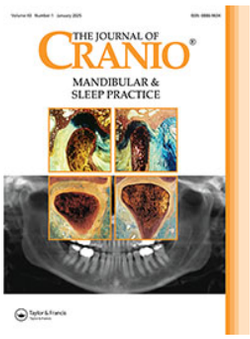

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PEDODONTICS

Association between the severity of possible sleep bruxism and possible awake bruxism and attrition tooth wear facets in children and adolescents

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ABSTRACT

Objective: To evaluate the association between the severity of possible sleep bruxism (PSB) and possible awake bruxism (PAB) and attrition tooth wear facets (ATWF) in children/adolescents.
Methods: Four hundred-thirty-four children/adolescents enrolled in schools in Lavras, Brazil, participated in this cross-sectional study. Caregivers answered a questionnaire about their childrens' PSB. Children/adolescents answered a questionnaire about the occurrence of PAB.
Results: ATWF among individuals without PSB and PAB was lower than those with moderate/severe PSB ($p = 0.038$) and moderate/severe PAB ($p = 0.003$). ATWF in anterior teeth was lower among individuals without PSB compared to those with mild ($p = 0.015$) and moderate/severe PSB ($p = 0.032$). ATWF in posterior teeth was lower among individuals without PAB compared to those with mild ($p = 0.046$) and moderate/severe PAB ($p = 0.017$).
Conclusion: The number of attrition tooth wear facets is proportional to the severity of PSB and PAB.

KEYWORDS
Bruxism; sleep bruxism; child; adolescent; tooth wear; tooth attrition; signs and symptoms

Introduction

Bruxism is defined as a behavior characterized by masticatory muscle activity of grinding and/or clenching teeth. This behavior has two circadian manifestations: sleep bruxism (SB) and awake bruxism (AB) [1]. SB is defined as a rhythmic (phasic) or non-rhythmic (tonic) masticatory muscle activity during sleep, whereas AB is a masticatory muscle activity during wakefulness characterized by repetitive or prolonged contact of the teeth, as well as bracing and thrusting [1]. There are three distinct definitions of bruxism, according to the International Consensus on Bruxism: possible SB/AB, when the diagnosis is based on a positive report from the patient or parents/guardians; probable SB/AB, when the diagnosis is based on the presence of clinical signs with or without a positive report; and definite SB/AB, when there is a positive instrumental evaluation, through polysomnography (PSG), electromyography, or ecological momentary assessment (EMA), with or without a positive report and/or by the presence of clinical signs [1].

The etiology of bruxism is believed to be multifactorial [2] and controlled by the central nervous system [3]. However, its etiology warrants further investigation [4]. An umbrella systematic review found a large disparity in the prevalence of SB among children and adolescents, with SB ranging from 3.5% to 49.6% [5]. According to the literature, the prevalence of AB ranges between 12.4% and 37.3% [6–9].

The effects of bruxism include headaches, tooth wear, and exacerbation of temporomandibular disorders [10]. Masticatory muscle hypertrophy, indentations on the tongue and lip, linea alba on the inner face of the cheek, fractures of restorations, and tooth wear due to attrition are all clinical signs of SB and AB [1,11].

Bruxism can cause tooth wear by attrition [12,13], with wear facets primarily located at the level of the incisal edges, as well as on the cusps of canines and molars [14,15]. Tooth wear provides important information for both the dental and medical fields, as it is an indication of certain health conditions and a result of certain muscle activities [16].

Tooth wear can have a negative impact on a person's health by causing difficult chewing, loss of restorations, tooth sensitivity, pain, compromised aesthetics and, in more severe cases, pulp exposure [12,17,18]. Furthermore, because the dentist is challenged to perform increasingly complex restorations, the treatment can be costly for the patient and difficult to resolve [12]. As a result, it becomes increasingly important that diagnosis and preventive measures for tooth wear are carried

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out in a timely manner [12,19]. In this sense, it is important to note that there are still few studies that compare differences in attrition tooth wear facets (ATWF) characteristics between SB and AB in children and adolescents.

Given the importance of early detection of attrition tooth wear, this cross-sectional population-based study was designed to validate the relationship between the severity of possible sleep bruxism (PSB) and possible awake bruxism (PAB) and ATWF in children and adolescents.

Materials and methods

Ethical aspects

This study was approved by the Research Ethics Committee of the Federal University of Minas Gerais (protocol: #82839718400005149). All participants were informed of the research objectives and participated voluntarily. Parents/guardians and students signed an informed consent form.

Study design and study population

This cross-sectional observational study is nested in a 2018 study [20], in which the sample size was calculated using a prevalence of AB of 37.3%, a confidence interval of 95%, and a margin of error of 5% [8]. Due to cluster sampling, a correction of 1.2 was applied, resulting in an estimated sample of 431 people. To account for potential losses, 20% was added to this amount, resulting in a total of 517 students aged between 8 and 11 years, who went to public and private schools in Lavras, Brazil, as well as their parents/guardians. Lavras is located in southeastern Brazil, with a population of 92,200 and a Municipal Human Development Index of 0.782 [21]. There are 18 municipal schools and 11 private elementary school 1s in the city. The elementary school 1 corresponds to the first to fifth grades, with students aged between 6 and 11 years.

The researchers contacted all schools to determine the number of students enrolled in the age group in 2018/2. In 2018, 3,555 students in grades 3 through 5 were enrolled in public and private schools. Five public and 7 private schools were chosen at random from among the 29 public and private schools in Lavras (MG). The sample distribution was proportional to the total number of children/adolescents enrolled in public and private schools, as well as to the grade level (3^{rd} to 5^{th} grade). The children/adolescents were chosen at random using a two-stage sampling method. Schools were randomly selected in Stage 1, and school classrooms were randomly selected in Stage 2; all students in the classrooms were included. Selection was performed with sealed opaque envelopes.

Inclusion and exclusion criteria

The study included literate students who did not use antidepressant or anticonvulsant medications and had no cognitive impairment, neurological, or syndromic disorders [22]. Students' health information was provided by their parents/guardians and the school where they were enrolled.

Pilot study

The methodology was tested in a pilot study with 45 children and adolescents from a public school in Lavras, Minas Gerais, Brazil. Participants in the pilot study were not included in the main study. The pilot study results revealed that no changes to the proposed methodology were required.

Data collection

Calibration

Calibration was carried out to distinguish between attrition and erosive tooth wear. ATWF is characterized by tooth structure losses ranging from minor enamel loss to severe enamel loss [23]. These tooth structure losses occur because of one tooth contacting another, resulting in smooth and corresponding areas on the occlusion surface [12,13,24]. Erosion is caused by acids of intrinsic or extrinsic origin and is characterized by the following clinical signs: shiny and smooth enamel, intact enamel along the gingival margin, and cavities (shell shape) on the occlusal surface of the teeth [12,24,25].

Following this preliminary theoretical instruction, several photographs of tooth wear were evaluated. The inter-examiner assessments were carried out in accordance with the parameters of a gold standard researcher (inter-examiner agreement, Kappa = 0.69 to 0.76). The assessment was repeated one week later (intra-examiner agreement, Kappa = 0.71 to 0.82). The outcome was satisfactory [26].

Data collection instruments

Questionnaire directed to parents/caregivers

A questionnaire about the occurrence of SB report was sent to parents/guardians so that they could respond at home.

Questionnaire directed to children/ adolescents, and intraoral clinical evaluation

Children and adolescents completed a questionnaire that included a question about the presence of AB, and the questions were read aloud by the researcher to aid comprehension. This questionnaire was administered in a school setting on a previously scheduled day in a private room.

Furthermore, the ATWF intraoral clinical evaluation of children and adolescents was carried out in a separate room. The ATWF analysis followed the criteria of a previous study, in which the degrees of tooth structure loss were evaluated, ranging from light enamel wear (grade 1) to a loss of crown height ≥2/3 (grade 4) [23]. When there was a grade 1 to grade 4 loss of structure, wear was classified as absent or present. All dental components were examined. Teeth with caries or extensive restorations, on the other hand, were excluded from the study.

Assessment of possible sleep bruxism (PSB) and possible awake bruxism (PAB)

The report of the parents/guardians was used to verify the PSB frequency, and the following question was asked: "Have you ever observed if your child grinds their teeth during sleep?". There were three possible responses: "no," "yes, sometimes," and "yes, often" [1,27].

The following question was used to verify the frequency of PAB in children and adolescents: "Did you grind and/or clench your teeth during the day in the last two weeks?" There were three possible responses: "no," "yes, sometimes," and "yes, often" [1,27].

Based on the frequency of reporting of grinding and/or clenching teeth, PSB and PAB were classified as absent, mild, and moderate/severe. The "yes, sometimes" report was classified as possible mild SB/AB, and the "yes, often" report was classified as possible moderate/severe SB/AB.

Statistical analysis

The statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS Inc., version 21.0, Armonk, NY, USA). At first, descriptive analysis was performed. The Kolmogorov-Smirnov test revealed that the normality assumption had not been confirmed, so the Kruskal-Wallis test was used to assess the association between ATWF, PSB, and PAB, with a significance level of $p < 0.05$. In addition, the post hoc, Dunn test, was performed on all analyses that had statistical significance to show where there is a difference between the groups.

Results

A total of 504 children and adolescents were invited to participate in the study; however, 70 were excluded due to loss of information or refusal to participate, forming a final sample of 434 children and adolescents. The mean age of the participants was 9.14 years (DP ± 1.00). The majority of students (51.8%) were female, while 209 (48.2%) were male. Most participants (n = 319; 73.5%) attended public schools, while 115 (26.5%) attended private schools. Mild PSB had the highest percentage, with 136 (31.3%), compared to moderate/severe PSB, with 29 (6.7%). PSB was not present in a high percentage of the sample (n = 268; 61.8%). In terms of PAB, 159 (36.6%) had mild PAB, 31 (7.1%) had moderate/severe PAB, and 244 (56.2%) did not have PAB.

The Kruskal-Wallis test revealed that PSB has an effect on tooth wear [$x^2(2) = 9.856$]; $p = 0.007$ (Table 1). Post hoc analysis revealed differences between the absent and moderate/severe groups ($p = 0.038$) (Table 1). Regarding PAB, the test revealed an association between PAB and tooth wear [$x^2(2) = 12.579$]; $p = 0.002$. The post hoc analysis also revealed differences in the absent and moderate/severe groups ($p = 0.003$) (Table 2). When compared to those without bruxism, children and adolescents with moderate/severe PAB and moderate /severe PSB had a greater number of teeth with ATWF.

In terms of wear distribution, the test revealed that PSB has an effect on tooth wear in anterior teeth [$x^2(2) = 12.249$]; $p = 0.002$ (Table 3), and the post hoc analysis revealed differences between the absent and mild ($p = 0.015$) and absent and moderate/severe ($p = 0.032$) groups (Table 3). There was no statistical

Table 1. Association between possible sleep bruxism (PSB) and number of teeth with attrition tooth wear facets (ATWF).

PSB	N	Median	Minimum	Maximum	*p*
Absent	268	13.5[a]	2	23	
Mild	136	14.5[ab]	5	24	**0.007**
Moderate/ severe	29	16[b]	7	21	
Total	433				

Kruskal-Wallis test; Significance level at $p < 0.05$. Bold values represent statistically significant association. Groups with different letters were statistically significant: The post hoc test showed difference between absent and moderate/severe groups ($p = 0.038$).

Table 2. Association between possible awake bruxism (PAB) and number of teeth with attrition tooth wear facets (ATWF).

PAB	N	Median	Minimum	Maximum	*p*
Absent	244	13[a]	2	23	
Mild	159	14[ab]	3	24	**0.002**
Moderate/ severe	31	15[b]	5	22	
Total	434				

Kruskal-Wallis test; Significance level at $p < 0.05$. Bold values represent statistically significant association. Groups with different letters were statistically significant: The post hoc test showed difference between absent and moderate/severe groups ($p = 0.003$).

Table 3. Association between possible sleep bruxism (PSB) and number of anterior teeth with attrition tooth wear facets (ATWF).

PSB	N	Median	Minimum	Maximum	*p*
Absent	268	6[a]	0	12	
Mild	136	7[b]	0	12	**0.002**
Moderate/ severe	29	8[b]	2	12	
Total	433				

Kruskal-Wallis test; Significance level at $p < 0.05$. Bold values represent statistically significant association. Groups with different letters were statistically significant: The post hoc test showed difference between absent and mild group ($p = 0.015$) and absent and moderate/severe group ($p = 0.032$).

Table 4. Association between possible sleep bruxism (PSB) and number of posterior teeth with attrition tooth wear facets (ATWF).

PSB	N	Median	Minimum	Maximum	*p*
Absent	268	8	0	12	
Mild	136	8	1	12	0.195
Moderate/ severe	29	9	2	12	
Total	433				

Kruskal-Wallis test; Significance level at $p < 0.05$.

Table 5. Association between possible awake bruxism (PAB) and number of posterior teeth with attrition tooth wear facets (ATWF).

PAB	N	Median	Minimum	Maximum	*p*
Absent	244	7[a]	0	12	
Mild	159	8[b]	0	12	**0.004**
Moderate/ severe	31	9[b]	3	12	
Total	434				

Kruskal-Wallis test; Significance level at $p < 0.05$. Bold values represent statistically significant association. Groups with different letters were statistically significant: The post hoc test showed differences between absent and mild group ($p = 0.046$) and absent and moderate/severe group ($p = 0.017$).

Table 6. Association between possible awake bruxism (PAB) and number of anterior teeth with attrition tooth wear facets (ATWF).

PAB	N	Median	Minimum	Maximum	*p*
Absent	244	6	0	12	
Mild	159	6	0	12	0.077
Moderate/ severe	31	7	2	12	
Total	434				

Kruskal-Wallis test; Significance level at $p < 0.05$.

difference between PSB in the analyzed groups for posterior teeth (Table 4). In terms of PAB, the test revealed that PAB has an effect on tooth wear in posterior teeth [$x^2(2) = 11.202$]; $p = 0.004$ (Table 5), and the post hoc analysis revealed differences between the absent and mild ($p = 0.046$) and absent and moderate/severe ($p = 0.017$) groups (Table 5). In terms of the anterior teeth, there was no statistical difference in PAB between the groups studied (Table 6).

Discussion

The current cross-sectional study looked at the relationship between the severity of PSB, PAB, and ATWF in children and adolescents. The SB and AB are muscle activities that present attrition tooth wear as a clinical sign [1,11]. It is worth noting that attrition wear can occur on the incisal edges, buccal/lingual surfaces, and occlusal surfaces of teeth [15], resulting in the loss of dental structures such as enamel and dentin [12].

According to the findings of this study, mild PSB has a prevalence of 31.3%, and moderate/severe PSB has a prevalence of 6.7%. These findings are similar to those of Serra-Negra et al. [28], who discovered a prevalence of 35.3% for possible SB in a cross-sectional study conducted in the city of Belo Horizonte, Brazil, with a sample of 652 children aged between 7 and 10 years. These findings are also consistent with those of another study performed with children and adolescents aged between 6 and 12 years, in which 32% of the students had probable SB [29].

In terms of PAB, this study found that 36.6% of children and adolescents had mild PAB, and 7.1% had moderate/severe PAB, which is similar to data from Winocur et al. [9], which discovered a prevalence of 34.5% of possible AB in a sample of adolescents. The results of this study also corroborate the findings of a research conducted by Rubin et al. [8], in which the sample included children and adolescents aged between 6 and 17 years, and the prevalence of possible AB was found to be 37.3%.

Some surveys on SB and AB, on the other hand, found results that contradicted the current study. Previous research found a prevalence of 22.2% [30] and 9.2% for SB [7] and 19.2% [7] and 8.7% for AB [31]. These disparities in prevalence are due to differences in the diagnostic protocol for SB and AB [7], the age range assessed, and the sample size included in the studies [20].

According to the findings of this study, children and adolescents with moderate/severe PSB had a greater number of teeth with ATWF than those who did not present PSB. In terms of PAB, children and adolescents with moderate/severe PAB had a greater number of ATWF than those without PAB. In the study conducted by Li et al. [32], 90 % of the sample who reported teeth grinding and clenching had at least one tooth presenting tooth wear, with severe tooth wear being associated with SB but not with AB. Both self-reported SB and AB were significantly associated with attrition tooth wear in posterior and anterior teeth in the study by Tsiggos et al. [33]. However, no significant association between SB and attrition tooth wear was found in a recent study using polysomnographic parameters to diagnose SB [34], and

the evidence of the relationship between tooth wear and AB is considered sparse in the literature [32].

Individuals with mild PSB and moderate/severe PSB had a greater number of anterior teeth with ATWF than those without PSB when it came to the distribution of wear in the dental arch. Scores of Rhythmic Masticatory Muscle Activity (RMMA) on electromyography can be used to quantify SB episodes [35–37]. They are classified as phasic (3 episodes or more, each lasting 0.25 to 2.0 s), tonic (sustained contraction > 2 s), or mixed (phasic and tonic) [35–38]. Patients with SB had three times the frequency of RMMA as patients without SB, and this activity was associated with teeth grinding in 45% of cases [35,38]. Based on electromyographic recordings, more than 88% of SB episodes were classified as phasic or mixed type [37]. Thus, the phasic and mixed types of this activity may account for the higher number of anterior teeth with ATWF in children and adolescents with mild and moderate/severe PSB. Due to increased teeth grinding activity, wear on anterior teeth can be substantial.

In terms of PAB, children and adolescents with mild PAB and moderate/severe PAB had more posterior teeth with ATWF than those without PAB. AB is thought to be characterized primarily by masticatory muscle contraction [6], as well as repetitive contact of the teeth [1]. This activity may occur due to the overloading of masticatory muscles such as the masseter and temporalis [39]. Therefore, a greater force load can be deposited on the posterior teeth, causing tooth wear.

The damage caused by tooth wear is irreversible, and it is believed that it can compromise childrens' teeth for the rest of their lives [19]. Thus, it is critical that dentists are aware of this condition and conduct a more thorough assessment of the factors that may be associated with bruxism and tooth wear.

Limitations

There are some limitations to this study. The first is related to the study design; because it is a cross-sectional study, causality cannot be inferred. The second point is about diagnosing possible SB and AB. Currently, PSG is considered the gold standard test for diagnosing SB, and precision laboratory tests, such as electromyography and EMA, are used for diagnosing AB [1]. Finally, the cause of tooth wear is multifactorial. This condition can be caused by a combination of tooth friction, abrasion, and erosion [40]; it can be caused by muscle activity (such as bruxism); or it can be caused by the natural function itself (chewing) [12,13], making the diagnosis of this condition extremely difficult.

This work, on the other hand, has potential. For starters, this study provides a better understanding of tooth wear as a clinical sign of SB and AB. Furthermore, according to the authors' knowledge, this is the first study that provides important information on the distribution of tooth wear by attrition in the dental arch based on the circadian manifestation of bruxism.

Conclusion

There was an association between the severity of PSB and PAB and the ATWF. The location of the ATWF differed, with anterior teeth associated with PSB and posterior teeth associated with PAB.

Disclosure statement

No potential conflict of interest was reported by the authors.

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