Oral Health-Related Quality of Life in Patients with Temporomandibular Disorders

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Aims: To measure the oral health-related quality of life (OHRQoL) in patients with temporomandibular disorders (TMD) compared to controls and analyze its association with various demographic and clinical parameters. **Methods:** The survey included 187 TMD patients and 200 controls. OHRQoL was measured using the validated Hebrew version of the Oral Health Impact Profile-14 (OHIP-14). A self-report questionnaire assessed personal details, smoking habits, history of trauma and orthodontic treatment, comorbid headaches, oral habits, and pain. TMD patients were divided into diagnostic categories according to the newly recommended diagnostic criteria for TMD (DC/TMD) Axis I protocol. Differences between groups were examined with a Pearson chi-square test for categorical variables and analysis of variance (ANOVA) for continuous variables. **Results:** Among TMD patients, the diagnostic categories included: *(1)* masticatory muscle disorders (MMD; n = 38; 20.32%), *(2)* isolated disorders of the temporomandibular joint (TMJ; n = 46; 24.59%), *(3)* patients with both MMD and TMJ (TMP; n = 103; 55.08%). Compared to controls, TMD patients exhibited worse global OHIP-14 scores (12.50 ± 8.14 vs 9.58 ± 10.00; $P = .002$) and worse scores in the following domains: physical pain ($P < .001$), psychological discomfort ($P = .005$), physical disability ($P = .004$), and psychological disability ($P = .013$). Among TMD patients, those categorized as TMP exhibited the highest scores in the physical pain ($P = .02$) domain. Previous orthodontic treatment, comorbid headache and body pain, limitations in mouth opening and lateral movement, pain, and muscle tenderness scores were found to be strongly related to the OHIP-14. **Conclusion:** TMD patients suffered from impaired OHRQoL considerably more than controls. OHRQoL in TMD patients is a multidimensional phenomenon influenced by previous orthodontic treatment, comorbid symptoms, pain, functional limitations, and muscle tenderness scores. *J Oral Facial Pain Headache 2015;29:231–241. doi:10.11607/ofph.1413*

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Oral health-related quality of life (OHRQoL) is a conceptual model targeting the patient's perception of oral health. OHRQoL characterizes structural, behavioral and psychosocial consequences of oral disease using the framework of the World Health Organization (WHO) International Classification of Impairments, Disabilities and Handicaps.[1] The Oral Health Impact Profile (OHIP), originally developed by Slade and Spencer,[2] is the most widely used OHRQoL instrument and has been translated and validated in various languages.[3–5] The English short form, OHIP-14, was translated to Hebrew and validated by Kushnir et al[6]; it is well suited to measure aspects of disability in patients with signs and symptoms of orofacial pain and temporomandibular disorders (TMD).[7–10]

Some investigators have demonstrated that TMD can have a significant impact on quality of life.[2,5,9,11–17] However, all these studies investigated the influence of the specific diagnosis according to the Research Diagnostic Criteria for TMD (RDC/TMD) guidelines,[18] and evaluation according to the newly recommended diagnostic criteria for TMD (DC/TMD) protocol[19] is warranted.

Personal details
(The questionnaire is anonymous and results will be used only for research purposes)
1. Gender: Male / Female
2. Age _____
3. Country of birth: 'Western' (North and South America, Europe) / Africa / Asia / Israel

Health
1. Are you healthy? Yes / No Details _____
2. Do you currently take medication(s) on a regular basis? Yes / No Details _____
3. Smoking: Yes / No

History of trauma
1. Have you had a traumatic event to the head and/or neck? Yes / No Details _____
2. Have you had jaw fractures? Yes / No Details _____
3. Have you had whiplash injury? Yes / No Details _____

History of orthodontic treatment
Have you had orthodontic treatments? Yes / No

If your answer was yes, please continue with the questions below.
1. On which jaw was the orthodontic treatment? Upper (maxilla) / Lower (mandible)
2. Which appliance was used during the treatment? Fixed appliance / Removable appliance
3. Have you had extractions for the orthodontic treatment? Yes / No
4. Did you use a retainer following orthodontic treatment? Yes / No
5. Did you have pain in the TMJ area during orthodontic treatment? Yes / No

History of headache
1. Have you suffered from a headache that was not due to illness over the last 12 months? Yes / No
2. I suffer from: TTH (tension-type headache) / migraine / none

Oral habits
1. Do you clench your teeth? Yes / No
2. Do you grind your teeth? Yes / No
3. Do you bite your nails? Yes / No
4. Do you suffer from sleep bruxism? Yes / No
5. Does your partner report that you suffer from sleep bruxism? Yes / No

Pain evaluation
1. How strong is your pain? Answer the following questions, considering '0' as no pain and '10' as the worst pain imaginable in the last 6 months.
   a. Current angle of the jaw VPS (verbal pain score) _____
   b. Maximal angle of the jaw VPS _____
   c. Current preauricular VPS _____
   d. Maximal preauricular VPS _____
2. Have ever you suffered from pain in other body parts? None / Yes

Thank you for participating

Fig 1 Questionnaire.

Moreover, the impact of subjective and objective signs and symptoms of TMD on the OHRQoL and its domains has not been fully explored. Specifically, the relationship between the OHRQoL and comorbid headaches, trauma history, presence of oral habits, history of orthodontic treatment, and muscle tenderness scores have not been investigated. The muscle tenderness score, also known as the total tenderness score (TTS), is commonly used in headache practice for the assessment of pericranial muscle tenderness and adds valuable information beyond the number of involved muscles.[20–25] For example, in patients with tension-type headache compared with asymptomatic subjects, an increased tenderness of the pericranial muscles was observed.[20,22,23,26,27] Muscle tenderness further increases during the cephalalgic attacks.[28–30] In patients with masticatory muscle disorders, the tenderness score was found to correlate with the pain scores better than the number of involved muscles.[31] Therefore, tenderness scores may add further information beyond the number of involved muscles, and investigating their influence on the OHRQoL is justified.

The magnitude of the impact of TMD diagnoses on OHRQoL depends on the definition of the comparison group. TMD patients often seek consultation with a dentist for their TMD, especially for pain-related TMD.[19] Therefore, comparison of OHRQoL between treatment-seeking TMD patients and treatment-seeking patients in the dental setting seems to be a more valid measurement, although subjects from the general population are the most conceivable choice for comparison. Nevertheless, in studies of OHRQoL in TMD patients, the control group has been composed of either TMD-free dental students,[15] individuals who were accompanying patients to one of the hospital restorative clinics for routine dental care or nonclinical university staff,[12] a national sample of subjects,[2] patients with dental anxiety,[8] or a general population in the surrounding areas.[32,33] Several other studies have not included a control group.[9,10,13,17,34]

The aims of the present study were to measure the OHRQoL in TMD patients compared to controls and analyze its association with various demographic and clinical parameters.

Materials and Methods

Utilization of human subject data followed the approved protocol and requirements of the Institutional Review Board and all patients (including the control group) read, understood, and signed an informed consent form and received free and unconditional treatment.

Extraoral examination

1. Symmetry of the face: Yes / No
2. TMJ sounds:
   a. Right: Click / Crepitus / Click + crepitus / Reciprocal click / No sound
   b. Left: Click / Crepitus / Click + crepitus / Reciprocal click / No sound

Mouth opening

1. Mouth opening:
   a. Unassisted mouth opening _____ mm
   b. Assisted mouth opening _____ mm
2. Pain in opening: 0 (no pain) / 1 (mild) / 2 (moderate) /3 (severe)
3. Deviation in opening: Right deviation / Right deflection / Left deviation / Left deflection / None
4. Limitation in lateral movement: Limitation to right / Limitation to left / Limitation to right and left / None
5. End-feel: Soft end-feel / Hard end-feel

Muscle tenderness scores

0 (no pain) / 1 (mild) / 2 (moderate) /3 (severe)

Masseter: R _____ L _____
Temporalis: R _____ L _____
Lateral pterygoid: R _____ L _____
Medial pterygoid: R _____ L _____
MTS: _____

Suboccipital group: R _____ L _____
Sternocleidomastoid: R _____ L _____
Trapezius: R _____ L _____
CTS: _____
MTS: _____
TTS: _____
No. of tender muscles: _____

Intraoral examination

1. Oral hygiene: Good / Moderate / Poor
2. Missing teeth: Upper Kennedy I / Upper Kennedy II / Upper Kennedy III / Upper Kennedy IV / Lower Kennedy I / Lower Kennedy II / Lower Kennedy III / Lower Kennedy IV / Upper Kennedy I, lower Kennedy I / Upper Kennedy II, lower Kennedy II / Upper Kennedy III, lower Kennedy III / None
3. Occlusal relationships: Tooth crowding / Right unilateral crossbite / Left unilateral crossbite / Bilateral crossbite/ Tête-à-tête contact / Slight anterior open bite / Moderate anterior open bite /Severe anterior open bite / Deep bite / Scissors bite / Lateral open bite / Severely prognathic mandible / None
4. Angle class: I / II / III

Intraoral signs and symptoms of bruxism

1. Existence of abfractions: Yes / No
2. Existence of amalgam fractures: Yes / No

Fig 2 Clinical examination.

Study Groups

During the study period (March 1 to December 31, 2011), 200 consecutive patients who were referred to the TMD Clinic at the Department of Prosthodontics, Oral and Maxillofacial Center, Tel-Hashomer, Israel, with TMD as their primary complaint, were included in the study. This department is a secondary prosthodontics referral center that manages treatment of TMD patients referred by dentists and physicians from primary clinics throughout the country.

Two hundred consecutive, TMD-free individuals attending conservative dental treatment in a primary dental clinic formed the control group. Patients were interviewed in Hebrew at the first visit before medications were prescribed. The resultant data were recorded on a standard intake form.

Inclusion Criteria and Diagnoses

Included were patients aged 18 to 50 years. TMD patients were diagnosed according to Axis I of the RDC/TMD,[18] which was the most accepted diagnostic instrument while the study was performed. Redistribution of the study population was performed before statistical analysis of the data, according to Axis I of the DC/TMD.[19] Exclusion criteria for both groups were presence of drug abuse, a comorbid malignant disease or significant medical condition, and pregnancy or nursing.

TMD patients were divided into three diagnostic categories according to Axis I DC/TMD diagnostic criteria[19,35,36]:

1. Masticatory muscle disorders (MMD), which included only the diagnoses of "myalgia" (ie, "local myalgia," "myofascial pain," or "myofascial pain with referral")[19]
2. Isolated temporomandibular joint (TMJ) disorders, which included the DC/TMD diagnoses of "arthralgia" and the following joint disorders: disc displacement with reduction, disc displacement with reduction with intermittent locking, disc displacement without reduction with limited opening, and disc displacement without reduction without limited opening[19]
3. Both MMD and TMJ disorders (TMP)

Data Collection

The study was based on a questionnaire (Fig 1) and on clinical examination (Fig 2). The questionnaire consisted of several parts: *(1)* personal details including age, gender, country of birth, and smoking habits; *(2)* history of trauma; *(3)* history of orthodontic treatment; *(4)* history of headache; *(5)* oral habits; and *(6)* pain characteristics (Fig 1).

Pain Evaluation

Patients were asked to rate their regional pain intensity via a 0 to 10 verbal pain scale (VPS) for both current and maximal recalled pain in the last 6 months. The presence of pain in other body parts was also recorded (yes/no) (Fig 1).

Clinical Examination

The extraoral examination included the following data: facial symmetry, TMJ sounds, assisted and unassisted interincisal mouth opening, end-feel (the sensation imparted to the examiner's hands at the end point of the available range of motion), pain in opening, deviation in opening, and limitation in lateral movement (Fig 2).

The intraoral examination included assessment of the level of oral hygiene, missing teeth, occlusal relation, Angle's classification, and presence of signs of bruxism, including abfractions and amalgam fractures (Fig 2).

Muscle Tenderness Scores

The masticatory apparatus (TMJs and masticatory muscles) and neck muscles were examined for sensitivity to palpation (Fig 2). Examinations were performed always in the same order. The following muscles were examined bilaterally: *(1)* masticatory muscles including masseter, temporalis, medial pterygoid, and lateral pterygoid; *(2)* cervical muscles including suboccipital group (as one), sternocleidomastoid, and trapezius. Muscle palpation was performed with about 2 to 3 pounds of pressure (previous examiner calibration).[35,36] Tenderness to palpation was graded on a 4-point ordinal scale: 0 (no pain), 1 (mild), 2 (moderate), and 3 (severe). The muscle tenderness score was calculated as the summated palpation scores from all the muscles examined. A masticatory muscle tenderness score (MTS) and a cervical muscle tenderness score (CTS) were calculated individually; when combined these gave the total muscle tenderness score (TTS) for each patient. MTS and TTS were evaluated with and without the lateral pterygoid muscle (MTS No Lat ptry and TTS No Lat ptry, respectively). The number of tender muscles per patient was also recorded (Fig 2).

OHRQoL

The survey included the validated Hebrew version of the OHIP-14.[6] The OHIP-14 has 14 items translated from the English-language OHIP. For each OHIP-14 question, subjects were asked how frequently they had experienced the impact in the last 6 months. Responses were made on a 5-point ordinal scale: 0—never , 1—hardly ever, 2—occasionally, 3—fairly often, and 4—very often. OHRQoL impairment was characterized by the OHIP-14 global score, with a potential range of 0 (no adverse impacts within the last 6 months) to 56 (all 14 impacts experienced very often within the last 6 months).

The OHIP-14 includes seven conceptual domains of OHRQoL: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap.[4] OHIP-14 domains were calculated for each of the domains by summing the response scores for the two corresponding items. The OHIP-14 global score and its seven domains were compared between the TMD and control groups and between the three diagnoses comprising the TMD group (ie, MMD, TMJ, and TMP). Relationships between OHIP-14 score and the various clinical, demographic, and habitual parameters were assessed.

Statistical Analysis

Data were tabulated and statistical analyses performed using SPSS software (version 21.0). A two-tailed level of statistical significance (α) was set at 5%.

Differences between groups were examined with Pearson chi-square for categorical variables and analysis of variance (ANOVA) for continuous variables. Based on the univariate results, significant parameters were selected for multivariate logistic regression (LR) using a stepwise backward model.

Continuous variables are presented as means and standard deviations, ordinal data are presented as medians, and categorical variables are presented as frequencies and percentages.

Results

General Description

Overall, 387 patients completed the study. The TMD group consisted of 187 patients and the control group consisted of 200 patients. Thirteen patients in the TMD group were excluded from the final analysis due to missing data.

The mean age of the TMD group was 21.12 ± 3.83 years (22.00 ± 6.04, 21.30 ± 3.81, and 20.71 ± 2.58 years in the MMD, TMJ, and TMP groups, respectively; $P = .199$); 76 (40.6%) patients were males and 111 (59.4%) were females. Most patients in the MMD, TMJ, and TMP groups were born in Israel (65.8%, 76.1%, and 87.3%, respectively; $P = .055$), had 12 years of education (84.2%, 95.7%, and 91.2%; $P = .064$), and were nonsmokers (81.1%, 67.4%, and 74.8%; $P = .360$). TMP was the most frequent diagnosis (n = 103; 55.08%), followed by TMJ (n = 46; 24.59%) and MMD (n = 38; 20.32%). There were no statistical differences in any of the demographic parameters between TMD patients ($P > .05$).

The mean age of the control group was 20.93 ± 3.74 years; 110 (55.0%) patients were male and

Table 1 Mean Oral Health Impact Profile (OHIP-14) Global and Domain Scores Among TMD Patients Compared to Control Patients

	n	Mean	95% Confidence interval for mean		*P*
			Lower bound	Upper bound	
OHIP-14 global score					
TMD group	187	12.50 ± 8.14	11.32	13.67	
Control	200	9.58 ± 10.00	8.19	10.97	.002
Total	387	10.99 ± 9.25	10.06	11.91	
Functional limitation (OHIP-1+2)					
TMD group	187	0.59 ± 1.09	0.43	0.75	
Control	200	0.60 ± 1.14	0.43	0.76	.953
Total	387	0.59 ± 1.11	0.48	0.70	
Physical pain (OHIP-3+4)					
TMD group	187	4.27 ± 2.42	3.92	4.62	
Control	200	2.25 ± 1.94	1.97	2.52	< .001
Total	387	3.22 ± 2.40	2.98	3.47	
Psychological discomfort (OHIP-5+6)					
TMD group	187	2.39 ± 2.36	2.05	2.73	
Control	200	1.76 ± 1.97	1.48	2.04	.005
Total	387	2.06 ± 2.19	1.85	2.28	
Physical disability (OHIP-7+8)					
TMD group	187	1.85 ± 2.32	1.52	2.19	
Control	200	1.26 ± 1.73	1.01	1.5	.004
Total	387	1.54 ± 2.05	1.34	1.75	
Psychological disability (OHIP-9+10)					
TMD group	187	1.44 ± 1.91	1.17	1.70	
Control	200	1.01 ± 1.34	0.82	1.20	.013
Total	387	1.23 ± 1.67	1.06	1.40	
Social disability (OHIP-11+12)					
TMD group	187	1.26 ± 1.77	1.01	1.52	
Control	200	1.26 ± 1.93	0.98	1.53	.970
Total	387	1.26 ± 1.86	1.07	1.44	
Handicap (OHIP-13+14)					
TMD group	187	1.12 ± 1.65	0.89	1.36	
Control	200	1.04 ± 1.72	0.79	1.28	.609
Total	387	1.08 ± 1.68	0.91	1.25	

90 (45.0%) were female. Most patients in the control group were born in Israel (79.8%), had 12 years of education (96.4%), and were nonsmokers (62.8%).

There were significantly more females and smokers in the TMD group compared to control group ($P = .005$ and $P = .016$, respectively). There were no statistically significant differences in any of the other demographic parameters between the study groups ($P > .05$).

OHIP-14 Scores

The OHIP-14 scores of the TMD group compared to the control group are presented in Table 1. Compared to the control group, TMD patients exhibited worse OHIP-14 global scores (12.50 ± 8.14 vs 9.58 ± 10.00; $P = .002$) as well as in the following individual domains: physical pain ($P < .001$), psychological discomfort ($P = .005$), physical disability ($P = .004$), and psychological disability ($P = .013$) (Table 1).

Among TMD patients, the physical pain domain was where the highest impact was recorded (4.27 ± 2.42), while the lowest impact was recorded in the handicap domain (0.59 ± 1.09). Patients with comorbid muscle and joint pain (ie, TMP) demonstrated the highest mean OHIP-14 global scores (13.20 ± 7.85), followed by MMD patients (13.03 ± 8.80) and TMJ patients (10.48 ± 8.07); however, these differences did not reach statistical significance ($P = .153$). TMP patients had the highest scores on the physical pain domain compared to MMD and TMJ patients (4.70 ± 2.25 vs 3.53 ± 2.59 and 3.93 ± 2.47, respectively; $P = .021$).

OHIP-14 global score was tested in relation to demographic parameters among the study population (N = 387), with no significant association found for any of these: age ($P = .113$), gender ($P = .538$), country of birth ($P = .917$), years of education ($P = .384$), and smoking ($P = .281$).

The influence of clinical parameters on the OHIP-14 global score was analyzed in TMD patients (Tables 2 and 3). Several clinical parameters were associated with statistically significant worse OHIP-14 scores.

Table 2 ANOVA Analysis of Oral Health Impact Profile (OHIP-14) Scores with Discrete Critical Clinical Parameters Among TMD Patients

	OHIP-14 severity score		
Clinical parameter	n	Mean ± SD	*P*
History of whiplash			
Yes	5	22.20 ± 7.49	.007
No	182	12.23 ± 8.01	
History of orthodontic treatment			
Yes	67	10.75 ± 7.78	.028
No	120	13.47 ± 8.21	
History of maxillary orthodontic treatment		1	
Yes	63	0.38 ± 7.82	.011
No	122	13.59 ± 8.19	
End-feel			
Soft	151	11.75 ± 7.85	.010
Hard	36	15.64 ± 8.68	
Pain in opening			
None	43	10.70 ± 7.25	.008
Mild	74	11.22 ± 6.45	
Moderate	52	14.29 ± 9.05	
Severe	18	16.89 ± 11.23	
Limitation in lateral movement		1	
None	132	1.30 ± 7.30	.013
Right	18	16.72 ± 10.36	
Left	36	14.64 ± 8.96	
Right and left	1	18.00 ± 0.00	
Comorbid headache			
None	149	11.82 ± 7.81	.029
Tension-type	13	12.62 ± 7.44	
Migraine	25	16.48 ± 9.50	
Preauricular pain			
Right	30	13.47 ± 7.05	.005
Left	31	15.29 ± 9.60	
Bilateral	73	13.21 ± 7.67	
None	53	9.34 ± 7.67	
Presence of pain in other body sites			
No	70	10.53 ± 7.70	.011
Yes	114	13.65 ± 8.23	

Table 3 Correlations of Oral Health Impact Profile (OHIP-14) Scores with Continuous Parameters Among TMD Patients

Parameter	Pearson correlation	*P*
Unassisted mouth opening	–0.264	< .001
Assisted mouth opening	–0.281	< .001
Current verbal pain scale (VPS)	0.310	< .001
Maximal verbal pain scale (VPS)	0.424	< .001
Number of tender muscles	0.247	.001
Masticatory muscle tenderness score (MTS)	0.278	< .001
Cervical muscle tenderness score (CTS)	0.211	.004
Total muscle tenderness score (TTS)	0.283	< .001
Masticatory muscle tenderness score without lateral pterygoid (MTS No Lat ptry)	0.233	.001
Total muscle tenderness score without lateral pterygoid (TTS No Lat ptry)	0.257	< .001

These included history of whiplash injury ($P = .007$), hard end-feel ($P = .010$), increasing levels of pain in opening ($P = .008$), limitation in lateral movement ($P = .013$), presence of comorbid migraine compared to tension-type headache or none ($P = .029$), presence of preauricular pain ($P = .005$), presence of pain in other body sites ($P = .011$), reduced assisted and unassisted mouth opening (both $P < .001$),

Table 4 Multivariate Regression Analysis of Oral Health Impact Profile (OHIP-14) Scores with Statistically Significant Clinical Parameters Among TMD Patients

	B	Standard error	β	*t*	*P*
Constant	3.325	4.407		0.755	.452
History of maxillary orthodontic treatment	3.321	1.117	0.191	2.973	.003
Assisted mouth opening	−0.172	0.061	−0.190	−2.821	.005
Limitation in lateral movement	1.363	0.664	0.136	2.053	.042
Current verbal pain scale (VPS)	0.476	0.229	0.148	2.079	.039
Maximal verbal pain scale (VPS)	1.063	0.257	0.301	4.138	< .001

B = unstandardized regression coefficient; β = standardized regression coefficient.

higher current and maximum total VPS scores (both $P < .001$), higher number of tender muscles ($P = .001$), and higher MTS ($P < .001$), CTS ($P = .004$), TTS ($P < .001$), MTS No Lat ptry ($P = .001$), and TTS No Lat ptry ($P < .001$).

Patients with a history of any orthodontic treatment, and in particular patients with a history of maxillary orthodontic treatment, exhibited significantly better OHIP-14 scores ($P = .028$ and $P = .011$, respectively) (Table 2).

The OHIP-14 global score was analyzed versus other clinical parameters, but no significant associations were found; these included history of trauma ($P = .282$), history of jaw fracture ($P = .157$), extractions for orthodontic treatment ($P = .101$), orthodontic treatment in the mandible ($P = .107$), use of fixed or removable appliances during orthodontic treatment ($P = .158$), use of a retainer following orthodontic treatment ($P = .214$), pain in the TMJ area during orthodontic treatment ($P = .839$), self-report of sleep bruxism ($P = .131$), partner report of sleep bruxism ($P = .052$), clenching habit ($P = .996$), grinding habit ($P = .307$), fingernail-chewing habit ($P = .273$), gum-chewing habit ($P = .502$), presence of abfractions ($P = .458$), presence of amalgam fractures ($P = .489$), level of oral hygiene (mild/moderate/poor, $P = .533$), Angle class (I, II, III, $P = .492$), occlusal relations ($P = .383$), facial symmetry ($P = .611$), deviation on mouth opening ($P = .191$), sounds in the right ($P = .368$) or left TMJ ($P = .198$), and missing teeth ($P = .365$).

Multivariate regression analysis was performed with the variables that were found to be significantly associated with the OHIP-14 scores in the univariate analysis ($P < .05$) (Table 4). History of maxillary orthodontic treatment remained in a statistically significant association with lower OHIP-14 scores ($P = .003$). Higher current VPS scores ($P = .039$), higher maximal VPS scores ($P < .001$), reduced assisted mouth opening ($P = .005$), and limitation in lateral movement ($P = .042$) remained in a statistically significant association with higher OHIP-14 scores.

Discussion

As expected, TMD patients exhibited significantly higher global OHIP-14 scores as well as higher scores in the following domains: physical pain, psychological discomfort, physical disability, and psychological disability. Comorbid pain and multiplicity of signs and symptoms were also associated with impaired OHRQoL. These findings correlate and strengthen the current perception that TMD is a complex condition, no longer regarded solely as a localized orofacial pain condition and best viewed within a biopsychosocial model of illness that involves a combination of biological, psychological, and social factors.[37,38]

The present study included only TMD patients seeking treatment for their complaints at a secondary center. These more persistent cases represent a selected, possibly more severe, patient population. In the 187 patients who met the inclusion criteria, TMP was the most frequent diagnosis, followed by TMJ and MMD. The distribution of diagnoses in other studies varies depending on the diagnostic criteria employed and differences in the studied populations.[39] The present study employed the new DC/TMD Axis I protocol, while in previous studies the RDC/TMD was the most commonly employed research tool. In agreement with the present findings, combined muscle and joint disorders (equivalent to the present study's TMP diagnosis within the TMD group) affect about half of the patients.[40]

The Influence of Demographics on OHIP-14

Interestingly, there was no significant association of OHIP-14 to any of the demographic parameters, including age, gender, years of education, birth country, and smoking. Therefore, it appears that the higher female prevalence in clinical series cannot be explained by a greater impact of TMD on women's lives.[5] Similarly, others also have reported that the difference between men and women regarding the impact of TMD on OHRQoL was small and not significant.[5,9,16] On the other hand,

other studies have reported that female gender[10] and higher age[2,5,10,16,33] correlated with higher OHRQoL scores. The difference could be attributed to age differences between the samples (eg, mean age of 21.02 ± 3.78 years in the present study vs 37.4 ± 16.2 years,[2] 36.1 ± 13.4 years,[16] and 41.48 ± 17.28 years[10]). Older patients report a poorer perception of their OHRQoL, associated with illness as well as with denture-related problems and dry-mouth syndrome, both of which limit mastication.[41] A strength of the current study was that the studied group included young and middle-aged individuals without significant medical conditions or disabilities; therefore, the influence of aging and illness on OHRQoL could be eliminated.

Differences in Global OHIP-14 Scores Between TMD Patients and Controls

TMD patients exhibited higher global OHIP-14 scores compared to control subjects. The mean global OHIP-14 score in the present study for TMD patients (12.50 ± 8.14) was in line with the scores presented for TMD patients by Barros et al (11.46),[9] Schierz et al (14.1 vs 4.1 in general population),[8] and Miettinen et al (15.7 vs 3.0 in dental student control group),[15] but lower than that presented by Blanco-Aguilera et al (20.57 ± 10.73, no control group).[10]

Comparison with other studies regarding differences in OHIP-14 scores between TMD patients and controls is challenging because, as noted in the introduction, in most studies the control group was from the general population.[2,32,33] Moreover, in some other studies there were no control groups.[9,10,13,17,34] However, in the present study, both the TMD group and the control group were composed of treatment-seeking patients in the dental setting. Patients seeking professional treatment for orofacial pain symptoms present unique characteristics in terms of psychological factors, specific pain behaviors, and different coping strategies compared to subjects in the general population.[42] The fact that TMD patients presented with higher OHIP global scores compared to controls in the present study reflects that TMD patients possess unique characteristics even compared to patients seeking dental treatment, who may also experience dental pain that may affect their OHRQoL. As expected, there was a relatively small difference between the TMD group and the patient-control group in the present study compared to the much larger difference between TMD and the population-control study by Schierz et al.[8]

Differences in OHIP-14 Domains Between TMD Patients and Controls

Compared to controls, TMD patients exhibited higher scores for the following domains: physical pain, psychological discomfort, physical disability, and psychological disability. However, there were no significant differences for the functional limitation, social disability, and handicap OHIP-14 domains. The findings are in keeping with those of a recent systematic review, that the most often affected OHIP subscales in TMD patients are those evaluating psychological discomfort and disability, and the least affected subscales concern social disability and handicap.[5] Overall among TMD patients, the highest impact was reported for the physical pain domain while the lowest impact was recorded for the handicap domain, similar to other studies.[8,43]

Differences in OHIP-14 Scores Between TMD Diagnoses

While TMP patients demonstrated the highest mean OHIP global scores, followed by MMD and TMJ, these differences were statistically insignificant. TMP patients also presented with the highest scores on the physical pain domain compared to MMD and TMJ patients. Similarly, patients with two pain-related diagnoses have been shown to have more impaired OHRQoL than subjects with one diagnosis.[32]

The Influence of Clinical Parameters on OHIP-14

Patients with a history of whiplash injury presented with significantly worse OHIP-14 scores. This can be explained by the fact that people with a chronic whiplash-associated disorder report chronic pain and limitation of functional activity with additional symptoms ranging from tenderness and stiffness to disorders of balance, vision, and emotions. These can lead to a permanent disability having a clear impact on these patients' quality of life.[44] However, due to the small number of whiplash patients (five), additional data are needed.

In the present study, patients with a history of any orthodontic treatment, and in particular patients with a history of maxillary orthodontic treatment, exhibited improved OHRQoL, which remained significant even after multivariate analysis. It is generally accepted that orthodontic treatment does not cause an increased risk to developing TMD[45–49] and may result in significantly improved OHRQoL.[50,51] Orthodontic treatment may lead to improvement in the patients' mental and emotional states, such as appearance[52] and in oral functional measures.[51]

The relationship of OHRQoL to pain is reflected in the present study by several observations, such as the physical pain domain, current and maximum total VPS scores as well as pain in other body sites, preauricular pain, and pain on mouth opening. Indeed, orofacial pain has previously been shown to have a great impact on the quality of life of orofacial pain

patients[53] and on TMD patients.[5,9,10,14,53] The present study evaluated both the current VPS and the maximal VPS in the last 6 months. Both were significantly associated with the OHIP-14 global score, which remained significant in the multivariate analysis. The maximal VPS reflects the subjective memory of pain experience and adds valuable information regarding the patient's pain perception and pain memory reconstruction over time, and therefore its strong association with OHRQoL is not surprising.

An association between quality of life and TMD severity is also reflected by the association of worse OHRQoL and limited mandibular mobility, such as end-feel, pain on opening, and limitation in lateral movement. Measures of pain on opening and limitation in lateral movement showed "dose-related" responses when measured against OHIP (Table 2). Similarly, Rener-Sitar et al[33] found that diagnoses associated with limited jaw movements contributed to more impaired OHRQoL, and Barros et al[9] reported a positive association between OHRQoL and a Function Index (FI), which included 12 items used to characterize pain or limitations related to mandibular range of motion and deviation of the mandible during opening movements. On the other hand, Reissmann et al did not find large differences between myofascial pain with and without limited mouth opening.[32]

Patients who suffered from migraines in the present study had a higher OHIP-14 score followed by patients with tension-type headache and patients without headache. Headache disorders determine relevant reductions in general functioning and quality of life.[54] Recent reviews have reported that migraine substantially impairs a person's functions in different activity domains during attacks and diminishes health-related quality of life during and between attacks,[55] determining difficulties in specific aspects such as vitality, social functioning, and mental and physical health.[56] Migraine is one of the leading causes of disease-related disability, particularly in women, according to the World Health Organization (WHO, see http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf). Although quality of life has been widely explored in migraine, the influence of comorbid migraine in the context of TMD on OHRQoL has not been explored. Nevertheless, comorbid headaches did not have a significant association with the OHIP-14 global score in the multivariate analysis, reflecting that other factors have a stronger association with the OHIP-14 global score. This makes sense, as the OHIP was designed specifically for oral health-related problems.

Higher masticatory, cervical, and total muscle tenderness scores were positively associated with worse OHRQoL. Apart from the inaccessibility of the lateral pterygoid and posterior digastric muscles, it has been recommended that these sites be omitted from the DC/TMD protocol due to low reliability.[36,57–59] Therefore, MTS and TTS were evaluated with and without assessment of the lateral pterygoid muscle. Reduced health-related quality of life is associated with subjective pain and clinical signs from the neck and shoulders.[60] To the best of the authors' knowledge, the present study is the first evaluation of the influence of muscle tenderness scores that showed a specific effect of masticatory muscle tenderness on the OHRQoL.

In the multivariate analysis, the different subclasses of TMD (ie, TMJ, MMD, and TMP) did not remain in a significant association with OHIP-14. This reflects a commonality across painful disorders of the masticatory system in inducing changes in quality of life and functional ability.

The main strengths of the present study were the large sample size for both control subjects and TMD patients and the strict protocol utilizing the standardized, internationally accepted, OHIP-14 questionnaire and the DC/TMD criteria, which allowed for comparison across similar studies. An additional strength was that a population of patients seeking dental treatment was used for the control group. The major limitation of this study was that only the impact of physical conditions (eg, Axis 1) was evaluated; the impact of depression and somatization (eg, Axis 2) was not investigated. However, it is well documented that there is a relationship between these conditions and OHRQoL, implying that OHRQoL may be suitable to capture some of the impact of these conditions in a single measure.[2,32] It would have been advantageous to include a clinical examination according to the DC/TMD protocol in the control group. This would have allowed for the comparison of patients with TMD who were seeking treatment versus subclinical or mild TMD cases not seeking treatment.

Conclusions

TMD have a significant negative impact on OHRQoL and its domains. OHRQoL in TMD patients is a multidimensional phenomenon influenced by multiple parameters. TMD patients demonstrated higher OHRQoL scores when comorbid symptoms were present. Comorbid pain and multiplicity of signs and symptoms should signal more suffering and thus modification of treatment. TMD patients should therefore be monitored carefully for their OHRQoL and the appropriate treatment sought in order to improve their OHRQoL.

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