Frontiers in Dentistry

Evaluation of Association between the Severity of Temporomandibular Disorders and Quality of Sleep in a Selected Iranian Population

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Article Info

Article type:
Original Article

Article History:
Received: 18 September 2018
Accepted: 25 November 2018
Published: 29 June 2019

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A B S T R A C T

Objectives: Temporomandibular disorder (TMD), as a prevalent condition, has been reported to be related to changes in sleep quality. This study aims to assess the association between TMD severities and sleep quality in a selected Iranian population by the application of the Helkimo index and the Pittsburgh Sleep Quality Index (PSQI) questionnaire.

Materials and Methods: This study comprised 50 non-TMD subjects and 150 TMD patients, which were equally selected from each TMD severity category. The study was conducted at the School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran. The patients were first examined and categorized into four TMD severity groups according to the Helkimo index: Non-TMD, mild, moderate, and severe. Then, the patients completed the PSQI questionnaire, which was a standard version translated into Persian and adjusted for Iranian patients.

Results: Comparison of mean PSQI scores of the four groups revealed a significant difference ($P<0.001$). Pairwise comparisons showed that the severe, moderate, and mild TMD groups and the control received the highest to the lowest PSQI scores (12.26±2.35, 8.20±1.92, 6.88±1.89, and 5.28±1.32, respectively). Similarly, regression analysis indicated that by controlling the effect of demographic variables, the mean PSQI significantly increased as TMD severity increased.

Conclusion: According to the results, all three categories of mild, moderate, and severe TMD patients showed poor quality of sleep in comparison with non-TMD controls. The higher the severity of the disease, the lower the sleep quality.

Keywords: Temporomandibular Disorders; Severity of Illness Index; Sleep Hygiene

➢ **Cite this article as:** Zamani A, Haghnegahdar A, Vossoughi M. Evaluation of Association between the Severity of Temporomandibular Disorders and Quality of Sleep in a Selected Iranian Population. *Front Dent*. 2019;16(3):206-213. doi: 10.18502/fid.v16i3.1592

INTRODUCTION

Temporomandibular disorder (TMD) is an umbrella term for a group of musculoskeletal and neuromuscular conditions that involve the temporomandibular joint (TMJ), masticatory muscles, and all other associated tissues [1-4]. It is estimated that 50-80% of the population has at least one sign or symptom of

TMD [3,5,6]. Almost 10% of individuals affected by TMD require treatment since this disorder can cause severe functional limitations like an inability to chew and inability to work or participate in social activities [5,7-9].

Signs and symptoms of TMD can be divided into pain and dysfunction. The pain associated with TMD can be clinically expressed as masticatory muscle pain (MMP) or TMJ pain (synovitis, capsulitis, and osteoarthritis). TMD-related facial pain has been reported in 9-13% of the general population (with a female to male ratio of 2:1) but only 4-7% seek treatment (females four times more than males) [1,10-13]. TMD signs and symptoms, which include limited mandibular articulation with or without deviation during mouth opening, TMJ noise (pops and cracklings), headache, bruxism, and changes in sleep quality, peak among 20-40-year-olds [1,10-12,14,15] and require an interdisciplinary therapeutic approach [16-21]. On the other hand, since TMDs are categorized as chronic myofascial pain, they can cause sleep disturbances. Several studies show that pain worsens during sleep, likely by interfering with sleep onset and sleep maintenance. Just as pain disrupts sleep, sleep disturbances can increase sensitivity to pain, revealing the mutual nature of this relationship [22,23].

Sleep disorders include a range of problems associated with sleeping, such as "trouble falling or staying asleep, falling asleep at the wrong times, too much sleep, and abnormal behaviors during sleep" [24]. Poor sleep quality can severely impair the patient's health status and quality of life. It is documented that sleep disturbance has a great influence on the risk of infectious disease, cardiovascular disease, cancer, and depression [25]. Several studies have proven that poor sleep quality can be an etiological or perpetuating factor in TMD patients [2,9,26-35].

Some studies have reported an association between TMD and sleep disorders [36,37]. Both pain and poor sleep appear to be part of a complex and bidirectional interaction though the mechanism is still not well understood [38]. Moreover, the available scientific evidence on sleep disorders and TMD is still incomplete [5].

The nature and severity of sleep disturbance have been most commonly determined by the Pittsburgh Sleep Quality Index (PSQI), which provides a subjective evaluation of sleep quality [5,32,33]. This questionnaire has been shown to be a safe and reliable method for determining sleep quality and disturbances. The PSQI is also very reliable for measuring the number of hours spent in bed, sleep frequency, reasons for awakening and difficulty returning to sleep after awakening [5,32,34,35]. There are also different methods to classify the nature and/or severity of TMD for clinical or academic purposes. The Helkimo index is a practical and quantitative criterion that measures the severity of TMD based on mandibular pain and occlusal instability [39-41]. To classify the severity of TMD using the Helkimo index, each individual receives a total dysfunction score ranging from 0 to 25 points where higher scores indicate higher severity of the disorder.

The Helkimo index has been demonstrated to be an accurate and reliable measure to diagnose TMD and to classify its severity [42-44]. However, to the best of our knowledge, no study has yet assessed the association between TMD severity based on the Helkimo index and sleep

disturbances. Therefore, the present study investigates the association between TMD severity and sleep quality in a selected Iranian population by the application of the Helkimo index and the PSQI.

MATERIALS AND METHODS

This study comprised of 50 non-TMD subjects and 150 TMD patients for a total sample size of 200. This sample size was computed based on the comparison of mean PSQI score in TMD patients (7.1±4.0) and controls (5.1±3.1) [33] with α=0.05 and power=80%. Convenient sampling method was used to choose the study participants among patients who had referred to the School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran. Patients with any other medical diagnoses (such as respiratory diseases, apnea, deprivation, hypersomnia, hypoventilation,

Table 1: Comparison of demographic variables among the studied groups

Variables		Control	Mild TMD	Moderate TMD	Severe TMD	P-value
Age (year)		44.92±17.21	39.30±13.78	44.56±17.09	39.78±11.98	0.120
Sex	**Male N (%)**	29 (58)	24 (48)	25 (50)	6 (12)	<0.001
	Female N (%)	21 (42)	26 (52)	25 (50)	44 (88)	
Marital status	**Single N (%)**	38 (76)	37 (74)	22 (44)	12 (24)	<0.001
	Married N (%)	12 (24)	13 (26)	28 (56)	38 (76)	

TMD=Temporomandibular Disorder; quantitative and qualitative variables were summarized using mean±standard deviation (SD) and frequency (%), respectively

insomnia, iron deficiency, and parasomnia), responsible for disturbances in their normal sleep patterns, were excluded from the study. Additionally, subjects suffering from other chronic diseases (e.g. mental disorders) or those taking drugs (e.g. Propranolol) that interfere with normal sleep mechanisms and sleep quality were excluded from the study.

The patients were first examined by an experienced dentist and were categorized into four groups according to the Helkimo index scores as follows: TMD-free (Helkimo index=0), mild TMD (Helkimo index=1-4), moderate TMD (Helkimo index=5-9), and severe TMD (Helkimo index=10-25). The control group consisted of subjects with Helkimo score of zero (i.e. without TMD). This study has been approved by the ethics committee of Shiraz University of Medical Sciences, providing the acquirement of written informed consent form from all the participants. After obtaining written consent from all the participants, they completed a standard version of the PSQI questionnaire, which was translated into Persian and was adjusted for Iranian patients [45]. The written consent form is a standard form developed in full accordance with the World Medical Association Declaration of Helsinki by the Ethics committee of Shiraz University of Medical Sciences. The questionnaire included 19 questions to determine sleep quality. The patients answered the questions based on their personal experience. The total PSQI was computed by summation of all scores; the higher the score, the lower the sleep quality. The participants were asked to fill out the questionnaire in the presence of trained project executives.

The demographic data, Helkimo score, and PSQI score of each individual were analyzed and compared between the groups. Data were described using mean±standard deviation (SD) and frequency (%). One-way analysis of variance/Tukey's honestly significant difference (HSD) test and Chi-square test were applied to compare the groups in terms of demographic variables and PSQI score. The association between the Helkimo index and the PSQI was assessed by Pearson's correlation coefficient. We used a multiple linear regression analysis to assess the association between PSQI score and the Helkimo index of the groups by controlling the effects of other variables. Data were analyzed using PASW SPSS software version 18.0; SPSS Inc., Chicago, IL, USA).

RESUTS

Table 1 summarizes demographic variables in the study groups. The mean age was not statistically different between the four groups (P=0.120). However, sex and marital status ratios were not similar among the groups (P<0.001).

The severe TMD group consisted of more women and married participants. Comparison of mean PSQI scores of the four groups revealed a significant difference (P<0.001; Table 2). All paired groups were significantly different as shown by Tukey's HSD test. Study groups 3, 2, 1, and 0 received the highest to the lowest scores (12.26±2.35, 8.20±1.92, 6.88±1.89, and 5.28±1.32, respectively) as shown in Table 2.

Similarly, a positive and significant correlation was observed between PSQI score and the Helkimo index of TMD patients (r=0.70,

Table 2: Comparison of mean Pittsburgh Sleep Quality Index (PSQI) score between the studied groups

Group	Mean±SD	P-value*
Control	5.28±1.32[A]	<0.001
Mild TMD	6.88±1.89[B]	
Moderate TMD	8.20±1.92[C]	
Severe TMD	12.26±2.35[D]	

TMD: Temporomandibular Disorder; SD: Standard Deviation; *One-way analysis of variance *F* test. Mean values with different letters indicate a statistically significant difference (Tukey's honestly significant difference test).

P<0.001). A multiple regression analysis was performed to control the differences in sex and marital status observed in the study groups (Table 3).

Table 3: The results of the regression analysis

Variable	β	SE	P-value
Age	-.031	.009	.001
Sex(M/F)	-.099	.290	.734
Marital status(S/Ma)	-.305	.296	.304
Group(0/3)	-6.619	.423	<0.001
Group(1/3)	-5.207	.411	<0.001
Group(2/3)	-3.815	.392	<0.001

SE: Standard Error of estimate; M: Male; F: Female, S: Single; Ma: Married.

By controlling the potential effects of sex and marital status, the mean PSQI scores of the four groups were significantly different. In general, the mean scores of groups 2, 1, and 0 were less than that of group 3 by 3.81, 5.21, and 6.62, respectively. Moreover, the mean PSQI scores significantly increased in higher severity categories.

By controlling the effect of other variables, no significant differences were observed in the mean PSQI scores of the two genders (P=0.734). Likewise, no significant differences were observed in the mean PSQI scores of single and married individuals (P=0.304). However, age and PSQI scores showed a significant association; the mean PSQI score decreased by 0.03 unit for every one-year increase in age (P=0.001).

DISCUSSION

Patients with TMDs or problems involving the TMJ, musculoskeletal systems, and mastication increasingly refer to dentists. Since TMD has a multifactorial pathogenesis, a multidisciplinary treatment plan is needed to manage the cases.

On the other hand, sleep, as a physiologic behavior, plays a very important role in the health status of individuals. Sleep disorders interfering with normal treatment courses are considered as initiating or perpetuating factors for many health problems [38].

A bidirectional relation has been reported between TMD and sleep disorders [38].

Using the Helkimo index, the present study aimed to compare the quality of sleep between TMD patients with different levels of disease severity and the non-TMD control group. The Helkimo index is a practical method for classification of TMD patients based on clinical examination; each subject receives a score from 0 to 25 according to the extent of limitations in mandibular movements, which shows the severity of joint problems. There are some more sophisticated methods for classification of TMDs such as Research Diagnostic Criteria for TMDs (RDC/TMD). However, these methods are more applicable to academic purposes as they are complicated and time-consuming.

Dentists are more comfortable with a practical, clinical, and chair-side method, such as the Helkimo index, to diagnose TMDs. Simplicity accelerates diagnostic procedures. Therefore, we used the Helkimo index to determine the severity of TMD since it is easy and fast-responding. The severity of sleep problems was determined by the PSQI, which is a multidimensional questionnaire for verifying different aspects of sleep problems. It needs an expert to interpret the different dimensions (subscales) of its results. Nevertheless, there are reports that the global score, which is a generalized and simplified summation of other dimensions of the questionnaire, can be sufficiently applied to TMD patients' treatment planning [33]. By applying these two simplified modifications (the Helkimo index and the PSQI global score),

we compared the sleep status of TMD patients with non-TMD cases in our study.

All TMD groups had higher mean PSQI scores than the control group. The higher the level of disease severity, the higher the mean PSQI score. A positive correlation was observed between age and sleep quality. However, the correlation between the Helkimo index and sleep quality was negative. To date, no study has utilized the Helkimo index to assess the association between TMD severities and sleep quality. A systematic review showed that some studies have used non-standardized assessments instead of validated questionnaires, such as the PSQI and the Sleep Assessment Questionnaire (SAQ), to analyze sleep quality [5].

Rener-Sitar et al [46] studied self-reported sleep quality in 609 TMD cases and 88 controls using the PSQI questionnaire. They employed RDC/TMD for the diagnosis of TMD. The mean PSQI was higher in TMD patients with pain-related diagnoses when compared to the control group [46]. Similar to our results, mean PSQI scores did not differ between females and males. However, unlike our study, older TMD patients had significantly higher PSQI scores than younger subjects [46]. Sanders et al [23] conducted cohort and matched case-control studies derived from the Orofacial Pain: Prospective Evaluation and Risk Assessment (OPPERA) project. The cohort study revealed that the incidence rate of TMD was approximately twice in participants with poor sleep quality (PSQI>5) in comparison with those having good sleep quality (PSQI≤3) [23].

This confirms the bidirectional relation between TMD and sleep disorders. The pain associated with TMD can cause sleep disorders; sleep deficiency initiates TMJ problems, probably by lowering the pain threshold [38]. In the nested case-control study, 220 TMD cases and 193 matched TMD-free controls from the OPPERA project were studied. However, no statistically significant differences were found regarding sleep quality and TMD status. Likewise, no statistically significant differences were found after quantitative sensory testing (QST) of thermal pain, pressure pain, and mechanical pain [23]. We also found the lower quality of sleep in TMD patients and recommend that these two problems should be treated simultaneously to get better results. Oliveira et al [16] conducted a study on 160 nurses in Brazil to evaluate the association between TMD and anxiety, quality of sleep, and quality of life. They used Fonseca's questionnaire to evaluate the presence and severity of TMD. The SAQ was also used to measure the quality of sleep. They reported that of the participating nurses, 41 (25.6%) were TMD-free (Fonseca's score≤15), 66 (41.3%) had mild (Fonseca's score=20-40), 39 (24.4%) had moderate (Fonseca's score=45-65), and 14 (8.8%) had severe (Fonseca's score≥70) TMD. The SAQ scores were significantly different between these categories. The mean SAQ scores were higher in all TMD groups when compared to non-TMD participants [16]. Rener-Sitar et al [33] evaluated the dimensionality construct of the PSQI questionnaire quality in 609 TMD cases in the United States. The RDC/TMD classification system was used to evaluate the pain status of patients (i.e. pain-related TMD and pain-free TMD). It was demonstrated that sleep quality measured in TMD patients by using the PSQI is a one-dimensional structure and can be sufficiently characterized by a total score. They also showed that patients with pain-related TMD had a higher mean total score than pain-free TMD cases [33]. As it was mentioned before, we also used the global score (one-dimensional structure of the PSQI) and gained similar results. Veiga et al [5] systematically reviewed 13 articles published between 1990 and 2012. Eight of these articles analyzed sleep quality in TMD patients using validated questionnaires such as the PSQI (7 articles) and the SAQ (1 article). Regardless of the method used for evaluation of sleep quality, their review showed that TMD patients generally experience poor quality of sleep [5].

Since different studies, irrespective of the method employed for evaluating TMD status (RDC/TMD or the Helkimo index) and/or sleep quality (PSQI or SAQ), have confirmed the relationship between TMD and poor sleep

quality, it can be concluded that this relation is real and proven in all studies independent of the method used. It is highly suggested that physicians pay attention to the sleep quality of TMD patients in all stages of diagnosis and treatment. Missing or ignoring the sleep problems of TMD patients may lead to a prolonged disease course and even treatment failure. In some cases, it is even possible that treating the sleep problems results in spontaneous relief of TMDs.

CONCLUSION

In conclusion, all three categories of mild, moderate, and severe TMD patients showed poor quality of sleep in comparison with non-TMD controls in our study. The higher the severity of the disease, the lower the quality of sleep. Moreover, the PSQI score significantly increased in TMD patients as the Helkimo index score increased. Age exhibited a significant inverse association with the PSQI score, resulting in higher sleep quality with aging.

ACKNOWLEDGMENTS

The present manuscript is extracted from a thesis by Dr. Aisa Zamani. The authors thank the Vice-Chancellery of Shiraz University of Medical Sciences for supporting this research (Grant number: 15014).

CONFLICT OF INTEREST STATEMENT

None declared.

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