-Vera JL, Gil-Martínez A. Temporomandibular disorders: Improving outcomes using a multidisciplinary approach. *J Multidiscip Healthc* 2019;12:733–747.
5. Peng Y. Temporomandibular joint disorders as a cause of aural fullness. *Clin Exp Otorhinolaryngol* 2017;10:236–240.
6. Porto De Toledo I, Stefani FM, Porporatti AL, Mezzomo LA, Peres MA, Flores-Mir C, et al. Prevalence of otologic signs and symptoms in adult patients with temporomandibular disorders: A systematic review and meta-analysis. *Clin Oral Investig* 2017;21:597–605.
7. Fernandes G, Siqueira JT, Godoi Gonçalves DA, Camparis CM. Association between painful temporomandibular disorders, sleep bruxism and tinnitus. *Braz Oral Res* 2014;28.
8. Hernández-Nuño de la Rosa MF, Keith DA, Siegel NS, Moreno-Hay I. Is there an association between otologic symptoms and temporomandibular disorders?: An evidence-based review. *J Am Dent Assoc* 2022;153:1096–1103.
9. International Network for Orofacial Pain and Related Disorders Methodology. A Consortium Focused on Clinical Translation Research. Examination form: North America. Updated April 25, 2018. Accessed February 2, 2023. [Available from: <https://ubwp.buffalo.edu/rdc-tmdinternational/tmd-assessmentdiagnosis/dc-tmd/>]
10. Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain* 1983;17:45–56.
11. Kusdra PM, Stechman-Neto J, Leão BLC, Martins PFA, Lacerda ABM, Zeigelboim BS. Relationship between otological symptoms and TMD. *Int Tinnitus J* 2018;22:30–34.
12. Çebi AT. Presence of tinnitus and tinnitus-related hearing loss in temporomandibular disorders. *Cranio* 2020;1–5.
13. Demirkol N, Demirkol M, Usumez A, Sari F, Akcaboy C. The potential etiologic factors influencing tinnitus intensity in patients with temporomandibular disorders. *Cranio* 2018;36:360–365.
14. Peleg O, Haddad L, Kleinman S, et al. Temporomandibular disorders and bruxism in patients attending a tinnitus clinic. *Appl Sci* 2022;12:4970.
15. Calderon Pdos S, Hilgenberg PB, Rossetti LM, Laurenti JV, Conti PC. Influence of tinnitus on pain severity and quality of life in patients with temporomandibular disorders. *J Appl Oral Sci* 2012;20:170–173.
16. Totta T, Santiago G, Gonçalves ES, Saes Sde O, Berretin-Felix G. Auditory characteristics of individuals with temporomandibular dysfunctions and dentofacial deformities. *Dental Press J Orthod* 2013;18:70–77.
17. Mikkonen J, Luomajoki H, Airaksinen O, Neblett R, Selander T, Leinonen V. Cross-cultural adaptation and validation of the Finnish version of the central sensitization inventory and its relationship with dizziness and postural control. *BMC Neurol* 2021;21:141.
18. Robinson LJ, Durham J, Newton JL. A systematic review of the comorbidity between temporomandibular disorders and chronic fatigue syndrome. *J Oral Rehabil* 2016;43:306–316.
19. Unell L, Ström D, Ekman K, Johansson A, Arnrup K, Carlsson GE. A 3-year study of patients with tinnitus and jaw muscle tenderness. *Cranio* 2019;37:304–309.
20. Hernández-Nuño de la Rosa MF, Keith DA, Siegel NS, Moreno-Hay I. Is there an association between otologic symptoms and temporomandibular disorders?: An evidence-based review. *J Am Dent Assoc* 2022;153:1096–1103.
21. Micarelli A, Viziano A, Granito I, Micarelli RX, Augimeri I, Alessandrini M. Temporomandibular disorders and cervicogenic dizziness: Relations between cervical range of motion and clinical parameters. *Cranio* 2022;40:348–357.
22. Maciel LFO, Landim FS, Vasconcelos BC. Otological findings and other symptoms related to temporomandibular disorders in young people. *Br J Oral Maxillofac Surg* 2018;56:739–743.