Assessment of Anxiety and Coping Features in Bruxers: A Portable Electromyographic and Electrocardiographic Study

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Aims: To determine whether there is a correlation between any psychological features and sleep bruxism (SB). **Methods:** A total of 36 healthy volunteers underwent an in-home evaluation with a portable device combining electromyographic (EMG) and electrocardiographic (ECG) recordings for the diagnosis of SB. They were administered questionnaires that assessed state and trait anxiety levels and coping strategies. The study hypothesis was that the SB index was significantly correlated with an individual's anxiety and coping. Correlation between SB index and psychological features was assessed and a comparison between SB prevalences in subjects with different psychological scores was carried out. **Results:** Correlation analysis showed that the SB index was not correlated with any of the psychological scales; however, there were some significant correlations (*r* values range from 0.393 to 0.458) between the SB index and specific items from the trait anxiety and coping scales. Cross-tabulations of subjects with SB and with high (overmedian) or low (undermedian) scores for the various psychological measures revealed significant correlations between the prevalence of SB in higher-scoring subjects for state anxiety scores (Phi coefficient = .456; $P = .006$), trait anxiety scores (Phi = 0.369; $P = .027$), and social support coping strategy (Phi = 0.387; $P = .020$). **Conclusion:** These findings support the study hypothesis only in part and confirm the absence of a clear-cut relationship between SB and psychological features. *J Oral Facial Pain Headache 2016;30:249–254. doi: 10.11607/ofph.1616*

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Sleep bruxism (SB) is a condition that is a manifestation of different activities of the masticatory muscles during sleep.[1] There are suggestions that SB may result in several clinical problems such as orofacial pain, temporomandibular disorders (TMD), tooth wear, failure of dental restorations, and complications of implant- or teeth-supported rehabilitations.[2–4] At present, knowledge on SB etiology is not conclusive, and it appears that several neurologic, biologic, psychological, and social factors may interact to generate SB.[5,6]

While there is general consensus that SB is centrally mediated, the relative importance of the above factors at the individual level must be further explored to obtain a better understanding of the pathophysiology of SB and to define the most suitable management strategies. For example, the literature on the role of psychological factors (eg, stress, anxiety, and depression) has reported controversial findings.[7–11] A systematic review on the topic showed that investigations relying on self-reported SB diagnoses found correlations with some psychological features that were not replicated in studies based on objective SB measurements.[12]

A recent consensus panel proposed a SB diagnostic grading for which measurements of electromyographic (EMG) masseter activity by means of polysomnography (PSG) are required for a "definite" diagnosis.[1] The adoption of validated PSG criteria should increase the consistency of literature findings.[13,14] Unfortunately, PSG has some disadvantages (eg, high cost, amount of time needed for manual/visual

scoring, laboratory environment) and is mainly used for research purposes with minor impact on clinicians' daily routines.[15] This led to the introduction of more easy-to-use, EMG–home-recording devices, which may be viewed as a good option for obtaining a diagnosis of SB.

Studies on the topic of the SB-psyche relationship that have utilized PSG/EMG measurements for the diagnosis of SB are scarce.[12] Interestingly, an investigation based on home recordings of sleep-time masticatory muscle activity (MMA) in a group of healthy volunteers completing a battery of psychometric questionnaires suggested that MMA may be more related to trait anxiety than to state anxiety or other psychological symptoms.[16] Such findings could not be replicated due to the technologic difficulties experienced with the recording instruments used in that investigation. Recent studies have validated a commercially available portable device providing combined surface EMG and electrocardiographic (ECG) measurements, which showed an excellent diagnostic accuracy compared with standard PSG for the diagnosis of SB.[17] The adoption of such a device represented a step forward with respect to previous instruments, most of which were dedicated to research settings and were not suitable for easy use.

Based on these premises, this study was initiated to gain a deeper understanding of the relationship between psychological factors and SB by assessing a spectrum of pyschological features in healthy individuals who performed home recordings of EMG/ECG with a portable device. The study design aimed to answer the clinical research question: "is there a correlation between any psychological features and SB?" The study hypothesis was that the SB index was significantly correlated with an individual's anxiety and coping. The null hypothesis was that the psychological features here investigated (ie, state anxiety, trait anxiety, and coping capability) were not related with instrumentally diagnosed SB.

Materials and Methods

Subjects and Study Design

This study was performed in 36 healthy volunteers (20 females, 16 males) ranging from 25 to 37 years old (mean age ± standard deviation [SD] = 28 ± 3 years) recruited from among personnel and staff of the Postgraduate School of Orthodontics at the University of Ferrara in Ferrara, Italy. Exclusion criteria were the presence of TMD as diagnosed with the guidelines of the American Academy of Orofacial Pain[18] and a history of neurologic, mental, or sleep disorders (periodic leg movements, insomnia, etc). Participants could not be under medications or the effect of alcohol, nicotine, or caffeine at the time of recording. The procedures were approved by the Ethics Committee of the Postgraduate School of Orthodontics, University of Ferrara, Ferrara, Italy. All individuals gave their informed consent in accordance with the Helsinki Declaration and understood that they were free to withdraw from the experiment at any time.

All subjects underwent an instrumental in-home evaluation with a portable device (Bruxoff, OT Bioelettronica) that allowed the simultaneous recording of EMG signals from both of the masseter muscles as well as ECG signals reflecting heart rate. Each participant underwent two consecutive recording nights (at least 4 hours of sleep per night). The first night was an accommodation session to familiarize the participant with the device and only data recorded during the second night were considered for statistical analyses. Technical details about the device as well as the recording procedure have been described elsewhere.[17,19,20] Previous studies have shown that the portable device has high sensitivity (92.3%) and specificity (91.6%) for the diagnosis of SB when the diagnostic cut-off is set at 4 SB episodes per hour,[17] as suggested by the most recent PSG/SB criteria.[14,21,22] In addition, a reliability study showed good repeatability as far as the number of SB episodes per night, SB episodes per hour, and heart rate are concerned.[23]

During the afternoon hours of the second recording day, participants were administered the Italian versions of validated questionnaires for the evaluation of state and trait anxiety levels (ie, State-Trait Anxiety Inventory-form Y [STAI-Y])[24] and coping strategies (ie, Coping Orientation to Problems Experienced [COPE]).[25] For both questionnaires, the validated Italian-language version was adopted.[26,27] In brief, the STAI-Y is a self-report questionnaire consisting of two Likert-type scales, with 20 items each, that differentiate between state anxiety (ie, transient, momentary emotional status that results from situational stress) and trait anxiety (ie, predisposition to react with anxiety in stressful situations).[24] The COPE inventory was originally comprised of 15 scales, with 4 items each, assessing a variety of coping strategies;[25] ie, the various cognitive and behavioral strategies that individuals use to manage their stress.[28] The validated Italian version (COPE-NVI) used in this investigation was based on a slightly different factor analysis with respect to the original publication, showing that the tool consists of five large essentially independent coping strategies: *(1)* social support; *(2)* avoidance strategies; *(3)* positive attitude; *(4)* problem solving; and *(5)* turning to religion. For further details on the questionnaires used in this investigation, readers are referred to the original publications.[24–27]

Table 1 Correlation Values (*r*) and Level of Significance Between Scores in the Psychological Scales and SB Index

Psychological scale	*r* (*P*)
STAI-Y: State anxiety	0.086 (.640)
STAI-Y: Trait anxiety	0.177 (.318)
COPE: Social support	0.057 (.761)
COPE: Avoidance strategies	0.157 (.398)
COPE: Positive attitude	0.175 (.347)
COPE: Problem solving	0.174 (.351)
COPE: Turning to religion	0.306 (.093)

STAI-Y = State-Trait Anxiety Inventory-form Y.
COPE = Coping Orientation to Problems Experienced.

Table 2 Correlation Values (*r*) Between Scores of the Significant Psychological Items and SB Index

Item		*r*
Trait anxiety:	"I become tense and upset when I think about my present concerns."	0.410
Avoidance:	"I refrain from doing anything as long as the situation permits."	0.458
Avoidance:	"I refuse to believe that it happened."	0.393

Table 3 Comparison of Mean SB Index and Standard Deviation (SD) Between Subjects with High or Low Scores in the Various Psychological Scales

Psychological scale	SB index in subjects with high scores (SD)	SB index in subjects with low scores (SD)	*P*
STAI-Y: State anxiety	5.4 (3.0)	3.7 (2.1)	.072
STAI-Y: Trait anxiety	5.3 (2.1)	3.7 (3.0)	.081
COPE: Social support	5.4 (1.8)	4.2 (3.1)	.198
COPE: Avoidance strategies	4.6 (3.0)	5.0 (2.0)	.649
COPE: Positive attitude	5.6 (2.3)	4.0 (2.6)	.069
COPE: Problem solving	4.7 (1.9)	4.9 (3.0)	.856
COPE: Turning to religion	4.3 (2.6)	5.2 (2.5)	.307

t test. STAI-Y = State-Trait Anxiety Inventory-form Y; COPE = Coping Orientation to Problems Experienced.

The Shapiro-Wilk test was used to assess normality of variables. Correlation analysis between the Bruxoff index (ie, number of SB episodes per hour of sleep [from here on referred to as "SB index"]) and the scores in the psychological questionnaires was performed. Also, based on previous suggestions that subjects with high (overmedian) or low (undermedian) psychological impairment may have a different amount of sleep-time jaw muscle activity,[15] a comparison was performed between the SB indexes of the so-defined groups using *t* test. In addition, data concerning the high or low psychological scores were cross-tabulated with the presence or absence of SB.[22] Phi coefficients were assessed. Level for statistical significance was set at $P \leq .05$, with Bonferroni correction for multiple comparison, when needed. All statistical procedures were performed with the software SPSS 21.0 (IBM).

Results

Based on automatic software analysis, the mean (± SD) SB index was 4.8 ± 2.6 (range 0.4 to 10.9). Of the 36 subjects taking part in the study, 14 (38.8%) recorded a SB index score higher than 4 and were thus classified as sleep bruxers.

Mean scores (± SD) in the state anxiety and trait anxiety scales were 38.2 ± 10.1 and 39.8 ± 9.0, respectively. Mean scores in the COPE scales were 29.9 ± 8.0 for social support, 23.3 ± 5.6 for avoidance strategies, 31.8 ± 4.3 for positive attitude, 34.3 ± 5.5 for problem solving, and 17.4 ± 3.7 for turning to religion.

All of the variables had a normal distribution (Shapiro-Wilk statistics ranging from 0.938 to 0.970; $P > .05$).

Correlation analysis showed that the SB index was not correlated with any of the psychological scales (Table 1). As for the specific items, the Bonferroni-corrected analysis showed a significant correlation with the trait anxiety item "I become tense and upset when I think about my present concerns" as well as with the COPE avoidance strategy items "I refrain from doing anything as long as the situation permits" and "I refuse to believe that it happened." No significant correlations were found for the state anxiety items. The *r* values of significant correlations ranged from 0.393 to 0.458 (Table 2).

Subjects with high psychological scores showed a slight tendency to have a higher number of SB episodes, but differences with respect to subjects with low psychological scores were not significant (Table 3). Similarly, there were no significant differences

Table 4 Prevalence of SB in Subjects with High or Low Scores in the Various Psychological Scales and Phi Correlation Values

Psychological scale	Prevalence of SB in subjects with high scores	Prevalence of SB in subjects with low scores	Phi (*P*)
STAI-Y: State anxiety	61.1	16.6	0.456 (.006)
STAI-Y: Trait anxiety	55.0	18.7	0.369 (.027)
COPE: Social support	58.8	21.0	0.387 (.020)
COPE: Avoidance strategies	31.2	45.0	−0.140 (.400)
COPE: Positive attitude	44.4	33.3	0.114 (.494)
COPE: Problem solving	31.2	45.0	−0.140 (.400)
COPE: Turning to religion	40.0	38.0	0.019 (.908)

STAI-Y = State-Trait Anxiety Inventory-form Y; COPE = Coping Orientation to Problems Experienced.

in the mean psychological scores of SB vs nonSB subjects.

Cross-tabulations of subjects with SB and with high scores (overmedian) or low scores (undermedian) for the various psychological measures revealed some significant correlations with the presence of SB. Significant correlations were found for state anxiety scores (Phi = 0.456; $P = .006$), trait anxiety scores (Phi = 0.369; $P = .027$), and social support (Phi = 0.387; $P = .020$) (Table 4).

Discussion

Knowledge of the relationship between SB and psychological factors is limited, especially due to the controversial role of anxiety, depression, and stress.[12] Inconclusive findings are likely due in part to the different approaches to diagnosing SB, as exemplified by the association between stress and bruxism that was hypothesized in an early EMG study[7] and was not replicated in more recent papers.[8–11] In short, it seems that the results of studies adopting EMG measurement and/or sleep laboratory equipment do not support the observations of investigations using a clinical and/or self-report diagnosis of bruxism.[12] There are different possible explanations for such findings, which may be due to problems in studying bruxism clinically or anamnestically based on, for instance, pain symptoms or the concurrent presence of different psychological disorders and bruxism forms.[29–34]

A couple of years after the systematic review by Manfredini and Lobbezoo,[12] an investigation in healthy young adults suggested that the duration of sleep-time masticatory muscle activity, as identified by the total work produced by the four main jaw muscles measured with a four-channel home-based EMG recording, may be related to trait anxiety.[16] This study has remained unique in its kind so far, likely due to the technologic and logistic difficulties of performing such investigations.

The present study aimed to gather further data on the topic by adopting a recently introduced device for the combined sleep-time measurement of bilateral masseter EMG activity and ECG in the home environment.[17,23] The study hypothesis was that the so-detected SB index is correlated with an individual's anxiety and coping.

In general, the findings only partly support the study hypothesis. There was an absence of correlation between the SB index and the scores in the three psychological features under investigation; state anxiety, trait anxiety, and coping. Nonetheless, there were some interesting findings. First, the correlation analysis with specific items showed that personality features such as those unveiled by the affirmations "I become tense and upset when I think about my present concerns," "I refrain from doing anything as long as the situation permits," and "I refuse to believe that it happened" are associated with high SB activity. This may indicate that sleep-time masseter activity is associated, at least in part, with an avoidance personality pattern. This observation supports suggestions from previous reports on clinically and self-reported diagnosed bruxism that assessed the personality traits of subjects with bruxism behavior.[10,29]

Second, the number of SB episodes per hour in subjects with high anxiety scores was higher than subjects with low anxiety scores, although not significantly. This finding confirms a previous observation that individuals with high anxiety levels show a higher amount of jaw muscle work during sleep.[16] Results from that preliminary investigation showing that most of this activity is performed within the first 2 hours of sleep could not be replicated here due to the automatic software scoring adopted in this study. Future studies on manual scoring of EMG data are needed to verify the muscle activity per hour–increment.

Third, cross-tabulations of data concerning the presence or absence of SB with respect to the presence or absence of high psychological scores showed significant correlations with state anxiety, trait anxiety, and social support coping strategy. While it

is noteworthy that some features of coping may be related to SB, it is also important that the SB-psyche relationship affects anxiety as a whole. Indeed, both transient anxiety levels (ie, state anxiety) and personality features (ie, trait anxiety) are equally related with the presence of SB. Such a relationship was hypothesized decades ago,[7] but it was never confirmed by the very few studies on the argument that adopted a definitive SB measurement.[12]

The above suggestions should represent a starting point for future studies taking into account the limitations of this present investigation. In particular, in light of the emerging evidence that SB is an umbrella term that includes very different motor phenomena with potentially different etiologies and clinical meanings,[1,32,34] it is plausible that a discrimination between the various types of SB will help researchers delve more deeply into the assessment of the SB-psyche relationship as well. Full-night PSG with audio-video recordings and performing a concurrent evaluation of sleep apnea or other sleep disorders are still required for a definitive diagnosis of SB. In addition, the inclusion of larger sample sizes and multiple observation points that take into account the time-variant nature of SB may be other suitable strategies for increasing the internal validity of findings.[35,36]

Conclusions

This investigation was designed to test the hypothesis that in a population of young healthy adults, there is a correlation between some psychological features (ie, state anxiety, trait anxiety, and coping capability) and SB, as diagnosed with a portable EMG/ECG recorder in a home environment. The findings support the study hypothesis only in part. On one hand, there was an absence of correlation between the SB index and the scores in the three psychological features under investigation; on the other hand, the correlation with some specific questionnaire items may indicate that sleep-time masseter activity is associated, at least in part, with an avoidance personality pattern. In addition, cross-tabulations of data concerning the presence or absence of SB with respect to the presence or absence of high psychological scores showed that SB prevalence was significantly correlated with high state anxiety, trait anxiety, and social support coping strategy scores.

Taken together, the findings confirm the absence of a clear-cut relationship between SB and psychological factors. Studies with multiple observation points and that take into account the differential diagnosis of SB motor activities are warranted.

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