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Comparison of psychological states and oral health–related quality of life of patients with differing severity of temporomandibular disorders

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Abstract

Background: Studies on temporomandibular disorder (TMD) severity in patient populations are scarce.

Objectives: This study sought to compare the psychological states and oral health–related quality of life (OHRQoL) among patients with differing TMD severity.

Methods: Adult patients (≥18 years old) with and without (controls) TMDs were recruited from the TMD/oro-facial pain centre and prosthodontics department, respectively. The presence and severity of TMDs were established with the Fonseca Anamnestic Index (FAI), and TMD diagnoses were confirmed with the Diagnostic Criteria for TMDs (DC/TMD). Psychological states and OHRQoL were examined with the Depression, Anxiety, Stress Scales-21 (DASS-21) and Oral Health Impact Profile for TMDs (OHIP-TMD). Data were subjected to chi-square, Kruskal-Wallis/Mann-Whitney *U* tests and Spearman's correlation ($\alpha = .05$).

Results: A total of 961 participants with a mean age of 32.99 ± 13.14 years (71.19% women) were assessed. Frequencies of the various TMD categories were as follows: no TMD/controls (12.07%), mild TMD (24.56%), moderate TMD (40.37%) and severe TMD (23.00%). The three most common TMD-related symptoms were TMJ noises, mouth opening difficulty and muscle pain. Participants with moderate/severe TMD presented a higher proportion of intra-articular and/or combined disorders. They reported significantly higher levels of depression, anxiety, stress and poorer OHRQoL than their counterparts with no/mild TMD ($p < .001$). Moderate-to-strong correlations were observed between FAI and DASS-21/OHIP-TMD scores (rs = 0.42–0.72).

Conclusions: Patients with moderate/severe TMD had significantly higher levels of psychological disturbance and poorer OHRQoL. As OHRQoL and psychological states are correlated, psychological well-being must be considered when managing patients with moderate/severe TMDs.

KEYWORDS

oral health–related quality of life, psychology, severity, temporomandibular disorders

Min-Juan Zhang is co-first author.

1 | BACKGROUND

Temporomandibular disorders (TMDs), characterised by pain and/or dysfunction of the temporomandibular joints (TMJs), masticatory musculature and related structures, are a growing public health concern.[1] It affects about 15% of the general adult population and is more common among women.[2,3] Based on the contemporary Diagnostic Criteria for TMDs (DC/TMD) standard, TMDs can be broadly divided into pain-related (mainly myalgia and arthralgia) and intra-articular TMJ disorders (mostly disc displacements and degenerative diseases of the TMJs).[4,5] The 'biopsychosocial model' of TMDs is well established, and psychological factors are important contributors to the aetiology of TMDs.[6] The presence of TMDs has been found to negatively affect oral health–related quality of life (OHRQoL), a self-reported construct concerning the functional, psychological and social impacts of oral conditions.[7–9] However, most prior studies had used generic OHRQoL measures, particularly the Oral Health Impact Profile (OHIP), that are less sensitive, specific and responsive than condition-specific ones.[10] Durham et al. created a TMD-specific OHRQoL measure called the OHIP-TMD whose items were designed to capture the symptoms and effects of TMDs.[11]

Research on the severity of TMDs is still uncommon and is constrained by the complexity of defining the 'severity' construct and the limited number of validated instruments available. The most popular tool for characterising TMD severity is the Fonseca Anamnestic Index (FAI).[12] Founded on the Helkimo index,[13] the original Portuguese and English versions have been translated into many languages including Chinese, Arabic, Spanish, as well as Turkish, and validated.[14–17] The FAI was also found to accurate and produced consistent outcomes with other TMD screening/diagnostic instruments including the American Academy of Orofacial Pain Questionnaire and the Research Diagnostic Criteria for TMDs (RDC/TMD).[18–20] Recently, it was also confirmed to be reliable for assessing TMD severity.[21] The FAI was used in many studies to determine the presence and severity of TMDs in non-patient populations.[22–26] However, studies on TMD severity in patient populations are scarce and its relationship with psychological distress and OHRQoL had not been commonly investigated.

The purpose of this study was thus to compare the psychological states and OHRQoL among patients with differing severity of TMDs. The frequency of the various TMD symptoms and DC/TMD diagnoses were also characterised. Furthermore, the affiliations between TMD severity, psychological distress and OHRQoL were explored. The null hypotheses for the study were as follows: (a) no differences in psychological distress and OHRQoL among patients with differing TMD severity are present, and (b) TMD severity, psychological states and OHRQoL are not correlated.

2 | METHODS

2.1 | Study participants

Ethics approval was obtained from the Biomedical Institution Review Committee of Peking University School of Stomatology (reference number: PKUSSIRB-201732009) for this case-control study. The minimum sample size for four comparison groups (n = 280) was calculated a priori with the G*Power software version 3.1.9.3 using the Wilcoxon-Mann-Whitney model, an effect size of 0.25, an alpha error of 0.05 and 95% power.[27] Participants with and without (controls) TMDs were enrolled from successive patients presenting at the TMD/oro-facial pain centre and prosthodontics department of the Peking University Hospital of Stomatology, respectively. Patients who were aged ≥18 years and proficient in the Chinese language with the presence or absence of DC/TMD defined TMDs were included, while those with a history of oro-facial trauma, narcotics misuse, uncontrolled mental, autoimmune or metabolic disorders, illiteracy and cognitive deficiencies were duly excluded. All eligible patients were provided information regarding the study and signed consent was attained from all amenable ones. All participants were instructed to complete a demographic and medical survey, the Chinese language versions of the Fonseca Anamnestic Index (FAI), the Symptom Questionnaire (SQ) of the DC/TMD, the Depression, Anxiety, Stress, Scales-21 (DASS-21) and the OHIP-TMD at their intake visits.[14,28–30]

2.2 | TMD severity and diagnoses

The FAI was utilised to identify the presence of TMDs and to categorise TMD severity. It contains 10-items concerning pain (headaches, neck, masticatory muscles and TMJ pain) and function-related (TMJ sounds, difficulty with jaw opening and lateral movements) TMD symptoms as well as risk factors associated with TMDs (parafunction [teeth clenching/grinding], malocclusion and emotional tension). The items are appraised utilising a 3-point response scale with no = 0 points, sometimes = 5 points and yes = 10 points. The severity of TMDs was classified as: no TMD = 0 to 15 points; mild TMD = 20 to 40 points; moderate TMD = 45 to 65 points; and severe TMD = 70 to 100 points. The SQ of the DC/TMD involves 14 items relating to the history and characteristics of TMD symptoms (specifically facial pain, headaches, TMJ sounds, TMJ closed and open locking) and was designed to facilitate the gathering of information necessary for deriving the DC/TMD Axis I diagnosis. Participants who tested positive for the presence of TMDs with the FAI were put through a protocolised clinical evaluation by a DC/TMD trained and calibrated dental specialist. TMD diagnoses were subsequently made based on the SQ, clinical findings and the DC/TMD diagnostic algorithms and stratified into pain-related TMDs (PT), intra-articular TMDs (IT) and combined TMDs (CT).[4] Participants who tested positive for TMDs with the FAI but did not qualify for a physical DC/TMD diagnosis (n = 21) were duly omitted from the study.

2.3 | Depression, anxiety, stress and OHRQoL

Psychological distress and OHRQoL were examined with the DASS-21 and OHIP-TMD, respectively. The DASS-21 is an established

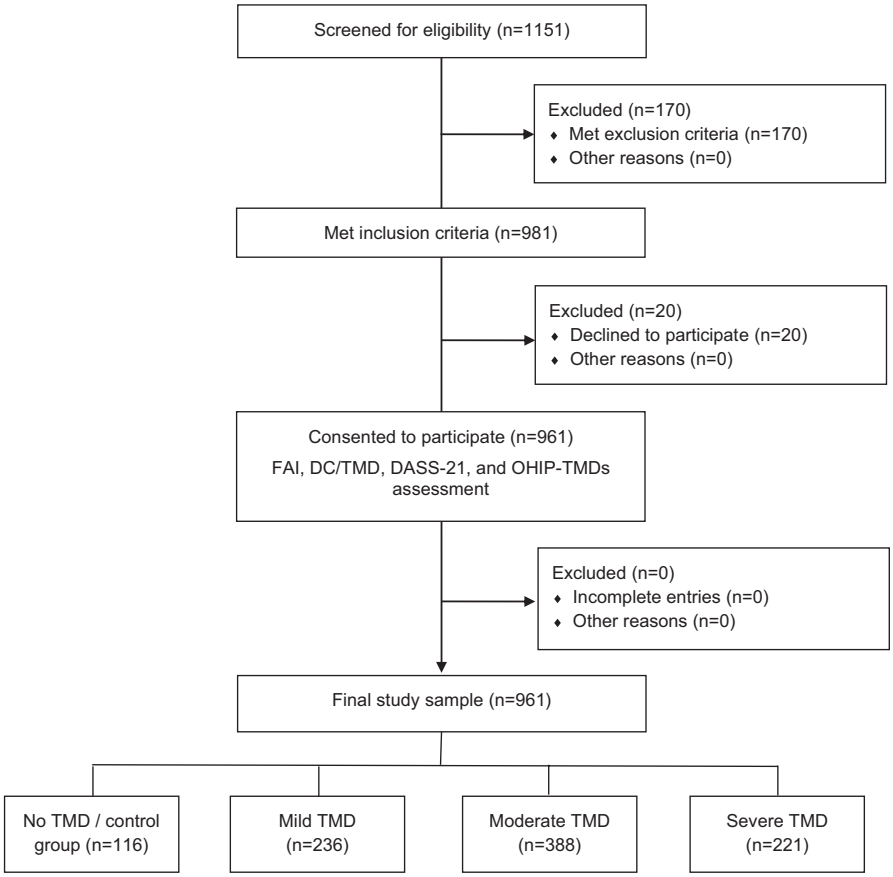

FIGURE 1 Flow diagram specifying the enlistment of participants

psychological scale and has been used in prior TMD research.[24,26,29] It comprises of 21 items that are divided into three subscales evaluating the emotional states of depression, anxiety and stress. The items are appraised using a 4-point response scale that ranges from 0 = did not apply to me at all to 3 = applied to me very much or most of the time. Subscale scores for the three emotional constructs and obtained by totalling the seven specified items with greater scores indicating higher levels of psychological distress. The cut-off points for the range of severity labels (normal to extremely severe) are obtainable from the DASS manual.[31]

The OHIP-TMD consists of 22 items and seven domains, namely functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. The items are assessed with a 5-point response scale varying from 0 = never to 4 = very often. Global and domain OHIP scores are obtained by totalling all 22 and the specified domain items accordingly with greater scores indicating worse or poorer OHRQoL.

2.4 | Statistical analyses

All statistical evaluations were carried out using the IBM SPSS Statistics for Windows software version 24.0 (IBM Corporation, Armonk, New York, USA) with the significance level set at 0.05. The Shapiro-Wilks test was employed to verify the data normality. As data were not normally distributed, non-parametric statistics comprising of chi-square, Kruskal-Wallis and Mann-Whitney U tests were applied. Qualitative data were presented as frequencies (with percentages). Quantitative ones were displayed as both means (with standard deviations) and medians (with interquartile ranges) to facilitate comparisons with prior studies. Associations between FAI, depression, anxiety, stress and global OHIP scores were examined with Spearman's rank-order correlation. Correlation coefficients (r_s) were afterwards categorised as: weak = 0.1–0.3; moderate = 0.4–0.6; and strong = 0.7–0.9.[32]

3 | RESULTS

3.1 | Study population

Out of a total of 1151 patients assessed for eligibility, 170 met the exclusion criteria, and 20 declined participation. The eventual study cohort (n = 961) had a mean age of 32.99 ± 13.14 years and comprised of 71.19% women. Of these, 845 participants had TMDs (mean age 33.17 ± 13.55 years; 81.42% women) while 116 with no TMDs (mean age 31.66 ± 9.50 years; 62.93% women) served as controls. The flow diagram specifying the enlistment of the participants is shown in Figure 1. Table 1 reflects the frequency and characteristics of the TMD and control groups. Based on the FAI, 12.07% of the participants reported no TMD, and 24.56%, 40.37%, 23.00% had mild, moderate and severe TMD respectively. Participants with

severe TMD were significantly older than those with moderate TMD. For all TMD severity groups, the proportion of women was substantially greater than men. The TMD disease durations of participants with moderate/severe TMD were considerably longer than those with mild TMD.

Table 2 presents the frequency distribution of the various TMD symptoms/risk factors and DC/TMD subtypes. The three most common TMD symptoms were TMJ noises (79.19%), opening difficulty (75.75%) and muscle pain (75.34%). All three symptoms were significantly more prevalent in the moderate and severe TMD groups than the mild TMD group. Side movement difficulty (56.60%), headaches (46.93%) and parafunction (44.02%) were less often reported. Some TMD-related symptoms, particularly neck pain (42.24%), and TMD risk factors were also conveyed by the no TMD (control) group but rates were considerably lower than those with TMDs. Among the participants with DC/TMD defined conditions ($n = 845$), 47.46%, 40.36% and 12.19% had IT, CT and PT, respectively. The prevalence of CT in the moderate/severe TMD groups was significantly greater than that for the mild TMD group. Conversely, the mild TMD group had a significantly higher frequency of IT than the moderate/severe TMD groups.

The mean/median DASS-21 and OHIP-TMD scores for the TMD and control groups are displayed in Tables 3 and 4. Significant differences in depression, anxiety, and stress scores were present among the various groups as follows: severe > moderate > mild ≥ no TMD. While mean stress scores were the highest for the no/mild TMD groups, mean anxiety scores were observed to the greatest for the moderate/severe TMD groups. Significant differences in global OHIP scores were as follows: severe >moderate > mild > no TMD. All OHIP domains followed a similar trend. For the mild, moderate and severe TMD groups, mean physical pain and psychological discomfort/disability scores were noted to the highest when contrasted to the other OHIP domains.

The correlations involving the FAI, DASS-21 and OHIP-TMD scores are reflected in Table 5. Correlation coefficients (r_s) between the FAI (or TMD severity) and psychological states were moderately strong ($r_s = .42–.51$) while that between FAI and OHRQoL was strong ($r_s = .72$). Associations between OHRQoL and depression, anxiety, as well as stress were also moderately strong ($r_s = .50–.54$). Strong correlations were observed among the three emotional constructs ($r_s = .73–.78$).

4 | DISCUSSION

4.1 | Overview and TMD symptoms/subtypes

This study compared the psychological states and OHRQoL among participants with differing TMD severity and established the associations between TMD severity, psychological distress and OHRQoL. As significant differences in psychological distress/OHRQoL were noted among the different TMD severity groups and FAI, DASS-21 and OHIP-TMD scores were correlated, the two null hypotheses were duly discarded. Although the accuracy and the psychometric properties of the FAI are recognised,[14–20] it may over-estimate the presence of TMDs due to the reporting of non-TMD-specific symptoms (e.g., headache and neck pain) and risk factors.[33] A short-form version of the FAI (SFAI) comprising the five TMD-specific items was introduced lately but has only been validated for muscle disorders in women.[34] For the fore mentioned reasons, the DC/TMD was used to confirm the presence of TMDs. Participants with more severe TMDs were generally older and this phenomenon may be attributed to longer TMD disease duration as well as the peak incidence of TMD symptoms in middle age.[35] The high proportion of women among the participants with TMDs corroborated earlier studies indicating the higher odds of women developing TMDs.[3] The latter was attributed to genes, hormones, psychosocial, environmental and cultural factors, in addition to gender variances in perception and modulation of pain.[3] The higher frequency of CT (i.e., PT plus IT) in the moderate/severe TMD group was consistent with the anticipated number of TMD symptoms. Intra-articular TMJ disorders were more common in the mild TMD group and were also the most prevalent TMD diagnostic subtype in community samples.[36]

4.2 | TMD severity and psychological states

Up to now, TMD severity studies were conducted largely on non-patient samples.[22–26] Kmeid et al., in a cross-sectional study, determined that higher FAI scores were related to higher depression, anxiety and stress scores in the general population.[25] Their results were supported by the present work. Significantly higher levels of

TABLE 1 Characteristics of the TMD and control (no TMD) groups

	Total	No TMD	Mild TMD	Moderate TMD	Severe TMD	*p*-value
Total *n* (%)	961 (100)	116 (12.07)	236 (24.56)	388 (40.37)	221 (23.00)	
Age Mean ± SD	32.99 ± 13.14	31.66 ± 9.50	33.26 ± 14.27	32.27 ± 13.24	34.65 ± 13.24	.031*
Median (IQR)	29.00 (14.00)	29.00 (8.75)[a,b]	28.50 (17.75)[a,b]	28.00(14.00)[a]	30.00(19.00)[b]	
Gender Male, *n* (%)	200 (20.81)	43 (37.07)	68 (28.81)	65 (16.75)	24 (10.86)	<.001#
Female, *n* (%)	761 (79.19)	73 (62.93)	168 (71.19)	323 (83.25)	197 (89.14)	
TMD duration Mean ± SD	11.49 ± 25.70	0.00 ± 0.00	13.15 ± 29.58	12.72 ± 25.12	13.60 ± 27.53	<.001*
(months) Median (IQR)	2.00 (10.00)	0.00 (0.00)[a]	1.00 (9.13)[b]	2.50 (11.50)[c]	4.50 (11.00)[c]	

Note: Results of Kruskal-Wallis/post hoc Mann-Whitney U test* and chi-square/post hoc Bonferroni test #($p < .05$). Same letters indicate no statistically significant difference, while different letters indicate statistically significant differences between groups (pairwise comparison).

TABLE 2 Frequency of TMD symptom/risk factors and DC/TMD subtypes for the TMD and control (no TMD) groups

Measure	Symptoms/Subtypes	Total *n* (%)	No TMD *n* = 116	Mild TMD *n* = 236	Moderate TMD *n* = 388	Severe TMD *n* = 221	*p*-value
FAI *n* = 961	Opening difficulty	728 (75.75)	0 (0.00)[a]	151 (63.98)[b]	359 (92.53)[c]	218 (98.64)[d]	<.001[#]
	Side movement difficulty	544 (56.60-)	0 (0.00)[a]	72 (30.51)[b]	273 (70.36)[c]	199 (90.05)[d]	<.001[#]
	Muscle pain	724 (75.34)	11 (9.48)[a]	144 (61.02)[b]	350 (90.21)[c]	219 (99.10)[d]	<.001[#]
	Headache	451 (46.93)	15 (1.00)[a]	52 (22.03)a	197 (50.77)[b]	187 (84.62)[c]	<.001[#]
	Neck pain	579 (60.25)	49 (42.24)[a]	87 (36.86)[a]	246 (63.40)[b]	197 (89.14)[c]	<.001[#]
	TMJ pain	602 (62.64)	0 (0.00)[a]	99 (41.95)[b]	291 (75.00)[c]	212 (95.93)[d]	<.001#
	TMJ noises	761 (79.19)	0 (0.00)[a]	196 (83.05)[b]	354 (91.24)[c]	211 (95.48)[c]	<.001[#]
	Parafunction	423 (44.02)	28 (24.14)[a]	67 (28.39)[a]	164 (42.27)[b]	164 (74.21)[c]	<.001[#]
	Malocclusion	644 (67.01)	24 (20.69)[a]	124 (52.54)[b]	287 (73.97)[c]	209 (94.57)[d]	<.001[#]
	Emotional tension	679 (70.66)	39 (33.62)[a]	125 (52.97)[b]	301 (77.58)[c]	214(96.83)[d]	<.001[#]
DC/TMD *n* = 845	Pain-related TMDs	103 (12.19)	--	29 (12.29)[a]	41 (10.57)[a]	33 (14.93)[a]	<.001[#]
	Intra-articular TMDs	401 (47.46)	--	160 (67.80)[a]	187 (48.20)[b]	54 (24.43)[c]	<.001[#]
	Combined TMDs	341 (40.36)	--	47 (19.92)[a]	160 (41.24)[b]	134 (60.63)[c]	<.001[#]

Note: Results of chi-square test/post hoc Bonferroni test[#] ($p < .05$). Same letters indicate no statistically significant difference, while different letters indicate statistically significant differences between groups (pairwise comparison). FAI symptom prevalence='sometimes' or 'yes' response to any item.

psychological distress were reported by the moderate/severe TMD groups and moderately strong correlations between FAI and DASS-21 scores were identified. Mean anxiety scores were the highest for the moderate/severe TMD groups and the anxiety subscale also yielded the strongest correlation to TMD severity (i.e., FAI scores). Based on the DASS scoring manual,[31] the severe TMD and moderate TMD groups had extremely severe and severe anxiety symptoms, respectively. Findings were in agreement with that of Lei et al. who suggested that anxiety was more related to TMD symptoms than depression and stress.[37] Painful TMDs have been linked to poorer adaptive capacity and higher depression, anxiety and stress levels.[38,39] Participants with moderate/severe TMD with their high prevalence of CT, may suffer from both PT and IT leading to increased psychological disturbance and poorer OHRQoL.

4.3 | TMD severity and OHRQoL

Although more TMD signs/symptoms and diagnoses have been associated with greater OHRQoL impact, few studies have examined these relationships using TMD-specific OHRQoL measures.[7,40,41] Natu et al., in their study of Asian community youths, determined that global and domain OHIP-TMD scores varied depending on TMD severity.[26] In this study, significant differences in global and domain OHIP-TMD scores were also observed among the various TMD severity groups. Individuals with greater TMD severity presented significantly worse OHRQoL. The psychological discomfort/disability and physical pain domains were usually the most impaired and findings substantiated the systematic review by Bitiniene et al. that concluded 'psychological and physical ailments' caused by TMD reduced quality of life.[8] The correlation between TMD severity and OHRQoL was strong (r_s = .72) providing further support for the fidelity of the OHIP-TMD. Even so, the length (number of items) of the OHIP-TMD could be reduced using Rasch analysis and other techniques to facilitate its routine application in research and clinical practice.[42] Correlations between OHIP-TMD and DASS-21 scores were moderately strong (r_s = .50–.54) implying that the poorer OHRQoL in TMD patients may be partial to depression, anxiety and stress. The three emotional constructs were strongly related (r_s = .73–.78) and may be explained by their co-existence and link by way of the hypothalamic-pituitary-adrenal (HPA axis).[43]

4.4 | Study limitations

The present study had several constraints. First, the number of samples in the four TMD severity groups was disproportionate. While unequally sized groups can lead to unequal variances and loss of power, it could not be avoided due to the difficulties of recruiting control participants and the inability to foretell the distribution of TMD severity till the FAI scores were computed. However, this drawback was placated by the use of non-parametric statistical techniques. Second, the use of the FAI to categorise TMD severity might

TABLE 3 Mean and median DASS-21 scores for the TMD and control (no TMD) groups

Variables	Total	No TMD	Mild TMD	Moderate TMD	Severe TMD	*p*-value
Depression						
Mean ± SD	6.52 ± 8.73	3.22 ± 4.62	3.31 ± 5.44	5.97 ± 7.81	12.63 ± 11.29	**<.001***
Median (IQR)	4.00 (10.00)	0.00 (6.00)[a]	0.00 (4.00)[a]	4.00 (8.00)[b]	10.00 (14.00)[c]	
Anxiety						
Mean ± SD	8.21 ± 8.01	3.21 ± 3.96	4.92 ± 5.11	8.24 ± 6.89	14.33 ± 9.89	<.001*
Median (IQR)	6.00 (10.00)	2.00 (6.00)[a]	4.00 (7.50)[b]	6.00 (10.00)[c]	12.00 (14.00)[d]	
Stress						
Mean ± SD	4.40 ± 5.62	6.08 ± 7.28	9.50 ± 8.97	17.65 ± 11.16	9.92 ± 9.94	<.001*
Median (IQR)	8.00 (14.00)	2.00 (8.00)[a]	4.00 (8.00)[a]	8.00 (12.00)[b]	16.00 (18.00)[c]	

Note: Results of Kruskal-Wallis/post hoc Mann-Whitney U test* ($p < .05$). Same letters indicate no statistically significant difference, while different letters indicate statistically significant differences between groups (pairwise comparison).

TABLE 4 Mean and median OHIP-TMD scores for the TMD and control (No TMD) groups

Variables	Total	No TMD	Mild TMD	Moderate TMD	Severe TMD	*p*-value
Global OHIP						
Mean ± SD	32.55 ± 21.77	1.95 ± 4.99	23.26 ± 15.49	35.13 ± 16.31	54.01 ± 16.40	<.001*
Median (IQR)	32.00 (34.00)	0.00(1.75)[a]	20.00 (22.75)[b]	34.50 (23.00)[c]	55.00 (25.50)[d]	
Functional limitation						
Mean ± SD	4.00 ± 2.69	0.17 ± 0.58	3.00 ± 2.26	4.60 ± 2.23	6.02 ± 1.88	<.001*
Median (IQR)	4.00 (4.00)	0.00(0.00)[a]	3.00 (3.75)[b]	4.00 (3.00)[c]	6.00 (3.00)[d]	
Physical pain						
Mean ± SD	6.33 ± 4.89	0.50 ± 1.45	4.05 ± 3.50	6.68 ± 3.67	11.22 ± 4.32	<.001*
Median (IQR)	6.00 (8.00)	0.00(0.00)[a]	3.00 (5.00)[b]	7.00 (5.00)[c]	11.00 (6.00)[d]	
Psychological discomfort						
Mean ± SD	7.90 ± 5.06	0.66 ± 1.34	6.39 ± 4.32	8.69 ± 4.09	11.91 ± 3.78	<.001*
Median (IQR)	8.00 (8.00)	0.00 (1.00)[a]	6.00 (7.00)[b]	9.00 (6.00)[c]	12.00 (7.00)[d]	
Physical disability						
Mean ± SD	3.13 ± 2.32	0.18 ± 0.58	2.36 ± 1.89	3.53 ± 2.05	4.77 ± 1.99	<.001*
Median (IQR)	3.00 (4.00)	0.00 (0.00)[a]	2.00 (3.00)[b]	4.00 (3.00)[c]	5.00 (2.00)[d]	
Psychological disability						
Mean ± SD	6.72 ± 5.56	0.23 ± 1.03	4.81 ± 4.30	7.03 ± 4.80	11.62 ± 4.86	<.001*
Median (IQR)	6.00 (10.00)	0.00 (0.00)[a]	4.00 (7.00)[b]	7.00 (7.00)[c]	12.00 (8.00)[d]	
Social disability						
Mean ± SD	1.73 ± 2.08	0.09 ± 0.46	0.93 ± 1.44	1.65 ± 1.82	3.58 ± 2.30	<.001*
Median (IQR)	1.00 (3.00)	0.00 (0.00)[a]	0.00 (2.00)[b]	1.00 (3.00)[c]	4.00 (3.00)[d]	
Handicap						
Mean ± SD	2.75 ± 2.50	0.10 ± 0.43	1.72 ± 1.92	2.95 ± 2.21	4.88 ± 2.27	<.001*
Median (IQR)	2.00 (4.00)	0.00 (0.00)[a]	1.00 (3.00)[b]	3.00 (3.00)[c]	5.00 (4.00)[d]	

Note: Results of Kruskal-Wallis/post hoc Mann-Whitney U test* ($p < .05$). Same letters indicate no statistically significant difference, while different letters indicate statistically significant differences between groups (pairwise comparison).

represent an over-simplification of the 'severity' construct. The FAI only appraised the number and frequency of TMD symptoms/risk factors and other relevant parameters including disease chronicity, symptom intensity and disability produced were not considered. A new TMD severity index based on the symptoms specified in the DC/TMD incorporating the number of symptoms and their frequency, duration, intensities and interference caused is expedient. Third, the dimensional validity of the DASS-21 was recently challenged

TABLE 5 Correlations between FAI, DASS-21, and Global OHIP scores

Variables	FAI	Depression	Anxiety	Stress	Global OHIP
FAI	–	–	–	–	–
Depression	0.42**	–	–	–	–
Anxiety	0.51**	0.73**	–	–	–
Stress	0.49**	0.78**	0.78**	–	–
Global OHIP	0.72**	0.51**	0.50**	0.54**	–

Note: Results of Spearman correlation**($p < .01$).

with studies indicating 3-factor, bi-factor, as well as 1-factor structures.[44] The disparity was rationalised by inter-factor correlations that are expected to vary depending on the population/conditions being examined. Lastly, like all other self-reported health questionnaires, the DASS-21 and OHIP-TMD may be disposed to various outcome partialities arising from non-participation, recall, cognitive, social desirability and other biases.[45] While non-participation bias was mitigated by the very high response rate (97.96%) in this study, the other inherent biases could not be ruled out.

5 | CONCLUSION

This case-control study compared the psychological states and OHRQoL of participants with differing TMD severity and examined the affiliations between TMD severity, psychological distress and OHRQoL. TMJ noises (79.19%), mouth opening difficulty (75.75%) and muscle pain (75.34%) were found to be the most common symptoms. Participants with moderate/severe TMD had significantly higher levels of depression, anxiety and stress and poorer OHRQoL than those with no/mild TMD. Correlations between TMD severity and psychological states/OHRQoL were moderately strong to strong (r_s = .42–.72). Collectively, the results of this study indicate that the FAI may be a useful tool for screening the presence/severity of TMDs and patients with greater TMD severity have higher levels of psychological distress, especially anxiety and worse OHRQoL. The physical pain and psychological discomfort/disability domains appeared to be the most impacted. Considering the latter and the correlation between OHRQoL and psychological states (r_s = .50–.54), patients with moderate/severe TMD should be assessed for comorbid psychological disturbance and managed accordingly. Interventions targeted at promoting psychological well-being may be beneficial for reducing the impact and psychological distress associated with TMDs.

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CONFLICT OF INTEREST

The authors have no financial or personal conflict of interest to declare.

AUTHOR CONTRIBUTIONS

Adrian Ujin Yap (first author) contributed to conceptualisation; data curation; formal analysis; methodology; project administration; validation; visualisation; and writing—original draft and reviewing and editing. Min-Juan Zhang (co-first author) contributed to data curation; formal analysis; methodology; project administration; validation; visualisation; writing—original draft and reviewing and editing. Ye Cao contributed to formal analysis; investigation; methodology; project administration; validation; and review and editing. Jie Lei contributed to formal analysis; investigation; methodology; project administration; and review and editing. Kai-Yuan Fu contributed to conceptualisation; data curation; funding acquisition; investigation; methodology; project administration; resources; supervision; validation; and writing—review and editing. The data used to support the findings of this study are available from the corresponding author upon request.

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