Comparison of Sleep Quality and Clinical and Psychologic Characteristics in Patients with Temporomandibular Disorders

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Aims: *To explore the relationships between sleep quality, perceived pain, and psychologic distress among patients with temporomandibular disorders (TMD).* ***Methods:*** *A total of 137 consecutive patients who sought care at the University of Kentucky Orofacial Pain Center for the management of TMD participated in this study and completed a battery of standardized, self-report questionnaires at their first clinic visit. The Pittsburgh Sleep Quality Index (PSQI) and the Multidimensional Pain Inventory (MPI) were used to measure patients' sleep quality and multiple dimensions of pain and suffering, respectively. The Revised Symptom Checklist-90 (SCL-90R) was used to evaluate psychologic symptoms. A median cutoff (PSQI total score: 10) divided the patients into 2 groups, ie, 67 poor sleepers and 70 good sleepers.* ***Results:*** *There were no statistically significant differences in gender and age distributions between the 2 groups. Poor sleepers reported significantly higher scores than good sleepers on each of the 14 scales of the SCL-90R ($P < .003$) and on 7 of the 13 scales of the MPI ($P < .05$). Stepwise multiple regression analyses demonstrated that poorer sleep quality was predicted by higher pain severity ($P < .001$), greater psychologic distress ($P < .05$), and less perceived life control ($P < .05$).* ***Conclusion:*** *This study supports the frequent comorbidity of reported sleep disturbance, perceived pain severity, and psychologic distress in patients with TMD.*

J OROFAC PAIN 2002;16:221–228.

Key words: temporomandibular disorders, sleep quality, psychological tests

Poor sleep quality is a very common clinical characteristic reported by chronic pain patients.[1–6] Patients with temporomandibular disorders (TMD), especially those with a chronic pain condition, also complain frequently of sleep disturbances.[7–10] Consequently, the evaluation and improvement of sleep quality may be an important treatment consideration for many TMD patients. There are few well-designed studies, however, that have explored the relationship between sleep quality and TMD-associated symptoms.[9,10]

Although pain is probably the most commonly postulated cause of sleep disturbances occurring in pain patients, psychologic distress, such as anxiety or depression, has also been suggested to explain sleep disturbances in chronic pain patients.[3,10,11] For some time, it has been reported that TMD patients are psychologically more distressed than healthy controls.[12–15] More recently, group comparison studies also demonstrated that TMD patients had higher levels of psychologic distress, including anxiety and depression, than matched controls.[7,16,17] This high prevalence of distress

suggests that not only the intensity of perceived pain but also psychologic distress may be closely associated with sleep quality, although whether it is the pain or the psychologic distress that induces poor sleep is difficult to determine. Unfortunately, the relationship between sleep quality, pain intensity, and psychologic symptoms in chronic TMD patients is currently not well understood. Therefore, the objectives of this study were to explore the relationships between sleep quality, perceived pain, and psychologic distress among patients with TMD.

Materials and Methods

Subjects

A total of 137 consecutive TMD patients (13 men and 124 women, ages 18 to 70 years; mean age 36.25 ± 11.81 years) who sought care at the Orofacial Pain Center at the University of Kentucky for the management of TMD participated in this study. TMD includes myofascial pain, capsulitis, synovitis, internal derangement, and osteoarthritis/osteoarthrosis according to the classification of TMD of the American Academy of Craniomandibular Disorders[18] and the Research Diagnostic Criteria.[19] The TMD patients were classified, on the basis of results obtained from clinical and radiographic examinations, as myofascial pain (68 patients/49.6%), internal derangement (16 patients/11.7%), capsulitis/synovitis (13 patients/9.5%), osteoarthritis/osteoarthrosis (14 patients/10.2%), and others (26 patients/19.0%). The "others" included a broader variety of TMD-related diagnoses such as neuropathic pain, burning mouth syndrome, etc. The average pain rating that patients reported was 6.9 on a 10-point scale with a range of 0 to 9, and average pain duration was 50.2 months. Patients who were diagnosed with fibromyalgia, chronic fatigue syndrome, or rheumatoid arthritis were excluded from this study. Within the clinical sample, 26% of the patients had a primary diagnosis of cervical myofascial pain, 13% of the patients had a secondary diagnosis of cervical myofascial pain, and 12% of the patients had a tertiary diagnosis of cervical myofascial pain. Additionally, 2% of the patients received a tertiary diagnosis of cervical spine disorder. Patients who had a history of psychiatric disorders or who were currently receiving treatment for a sleep disturbance were also excluded. Some subjects took medication that could have influenced sleep quality (and structure): 49% of the patients reported no use of sleep medication, 9% of the patients reported sleep medication use less than once per week, 12% reported usage 1 to 2 times per week, and 31% reported sleep medication use 3 or more times per week.

Measurement of Patients' Clinical Characteristics

At the first clinic visit prior to clinical examination, patients completed 3 questionnaires together with a routine pain history questionnaire. The Pittsburgh Sleep Quality Index (PSQI) was used to measure patients' sleep quality.[20] The PSQI is a 19-item self-report questionnaire that assesses sleep quality and disturbances over a 1-month time period and yields a global score for sleep quality that has acceptable internal consistency (Cronbach's alpha = .83).[20] The authors of the PSQI showed that a global PSQI score greater than 5 yielded a diagnostic sensitivity of 85.5% and specificity of 86.5% in distinguishing good and poor sleepers. The odds ratio for these data was 37.9, ie, the odds of a sleep disorder are 37.9 times greater for those who have a global PSQI score greater than 5 than for those who have a PSQI score < 5.

The Multidimensional Pain Inventory (MPI) was used to evaluate a number of pain-related constructs. The MPI is a 61-item self-report inventory that yields scores on 13 scales (pain severity, interference, life control, affective distress, support, punishing responses, soliciting responses, distracting responses, household chores, outdoor work, activities away from home, social activities, general activity level). The MPI was standardized on a large sample of chronic pain patients and yields T-scores (mean = 50, SD = 10) for each subscale.[21] Psychometric properties of the MPI are well established and reported elsewhere.[21]

The Revised Symptom Checklist-90 (SCL-90R), a 90-item self-report inventory, was used to evaluate psychologic symptoms.[22,23] Respondents rated each item on a 5-point scale (from "not at all"[0] to "extremely"[4]) for how much each problem had distressed or bothered them during the past 7 days. The SCL-90R yields 9 subscale scores measuring psychologic symptomatology (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) along with 3 global indices of distress (global severity index, positive symptom distress index, and positive symptom total). The SCL-90R has demonstrated reliability and validity in a large number of studies summarized by Derogatis.[24]

Statistical Analysis

The chi-square test and Student *t* test were used to compare sociodemographic and descriptive characteristics of good sleepers and poor sleepers (determined on the basis of PSQI scores). Student *t* tests were also used to assess group differences on the T-scores of SCL-90R and MPI. Because of the large number of statistical tests, the Bonferroni correction was applied to protect against Type I error. The significance level was set at $\alpha = .0071$ (.05/7) for analysis of the frequency distribution of answers for questions regarding sleep quality included in the routine pain history questionnaire. Alphas of .0042 (.05/12) and .0038 (.05/13) were chosen as the levels of significance for analyses of comparison of SCL-90R and MPI T-scores, respectively.

To explore predictors of sleep disturbance, univariate correlations of total sleep quality (global PSQI) with sociodemographic, pain, and psychologic characteristics were conducted. Subsequently, a multiple-regression analysis was performed to identify the strongest independent predictors of total sleep quality. Beta refers to beta weight, and the standardized value is interpreted as relative weight, indicating how much each variable contributes to the value of Y in the multiple regression model (in this article, sleep quality). Levels of significance were based on 2-tailed tests where $P < .05$ was considered statistically significant. All data analyses were conducted with the SPSS analysis program.

Results

Grouping of Subjects by Sleep Quality

The mean value ± SD of total samples for PSQI was 9.89 ± 4.47. The distribution of global PSQI score for TMD patients is presented in Table 1. Using the median cutoff (global PSQI score = 10), patients were divided into 2 groups: 67 poor sleepers (3 men and 64 women, ages 18 to 70 years; mean 35.96 ± 11.06 years) and 70 good sleepers (10 men and 60 women, ages 18 to 67 years; mean 36.53 ± 12.56 years). Sociodemographic and descriptive data were compared between the 2 groups. As shown in Table 2, there were no statistically significant differences between good and poor sleepers for gender, age, primary diagnosis of TMD, pain duration, and self-reported pain severity. However, poor sleepers reported unemployment and disability more often than good sleepers did.

The concurrent validity of dividing patients into the 2 groups on the basis of the global PSQI score was ascertained from answers for the 7 dichotomous sleep items that are included in the routine pain history questionnaire. Frequencies of answers to each item were compared (chi-square test) between good and poor sleepers. Of 7 sleep items, 6 showed statistically significant differences in frequencies between the 2 groups (Table 3), suggesting that the global PSQI score is a valid indicator of sleep quality.

Table 1 Distribution of Global PSQI Score for TMD Patients

Global PSQI score	No. of patients
2	3
3	5
4	13
5	10
6	12
7	14
8	8
9	10
10	9
11	9
12	9
13	5
14	6
15	6
16	8
17	7
18	5
19	2

Comparison of Psychologic and Pain Data Between Groups

Poor sleepers reported significantly higher scores than good sleepers on all 9 subscales and the 3 global scales of the SCL-90R (Table 4), suggesting that poor sleepers experienced significantly more severe psychologic symptoms than good sleepers. On 7 of the 13 scales of the MPI, poor sleepers reported greater dysfunction than good sleepers (Table 5). There were significant differences between good and poor sleepers on ratings of pain severity, interference, life control, affective distress, and support. Additionally, all 3 individual scales designed to assess patients' social environment related to pain (punishing responses, soliciting responses, and distracting responses) were significantly different. In contrast, there were no significant differences between good and poor sleepers on the 5 scales designed to measure patients' daily activities (household chores, outdoor work, activities away from home, social activities, and general activity level).

To identify predictors of sleep quality, stepwise multiple regression analyses were conducted with

Table 2 Comparison of Sociodemographic Characteristics Between Good and Poor Sleepers

Sociodemographic data	Good sleepers (n = 70)	Poor sleepers (n = 67)	*P*
Age at first visit (y)*	36.53 ± 12.56	35.96 ± 11.06	.78
Gender			
Male	10 (14.3)	3 (4.5)	.05
Female	60 (85.7)	64 (95.5)	
Marital status			
Married	45 (64.3)	40 (59.7)	.50
Single	23 (32.9)	26 (38.8)	
Missing	2 (2.9)	1 (1.5)	
Employment			
Employed	51 (72.9)	33 (49.3)	.003
Unemployed	17 (24.3)	33 (49.3)	
Missing	2 (2.9)	1 (1.5)	
Disability receiving/applying			
Yes	4 (5.7)	15 (23.4)	.004
No	65 (92.2)	49 (73.1)	
Missing	1 (1.4)	3 (4.5)	
Lawyer consult			
Yes	5 (7.1)	8 (11.9)	.64
No	58 (82.9)	53 (79.1)	
Unsure	1 (1.4)	1 (1.5)	
Missing	6 (8.6)	5 (7.5)	
Smoking			
Yes	17 (24.3)	24 (35.8)	.12
No	52 (74.3)	41 (61.2)	
Missing	1 (1.4)	2 (3.0)	
Primary diagnosis of TMD			
Myofascial pain	29 (41.4)	39 (58.2)	.23
Internal derangement	10 (14.3)	6 (9.0)	
Capsulitis/synovitis	6 (8.6)	7 (10.4)	
Osteoarthritis	10 (14.3)	4 (6.0)	
Other	15 (21.4)	11 (16.4)	
Pain duration (mo.)*	50.08 ± 72.84	50.29 ± 60.24	.99
Pain severity (0 to 10)*	6.35 ± 2.67	7.39 ± 2.17	.016

Percentages shown in parentheses: *Data are presented as mean ± SD.

the total sleep quality index (global PSQI) as the criterion variable. Potential predictor variables were entered in 3 separate steps: sociodemographic, pain, and psychologic characteristics. Variables entered into the model included age, marital status, smoking, pain severity (MPI pain severity), perceived life control (MPI life control), and global psychologic distress (SCL-90R Global Severity Index). Non-significant predictors ($P > .05$) were trimmed from the model. Results showed that the overall model was statistically significant ($F[3,129] = 19.22$, $P < .001$) and explained 31% of variance in total sleep quality scores (Table 6). Three variables were retained in the model. Poorer sleep quality was predicted by higher pain severity (ß = 0.29, $P < .001$), greater psychologic distress (ß = 0.24, $P < .05$), and less perceived life control (ß = –0.18, $P < .05$).

Discussion

This study has clearly demonstrated a positive relationship between sleep disturbance and perceived pain severity for TMD patients that is consistent with a substantial body of clinical data[25]

Table 3 Frequency Distribution (n and %) of Answers of Good and Poor Sleepers for Questions Regarding Sleep Quality Included in the Routine Pain History Questionnaire.

Sleep items	Good sleepers (n = 70)	Poor sleepers (n = 67)	*P*
Sleep well			
Yes	56 (80.0)	15 (22.4)	< .0001
No	13 (18.6)	50 (74.6)	
Missing	1 (1.4)	2 (3.0)	
Pain interferences with sleep			
Yes	20 (28.6)	47 (70.1)	< .0001
No	49 (70.0)	18 (26.9)	
Missing	1 (1.4)	2 (3.0)	
Awaken frequently during the night			
Yes	14 (20.0)	49 (73.1)	< .0001
No	55 (78.6)	16 (23.9)	
Missing	1 (1.4)	2 (3.0)	
Restless sleeper			
Yes	17 (24.3)	34 (50.7)	.001
No	52 (74.3)	31 (46.3)	
Missing	1 (1.4)	2 (3.0)	
Vivid dreams or nightmares			
Yes	16 (22.9)	23 (34.3)	.12
No	53 (76.0)	42 (62.7)	
Missing	1 (1.4)	2 (3.0)	
Go to bed more tired than daily activities justify			
Yes	18 (25.7)	33 (49.2)	.003
No	51 (72.9)	32 (47.8)	
Missing	1 (1.4)	2 (3.0)	
Feel rested in the morning			
Yes	44 (62.9)	13 (19.4)	< .0001
No	25 (35.7)	52 (77.6)	
Missing	1 (1.4)	2 (3.0)	

Table 4 Comparison of SCL-90R T-Scores (Mean and SD) Between Good and Poor Sleepers with TMD

SCL-90R subscale	Good sleepers	Poor sleepers	T	*P*
Somatization	55.9 (9.1)	64.9 (9.4)	5.70	< .001
Obsessive-compulsive	53.2 (11.2)	59.8 (13.3)	3.14	.002
Interpersonal sensitivity	50.1 (8.7)	57.6 (13.0)	3.98	< .001
Depression	51.9 (9.2)	59.0 (10.9)	4.12	< .001
Anxiety	49.8 (10.0)	58.9 (12.5)	4.75	< .001
Hostility	50.4 (8.6)	57.4 (11.5)	4.08	< .001
Phobic anxiety	47.2 (5.8)	54.6 (11.7)	4.72	< .001
Paranoid ideation	48.1 (8.5)	53.3 (11.3)	3.05	.003
Psychoticism	51.3 (9.1)	57.1 (9.9)	3.58	< .001
Global Severity Index	52.2 (9.6)	61.8 (10.5)	5.59	< .001
Positive Symptom Distress Index	54.8 (8.6)	63.2 (9.2)	5.55	< .001
Positive Symptom Total	50.5 (9.8)	59.0 (10.2)	5.00	< .001

The level of significance = .0042.

Table 5 Comparison of MPI T-Scores (Mean and SD) Between Good and Poor Sleepers with TMD

MPI scale	Good sleepers	Poor sleepers	T	*P*
Part I				
Pain severity	37.6 (15.0)	47.5 (10.8)	4.45	< .001
Interference	23.5 (13.4)	38.5 (14.9)	6.24	< .001
Life control	54.1 (6.0)	49.6 (9.0)	3.48	.001
Affective distress	41.6 (9.4)	49.1 (9.6)	4.63	< .001
Support	43.9 (12.2)	46.4 (9.0)	4.63	.001
Part II				
Punishing responses	43.7 (6.2)	46.7 (8.8)	2.06	.042
Soliciting responses	46.0 (10.7)	52.0 (10.7)	2.93	.004
Distracting responses	44.6 (9.4)	49.9 (9.9)	2.85	.005
Part III				
Household chores	55.4 (9.6)	55.8 (8.8)	0.25	.806
Outdoor work	55.3 (11.6)	55.2 (12.0)	0.95	.924
Activities away from home	53.8 (10.8)	50.7 (9.8)	1.74	.084
Social activities	54.3 (10.5)	51.5 (9.6)	1.60	.111
General activity level	56.4 (11.0)	54.7 (9.4)	0.96	.339

The level of significance = .0038.

Table 6 Stepwise Multiple Regression Results Predicting Total Sleep Quality from Sociodemographic, Pain, and Psychologic Characteristics

Final model variables*	$\beta^{\dagger}$	R^2	ΔR^2	ΔF	df	*P* for ΔF
MPI pain severity	.29	.20	.20	32.73	1,131	.000
SCL-90R Global Severity Index	.24	.29	.09	15.90	1,130	.000
MPI life control	–.18	.31	.02	4.08	1,129	.046

Final model: ($F(3,129) = 19.22$, $P < .001$, $R^2 = .31$).

*Variables not entering the final model included age, marital status, and smoking.

†Betas (β) are taken from the final solution of the stepwise multiple regression model.

and the results of another study.[26] The results also revealed a positive relationship between sleep disturbance and psychologic symptomatology in the TMD patients in the present sample. Although persistent pain, sleep disturbance, and psychologic distress are frequently observed in various chronic pain conditions,[5,8] it is difficult to determine which of these began first. Our regression analyses indicated that perceived pain severity and psychologic distress independently predict sleep disturbance. In other words, both perceived pain and psychologic distress could be important risk factors of sleep disturbance in TMD patients. Morin et al[27] also reported that chronic pain preceded or coincided with a complaint of poor sleep in approximately 90% of patients in an outpatient pain clinic. If pain is the causal factor of sleep disturbance in chronic pain patients, sleep disturbance is generally considered to improve with pain management. However, the results of a randomized, open, long-term drug comparison study suggested that opioid therapy for chronic low back pain has a positive effect on pain but little effect on sleep.[28] The results of another placebo-controlled trial also showed that tramadol, a centrally acting analgesic, was effective in treating the pain of diabetic neuropathy, but had no statistically significant treatment effects on sleep.[29] Also, sleep complaints are not always associated with depression and anxiety in chronic pain patients.[30] These results suggest that the cause-and-effect relationship among sleep/pain/psychologic prob-

lems in chronic pain patients is still uncertain and that each problem might occur independently in some clinical cases.

From a treatment standpoint, successful management of sleep problems in chronic TMD patients is indicated because significant quality-of-life impairments are associated with sleep disturbance.[31] Sleep disturbance in TMD patients should not be ignored as a significant symptom. The uncertainty of the cause-and-effect relationship among pain, sleep, and psychologic distress in chronic pain patients, however, means that very specific treatment for sleep disturbance is not necessarily effective in reducing pain or psychologic problems. Treatment programs aimed at altering lifestyle factors, for instance, may represent alternatives for dealing with sleep/pain/psychologic problems simultaneously in chronic TMD patients.[32] Since treatment of sleep disturbance may offer the added benefit of diminishing illness intrusiveness and may, thereby, enhance quality of life in chronic physical illness,[33] therapists should be alert to the importance of improving the sleep quality of TMD patients.

One of the interesting features of the present data set is that none of the scales that assessed patients' daily activities were related to sleep quality. These findings indicate that daily activities are not disrupted by sleep disturbance in TMD patients and suggest that daily routines or habits may be resistant to change, even in the face of sleep disruptions, for chronic pain patients. It might also be possible that current measurement strategies for daily activities are not sensitive enough to detect the changes in daily routines that may come as a result of changes in sleep patterns. Whatever the case, daily activities do not appear to be linked to the overall quality of sleep in chronic TMD patients. It is difficult, however, to determine whether this result is unique for TMD patients because of scarce literature available. An epidemiologic study among elderly Swedish also reported that mobility problems had the most negative impact on daily activities, whereas sleeping problems had virtually no influence on daily activities.[34] These results may suggest that no influence of poor sleep quality on daily activities holds true even in other chronic pain conditions.

A potential limitation of the present study was the use of the median split technique to differentiate individuals who reported either good or poor sleep. It could be argued that such a strategy represents an arbitrary and somewhat artificial categorization strategy. Previous research conducted by the authors of the PSQI[20] suggests that scores greater than or equal to 5 indicated a significant likelihood of sleep disturbance among clinical samples. In our sample, fewer than 19% of the participants had global scores at or below the proposed clinical cutoff. This supports the contention that sleep disturbances are quite prevalent among chronic TMD patients, since over 80% of our sample had scores that exceeded the proposed cutoff point. It should be noted that although the majority of TMD patients showed high PSQI scores (> 5), nearly half of them did not report sleep disturbance in the routine clinical history questionnaire. This discrepancy suggests that the cutoff point of the PSQI (> 5) may be too low to identify TMD patients with sleep problems that should be managed. This is one of the reasons why we used 10 instead of 5 as a cutoff PSQI score categorizing TMD patients into poor and good sleepers.

A caution must be made about the generalizability of the results obtained from this study, since the sample was composed largely of women (90.5%). Although Pilowsky and colleagues[3] did not find gender differences in chronic pain patients classified as good, fair, or poor sleepers, women reported shorter duration and poorer quality of sleep in a study of healthy elderly community residents.[35] In addition, it should be pointed out that the study sample included many patients over 40 years old and that sleep disturbance is a common complaint in elderly people regardless of physical conditions. Sleep disturbance in elderly patients might have occurred independent of pain or psychologic problems. Sleep quality was not estimated by objective measures in the present study, but with brief standardized "self-reports," and no comparison was made between controls/asymptomatic subjects. Interpretation of the results of this study should take these limitations into consideration.

Conclusion

This study confirms the frequent comorbidity of reported sleep disturbance, subjective pain intensity, and psychologic distress in patients with chronic TMD. Future study should be focused on the understanding of the pathophysiologic relationships of these comorbid symptoms. For the present time, these results suggest that sleep quality may be an important treatment target to address in concert with interventions focused on managing the chronic pain itself. Failure to consider the multiple factors associated with sleep dysfunctions, however, may limit the likely success of such efforts.

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