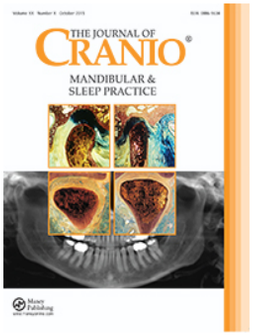

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CLINICAL PRACTICE

Awake bruxism frequency and psychosocial factors in college preparatory students

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ABSTRACT

Objective: To assess the frequency of reported masticatory muscles activity during wakefulness (i.e., awake bruxism [AB]), levels of anxiety, depression, stress, and the oral health-related quality of life (OHRQoL) in college preparatory students.

Methods: Sixty-nine college preparatory students participated in the study. AB was evaluated by the Oral Behaviors Checklist (OBC) and a smartphone-based ecological momentary assessment (EMA; [Bruxapp®]). Anxiety and depression were measured by the Hospital Anxiety and Depression Scale, stress was evaluated by the Perceived Stress Scale, and OHRQoL was obtained by The Oral Health Impact Profile-14. Data were analyzed by Pearson's correlation coefficient ($\alpha = 0.05$).

Results: The average EMA-reported frequency of AB behaviors was 38.4%. Significant correlations were found between AB and the OBC, anxiety, depression, stress, and OHRQoL ($p < 0.001$).

Conclusion: College preparatory students demonstrated moderate frequency of AB, which was significantly correlated with psychosocial factors.

KEYWORDS
Bruxism; Bruxapp; youth; quality of life; anxiety; stress

Introduction

Bruxism is a behavior characterized by clenching and/or grinding of teeth, and/or by bracing or thrusting of the jaw muscles [1,2]. According to the most recent international expert consensus [1], bruxism may have two circadian manifestations: sleep and awake bruxism (AB).

AB has a multifactorial etiology, with an interaction of biological and psychosocial factors [3]. Genetics, environment, and lifestyle factors have been associated with increased susceptibility of AB occurrence in different age groups [4]. Literature shows that reports of this behavior may occur in approximately 22–36% of the population [5,6], with higher prevalence in younger individuals [7]. Moreover, it is associated with increased presence of painful TMD, which might reduce quality of life [8].

Some authors [9] demonstrated high prevalence of TMD signs and symptoms in college preparatory students, which were associated with emotional tension, anxiety, and oral parafunctions. For instance, around 53% of subjects aged between 16 and 19 years have shown at least one sign and/or symptoms of TMDs [10,11]. The college entrance exam is a highly competitive environment and is usually accompanied by social and/or family pressure, being considered an extremely stressful period. Consequently, anxiety, stress, and other emotional disorders are commonly found in this group.

Emotional factors may induce AB, and higher frequencies of this behavior could lead to orofacial pain, which would, cyclically, worsen psychological symptoms. Thus, it is relevant to assess such factors in this young population. A recent study has introduced the concept of smartphone-based ecological momentary assessment (EMA) to quantify AB frequency [12]. This method has been used in several clinical fields [13,14], providing relevant real-time data collection during the day, based on the natural environment of each individual. Thus, such an approach has been successfully proposed for AB assessment.

Although previous studies [15–17] have tried to associate the presence of oral parafunctions with the academic stage (high school, undergraduate, graduate), the correlation between AB frequency and psychological factors has not been described. Therefore, this clinical study aimed to evaluate AB frequency in college preparatory students and

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its correlation with levels of anxiety, depression, stress, and oral health-related quality of life (OHRQoL).

Materials and methods

Experimental design

This was a cross-sectional study that correlated AB frequency with levels of anxiety, depression, stress, and OHRQoL in college preparatory students.

Participants were selected without gender or ethical restrictions. To be included in the study, volunteers had to be regularly enrolled in the college preparatory exam course, have a cell phone compatible with the dedicated EMA application, be dentate, and have general good health. Exclusion criteria were any ongoing medical, psychological or pharmacological treatment; report of TMD or any other orofacial pain conditions; and history of any therapy for AB or TMD in the past 12 months. Sample size calculation indicated that a minimum of 39 participants would be sufficient to achieve a correlation of 0.5, considering $\beta = 0.1$ (power 90%) and $\alpha = 0.05$ (BioEstat software 5.3; Mamirauá Institute, Belém, Pará, Brazil).

All invited volunteers received a detailed explanation regarding the aim of the study and signed a consent form, which was approved by the local Ethics Committee (CAAE: 19038619.7.0000.5418). After selection, participants answered the questionnaires and were instructed to use the EMA app for seven days.

AB assessment

AB frequency was obtained by a self-reported questionnaire and by the EMA. Initially, the volunteers were asked to answer 19 questions of the Oral Behaviors Checklist (OBC)][18], which are based on the frequency of certain behaviors during wakefulness in the last month.

The smartphone app, Bruxapp (BruxApp Team, Pontedera, Italy), was used for the EMA evaluation of AB activities. This method allows real-time data collection in the natural environment of each volunteer, minimizing the occurrence of attention biases due to the immediate recall [19–21]. Following the app installation on volunteers' mobile phones, the software was set for the *Research* version that releases 20 alerts per day, for seven days. To limit expectation bias, Bruxapp was programmed to send the alerts at random intervals, which could vary from 8 h to 12 h and from 14 h to 22 h daily.

After each alert, the volunteer was instructed to report how the muscles and/or teeth were at that moment: relaxed, teeth contact, teeth clenching, teeth grinding, or jaw clenching without teeth contact, i.e., mandible bracing.

Psychological assessment

The Portuguese version of the Hospital Anxiety and Depression Scale (HADS) [22] was used to measure anxiety and depression levels. This scale has 14 queries: 7 questions are related to anxiety symptoms, and 7 questions are regarding depression. HADS questions address fears, insecurities, joy, slowness, and restlessness, among others. For each item, the respondents indicated how often they experienced each situation. Each question could be scored from 0 to 3, leading to a maximum score of 21 points. Scores from 0 to 7 indicated no anxiety/depression, 8 to 10 mild anxiety/depression, 11 to 14 moderate anxiety/depression, and 15 to 21 severe anxiety/depression.

Stress levels were evaluated by using the Perceived Stress Scale (PSS) [23]. The PSS assessed the individual's perception of how unpredictable and uncontrollable life events were in the past month. It consists of a 10-item questionnaire answered on a 5-point Likert-type scale, ranging from never to always [23]. The total score can range from 0 to 40, with results closer to 40 indicating higher stress levels.

To measure the impact of oral conditions on volunteers' quality of life, the Oral Health Impact Profile (OHIP-14) [24] was used. The OHIP-14 involves seven conceptual dimensions of oral health: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. The answers may vary among "never," "a few times," "occasionally," "often," and "very often," with scores ranging from 0 to 4, respectively. The higher the score, the more negative the OHRQoL.

Statistical analysis

The collected data were evaluated by means and frequencies. To estimate AB frequency obtained by the Bruxapp, the sum of positive replies to teeth contact, teeth clenching, teeth grinding, and mandible bracing was calculated. Then, the percentage was obtained based on the total alerts replied to during the seven valid days of evaluation. Pearson's correlation coefficient was used to verify the correlation between the total AB frequency, all possible AB behaviors evaluated by the application, and the OBC score. The correlations between the total AB frequency and levels of anxiety, depression, stress, OHRQoL, and participants' sex were also tested. Moreover, the independent *t*-test

was used to compare all the studied variables according to the sex. All statistical analysis were performed using SPSS 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY, USA), with a significance level of 5%.

Results

Seventy-eight (n = 78) of the 88 college preparatory students initially screened met the inclusion criteria and were invited to participate in the study. All volunteers answered the questionnaires and were instructed to use the Bruxapp® for one week. The day was considered valid for AB assessment if the participants replied to at least 60% of the alerts. If they failed to achieve this target, additional days were automatically added by the App until reaching the target of seven valid days. However, nine participants did not reply to the minimum of 12 alerts per day and were no longer willing to participate, which led to their exclusion from the study (Figure 1). Thus, 69 volunteers comprised the final sample, and participants spent from 7 to 15 days to complete the AB assessment. The selected volunteers had a mean age of 18.6 ± 1.5 years (72.5% females).

The average frequency of AB during the seven days was 38.4% (minimum 2.2%, maximum 90.6%). AB frequency was accounted summing the positive replies to mandibular bracing, teeth contact, teeth clenching, and teeth grinding (Figure 2). Considering the individual frequency of these oral conditions, teeth contact represented 18.6% of the total alerts, followed by mandibular bracing. Teeth grinding was the least frequent behavior, accounting for 0.8% of the positive alerts during the seven days.

Correlation coefficients between OBC scores and the Bruxapp® data are shown in Table 1. Statistically significant correlations were found for, teeth contact, and teeth clenching conditions, as well as the total AB frequency.

The mean values of the HADS, PSS, and OHIP-14 questionnaires and their correlation with AB frequency are shown in Table 2. In addition, participants' sex had a weak and significant correlation ($r = 0.291$; $p = 0.015$) with AB episodes, with higher prevalence in female students. The mean scores distribution of the evaluated variables according to the participants' sex can be seen in Table 3. Besides AB frequency, no outcome was statistically different between the sexes.

Discussion

This research evaluated the prevalence and factors associated with AB in healthy young college preparatory students, using a smartphone application for EMA evaluation. According to the literature [19], EMA allows data collection on AB and leads to patients' understanding of the behavior [21], enabling possible changes [20].

The average frequency of AB during the seven days was 38.4%. Recent studies assessing AB in healthy young people have shown a similar prevalence, either by using EMA [19] or self-reported data [25], finding a prevalence of 28.3% and 33.7%, respectively. These studies evaluated dental students and considered an average frequency of around 30% for AB episodes over one week as normal behavior in healthy young adults. Conversely, considering that undergraduate students are likely to experience stressful periods that may influence their psychological well-being, this

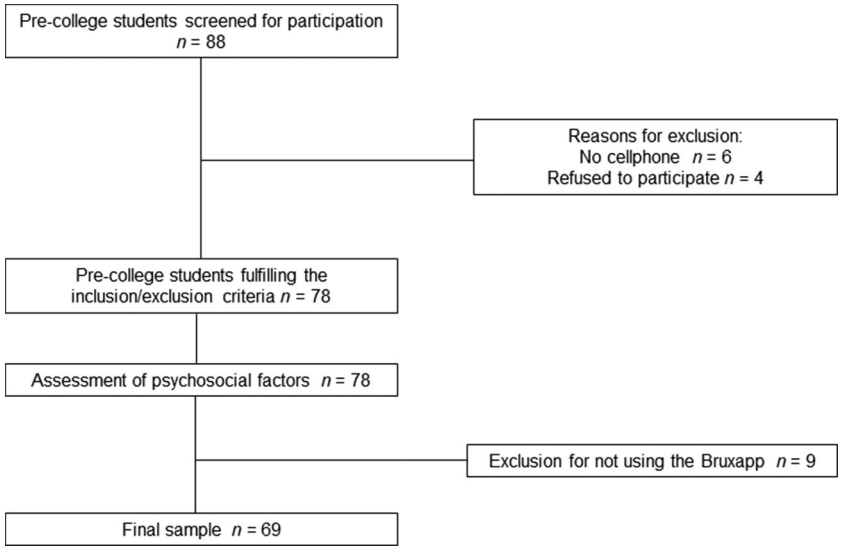

Figure 1. Flowchart of volunteers' selection.

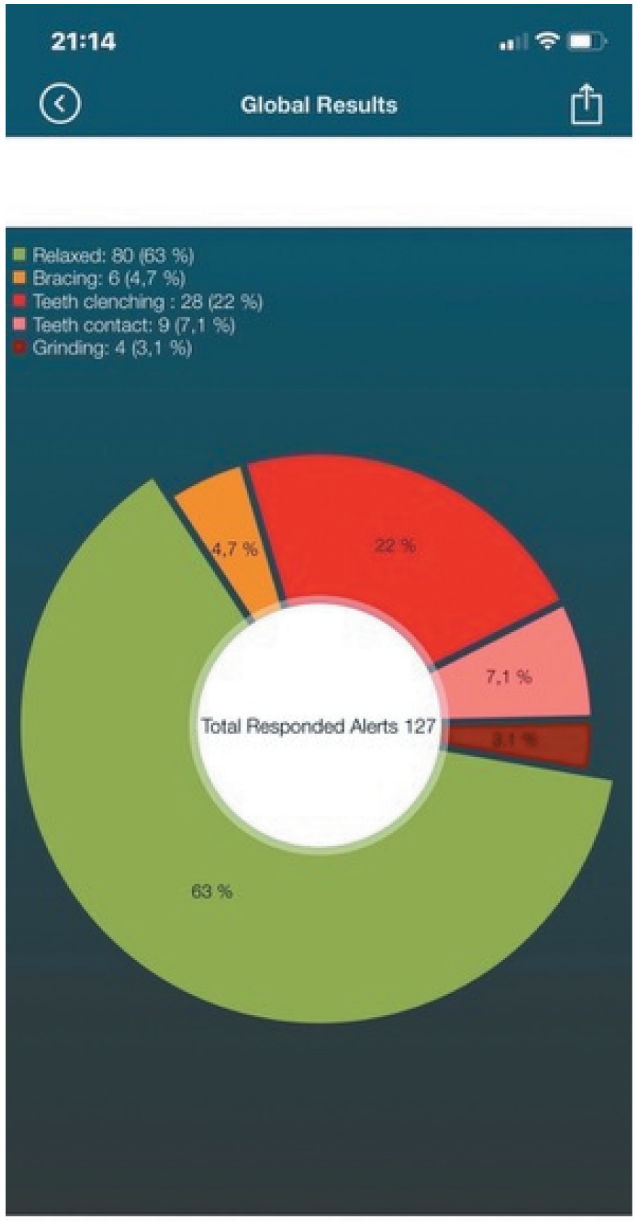

Figure 2. Screenshot example of Bruxapp records after seven days of evaluation. The patient reported 63% muscle relaxed condition, and the total Awake Bruxism (AB) frequency is the sum of all other behaviors.

Table 1. Mean (SD) frequencies of each AB behavior evaluated by the Bruxapp® application, and their correlation with the Oral Behaviors Checklist.

	Mean (SD)	*r*	*p-value*
Teeth contact	18.61 ± 13.7	0.375	0.001
Clenching	5.89 ± 8.0	0.384	0.001
Grinding	0.82 ± 2.9	0.044	0.718
Mandible bracing	13.11 ± 16.7	0.220	0.070
Total AB frequency	38.44 ± 24.4	0.491	< 0.001

SD: Standard deviation; AB: Awake bruxism.

Table 2. Mean scores (SD) of the assessed outcomes and their correlation with AB frequency.

	Mean (SD)	*r*	*p-value*
Anxiety	10.33 ± 4.4	0.433	< 0.001
Depression	6.61 ± 3.2	0.426	< 0.001
Stress	23.80 ± 6.0	0.485	< 0.001
OHRQoL	16.90 ± 11.0	0.478	< 0.001

SD: Standard deviation; AB: Awake bruxism; OBC: Oral Behaviors Checklist; OHRQoL: Oral Health-related Quality of Life.

frequency could be lower when assessing the general population. Therefore, the average frequency found in the present study could be considered high if compared to other groups of healthy adults. Thus, further studies with non-convenience samples should be conducted.

The most frequent behavior reported in this study was "teeth contact", followed by "mandible bracing", while "teeth grinding" had the lowest prevalence throughout the evaluation period. These results are in agreement with Bracci et al. [19] and could be explained

Table 3. Mean scores (SD) of each variable according to sex distribution.

	Male (n = 19)	Female (n = 50)	*p-value*
OBC	26.84 ± 9.7	30.18 ± 8.7	0.173
Anxiety	9.37 ± 4.5	10.70 ± 4.4	0.270
Depression	6.11 ± 3.2	6.80 ± 3.2	0.419
Stress	22.53 ± 7.1	24.28 ± 5.5	0.280
OHRQoL	13.58 ± 11.9	18.16 ± 10.5	0.123
Age	18.26 ± 1.0	18.72 ± 1.6	0.255
Total AB frequency	27.00 ± 21.3	42.79 ± 24.3	0.015

SD: Standard deviation; OBC: Oral Behaviors Checklist; OHRQoL: Oral health-related Quality of Life; AB: Awake bruxism.

by the higher perception of tooth contact compared to other behaviors. In addition, previous knowledge that bruxism is synonymous with tooth contact might induce volunteers' response.

AB was also assessed by the OBC, which showed a moderate correlation with the smartphone-based data (r = 0.491). Self-reported AB has been considered a reliable parameter to detect tooth clenching and/or nonfunctional activities of masticatory muscles [26]. However, the moderate correlation indicates that it is a useful tool for a general overview of the possible presence of behaviors, but it does not seem to be very accurate for AB assessment. Indeed, correlation levels with each specific behavior were lower. Teeth contact and clenching had a weak but significant correlation with the OBC; whereas, grinding and muscle bracing did not show a statistically significant correlation. These findings are of particular importance, considering that muscle bracing is one of the most clinically relevant manifestations of AB [19,27]. Sustained contraction may lead to muscle fatigue and pain as well as TMJ overload, and the fact that the patients are not able to recognize it with the OBC questionnaire may suggest that it is difficult to control without an EMA approach.

It has to be emphasized that the OBC does not have a specific guideline for score interpretation. However, a previous report comparing individuals with and without TMD showed that scores above 25 points would occur 17 times more often in TMD patients, representing a risk factor for TMD onset [28].

This study is the first in the literature to correlate psychological factors (i.e. anxiety, depression, and stress) with AB behaviors during seven days, finding a positive and significant correlation between them. This result corroborates previous reports demonstrating the role of psychosocial components on non-functional muscle activities [4,18,29]. It is known that AB might be the result of a transitory anxious reaction to stressful daily events, and stress sensitivity is one of the domains in the anxiety spectrum that mostly differentiates bruxers from non-bruxers [4]. A previous study showed that subjects with higher emotional stability or objectivity were less likely to clench and/or grind their teeth [30]. Considering the current findings, the average scores obtained for both anxiety and stress levels represent approximately half of the maximum punctuation of the questionnaires. Thus, it could be presumed that the participants had moderate anxiety and stress levels, which justifies the correlation with the mean frequency of AB as well as the slightly higher AB frequency values with respect to other smartphone-based studies.

Moreover, the association between AB and depressive mood has been supported [31] since patients with disturbances in the dopamine receptors (i.e. bipolar patients) were more likely to be bruxers [32]. Thus, AB is thought to be the result of emotional tension or psychosocial disorders that force the subject to respond with a prolonged contraction of the masticatory muscles. In addition, the OHRQoL was significantly correlated with AB and could be explained by the impact of these associated factors with the individual perception of oral health [33]. A recent study comparing pain-free patients with and without self-reported AB found higher values of anxiety, depression, and OHRQoL in individuals who reported AB [34]. The association between AB, psychosocial, psychopathological, and genetic factors has been previously reported [6,29], which endorse the correlations of the present study.

Regarding the participants' gender, significantly higher AB values were found in females, who had approximately 1.5 times more AB episodes than males. Although the absence of gender differences for both AB and sleep bruxism has been reported [6,19], Serra-Negra et al. [35] also found a higher occurrence of AB in women. This finding may be explained by the fact that females tend to be more sensitive to stress [36].

It is important to highlight that data collection was held in only one city, a few weeks preceding the college exams. Thus, this sample could not represent the entire population of college preparatory students. However, considering that Brazilian Universities adopt the National High School Exam, which is applied on the same day around the country, it is reasonable to consider that most college preparatory students were dealing with similar challenges and would have comparable psychosocial aspects.

Another possible limitation of this study was the non-homogeneous compliance to reply to at least 60% of the Bruxapp® alerts per day. Thus, volunteers spent from 7 to 15 days to achieve the minimum required of 12 alerts/day, which could cause tiredness in participating. Although self-reported questionnaires assessing AB and TMD, e.g. Oral Behaviors Checklist and the Diagnostic Criteria for TMD, screen the history of symptoms in the last 30 days, using EMA to

evaluate for this same amount of time would not be useful for clinical and research settings due to a strong decrease in compliance. The smartphone-based EMA is an easy-to-use approach, and a recent study found no differences in compliance on workdays and weekends [27]; however, some specific groups are not able to use a smartphone during the day. Thereby, it would be relevant to develop other tools, e.g., watches, to assess AB frequency.

It is important to emphasize that socioeconomic factors have an important influence on psychosocial aspects. Thus, it would have been relevant to evaluate several environmental issues, such as family relationships and income, and housing conditions. In addition, data on individual habits, such as regular practice of physical exercises, leisure habits, consumption of cigarettes, alcoholic beverages, or any psychoactive drugs, could be useful to refine knowledge on AB frequency. Moreover, the evaluation of the dental status could also deliver relevant information since this factor could affect the OHRQoL. Therefore, future studies should address those aspects to obtain a detailed evaluation of factors influencing the mental health and behavior of individuals.

Conclusion

College preparatory students had a moderate frequency of AB episodes, which was significantly correlated with psychological factors.

Disclosure of interest

The authors report no conflict of interest.

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