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Sleep Quality of Patients with Temporomandibular Disorders: Relationship to Clinical and Psychological Characteristics

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Purpose: The association between pain and sleep is described as a vicious cycle and psychological distress is well known as comorbid condition in the patients with pain and sleep problems. The aim of the study was to evaluate the prevalence of self-reported sleep disturbance and its relationship to clinical and psychological profiles in temporomandibular disorder (TMD) patients.

Methods: The sample consisted of 123 TMD patients (90 women and 33 men), with a mean age of 39.9±15.4 years. Self-report measures of sleep quality, pain and psychological profile were conducted via the Pittsburgh Sleep Quality Index (PSQI), the Brief Pain Inventory and the Symptom Checklist-90-Revision at the initial visit. The primary diagnosis of TMD were categorized as TMD with internal derangement without pain, TMD with joint pain, TMD with muscle pain and TMD with joint-muscle combined pain. The chi-square test, independent t-test, one-way ANOVA and multiple linear regression analysis were used for statistics.

Results: The patients was grouped as good sleepers (n=32, scores of 5 and lower) and poor sleepers (n=91, scores of 6 and higher) according to the recommended cutoff point of the global PSQI score (>5). TMD patients with pain showed poor sleep quality than TMD patients with internal derangement without pain. Poor sleepers had high pain interference and elevated psychological distress. Among them, pain interference and depression were significant predictors to sleep quality.

Conclusions: The results suggest that sleep disturbance is a prevalent complaint in TMD patients, and sleep problems in TMD patients are associated with pain and psychological distress.

Key Words: Psychological; Sleep; Temporomandibular joint disorders

INTRODUCTION

The reciprocal interaction between pain and sleep, can be described as a vicious cycle, has been recently focused of scientific and clinical interests. Previous studies revealed that experimental sleep deprivation induced alterations in pain-related factors such as inflammatory cytokines in the temporomandibular joint (TMJ)[1] and disrupted sleep contributed to enhanced pain perception via weakening of endogenous pain inhibitory system.[2,3] Conversely, painful condition also may alter sleep architecture and induce pain-related awakening during sleep.[4,5] Therefore, impaired sleep quality could contribute significantly to the suffering of pain patients. Fibromyalgia is notorious for its representative clinical symptoms including nonrestorative sleep and widespread musculoskeletal pain and may be one of the best fitted disease condition indicating interrelationships between sleep and pain.[6-8]

Although exact mechanism of complex interaction between pain and sleep is still under investigation, most clinicians who see the pain patients know that pain and poor sleep quality are closely related. Based on the current

literatures, the prevalence of sleep disturbance in chronic pain patients is reported between 50% and 88%.[9-11] In case of orofacial pain patients including temporomandibular disorder (TMD) patients, the prevalence of sleep difficulty was identified in 77% of the patients.[11] Consequently, the evaluation of sleep has come to the essentials for proper assessment and management of TMD. However, there is still insufficient research on the sleep quality of TMD patients in the clinical conditions. Therefore, there is a distinct clinical need to investigate the sleep profiles of TMD-related pain.

In addition to poor sleep, TMD patients often have psychological distress as comorbid conditions which also has been documented in other pain-related conditions.[7,12-15] Psychological factors including depression and anxiety, which have bi-directional relationship with pain, also can independently influence on sleep quality.[16] In fact, the search for the links between neurobiological and psychological conditions already began.[17] Naughton et al.[18] demonstrated that depression as well as pain severity is an important mediator of the relationship between sleep quality and pain-related disability using mediation analysis.

Although no causal relationships among pain, sleep disturbance, and psychological distress have been clearly documented, several studies focus on the complex associations between them that complicate diagnosis and treatment in chronic pain patients.[6-8,11,19-22] Unfortunately, limited studies documented the prevalence and clinical nature of sleep disturbance and associations with comorbid conditions including clinical and psychological aspects in the TMD patients.[16,23,24]

Therefore, this study was designed (1) to evaluate sleep quality of TMD patients using a reliable and valid tool (the Pittsburgh Sleep Quality Index, PSQI); (2) to investigate the relationship between clinical, psychological factors and sleep quality in the TMD patients.

MATERIALS AND METHODS

1. Subjects

A total of 123 TMD patients (90 women and 33 men; mean age, 39.9±15.4 years; range, 19-81 years) who visited first at the Orofacial Pain Clinic of Dankook University Dental Hospital (Cheonan, Korea) over 2 months' period from September to October in 2014 for the management of TMD were included in this study. The informed consent was obtained from all participants in this study. Pain, psychological profile and sleep quality were assessed with standard, reliable, validated self-report instruments administered at the initial evaluation. Exclusion criteria were as follows (1) patients who had a history of psychiatric conditions, (2) patients who had neurologic impairment or diseases (e.g., stroke, tumor, trauma, or epilepsy), (3) patients who had other systemic muscular disorders (e.g., fibromyalgia, inflammatory joint disease), (4) patients who were pregnant, and (5) patients who were being under 19 years of age. Experienced orofacial pain specialists conducted comprehensive clinical and radiographic examination and diagnosed all patients. Primary diagnosis of TMD according to the classification of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) was stratified into 4 groups, i.e., TMD with internal derangement without pain (TMD_ID, n=9), TMD with joint pain (TMD_J, n=40), TMD with muscle pain (TMD_M, n=52) and TMD with muscle-joint combined problem (TMD_MJ, n=22).

2. Questionnaires

The questionnaires were consisted of three parts;

1) Pittsburgh Sleep Quality Index

The PSQI, a 19-item self-rating inventory, provides valid and reliable measurements of overall sleep quality and disturbance.[25] It forms seven components, which are equally weighted on a 0 to 3 point scale: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, use of sleep medication, and daytime dysfunction. These components make up a global score, ranging from 0 to 21 (high scores indicate poorer sleep quality).

2) Symptoms Checklist

The Symptom Checklist-90-Revision (SCL-90R), a brief, self-report validated inventory, has been used to evaluate psychological profiles.[26,27] It contains 90 items and Patients rated each items on a 5-point scale (not at all, 0; extremely, 4) for how much each problem had distressed or bothered them during the past 7 days. It yields 9 subscale scores, including somatization, obsessive-compulsive, interpersonal

sensitivity, anxiety, depression, hostility, phobic anxiety, paranoid ideation, and psychoticism along with three global indices of distress (Global Severity Index, Positive Symptom Distress Index, and Positive Symptom Total). According to the standardized normative data of Korean,[28] T-scores of 9 symptom dimensions and 3 global indices were calculated and we used T-scores in this study.

3) Brief Pain Inventory

The Brief Pain Inventory (BPI) is a commonly used measure in pain research and clinics. It is a short, self-administered questionnaire with an 11-item numerical rating scale designed to assess the severity and impact of pain experienced.[29] The BPI pain severity score is the mean of the four BPI pain ratings: worst, least, average and current pain. The BPI pain interference includes 7 items to determine the functional interference caused by pain in the areas of daily activity, mood, relationship with others, etc. Korean version of the BPI was used and the question asking interference with walking ability was replaced by chewing ability because orofacial pain is hardly considered to be related with walking ability. Responses were based on the week before the completion of the BPI.

3. Dichotomization of Subjects by Sleep Quality

According to the recommended cutoff point of the PSQI (>5),[25] the patients in this study were categorized into 2 groups, i.e., good sleepers (scores of 5 and lower) and poor sleepers (scores of 6 and higher).

4. Statistical Methods

The chi-square test and independent t-test were used to compare demographic and clinical characteristics of good sleepers and poor sleepers. One-way ANOVA was used to analyze the sleep quality between different diagnoses. Pearson's correlations of sleep quality (PSQI scores) with demographic, pain and psychological profiles were performed and then, the multiple linear regression analysis with a stepwise method was conducted to explore predictors of sleep disturbance. Statistical tests were done at the 5% significance level. All statistical calculations were made using the PASW Statistics version 18.0 (IBM Co., Armonk, NY, USA).

RESULTS

1. Categorization of TMD Patients by Sleep Quality

The distribution of global PSQI score for TMD patients in the current study is depicted in the Fig. 1. The mean global PSQI score of all patients was 6.39±2.80. When TMD patients were categorized by the cutoff score (>5), good sleepers (11 male and 21 female; mean age, 40.84±16.07 years) were 32 (26%) and 91 (74%) were poor sleepers (22 male and 69 female; mean age, 39.54±15.22 years) (Table 1). As presented in the Table 2, poor sleepers reported significantly higher scores in all subcategories except the two scales (habitual sleep efficiency, p=0.063; use of sleep medication, p=0.065). The global PSQI score differed significantly between good sleepers (3.25±1.02) and poor sleepers (7.50±2.35).

2. Comparison of Clinical and Psychological Data between Groups

The clinical and descriptive data were compared between poor sleepers and good sleepers. As presented in Table 1, there were no significant differences between good and poor sleepers for sex, age, pain duration, pain severity, medication and smoking status. However, poor sleepers showed significantly high pain interference than good sleepers (p=0.009). The distribution of TMD patients according to the primary diagnostic group differed significantly between good and poor sleepers (p=0.042). TMD_ID group showed least PSQI scores and there were no significant

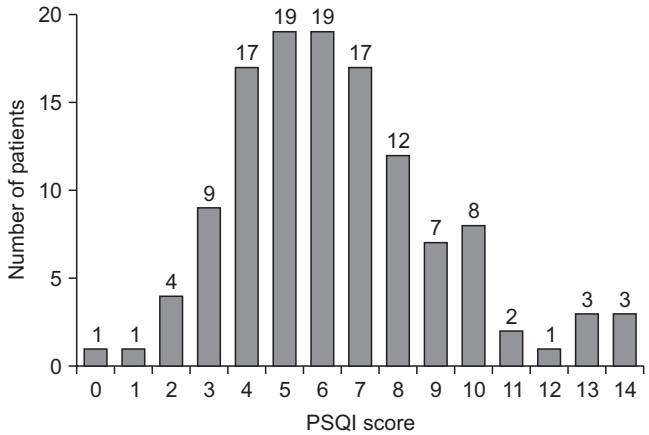

Fig. 1. Distribution of Pittsburgh Sleep Quality Index (PSQI) score in temporomandibular disorder patients (n=123).

Table 1. Clinical profiles of good and poor sleepers with temporomandibular disorder

Variable	Good sleeper (n=32)	Poor sleeper (n=91)	p-value
Sex			0.263[a]
Male	11 (34.4)	22 (24.2)	
Female	21 (65.6)	69 (75.8)	
Age (y)	40.84±16.07	39.54±15.22	0.682[b]
Diagnosis			0.042[a]
TMD_ID	5 (15.6)	4 (4.4)	
TMD_J	9 (28.1)	31 (34.1)	
TMD_M	16 (50.0)	36 (39.6)	
TMD_MJ	2 (6.3)	20 (22.0)	
Pain duration (n=114)			0.723[a]
Acute (<6 mo)	26 (59.1)	39 (55.7)	
Mean duration (mo)	3.9±1.2	8.1±2.2	
Chronic (≥6 mo)	18 (40.9)	31 (44.3)	
Mean duration (mo)	4.1±1.0	8.3±8.3	
Pain severity	3.51±2.20	4.08±2.29	0.224[b]
Pain interference	2.90±2.55	4.41±2.85	0.009[b]
Medication			0.537[a]
No	24 (75.0)	63 (69.2)	
Yes	8 (25.0)	28 (30.8)	
Smoking			0.798[a]
No	3 (9.4)	10 (11.0)	
Yes	29 (90.6)	81 (89.0)	

TMD_ID, internal derangement group; TMD_J, joint pain group; TMD_M, muscle pain group; TMD_MJ, joint+muscle pain group.
Values are presented as number (%) or mean±standard deviation.
For comparison of pain duration between good and poor sleepers, internal derangement group without pain (n=9) was excluded in the calculation.
[a]By chi-square statistic. [b]By independent t-test.

Table 2. PSQI scores of good and poor sleepers with temporomandibular disorder

PSQI	Good sleeper (n=32)	Poor sleeper (n=91)	p-value[a]
Subjective sleep quality	0.66±0.60	1.66±0.72	0.001
Sleep latency	0.25±0.44	0.95±0.69	0.001
Sleep duration	0.38±0.50	1.13 ±0.72	0.001
Habitual sleep efficiency	0.06 ±0.35	0.29±0.64	0.063
Sleep disturbances	0.91±0.39	1.53±0.67	0.001
Use of sleep medication	0.03±0.18	0.29±0.76	0.065
Daytime dysfunction	0.97±0.74	1.66±0.73	0.001
Global PSQI score	3.25±1.02	7.50±2.35	0.001

PSQI, Pittsburgh Sleep Quality Index.
Values are presented as mean±standard deviation.
[a]By independent t-test.

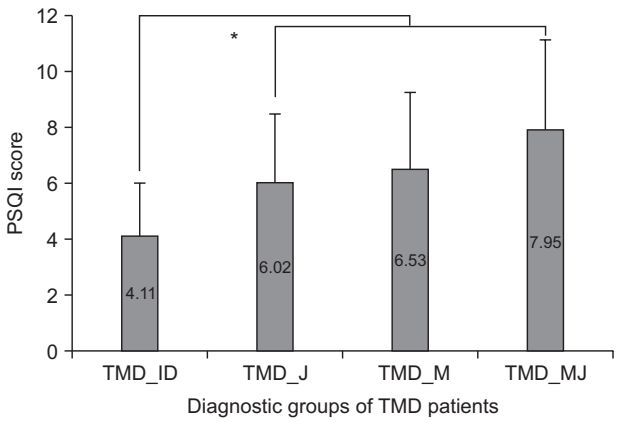

Fig. 2. Global Pittsburgh Sleep Quality Index (PSQI) scores of the different diagnostic groups of temporomandibular disorder (TMD) patients (n=123). TMD_ID, internal derangement without pain group (n=9); TMD_J, joint pain group (n=40); TMD_M, muscle pain group (n=52); TMD_MJ, joint+muscle pain group (n=22). One-way ANOVA, F=5.081, p=0.002. *Significant difference between TMD_ID and the other groups (Tukey post hoc analysis).

difference between other groups (Fig. 2). Pain groups including TMD_J, TMD_M, TMD_MJ exhibited poor sleep quality with the mean global PSQI score over 5. As shown in Table 3, poor sleepers presented significantly high scores than good sleepers in 7 out of 9 subscales and the 3 global scales of SCL-90R. Two parameters including phobic anxiety and paranoid ideation did not reach statistical significance.

3. Predicting the Influential Factors on the Sleep Quality of TMD Patients

Multiple linear regression analyses were performed using the 8 predictor variables (pain interference, somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, psychoticism) against the global PSQI score. Insignificant variables were removed from the model. As shown in Table 4, two variables were survived in the model and poor sleep quality was predicted by higher pain interference (β=0.218, p=0.007) and greater depression (β=0.127, p=0.001). This model was statistically significant (F=24.24, p=0.001) and explained 28.8% of variance of sleep quality.

DISCUSSION

Complains about sleep disturbance in several chronic pain conditions are variably reported from at least 50% to as high as 70% to 80%.[30] Riley et al.[11] assessed the prevalence of sleep disturbance in a sample of 128 orofacial pain

Table 3. SCL-90R scores of good and poor sleepers with temporomandibular disorder

SCL-90R subscale	Good sleeper (n=32)	Poor sleeper (n=91)	p-value[a]
Somatization	44.09±5.74	48.76±8.37	0.004
Obsessive_compulsive	39.34±6.50	46.66±9.09	0.001
Interpersonal sensitivity	41.59±6.67	45.23±9.26	0.040
Depression	39.16±5.58	45.95±9.77	0.001
Anxiety	40.31±4.04	46.58±8.87	0.001
Hostility	42.22±4.38	47.11±9.47	0.006
Phobic anxiety	43.09±7.80	46.62±10.08	0.075
Paranoid ideation	42.13±6.83	44.45±7.44	0.123
Psychoticism	40.91±4.45	45.33±7.69	0.003
Global Severity Index	39.63±5.71	46.23±9.39	0.001
Positive Symptom Distress Index	42.25±3.71	46.26±7.81	0.006
Positive Symptom Total	37.81±9.45	46.58±11.72	0.001

SCL-90R, Symptom Checklist-90-Revision.
Values are presented as mean±standard deviation.
[a]By independent-test.

Table 4. Multiple regression results predicting sleep quality from depression and pain interference

Predictor	β	t	R	R^2	R^2_{adj}	ΔF	p for ΔF	df1	df2
Depression	0.127	5.230[a]	0.494	0.244	0.237	38.971	0.001	1	121
Pain interference	0.218	2.728[b]	0.536	0.288	0.276	7.442	0.007	1	120

df, degree of freedom; β, regression coefficient; R^2, coefficient of determination; R^2_{adj}, adjusted coefficient of dtermination.
Final model: F=24.244 (p=0.001), R^2=28.8%.
[a]p<0.001. [b]p=0.007.

patients and reported that 77% of the patients showed subjective sleep disturbance. Consistent with previous studies, the findings from this study demonstrated that many TMD patients have sleep disturbance and the prevalence of poor sleepers in the sample was up to 74%. In the current study, the mean global PSQI score of 123 TMD patients was 6.39±2.80. On the other hand, 137 TMD patients in the Yatani et al.'s study[16] showed higher mean global PSQI score (i.e., 9.89±4.47) than ours. This difference in the subjective sleep quality between two TMD populations might be attributable to comorbid conditions of TMD as well as subject bias including different sociodemographic, cultural and ethnical backgrounds of the samples. Thus, data from the PSQI score should be carefully analyzed in the overall context.

Another finding from our study was that majority of patients with poor sleep quality were not surprisingly those with pain, not those without pain, i.e., TMD patients who diagnosed as internal derangement (those without pain) showed relatively good sleep quality than those with pain including muscle pain, joint pain and muscle-joint combined pain. On the other hand, Sener and Guler's investigation[23] which compared self-reported sleep quality in patients with myofascial pain and disc displacement versus asymptomatic controls reported that there was no significant difference in the global PSQI score between those with myofascial pain and patients with disc displacement. These conflicting results might be attributable to the difference in the stratification of TMD diagnosis between two studies. In our study, we defined the inclusion criteria of internal derangement group as patients with disc displacement without pain, i.e., patients with only internal derangement was regarded as a kind of control groups. In case of Sener and Guler's study,[23] inclusion criteria for disc displacement was disc displacement with intra-articular pain as well as disc displacement without pain. In the comparison of sleep quality between those with myofascial pain and control, myofascial pain group showed poor sleep quality in the Sener and Guler's findings.[23] Many correlation studies using clinical samples have consistently found that sleep disturbance

is positively related with pain severity.[15,31-33]

Although sleep quality was poorer in those with pain group than those without pain in the current study, correlation studies revealed that poor sleep quality was not related to pain severity. Interesting finding in this study exhibits that sleep quality in the TMD patients was associated with pain interference and pain interference was higher in the poor sleepers. Consistent with our findings, there are several studies have shown poor sleep complaints to be more robustly associated to mood, inactivity, cognitive rumination and pain-related disability than pain severity.[18,30]

Yatani et al.[16] also tried to find predictors of poor sleep quality in the TMD patients using Multidimensional Pain Inventory (MPI), SCL-90R, and PSQI. In their study, pain severity rather than interference were analyzed as one of the significant predictors for sleep disturbance. Considering that internal consistency between items for pain severity and interference in the MPI and the BPI is uncertain, direct comparison of this opposite results may be of course not easy. As things are, it cannot be determined from above studies whether sleep quality is influenced more by pain severity or whether pain interference is more influential to sleep quality. To date, as there is no objection to the role of pain dimension on sleep quality, it deserves to research further both the direct effect of pain (e.g., pain severity) and indirect effect of pain (e.g., pain interference) on sleep.

Besides pain dimension, depression as a psychological component showed more significant association with poor sleep quality in our findings as consistent with previous studies.[11,15,16,18] In Riley et al.'s cross-sectional analyses[11] for the orofacial pain patients, reduced sleep quantity was associated with depression and pain and, in addition, the longitudinal observation predicted that depression was more robust correlate of sleep disturbance than pain. Vlaeyen and Linton[34] also indicated the important mediating role of depression in the relationship between sleep quality and pain disability. This result can be seen other disease condition except TMD. Nicassio et al.'s cross-sectional findings[19] demonstrated that pain and depression play significant roles in self-reported sleep disturbance in patients with rheumatoid arthritis. On the other hand, one of the few longitudinal studies suggested that both of pain and poor sleep conditions may contribute to depression over time in patients with rheumatoid arthritis.[35] Fibromyalgia, one of the notorious chronic pain, also showed high rates of pain, poor sleep and depression but the associations between pain, depression and sleep were somewhat different.[6,22]

When we consider the cause and effect of relationship between pain, sleep and depression, it is still hard to bring to a conclusion. Smith[36] reviewed the relationship between depression and pain and reported that chronic pain increases risk of affective disturbance including depression and vice versa. The fear-pain model of Vlaeyen and Linton[34] indicated that if pain is interpreted as threatening, pain-related fear evolved. This leads to avoidance and hypervigilance followed by depression and disability. Depression might in turn maintain the pain experience thereby fueling the vicious circle. Lautenbacher[17] suggested the interface between sleep problems and the fear-avoidance model, i.e., pain experience may be directly exacerbated by sleep discontinuity and depression includes sleep disorders as a major symptom. Such findings suggest pain, depression and sleep are clinically interrelated although the nature of the complex relation is not yet well understood and advocate strongly for the inclusion of sleep problem, depression and disability into the evaluation of pain as both potential cause and effect. Future research should focus on the documenting the effect of treatment targeting these variables to tease out the complex relations among pain, sleep and mood.

Several limitations of this study should be mentioned. First, we used the self-reported questionnaire for evaluating subjective sleep quality. Although the validity of the PSQI questionnaire was identified by discrimination from controls and through positive correlations with polysomnography, the PSQI was correlated with sleep latency, but not for an estimate of sleep duration and sleep efficiency,[25] i.e., PSQI questionnaire is not a tool to analyze exactly clinical pain-related sleep disturbance but a screening tool for practitioners. We should be aware of its possibility of overestimation in the screening of sleep disturbance given that the validity of cutoff value in the TMD patients is not yet clear. In fact, several patients in the current study failed to recognize their sleep disturbance in the personal interviews although poor sleep quality was documented in the PSQI questionnaire with the cutoff value 5. Further studies in the variety of populations and correlation analyses with the

polysomnography are needed to identify and validate the cutoff value in the TMD patients. Second, cross-sectional design used in the current study does not reach any conclusion regarding the direction of the association between pain, sleep and depression. Further studies should take a longitudinal study design to find out the meaningful outcomes. Lastly, we need to include more variables related to sleep in the clinical investigation. Affleck and colleagues suggested that pain attention was bi-directionally correlated with sleep and such relation was not explained by changes in pain intensity.[37] In the Smith and Haythornthwaite's study,[30] sleep quality was primarily predicted by presleep cognitive arousal rather than pain domain and psychological distress using the MPI, Pre-Sleep Arousal Scale, the Beck Depression Inventory, and the PSQI.[9] Given the previous research findings, assessment and understanding of sleep should be performed on the multidimensional comorbid conditions.

Conclusively, the proportion of patients with poor sleep quality was high in the TMD patients, and poor sleep quality was associated with groups with TMD-related pain, high pain interference and psychological distress. Pain interference and depression were predictors and seem to have a role in poor sleep quality in TMD patients. These findings underscore that management of TMD patients should deservingly include more than one-dimensional treatment targeting only pain control for the successful approach of TMD-related pain.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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