Sleep Disturbance and Psychologic Distress: Prevalence and Risk Indicators for Temporomandibular Disorders in a Chinese Population

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Aims: To investigate the prevalence of sleep disturbance and psychologic distress in a population of Chinese patients with temporomandibular disorders (TMD) and whether sleep disturbance and psychologic distress are risk indicators for TMD. **Methods:** Validated Chinese versions of the Self-Rating Scale of Sleep (SRSS) and Depression, Anxiety and Stress Scales-21 (DASS-21) were used to measure sleep disturbance and psychologic distress of 510 TMD patients with a mean (± SD) age of 31.06 ± 14.40 years. TMD signs/symptoms and sociodemographic data were also collected. The patients were divided into seven diagnostic groups based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). For statistical analysis, the patients were subsequently grouped into those with (n = 128) and without (n = 382) myofascial pain. The data were analyzed using chi-square tests, independent-samples *t* test, as well as stepwise logistic regression at a significance level of $P < .05$. **Results:** The prevalence of moderate to severe sleep disturbance and psychologic distress was significantly higher in the myofascial pain group than in the non–myofascial pain group ($P < .05$). Stepwise logistic regression analysis demonstrated that sleep disturbance and anxiety were possible risk indicators for myofascial pain, with odds ratios of 2.41 and 4.10, respectively ($P < .05$). **Conclusion:** The Chinese population of TMD patients frequently reported a disturbed sleep condition and psychologic distress symptoms. Sleep disturbance and psychologic distress symptoms are possible risk indicators for myofascial pain in this population. *J Oral Facial Pain Headache 2015;29:24–30. doi:10.11607/ofph.1301*

Key words: *myofascial pain, psychologic distress, risk indicator, sleep disturbance, temporomandibular disorders*

Temporomandibular disorders (TMD) is a collective term comprising a number of clinical problems that involve the masticatory musculature, the temporomandibular joint (TMJ), and/or the associated structures. TMD can be divided into three main subgroups—muscle disorders, disc displacements, and other joint conditions—based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD).[1] TMD have many common symptoms; pain in the masticatory muscles and/or the TMJ area is the most common reason for treatment seeking.

Patients with TMD often show elevated measures of psychosocial distress, and multiple psychologic factors have been implicated as potential risk factors for the development of painful TMD.[2–4] However, the relationship between sleep disturbance and TMD has not been widely studied, especially in Asian populations.[3–9] Sleep disturbance has been found to be very frequent in Caucasian patients with painful TMD.[5,7,10–12] More recent studies have shown that sleep disturbance is a predictor or risk indicator of TMD pain and a poor treatment outcome.[6,9,13] It is associated with hypersensitivity of nociceptive pathways in the brain and with hyperalgesia in both orofacial and non-orofacial regions.[7] Sleep disturbance was also found to be associated with pain severity.[5] In rat models, sleep disturbance could be due to pain,[14–16] and analgesic medication that did not significantly alter sleep patterns was found to be effective for reducing nociceptive behaviors and improving sleep.[14]

It is relatively well known that psychologic distress (eg, anxiety, depression) may predispose, precipitate, and perpetuate TMD and is also reported to affect TMD treatment outcome.[3,4,17–20] Comorbidities of sleep disturbance and psychologic distress in TMD pain conditions are not uncommon.[5,6,10,13,21] Sleep disturbance and depression are proposed as predictors of TMD and TMD treatment response.[6,13,19] Methodological problems, however, exist in previous studies and include the lack of uniform diagnostic standards, relatively small sample sizes, no matched control group, and inadequate statistical analysis for controlling multiple variables. Lindroth and coworkers, using descriptive evaluation of sleep quality, found that the myofascial pain patients not only had poorer sleep quality but were also more psychologicly distressed than the joint pain patients.[21] It is not known if the poorer sleep in patients with myofascial pain is due directly to muscle disorders per se or indirectly to psychologic distress such as depression and anxiety. The interactions between these variables thus warrant investigation. Therefore, since sleep disturbance and psychologic distress appear to be comorbid and closely associated with TMD, the objectives of this study were to investigate the prevalence of sleep disturbance and psychologic distress in a population of Chinese patients with TMD and whether sleep disturbance and psychologic distress are risk indicators for TMD.

Materials and Methods

Patient Population

Approval from the Biomedical Institutional Review Board of Peking University was received before starting the study (PKUSSIRB-2012002). A total of 510 patients who visited the Center for TMD & Orofacial Pain, Peking University School & Hospital of Stomatology, from March 2012 to January 2013 were recruited. The patients were between 11 and 79 years of age with a mean (± SD) age of 31.06 ± 14.40 years. The majority of the patients were females (75.9%). Written informed consent was obtained from all study participants. Prior to the initial clinical assessment, all patients were asked to complete a series of neuropsychologic and sociodemographic questionnaires. General medical history, chief complaints, and specific present history including parafunctional habits, orofacial pain symptoms, TMJ noises, and mandibular dysfunction were gathered in detail. TMD and orofacial pain examinations were conducted according to the guidelines of the RDC/TMD.[1] Patient exclusion criteria are listed in Table 1. Patients receiving pain medication such as non6steroidal anti-inflammatory drugs were not excluded, but a washout period of at least 3 days was instituted prior to the clinical examination.[6]

Table 1 Patient Exclusion Criteria

History of major trauma (eg, road traffic accidents)
History of major operation
History of drug abuse
History of psychiatric disorders (eg, manic-depressive psychosis)
Neoplasia (eg, osteoma)
Immune system disease (eg, psoriatic arthritis)
Systemic or metabolic disease (eg, Parkinson disease)
Currently on medication with effects on central nervous system (eg, antidepressants, muscle relaxants)
Non-TMD muscle disease (eg, myospasm)
Non-TMD joint disease (eg, rheumatoid arthritis)

Assessment of Sleep Disturbance and Psychologic Stressors

The neuropsychologic questionnaires comprised the Chinese versions of the Self-Rating Scale of Sleep (SRSS) and the short-form version of the Depression, Anxiety and Stress Scales (DASS-21). Sleep disturbance was evaluated by SRSS, which is a self-reported questionnaire that was tailored for the Chinese population by Chinese psychologists. It is widely used in Chinese population studies, and normative data, test description, as well as reliability (Cronbach's alpha, $r = 0.6418$, $P < .0001$) and validity ($r = 0.5625$, $P < .0001$) have been established.[22] The SRSS included 10 items, each targeting a sleep problem (Table 2). Each statement has five graded answers, respectively scored as 1, 2, 3, 4, or 5. The patient selects a number from 1 to 5 depending on how much the statement applied to him/her over the past month. Total scores can therefore range from 10 to 50. The global scores of SRSS were classified into normal (scores < 23), mild sleep disturbance (scores between 23 and 29), moderate sleep disturbance (scores between 30 and 39), and severe sleep disturbance (scores > 39). Psychologic distress was evaluated by DASS-21, which omits overlapping items between anxiety and stress subscales from the full version but still has adequate reliability.[23,24] Validation of the Chinese version of the short-form DASS-21 has also been reported, with high internal consistency and composite reliability as well as good construct and criterion-related validity.[25,26] Psychologic distress (depression, anxiety, and stress) was also classified into normal, mild, moderate, severe, and extremely severe according to the computed scores from the developer's algorithm.[23,25–27] As sleep disturbance and psychologic distress are noteworthy symptoms in TMD patients, a moderate to severe/extremely severe score was used as a cutoff for positive symptoms based on the extrapolation of earlier findings.[3,5] So in this study,

Table 2 The Self-Rating Scale of Sleep Questionnaire and Targeted Symptoms

Questions	Symptoms targeted
Have you had enough sleep time?	Insufficient sleep time
How would you rate your sleep quality overall?	Poor sleep quality
How often have you dozed off during the day?	Daytime sleepiness
How many hours of actual sleep did you get at night?	Sleep hours
How often have you had trouble sleeping?	Difficulties in getting asleep
How often have you woken up in the middle of the night?	Disrupted sleep
How often have you woken up in the early morning?	Early awakening
How often have yo u had dreaminess or bad dreams?	Dreaminess or nightmares/night terrors
How often have you taken medicine (prescribed or "over the counter") to help you sleep?	Medication
How did you feel after insomnia?	Psychophysiologic response after insomnia

Table 3 Percentage of Patients with Moderate to Severe Neuropsychologic Distress in the TMD Diagnostic Subgroups

	I (n = 36)	II (n = 159)	III (n = 145)	I+II (n = 33)	I+III (n = 44)	II+III (n = 78)	I+II+III (n = 15)	Total (N = 510)
Sleep disturbance	19.4**##	5.0	3.4	21.2**##	11.4#	3.8	6.7	7.1
Depression	47.2**##	11.3	15.9	30.3**	20.5	11.5	26.7	17.6
Anxiety	69.4**##	31.4	22.1	66.7**##	54.5**##	30.8	60.0*##	36.5
Stress	38.9**##	9.4#	17.9*	33.3**#	25.0**	10.3	26.7*	17.5

*P < .05, **P < .01 compared to group II; #P < .05, ##P < .01 compared to group III.
Group I = exclusively myofascial pain; II = exclusively disc displacement; III = exclusively arthralgia or degenerative joint disease; I+II = myofascial pain plus disc displacement; I+III = myofascial pain plus arthralgia or degenerative joint disease; II+III = disc displacement plus arthralgia or degenerative joint disease; I+II+III = myofascial pain plus disc displacement plus arthralgia or degenerative joint disease.

patients were considered positive for sleep disturbance if the score of SRSS was ≥ 30, depression if DASS-21 depression item score was ≥ 14, anxiety if DASS-21 anxiety item score was ≥ 10, and stress if DASS-21 stress item score was ≥ 19.

Classification of TMD patients

All the patients were grouped into seven diagnostic groups according to the RDC/TMD.[1] These were group I (exclusively myofascial pain), II (exclusively disc displacement), III (exclusively arthralgia or degenerative joint disease), I+II (myofascial pain plus disc displacement), I+III (myofascial pain plus arthralgia or degenerative joint disease), II+III (disc displacement plus arthralgia or degenerative joint disease), I+II+III (myofascial pain plus disc displacement plus arthralgia or degenerative joint disease). If patients had bilateral TMD signs, only the major symptomatic side was used for data analysis. For example, a patient complained about joint pain and limited mouth opening on one side, which was diagnosed as disc displacement and arthralgia (II+III), and the patient also manifested joint click, diagnosed as disc displacement (II), on the other side. So the patient was finally grouped into II+III. For the purpose of statistical analysis, patients were further grouped into those with and without myofascial pain. Those with myofascial pain included subgroups I, I+II, I+III, and I+II+III, whereas those without myofascial pain encompass subgroups II, III, and II+III.

Statistical Analyses

Chi-square tests and independent-samples *t* test were used to compare average scores and the prevalence of neuropsychologic distress between the different TMD subgroups. The prevalence of sleep disturbance comorbid with psychologic distress such as depression, anxiety, and stress was calculated and compared between patients with and without myofascial pain. The correlation of sleep disturbance to psychologic distress was conducted using partial correlation analysis with individual psychologic factors regulated during analysis, eg, the association between sleep disturbance and depression was completed while controlling for anxiety and stress. Stepwise logistic regression analysis was used to determine sleep disturbance/psychologic distress as possible risk indicators for TMD. Variables including sex, age, educational level, disease duration, sleep disturbance, depression, anxiety, and stress were independently analyzed with a significance value of P < .05. All data analysis was conducted using SPSS software version 20.0.

Table 4 Comparison of Patients With/Without Myofascial Pain (MFP)

	MFP-group (n = 128)	Non-MFP group (n = 382)	χ^2/*t* test	*P*
Sex distribution (%)				
Female	80.50	74.30	$\chi^2 = 1.964$	.161
Male	19.50	25.70		
Mean age ± SD (y)	33.59 ± 15.30	30.22 ± 13.99	$t = 2.301$	< .05
Mean disease duration ± SD (mo)	18.78 ± 31.56	10.32 ± 22.75	$t = 2.796$	< .01
Sleep disturbance average score				
Mean ± SD	22.11 ± 6.67	18.83 ± 5.17	$t = 5.08$	< .01
Prevalence (%)	15.60	4.20	$\chi^2 = 19.11$	< .01
Depression average score				
Mean ± SD	10.41 ± 10.04	5.55 ± 6.60	$t = 5.11$	< .01
Prevalence (%)	31.30	13.10	$\chi^2 = 21.76$	< .01
Anxiety average score				
Mean ± SD	12.80 ± 8.70	6.93 ± 6.30	$t = 7.05$	< .01
Prevalence (%)	62.50	27.70	$\chi^2 = 49.98$	< .01
Stress average score				
Mean ± SD	14.56 ± 10.70	9.50 ± 8.43	$t = 4.87$	< .01
Prevalence (%)	31.30	12.80	$\chi^2 = 22.59$	< .01

Prevalence (%) = percentage of patients with moderate to severe neuropsychologic distress in each group.

Table 5 Partial Correlation of Sleep Disturbance With Psychologic Distress of Patients With/Without Myofascial Pain (MFP)

		Sleep disturbance	
Control variables		MFP-group *(r)*	Non-MFP group *(r)*
Anxiety and Stress	Depression	0.042	0.061
Depression and stress	Anxiety	0.267*	0.106*
Depression and anxiety	Stress	0.021	0.168**

*$P < .05$, **$P < .01$.

Results

Descriptive Data of TMD Subgroups

A total of 510 TMD patients were included in this study. The sample sizes for the various TMD subgroups were 36, 159, 145, 33, 44, 78, and 15, respectively (Table 3). The prevalence of neuropsychologic problems in the patients with myofascial pain (group I) and other diagnoses in combination with myofascial pain (group I+II, I+III, I+II+III) was much higher when compared to group II (disc displacement; $P < .05$) or group III (arthralgia or joint degenerative disease; $P < .01$) (Table 3).

When the patient cohort was divided into two groups, those with and without myofascial pain, no significant difference in sex distribution was observed between the two groups. The average age and disease duration for the myofascial pain group were significantly larger than the non–myofascial pain group ($P < .05$) (Table 4). The results of independent-samples *t* test showed that the patients with myofascial pain reported significantly higher scores of neuropsychologic distress than those without myofascial pain ($P < .01$). The prevalence of moderate to severe neuropsychologic distress in the myofascial pain group was also significantly higher than that in the non–myofascial pain group ($P < .01$) (Table 4).

Correlation of Sleep Disturbance with Psychologic Distress

Correlation of sleep disturbance scores with those of depression, anxiety, and stress respectively showed that sleep disturbance was weakly correlated with anxiety, in both the patients with and without myofascial pain ($P < .05$). Sleep disturbance was also weakly associated with stress in the patients without myofascial pain ($P < .01$) (Table 5).

Comorbidity of Sleep Disturbance with Psychologic Distress

The prevalence of comorbidity of sleep disturbance with psychologic distress in the patients with myofascial pain was significantly higher than that in the patients without myofascial pain ($P < .01$), with the exception of the prevalence of sleep disturbance comorbid with depression and stress (Table 6).

Assessment of Possible Risk Indicators

Stepwise logistic regression analysis demonstrated that sleep disturbance and anxiety were possible risk indicators for myofascial pain, with an odds ratio of 2.41 and 4.10, respectively. *P* values were significant even after controlling for other variables ($P < .05$, $P < .01$) (Table 7).

Table 6 Prevalence of Sleep Disturbance Comorbid With Psychological Distress (Moderate to Severe/Extremely Severe) Between the Patients With and Without Myofascial Pain (MFP)

Comorbidity	MFP group (n = 128)	Non-MFP group (n = 382)	*P* (chi-square test)
S & De	6.3%	1.3%	.002
S & An	13.3%	2.1%	< .001
S & St	7.0%	1.8%	.003
S & De & An	5.5%	0.5%	< .001
S & De & St	3.9%	1.3%	.067
S & An & St	7.0%	1.0%	< .001
S & De & An & St	3.9%	0.5%	.004

S = sleep disturbance; De = depression; An = anxiety; St = stress.

Table 7 Variables and Risk Indicators of Myofascial Pain (MFP)

	MFP group (n = 128)	Non-MFP group (n = 382)	OR (95% CI)
Sex (%)			
Male	19.50	25.70	1.74 (1.01–3.01)*
Female	80.50	74.30	
Age (y)	33.59 ± 15.30	30.22 ± 13.99	1.03 (1.01–1.04)**
Education (%)			
Postgraduate	10.90	10.50	1.24 (0.19–8.08)
Graduate	49.20	55.20	0.75 (0.13–4.41)
Senior high school	23.40	19.40	0.86 (0.14–5.24)
Junior high school	14.80	13.10	1.27 (0.20–8.19)
Elementary school	1.60	1.80	1.00
Disease duration (mo)	18.78 ± 31.56	10.32 ± 22.75	1.01 (1.002–1.02)*
Sleep disturbance (%)	15.60	4.20	2.41 (1.14–5.06)*
Depression (%)	31.30	13.10	1.64 (0.95–2.83)
Anxiety (%)	62.50	27.70	4.10 (2.52–6.68)**
Stress (%)	31.30	12.80	0.99 (0.53–1.84)

OR = odds ratio; CI = confidence interval; *$P < .05$, **$P < .01$.

Discussion

In the present study, Chinese myofascial pain patients were found to have significantly more frequent symptoms of sleep disturbance, depression, anxiety, and stress than other subtypes of TMD such as disc displacement, arthralgia, and joint degenerative diseases. The patient cohort was subsequently regrouped into two groups, one with a diagnosis of myofascial pain (128 patients) and the other with a non–myofascial pain diagnosis (382 patients). The myofascial pain group had a higher probability of psychologic distress and poor sleep quality, and the average age and disease duration were significantly larger than those of non–myofascial pain group, suggesting older age and predilection of chronicity in the patients with myofascial pain. Comorbidity of sleep disturbance with psychologic distress was more pronounced in the patients with myofascial pain, except for the combination of sleep disturbance comorbid with depression and stress. However, the *P* value was .067, close to statistical significance, and may be significant if the sample size was increased. Stepwise logistic regression analysis clearly indicated that sleep disturbance and anxiety were comorbid conditions acting as possible risk indicators for myofascial pain.

The etiology of TMD is multifactorial in nature, with biologic, behavioral, environmental, social, emotional, and cognitive factors acting alone or in combination. Studies have demonstrated that TMD patients have higher levels of psychologic and affective distress, and multiple psychologic factors have been implicated as potential risk factors for the development of painful TMD.[2–4] Comorbidities of sleep disturbance and psychologic distress in pain conditions are not uncommon.[5,6,10,13,21,28–30] However, few studies have investigated the role of sleep disturbance in TMD patients, especially in Asian populations.

Sleep is an important factor in restitution and is essential for the maintenance of cognitive performance, normal physiologic function, as well as hormonal fluctuation,[16] and disturbed sleep (eg, insomnia, sleep insufficiency, or disruption) is ubiquitous.[31,32] Besides self-reported sleep bruxism, insomnia (mainly primary insomnia) and sleep apnea were found to be the most frequent sleep disorders in TMD patients.[7] Sleep disturbance was reported to be a risk indicator for TMD

pain in a study controlling for multiple confounders including psychologic distress by logistic regression, based on a small sample size of 72 patients and 30 pain-free control subjects.[6] Quartana et al found that monthly variations of insomnia were positively associated with next-month variations in average daily TMD pain, but not vice versa.[9] Their study, however, solely focused on insomnia symptoms and cannot be generalized to other sleep disturbance. In addition, measures of psychologic distress, such as depression, which might vary with changes of pain intensity/insomnia symptoms, were not investigated. In one prospective study, sleep disturbance was found to be a predictor of a poor treatment outcome in TMD pain patients.[13] In another study, sleep disorders detected by polysomnography were associated with reduced mechanical and thermal pain thresholds at both orofacial and non-orofacial sites, indicating a link between sleep disorders and central pain sensitivity.[7] Poor sleep quality was predicted by higher pain severity, greater psychologic distress, and less perceived life control in 137 TMD patients by a stepwise multiple regression analysis. Findings suggest that pain and psychologic distress may be possible risk factors for sleep disturbance.[5] In a study comparing masticatory muscle pain (435 patients) and intracapsular pain (139 patients), no significant difference in pain severity and duration was found between the two groups of patients. Sleep quality was, however, significantly worse in the masticatory muscle pain patients.[21] The present work corroborated these findings and also showed that sleep disturbance was not only comorbid with psychologic distress but also a possible risk indicator for myofascial pain.

The full version of DASS (DASS-42), consisting of 42 items, was developed in 1995 to assess the crucial symptoms of depression, anxiety, and stress.[27] The questionnaire excludes somatic items and other markers of general distress from the measurement of depression but can efficiently differentiate anxiety from depression with sufficient validity and reliability. Normative population data are also available.[27,33–36] Subsequent research provided support for the validity and reliability of the short-form version of DASS (DASS-21) as a routine clinical tool. In comparison to DASS-42, DASS-21 is twice as short and therefore more acceptable for participants with limited concentration.[23,24]

There are some limitations of the present study. First, pain intensity, which might be a predisposing factor contributing to the neuropsychologic distress differences, was not included in the analysis. However, some studies have found no significant differences in pain intensity, duration, and pain measures, or any other measured variable for pain stimulation, in different subgroups of TMD and controls.[21,37] Secondly, as in many other studies, the sleep assessment measures employed in the present study are subjective, and subjective ratings of sleep quality are not as reliable as objective measures (eg, polysomnography). Nonetheless, patients' estimates of sleep parameters do shift in the same direction as objective measures,[38,39] and subjective scores of sleep quality parallel changes detected with polysomnography recordings.[40,41] Subjective assessment by questionnaires was selected over polysomnography due to convenience and feasibility, especially since a relatively large number of patients was involved. Thirdly, despite the relatively large sample size in the present study, diagnostic standardization according to the RDC/TMD, validated questionnaires assessing neuropsychologic distress, and controlled statistical analysis, case-control and cross-sectional studies remain vulnerable to biases. The latter can lead to an indefinite conclusion of the causality between neuropsychologic distress and TMD, as the study design was not longitudinal in nature. That is why neuropsychologic distress was considered as a possible risk indicator rather than a risk factor. A longitudinal cohort study is warranted to further confirm the findings of the present study.

Conclusions

Chinese TMD patients with myofascial pain have a high prevalence of sleep disturbance and psychologic distress symptoms. Sleep disturbance and psychologic distress symptoms such as anxiety are possible risk indicators for myofascial pain.

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