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Different association between specific manifestations of bruxism and temporomandibular disorder pain

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ABSTRACT

Introduction: A growing body of evidence suggests that bruxism exists in two separate manifestations. However, little is known about the association between specific manifestations of bruxism and temporomandibular disorder (TMD) pain.

Aim: The aim of our study was to analyze the association between TMD pain and specific diagnoses of bruxism (sleep, awake, and mixed diagnosis of sleep and awake bruxism).

Material and methods: 508 adult patients (296 women and 212 men), aged between 18 and 64 years (mean age 34 ± 12 years), attending to a clinic for general dental treatment. Patients were asked to fill an anonymous questionnaire, consisting of three questions, verifying the presence of TMD pain and two forms of bruxism. All questions were based on the Polish version of the Research Diagnostic Criteria for Temporomandibular Disorders patient history questionnaire. Cross tabulation was done, and χ^2 was used as a test of significance to find the association between the variables.

Results: Awake bruxism was associated with TMD pain only in men ($\chi^2 = 7.746$, $p < 0.05$) while mixed diagnosis of bruxism was associated with TMD pain in both women ($\chi^2 = 10.486$, $p < 0.05$) and men ($\chi^2 = 4.314$, $p < 0.05$). There was no statistically significant association between sleep bruxism and TMD pain. Gender-related differences in the presence of all bruxism diagnoses were also statistically insignificant.

Conclusions: Interaction between sleep and awake bruxism may increase the risk for TMD pain. We suggest considering concomitance as a confounder, when studying sleep or awake bruxism.

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1. Introduction

Bruxism is a common disorder defined as a repetitive jaw muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible [1]. Two distinct manifestations of this disorder are distinguished – sleep and awake. The term awake bruxism refers to the clenching of teeth and jaws during wakefulness. Sleep bruxism defined as clenching or grinding of teeth during sleep is classified as a sleep-related movement disorder that occurs as a response to micro-arousals during sleep [2]. Bruxism during wakefulness is commonly characterized by a clenching-type activity while sleep bruxism by a combination of clenching and grinding-type activity [3]. The etiology of both disorders is unknown. However, several risk factors have been identified. Studies showed that awake bruxism is linked to psychological factors, such as stress and anxiety [3], while sleep bruxism is associated with the consumption of alcohol, tobacco, coffee and use of certain drugs [4–6]. Considering significant differences between these two forms, it is crucial to discriminate between them at the etiologic, diagnostic, and therapeutic levels [3].

Clinical relevance of bruxism is related to its detrimental influence on the masticatory system. Except dental problems, such as tooth wear, tooth mobility and abfraction, bruxism is considered one of the major etiological factors of temporomandibular disorders (TMD). Accordingly, bruxism is diagnosed more frequently in TMD patients than in the general population [7]. The link between bruxism and TMD was investigated in many studies, showing that bruxism is associated predominantly with muscle conditions [8]. However, this activity is also attributed to temporomandibular joint disorders, such as disk displacement, adhesions, and capsulitis [9,10].

Bruxism as a whole is positively correlated with the presence of TMD pain [8]. However, little is known about the role of its specific forms in the etiology of painful TMD. It is suggested that awake and sleep bruxism are differently associated with TMD pain [11]. It is worth noting that most of the studies investigating this relationship did not rule out the presence of non-investigated form in the studied groups [8]. In our opinion, lack of such exclusion could have affected the outcomes because the presence of pain could have been caused by a concomitant form of bruxism.

For these reasons, the aim of our study was to analyze the association between the presence of TMD pain and specific diagnoses of bruxism (only sleep, only awake, mixed diagnosis of sleep and awake bruxism). The results were aimed to show how these different entities attribute to the incidence of TMD pain.

2. Material and methods

2.1. Study group

Five hundred and eight adult patients (296 women and 212 men), aged between 18 and 64 years (mean age 34 ± 12 years), attending to a dental clinic for general dental treatment. Detailed characteristic of the group is presented in Table 1.

Table 1 – General characteristic of the study group (n = 508).

	n	%
Education		
Elementary	14	2.8
Lower secondary	6	1.2
Secondary	212	41.7
Higher	265	52.2
Other	11	2.2
Place of residence		
Village	89	17.5
Town up to 10,000 citizens	42	8.3
City 10,000–500,000 citizens	72	14.2
City above 50,000 citizens	305	60.0
Age		
18–34 years	318	62.6
35–44 years	66	13.0
45–64 years	124	24.4

2.2. TMD pain self-report and diagnoses of bruxism

Patients were asked to fill an anonymous questionnaire, consisting of three questions, verifying the presence of TMD pain and two forms of bruxism. All questions were based on the Polish version of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) patient history questionnaire [12]. The presence of TMD pain was assessed using the question "*Have you had pain in the face, jaw, temple, in front of the ear or in the ear in the past month.*" The diagnoses of sleep and awake bruxism were obtained by self-report in answers of questions "*Have you been told, or do you notice that you grind your teeth or clench your jaw while sleeping at night?*" and "*During the day, do you grind your teeth or clench your jaw?*" respectively. Patients who answered positively only to one question were diagnosed with sleep or awake bruxism, depending the given answer. Patients who gave two positive answers were diagnosed with mixed sleep and awake bruxism. The term mixed bruxism will be used further in the text in reference to this diagnosis.

2.3. Statistical analysis

Cross tabulation of studied variables was done, and χ^2 was used as a test of significance to find the association between the presence of TMD pain and specific diagnoses of bruxism. Statistical analysis of sex differences was done using the χ^2 test. The level of significance was set at $p < 0.05$. Data were analyzed using IBM SPSS Statistics Version 20 software.

3. Results

We found a statistically significant association between the presence of TMD pain and the diagnoses of mixed and awake bruxism. Awake bruxism was associated with TMD pain only in men ($\chi^2 = 7.746$, $p < 0.05$) while mixed bruxism was associated with TMD pain in both women ($\chi^2 = 10.486$, $p < 0.05$) and men ($\chi^2 = 4.314$, $p < 0.05$). There was no statistically significant association between sleep bruxism and TMD

Table 2 – Cross-tabulation of bruxism manifestations and TMD pain (%).

	Sleep bruxism alone		Awake bruxism alone		Mixed bruxism	
	TMD pain	No TMD pain	TMD pain	No TMD pain	TMD pain	No TMD pain
Women	47.5	52.5	57.6	42.4	67.3*	32.7
Men	34.3	65.7	54.2*	45.8	46.4*	53.6
Total	42.6	57.4	56.1*	43.9	60*	40

* χ^2, $p < 0.05$.

pain. The occurrence of TMD pain was highest among patients with mixed bruxism and lowest in patients with sleep bruxism. Detailed results on the occurrence of TMD pain in patients with specific diagnoses of bruxism were presented in Table 2.

TMD pain was present in 39.8% of patients, predominantly in women, which proved to be statistically significant ($p < 0.05$) (Table 3). TMD pain was reported by 51.9% of bruxers, and 36.1% of non-bruxers and this difference was statistically significant ($p < 0.05$). About forty-five percent of participants were diagnosed with at least one form of bruxism. Detailed results on the prevalence of bruxism manifestations were presented in Table 4.

We found no statistically significant gender-related differences in the presence of all bruxism diagnoses.

4. Discussion

A growing body of evidence suggests that bruxism exists in two separate manifestations. However, little is known about the association between specific manifestations of bruxism and TMD pain. Although, experimental studies show that TMD pain may be attributed to awake bruxism [11], the results from observational studies are inconclusive. Rosetti et al. demonstrated that awake bruxism is a stronger risk factor for myofascial TMD pain than sleep bruxism [13]. Contrarily, Blanco Aguillera et al. and Fernandes et al. found TMD pain to be associated only with self-reported sleep bruxism [14,15].

Table 3 – Incidence of TMD pain (%).

	TMD pain	No TMD pain
Women	47.0*	53.0
Men	29.7*	70.3
Total	39.8	60.2

* Statistically significant difference between women and men (χ^2, $p < 0.05$).

Table 4 – Prevalence of self-reported bruxism (%).

	Sleep bruxism alone	Awake bruxism alone	Mixed bruxism	No bruxism
Women	19.9	11.1	17.6	51.4
Men	16.5	11.3	13.2	59.0
Total	18.5	11.2	15.7	54.5

Whereas, van der Meulen et al. did not find a significant relationship between TMD pain and self-reported bruxism [7]. As presented, the results are divergent, and the role of particular forms of bruxism in painful TMD remains unclear.

The purpose of our study was to find out how specific manifestations of bruxism are attributed to TMD pain. Hence, we investigated the relationship between self-reported TMD pain and three separate diagnoses of bruxism – sleep, awake, and mixed bruxism. Our approach was relatively new, as most of the studies did not exclude concomitance of the other form of bruxism from analyses of sleep or awake bruxism [8]. Accordingly, to our knowledge, this is the first study separately investigating this relationship with the diagnosis of mixed bruxism.

Our results showed that generically identified bruxism was significantly associated with TMD pain, as previously reported in other studies [8]. Nevertheless, specific forms of bruxism were differently associated with this symptom. TMD pain was significantly associated with awake and mixed bruxism. In our study, sleep bruxism was found not to be associated with TMD pain, which is compatible with the findings of Yachida et al. [16].

The study design did not enable us to establish a cause-effect relationship between the studied variables. There is also no consensus in the literature regarding this subject [3]. However, when considering a possible causality, we have to discuss both probable directions of this relation.

Tada et al. recently described the concept that bruxism is caused by the presence of pain. They demonstrated that low-level teeth clenching can continue despite painful symptoms. Additionally, the authors suggest that clenching may result from pain-regulatory mechanisms. They observed that clenching can inhibit pain processing by decreasing temporal summation [17]. These findings could explain the association between awake bruxism and TMD pain, reported in our paper.

Although, the observation mentioned above is interesting, in our opinion, it is more likely that bruxism is a cause of TMD pain, rather than its effect.

Bruxism as a risk factor for TMD was debated in the literature for decades. Few experimental studies assessed the role of awake bruxism in the development of TMD pain. Glaros and Burton showed that pain reports are positively correlated with the EMG activity of the masseter muscle. Moreover, they found parafunctional clenching to increase muscle pain that can lead to TMD diagnosis [18]. Tekeuchi et al. reported that prolonged low-level clenching can cause transient TMD-like pain. However, in their opinion, it is insufficient to initiate TMD without additional perpetuating factors [19].

The above findings suggest that awake bruxism may play an important role in the development of TMD pain. Association between awake bruxism and TMD pain can be supported by the fact, that awake bruxism is two times more prevalent in people with TMD than in healthy individuals [20]. This observation is also consistent with our findings.

Blanco Aguilera et al. and Fernandes et al., contrary to our findings, reported that TMD pain is associated only with sleep bruxism [14,15]. A possible explanation for this fact is that the authors did not exclude awake bruxism from the sample reporting sleep bruxism. Studies show that awake bruxism is concomitant in about 50% of patients with sleep bruxism [21]. A similar result (45.9%) was also obtained in our study. Therefore, it is probable that the presence of awake bruxism may have a strong influence on the outcome of such studies. Moreover, some studies suggest that both forms of bruxism may interact. Winocur et al. found that awake bruxism significantly increases the odds for sleep bruxism and vice versa [22]. Another paper reported that children presenting awake bruxism are more susceptible to sleep bruxism [23]. Possible interaction between sleep and awake bruxism is supported by the recent study, demonstrating that biofeedback therapy of awake bruxism can provide an effective approach to regulating sleep bruxism tonic electromyographic events [24].

In the study by Manfredini et al. authors compared diagnoses of TMD and bruxism between two specialized centers. In both centers, the highest prevalence of TMD was observed among patients with a mixed diagnosis of sleep and awake bruxism [21]. In our study, TMD pain was also predominant in this group. However, its occurrence in (15%) was lower while comparing with TMD patients (21–31.5%) [21].

The high occurrence of TMD in patients with mixed bruxism may suggest that this diagnosis is more attributed to TMD pain than the single diagnosis of awake bruxism. This possibility is intriguing, particularly when we hold in mind the potential interaction between these two forms. Another explanation for the fact that mixed bruxism is highly prevalent in TMD patients is that the presence of both activities may cause an accumulation of detrimental effects, which consequently leads to TMD.

Interestingly, the association between awake bruxism and TMD pain, in our study, was found only in men. It stands in contrast to the general view that women are predisposed to TMD pain more than men. However, various mechanisms may cause TMD pain [11]. It is possible that pain reports in our study were an effect of delayed onset muscle soreness induced by clenching. Exercise-induced pain in jaw muscles has been shown to be associated with lower pain scores in women than in men [11]. Higher pain scores in men, induced by experimental clenching, could explain why the pain was associated with awake bruxism only in men, in our study.

The findings presented in this paper have number of possible limitations. The external validity of our study was limited by the fact, that the study group was not representative for the general population. This can also explain why the prevalence of TMD and bruxism in our study was higher than the reported for the general adult population [25]. The study group consisted mainly of people aged 18–34 and 45–64 years, where TMD is most prevalent [26]. Consequently, age distribution may be responsible for high rate of TMD pain in our study. About forty-five percent or participants reported having at least one form of bruxism while the prevalence of such generically identified bruxism in the general population is lower and varies from 8% to 31.4% [25]. Bruxism and TMD pain are proved to be associated, so the high prevalence of this activity could be related to the high prevalence of TMD pain in the study group. Epidemiological data show that awake bruxism is more prevalent than sleep bruxism [25]. However, in our study bruxism was slightly more prevalent during sleep than during wakefulness. The difference was also possibly due to the fact that our population was not representative for the general population.

The results of this study could have also been affected by the fact that the questionnaires were completed in the dental office. This fact could have influenced the answers, especially with respect to TMD pain because dental office setting might have been suggestive at this point. TMD pain diagnosis was based solely on a single item questionnaire, which also could have carried a risk of bias. However, self-reported pain questions were proved to have good reliability and high validity for the prediction of TMD [27]. Regarding the fact that we wanted to study a large-sized sample, the questionnaire was most suitable for this purpose. We decided to use the question from RDC/TMD questionnaire, which is widely accepted by the scientific community and enables comparison between the studies. The particular question used in our study proved successful in predicting TMD [28].

Diagnoses of bruxism were also obtained by self-report. A study comparing self-reports of teeth clenching with electromyography, as an objective diagnostic method, showed that it can be used as a reliable screening parameter for awake bruxism [29]. Another study revealed a strong positive correlation between self-report and clinical diagnosis of awake bruxism. The levels of correlation for sleep bruxism were lower than for awake which could be explained by the fact that people may not be aware of the process ongoing during sleep [30]. This fact creates a risk of observation bias. Questionnaire-diagnosed bruxism, however, remains the most suitable approach to gather large-sample data for epidemiological purposes.

In summary, TMD pain is differently associated with specific forms of bruxism. Our findings support the opinion that it is important to indicate in studies, which form was assessed–sleep, awake, or both [1]. More attention should be paid to mixed bruxism and its relationship with TMD. We suggest studying mixed bruxism separately while the overlap to be considered a confounder in studies on sleep or awake bruxism. Possible interaction between sleep and awake bruxism is intriguing and may be clinically relevant. Hence, warrants further research.

Presented approach may be useful for planning future studies on the association between specific forms of bruxism and TMD. However, more studies will be needed to confirm our results on representative population samples.

5. Conclusions

1. Interaction between sleep and awake bruxism may increase the risk for TMD pain.

2. We suggest considering concomitance as a confounder, when studying sleep or awake bruxism.

Conflict of interest

None declared.

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None declared.

Ethics

The work described in this article has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans; Uniform Requirements for manuscripts submitted to Biomedical journals.

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