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Are mental health problems and depression associated with bruxism in children?

Andréa Coimbra Renner[1], Antônio Augusto Moura da Silva[1], Juliana Dalla Martha Rodriguez[1], Vanda Maria Ferreira Simões[2], Marco Antonio Barbieri[3], Heloísa Bettiol[3], Erika Bárbara Abreu Fonseca Thomaz[1] and Maria da Conceição Saraiva[4]

[1]Public Health Department, Federal University of Maranhão, São Luís, Maranhão, Brazil, [2]Department of Medicine I, Federal University of Maranhão, São Luís, Maranhão, Brazil, [3]Department of Puericulture and Pediatrics, Ribeirão Preto School of Medicine, University of São Paulo, Ribeirão Preto, São Paulo, Brazil, [4]Department of Paediatrics and Social Dentistry, Ribeirão Preto School of Dentistry, University of São Paulo, Ribeirão Preto, São Paulo, Brazil

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Abstract – *Objectives*: Previous studies have found an association between bruxism and emotional and behavioral problems in children, but reported data are inconsistent. The objective of this study was to estimate the prevalence of bruxism, and of its components clenching and grinding, and its associations with mental problems and depression. *Methods*: Data from two Brazilian birth cohorts were analyzed: one from 869 children in Ribeirão Preto – RP (São Paulo), a more developed city, and the other from 805 children in São Luís – SL (Maranhão). Current bruxism – evaluated by means of a questionnaire applied to the parents/persons responsible for the children – was defined when the habit of tooth clenching during daytime and/or tooth grinding at night still persisted until the time of the assessment. Additionally, the lifetime prevalence of clenching during daytime only and grinding at night only was also evaluated. Mental health problems were investigated using the Strength and Difficulties Questionnaire (SDQ) and depression using the Children's Depression Inventory (CDI). Analyses were carried out for each city: with the SDQ subscales (emotional symptoms, conduct problems, peer problems, attention/hyperactivity disorder), with the total score (sum of the subscales), and with the CDI. These analyses were performed considering different response variables: bruxism, clenching only, and grinding only. The risks were estimated using a Poisson regression model. Statistical inferences were based on 95% confidence intervals (95% CI). *Results*: There was a high prevalence of current bruxism: 28.7% in RP and 30.0% in SL. The prevalence of clenching was 20.3% in RP and 18.8% in SL, and grinding was found in 35.7% of the children in RP and 39.1% in SL. Multivariable analysis showed a significant association of bruxism with emotional symptoms and total SDQ score in both cities. When analyzed separately, teeth clenching was associated with emotional symptoms, peer problems, and total SDQ score; grinding was significantly associated with emotional symptoms and total SDQ score in RP and SL. Female sex appeared as a protective factor for bruxism, and for clenching and grinding in RP. Furthermore, maternal employment outside the home and white skin color of children were associated with increased prevalence of teeth clenching in SL. *Conclusions*: Mental health problems were associated with bruxism, with teeth clenching only and grinding at night only. No association was detected between depression and bruxism, neither clenching nor grinding. But it is necessary to be cautious regarding the inferences from some of our results.

Key words: bruxism; child; depression; mental health

Andréa Coimbra Renner, Departamento de Saúde Pública, Universidade Federal do Maranhão, Rua Barão de Itapary, 155 Centro 65020-070, São Luís, Maranhão, Brazil
Tel./Fax: 55 98 33019675
e-mail: rw310@terra.com.br

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Bruxism is a movement disorder characterized by teeth grinding and clenching during sleep (1). In a recent overview, it was classified as an awake or sleep parafunctional activity (2). Bruxism is a habit that can have a negative effect on the quality of life of affected individuals by damaging the teeth, periodontium, facial muscles, and the temporomandibular joint (3–6). This damage can be more

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severe in children because of the structural and morphofunctional characteristics of the deciduous teeth (7).

The reported prevalence of bruxism in children ranges from 6.5% to 49.0% (5, 8–11). Evidences suggest that self-reported bruxism increases with increase of age (12). It is not clear whether this variation reflects true differences in the prevalence or is due to differences in the methods employed, the lack of standardization of evaluation criteria (13), or the fact that studies have not used representative samples of the population. These factors impair the comparison of prevalences between different studies (13).

Some studies have demonstrated an association of bruxism with some psychological disorders such as hyperactivity (14), anxiety (8, 10, 15–17), behavioral disorders, problems of adjustment and learning difficulties (18), behavioral and emotional syndromes (19), and tension (16). However, other studies did not detect an association between anxiety (20), psychiatric disorders (14), and bruxism.

A study conducted in Brazil demonstrated an association between anxiety and bruxism in children with and without headaches (8), and a more recent study reported that the presence of high rates of irritability and anxiety was associated with a higher risk of bruxism in children (21).

Few population studies involving representative samples are available regarding the association between mental health and bruxism in children. Indeed, most studies have been conducted with little control of confounding factors, and with no distinction between grinding and clenching of the teeth. So, the objective of the present investigation was to estimate the prevalence of bruxism and of its components grinding and clenching, and its association with mental problems and depression in two population-based cohort studies of Brazilian children.

Materials and methods

Sample

Data for two cohorts of live-born infants were used; one cohort was from Ribeirão Preto (RP), more developed city, in 1994 and the other was from São Luís (SL), less developed city, in 1997/98. The RP cohort consisted of 2911 residents born at 10 hospitals in the city over a period of 4 months (April–August 1994), which represented 99% of all live births during this period (22). Losses corresponded to <5% of births. The SL cohort consisted of 2541 newborns enrolled in a systematic sample, in which one of each seven births at 10 hospitals in the city was selected randomly from March 1997 to February 1998 (23). Losses due to refusal or to the impossibility of locating the mother occurred in 5.8% of cases. The sample was representative of childbirths in the city, as hospital deliveries represented 96.3% of all city births.

Samples from the two cohorts were followed up at school age. Five birth weight groups were considered for the follow-up study: very low birth weight (VLBW < 1500 g), low birth weight (LBW 1500–2499 g), insufficient birth weight (IBW 2500–2999 g), normal birth weight (NBW 3000–4249 g), and high birth weight (HBW ≥ 4250). Children within the weight ranges with the smallest number of newborns (VLBW, LBW, HBW) were oversampled to increase statistical power. In the two cities, children from the samples were searched for at schools. All parents or the person responsible for a child in the VLBW, LBW, or HBW groups and a fraction of one of three in the IBW and NBW groups were invited to participate in the study by telephone or by post. In SL, after excluding multiple births (n = 50), stillbirths (n = 48), and deaths occurring in the first year of life (n = 65), 926 children were eligible for follow-up. We were able to follow up 673 children from the original sample, which is a follow-up rate of 72.7%. In RP, after excluding multiple births (n = 65) and deaths occurring in the first year of life (n = 47), 1144 children were eligible for follow-up. The follow-up rate was 69.1%.

Because mortality was very high in the group of infants weighing <2500 g, a nonrandom additional sample of infants was recruited for a total of 132 infants in SL and 79 in RP. Only infants whose birth weight and gestational age were confirmed in the maternity hospital registration book, in medical records, or in the health chart of the infant were included in the supplementary sample. Thus, the total follow-up sample consisted of 1674 infants, of which 869 were from RP and 805 from SL.

The power to detect a 10% difference in the prevalence of bruxism among the exposed and nonexposed groups (comparing those with and without mental health problems and depression) is 80%, assuming that the prevalence of bruxism is about 30%. The type I error rate was 5%.

A lower proportion of children born to mothers with ≤4 and ≥9 years of schooling and a higher percentage of preterm births and neonates weighing <2500 or ≥4250 g participated in the follow-up study in SL. There were no differences in the follow-up rate regarding the neonate's sex and maternal parity and marital status. In RP, there was a higher percentage of neonates in the follow-up study who weighed <2500 or ≥4250 g, were preterm neonates, born to married mothers and were born to mothers with no companion or aged ≥20 years. There was no difference in the follow-up rate regarding sex or maternal schooling.

Data collection and instruments for investigation

Anthropometric infant data and information about pregnancy, delivery, and postpartum period were obtained at birth. Information about bruxism and behavioral problems was obtained in 2004 and 2005 in RP, when the children were 9–11 years old, and in 2005 and 2006 in SL, when the children were 7–9 years of age. Three instruments were used: a socio-demographic and health questionnaire, the Strength and Difficulties Questionnaire (SDQ), and the Children's Depression Inventory (CDI).

A diagnosis of current bruxism was made when the respondents (parents/persons responsible for the children) declared that one or both the habits of teeth clenching during daytime and grinding at night still persisted until the time of the assessment (24). Additionally, the lifetime prevalence of clenching of the teeth during daytime only (awake bruxism) and grinding at night only (sleep bruxism) was also evaluated.

In this study, the SDQ (25) applied to the parents of children/adolescents aged 4–15 years was considered. The SDQ is used to define mental health problems and consists of four subscales: emotional symptoms, conduct problems, peer problems, and attention/hyperactivity disorder (25). The total scale and each subscale were dichotomized into the absence and presence of behavioral problems (25–27). The questionnaire has been adapted and validated for Brazilian children (28).

The CDI is a self-report inventory that consists of 27 items, where the child points out the reply that best describes how he/she feels. It was adapted and validated for Brazilian schoolchildren by Gouveia et al. (29). The cutoff point in which a child is considered to 'be depressed' is 17 points or more (29).

Data analysis

The dependent variable was current bruxism. Furthermore, the lifetime prevalence of teeth grinding at night and clenching was also analyzed, separately, which were dichotomized into present or absent. The independent variables were depression, total SDQ score, and the scores for its subscales. The confounding factors considered were sex of children (male and female), skin color of children (white and nonwhite), birth weight (≥2500, 1500–2499, 500–1499 g), preterm birth (<37 weeks of gestational age determined on the basis of the last normal menstrual period), type of delivery (vaginal and cesarean section), maternal age (<20, 20–34, ≥35 years), maternal schooling measured as years of study (0–4, 5–8, ≥9), occupation of head of the family (nonmanual, skilled and semiskilled manual, unskilled manual, unemployed), maternal smoking during pregnancy (yes – if she smoked at least one cigarette per day, or no), maternal marital status (married, cohabiting, no companion), family income (measured as monthly minimum wages and categorized as unknown, low, medium, or high according to tertiles), number of household dwellers (1–4, ≥5) and maternal job outside the home (no or yes). Data on the confounding factors were collected at birth.

The Poisson regression method was used (30). After univariable analysis, the variables that presented significant associations ($P < 0.20$) were submitted to stepwise multivariable analysis carried out separately for the SDQ subscale scores and for the total SDQ score, with the level of significance set at 0.05. The models were stratified according to city. The prevalence ratio (PR) and its 95% confidence interval (95% CI) were calculated by the robust method. PR was used because bruxism (clenching/grinding), mental health problems, and depression were all evaluated at the same moment. Owing to the complex sampling design, estimates were weighted. The variables used for weighting in each city were birth weight and preterm birth.

The study was approved by the Research Ethics Committees of each University. The persons who agreed to participate in the study gave written informed consent.

Results

There was no difference in the prevalence of bruxism between the two cities (RP = 29%; SL = 30%, $P > 0.05$). Grinding at night (RP =

35.7%; SL = 39.1%) was more prevalent than clenching (RP = 20.3%; SL = 18.8%) in both cities. The prevalence of mental health problems was higher in SL (48%) than in RP (39%) ($P < 0.001$). Additionally, the prevalence of childhood depression was also higher in SL (22%) than in RP (6%) ($P < 0.001$).

Univariable analysis showed that in RP, female sex was a protective factor against bruxism (PR = 0.64), whereas VLBW (PR = 1.53), unskilled manual occupation/unemployment of the family head (PR = 1.78), and children of cohabiting marital status mothers (PR = 1.46) were factors associated with a high prevalence of bruxism. Preterm birth was not associated with bruxism. Mental health problems measured by the total SDQ score (PR = 1.79) and the subscales for emotional symptoms (PR = 1.86), conduct problems (PR = 1.55), peer problems (PR = 1.48), and hyperactivity (PR = 1.53) were associated with a high prevalence of bruxism (Table 1). Clenching of the teeth was statistically associated with female sex of children (PR = 0.70), maternal smoking during pregnancy (PR = 1.41), high maternal schooling (PR = 0.68), unemployed or unskilled manual occupation of family head (PR = 1.90), and emotional symptoms (PR = 2.05), conduct problems (PR = 1.48), peer problems (PR = 1.75), hyperactivity (PR = 1.73) and total SDQ score (PR = 1.93) (Table 2). Finally, teeth grinding at night was statistically associated with female sex of children (PR = 0.78), emotional symptoms (PR = 1.52), conduct problems (PR = 1.33), peer problems (PR = 1.35), hyperactivity (PR = 1.32), and total SDQ score (PR = 1.55) (Table 3).

In SL, univariable analysis showed that children of high-income parents had a higher prevalence of bruxism (PR = 1.42) compared to children of medium-income parents. Mental health problems measured by the total SDQ score (PR = 1.54) and the subscales for emotional symptoms (PR = 1.38) and peer problems (PR = 1.43) were associated with a high prevalence of bruxism (Table 1). Teeth clenching was associated with parity (PR = 0.71), maternal job outside the home (PR = 1.47), nonwhite color of children (PR = 0.68), emotional symptoms (PR = 1.83), conduct problems (PR = 1.50), peer problems (PR = 1.68), and total SDQ score (PR = 1.89) (Table 2). Furthermore, grinding at night was associated with high family income (PR = 1.41), emotional symptoms (PR = 1.35), peer problems (PR = 1.26), and total SDQ score (PR = 1.29) (Table 3).

In the multivariable analysis for RP, VLBW children and emotional symptoms (subscale model), and total score (score model) continued to be statistically associated with bruxism. Female sex appeared as a protective factor in both the subscale and total score models (Table 4). The multivariable analysis separately for clenching (Table 5) and grinding of the teeth (Table 6) was similar to the results for bruxism, except because peer problems were also associated with clenching (Table 5).

In the multivariable analysis for SL, only emotional symptoms (subscale model) and total score (score model) remain statistically associated with a high prevalence of bruxism (Table 4), clenching (Table 5), and grinding (Table 6). Additionally, clenching of the teeth was more prevalent among children with nonwhite skin color and with peer problems in the subscale model (Table 5). In the total score model, maternal job outside the home, nonwhite skin color of children (PR = 0.68), and total SDQ score showed statistically significant associations with clenching (Table 5).

Depression was not associated with bruxism, clenching during daytime only, or grinding at night only in either city ($P > 0.20$, data not shown).

Discussion

In both cities, emotional symptoms and mental health problems (total score) were associated with a high prevalence of bruxism; emotional symptoms, peer problems, and mental health problems (total score) were associated with a high prevalence of clenching; and emotional symptoms and mental health problems (total score) were associated with a high prevalence of grinding at night; female sex was found to be a protective factor for both bruxism, clenching and grinding at night. Depression was not associated with bruxism, clenching or grinding at night in either city.

The prevalence of bruxism was high in both cities, with no significant difference between them: 29% in RP and 30% in SL, which was similar to values observed in a number of other studies (8, 10, 15, 19, 21). However, the prevalence was higher than the value detected in a study in China on 5979 children aged two to 12 years, which was 6.5% (9). Grinding at night (RP = 35.7%; SL = 39.1%) was more prevalent than clenching during daytime (RP = 20.3%; SL = 18.8%) in both cities. We could not find other studies in children to compare with these data.

Table 1. Univariable analysis of the factors associated with bruxism in the Ribeirão Preto, 1994, and São Luís, 1997/98, birth cohort studies, Brazil

	Ribeirão Preto				São Luís			
Variables	*n*	%[a]	PR	95%CI	*n*	%[a]	PR	95% CI
Sex of the children								
Male (ref)	441	34.5	1.00					
Female	428	22.1	**0.64**	0.50–0.81				
Birth weight								
≥2500 g (ref)	630	28.1	1.00					
1500–2499 g	197	29.9	1.07	0.82–1.37				
500–1499 g	42	43.1	**1.53**	1.05–2.23				
Occupation of family head								
Nonmanual (ref)	162	20.2	1.00					
Skilled and semiskilled manual	511	28.8	1.43	0.99–2.06				
Unskilled manual and unemployed	148	36.0	**1.78**	1.18–2.70				
Family income[b]								
Medium (ref)					233	24.2	1.00	
Low					249	30.6	1.26	0.92–1.72
High					220	34.5	**1.42**	1.04–1.94
Unknown					103	34.4	1.42	0.93–2.16
Maternal marital status								
Married (ref)	532	24.8	1.00					
Cohabiting	180	36.1	**1.46**	1.11–1.92				
No companion	120	33.5	1.35	0.98–1.87				
Emotional symptoms (SDQ)								
No (ref)	388	19.2	1.00		327	24.5	1.00	
Yes	481	35.8	**1.86**	1.44–2.42	478	33.9	**1.38**	1.08–1.78
Conduct problems (SDQ)								
No (ref)	552	23.6	1.00					
Yes	317	36.7	**1.55**	1.23–1.96				
Peer problems (SDQ)								
No (ref)	617	25.0	1.00		585	26.8	1.00	
Yes	252	37.1	**1.48**	1.17–1.88	220	38.5	**1.43**	1.13–1.83
Hyperactivity (SDQ)								
No (ref)	628	36.2	1.00					
Yes	241	47.9	**1.53**	1.21–1.93				
Total score (SDQ)								
Normal (ref)	516	21.6	1.00		419	23.8	1.00	
Abnormal	353	38.7	**1.79**	1.42–2.26	386	36.8	**1.54**	1.22–1.96

PR, prevalence ratio; 95% CI, 95% confidence interval; ref, reference category; SDQ, Strength and Difficulties Questionnaire.
The variables shown in the table were those that presented a *P*-value < 0.20. Bold values represent statistically significant associations (p<0.05).
[a]With bruxism (weighted).
[b]Family income measured as monthly minimum wages and defined by tertiles.

The prevalence of bruxism, clenching only, and grinding only appears to be highly variable, which is probably due to the lack of standardization of its diagnosis (13, 31). Various bruxism detecting methods have been proposed, but it seems that there is no consensus concerning what is the best method to detect bruxism. Sleep laboratory systems and audio system are precise but are only useful to detect sleep bruxism (32). Additionally, many of these techniques are not feasible to be used in population-based studies.

Some studies have used a clinical examination for the detection of dental facet wear (3, 5, 20), alone or in combination with an interview. According to Abe et al. (33), the presence of tooth wear has a modest diagnostic value. Other studies have used only questionnaires for the detection of bruxism (9–11, 15, 19). Although this is a subjective method, it is valid because it reflects the perception of a clearly visible sign by parents or schoolmates (34). The diversity of methods used in various studies, together with this lack of standardization of the criteria for the diagnosis of bruxism, impairs the comparison of prevalences among studies.

In the present study, bruxism was defined as a subjective perception by means of a questionnaire

Table 2. Univariable analysis of the factors associated with clenching of the teeth in the birth cohort studies in Ribeirão Preto, 1994, and São Luís, 1997/98, Brazil

	Ribeirão Preto				São Luís			
Variables	*n*	%[a]	PR	95% CI	*n*	%[a]	PR	95% CI
Sex of children								
Male (ref)	441	24.3	1.00					
Female	428	16.2	**0.70**	0.49–0.90				
Birth weight								
≥2500 g (ref)	630	20.0	1.00					
1500–2499 g	197	22.5	1.12	0.82–1.53				
500–1499 g	42	30.9	1.55	0.95–2.52				
Type of delivery								
Vaginal (ref)					548	17.1	1.00	
Cesarea					254	22.8	1.33	0.97–1.84
Parity								
1					376	15.5	1.00	
2–4(ref)					386	21.7	**0.71**	0.51–0.99
5+					40	22.0	1.01	0.51–2.01
Maternal smoking during pregnancy								
No (ref)	639	18.7	1.00					
Yes	193	26.3	**1.41**	1.01–1.96				
Maternal schooling								
5–8(ref)	332	22.3	1.00					
9+	279	15.1	**0.68**	0.46–0.99				
0–4	190	25.0	1.12	0.78–1.61				
Maternal job outside the home								
No (ref)	499	22.3	1.00		613	17.1	1.00	
Yes	334	17.0	0.76	0.55–1.05	183	25.2	**1.47**	1.05–2.06
Number of household dwellers								
1–4 (ref)	553	18.3	1.00		323	21.3	1.00	
5+	279	24.6	1.34	0.99–1.82	471	17.2	0.81	0.59–1.11
Occupation of family head								
Nonmanual (ref)	162	13.1	1.00					
Skilled and semiskilled manual	511	20.8	1.59	0.99–2.57				
Unskilled manual and unemployed	148	24.8	**1.90**	1.10–3.27				
Skin color of children								
White (ref)					187	25.0	1.00	
Nonwhite					618	16.9	**0.68**	0.48–0.94
Emotional symptoms (SDQ)								
No (ref)	388	12.9	1.00		327	12.7	1.00	
Yes	481	26.4	**2.05**	1.47–2.85	478	23.2	**1.83**	1.28–2.62
Conduct problems (SDQ)								
No (ref)	552	17.3	1.00		417	15.1	1.00	
Yes	317	25.6	**1.48**	1.10–1.98	388	22.7	**1.50**	1.09–2.07
Peer problems (SDQ)								
No (ref)	617	16.8	1.00		585	15.9	1.00	
Yes	252	29.3	**1.75**	1.31–2.34	220	26.8	**1.68**	1.23–2.31
Hyperactivity (SDQ)								
No (ref)	628	17.1	1.00		541	17.3	1.00	
Yes	241	29.5	**1.73**	1.29–2.3	264	22.1	1.28	0.93–1.76
Total score (SDQ)								
Normal (ref)	516	14.8	1.00		419	13.2	1.00	
Abnormal	353	28.7	**1.93**	1.44–2.59	386	25.0	**1.89**	1.36–2.63

PR, prevalence ratio; 95% CI, 95% confidence interval; ref, reference category; SDQ, Strength and Difficulties Questionnaire.
The variables shown in the table were those that presented a *P*-value < 0.20. Bold values represent statistically significant associations (p<0.05).
[a]% with clenching (weighted).

responded by parents/persons responsible for children. It may have caused difficulties in defining both grinding at night and clenching during daytime. However, many important epidemiological studies have been performed using the subjective report of bruxism as a useful and valid method (4,

Table 3. Univariable analysis of the factors associated with teeth grinding at night in the birth cohort studies in Ribeirão Preto, 1994, and São Luís, 1997/98, Brazil

	Ribeirão Preto				São Luís			
Variables	*n*	%[a]	PR	95% CI	*n*	%[a]	PR	95% CI
Sex of children								
Male (ref)	441	40.1	1.00					
Female	428	31.2	**0.78**	0.64–0.95				
Preterm birth								
No (ref)	624	34.8	1.00					
Yes	245	42.4	1.22	1.00–1.49				
Birth weight								
≥2500 g (ref)	630	35.0	1.00					
1500–2499 g	197	42.4	1.21	0.99–1.48				
500–1499 g	42	42.9	1.22	0.84–1.77				
Maternal schooling								
5–8 (ref)					345	37.4	1.00	
9+					327	44.2	1.18	0.96–1.44
0–4					126	31.2	0.83	0.60–1.15
Maternal age								
<20					234	33.1	1.00	
20–34 (ref)					528	41.7	0.97	0.62–1.51
35+					38	40.3	0.80	0.63–1.00
Maternal job outside the home								
No (ref)					613	37.2	1.00	
Yes					183	46.1	1.24	1.00–1.53
Family income[b]								
Medium (ref)					233	32.5	1.00	
Low					249	38.6	1.19	0.92–1.54
High					220	45.8	**1.41**	1.10–1.81
Unknown					103	43.0	1.32	0.93–1.87
Emotional symptoms (SDQ)								
No (ref)	388	27.8	1.00		327	32.5	1.00	
Yes	481	42.2	**1.52**	1.23–1.88	478	43.8	**1.35**	1.10–1.65
Conduct problems (SDQ)								
No (ref)	552	31.9	1.00					
Yes	317	42.5	**1.33**	1.09–1.62				
Peer problems (SDQ)								
No (ref)	617	32.5	1.00		585	36.5	1.00	
Yes	252	43.9	**1.35**	1.10–1.65	220	46.0	**1.26**	1.03–1.54
Hyperactivity (SDQ)								
No (ref)	628	32.9	1.00					
Yes	241	43.6	**1.32**	1.08–1.62				
Total score (SDQ)								
Normal (ref)	516	29.3	1.00		419	34.6	1.00	
Abnormal	353	45.6	**1.55**	1.28–1.89	386	43.9	**1.29**	1.05–1.53

PR, prevalence ratio; 95% CI, 95% confidence interval; ref, reference category; SDQ, Strength and Difficulties Questionnaire.
The variables shown in the table were those that presented a *P*-value < 0.20. Bold values represent statistically significant associations (p<0.05).
[a]% with grinding (weighted).
[b]Family income measured as monthly minimum wages and defined by tertiles.

12, 26, 35). In a study about the validity of the subjective criteria for bruxism detection in a controlled polysomnographic study, bruxers reported frequent grinding sounds during sleep, while asymptomatic controls had no complaint, sign, or symptom associated with bruxism. Subjective reports of bruxism-grinding sounds were corroborated by grinding in the laboratory, with a sensitivity of 78% and with a specificity of 94% (36). So, although there are limits regarding the use of a subjective method to classify bruxism in this research, it can still be considered a valid tool.

In the final model, both the emotional symptoms subscale and the total mental health problems score were consistently associated with a high prevalence of bruxism, clenching during daytime only,

Table 4. Multivariable analysis of the factors associated with bruxism in the Ribeirão Preto, 1994, and São Luís, 1997/98, birth cohort studies, Brazil

	Ribeirão Preto		São Luís	
Variables	PR	95% CI	PR	95% CI
Model with the SDQ subscales				
Sex				
Male (ref)	1.00			
Female	**0.64**	0.50–0.81		
Birth weight				
≥2500 g (ref)	1.00			
1500–2499 g	1.04	0.81–1.34		
500–1499 g	**1.55**	1.05–2.30		
Emotional symptoms (SDQ)				
No (ref)	1.00		1.00	
Yes	**1.79**	1.36–2.34	**1.33**	1.09–1.63
Peer problems (SDQ)				
No (ref)			1.00	
Yes			1.33	0.97–1.42
Conduct problems (SDQ)				
No (ref)	1.00			
Yes	1.27	1.00–1.62		
Model with the total SDQ score				
Sex				
Male (ref)	1.00			
Female	**0.67**	0.53–0.86		
Total score (SDQ)				
Normal (ref)	1.00		1.00	
Abnormal	**1.72**	1.36–2.17	**1.54**	1.22–1.96

PR, prevalence ratio; 95% CI, 95% confidence interval; ref, reference category. Bold values represent statistically significant associations (p<0.05).
The variables for adjustment for both cities were sex, weight, preterm birth, type of delivery, maternal age, maternal schooling, occupation of family head, maternal smoking, marital status, family income, mother's job, and number of household dwellers. The variables shown in the table were those that presented a *P*-value < 0.10.

Table 5. Multivariable analysis of the factors associated with clenching of the teeth in the birth cohort studies in Ribeirão Preto, 1994, and São Luís, 1997/98, Brazil

	Ribeirão Preto		São Luís	
Variables	PR	95% CI	PR	95% CI
Model with the SDQ subscales				
Sex				
Male (ref)	1.00			
Female	**0.66**	0.49–0.89		
Maternal smoking during pregnancy				
No (ref)	1.00			
Yes	1.34	0.97–1.85		
Skin color of children				
White (ref)			1.00	
Nonwhite			**0.66**	0.48–0.91
Number of household dwellers				
1–4 (ref)			1.00	
5+			0.75	0.55–1.02
Emotional symptoms (SDQ)				
No (ref)	1.00		1.00	
Yes	**1.82**	1.28–2.59	**1.52**	1.04–2.22
Peer problems (SDQ)				
No (ref)	1.00		1.00	
Yes	**1.42**	1.07–2.00	**1.53**	1.09–2.15
Conduct problems (SDQ)				
No (ref)			1.00	
Yes			1.36	0.98–1.88
Model with the total SDQ score				
Sex of children				
Male (ref)	1.00			
Female	**0.71**	0.53–0.96		
Maternal job outside the home				
No (ref)			1.00	
Yes			**1.50**	1.08–2.08
Skin color of children				
White (ref)			1.00	
Nonwhite			**0.68**	0.49–0.94
Total score (SDQ)				
Normal (ref)	1.00		1.00	
Abnormal	**1.87**	1.40–2.50	**1.91**	1.38–2.64

PR, prevalence ratio; 95% CI, 95% confidence interval; ref, reference category. Bold values represent statistically significant associations (p<0.05).
The variables for adjustment for both cities were sex, weight, preterm birth, type of delivery, maternal age, maternal schooling, occupation of family head, maternal smoking, marital status, family income, mother's job, and number of household dwellers. The variables shown in the table were those that presented a *P*-value < 0.10.

and grinding at night only in RP and SL. The emotional symptoms subscale includes nonspecific emotional problems that may include anxiety and/or depression symptoms (37). The results of the association between mental health problems and bruxism obtained in the present study are similar to the association observed between anxiety and bruxism in other studies (10, 15–17, 19). In another study in RP (Brazil), anxiety was associated with bruxism in 374 children aged 8–13 years (8). Children with high indices of irritability and anxiety in Belo Horizonte (Brazil) had a twofold higher chance of having night bruxism compared with children of the same age with bruxism and low levels of these personality traits (21). Shang et al. (19) investigated the relationship between behavioral problems, perinatal factors, and sleep disturbances in a sample of 1391 children from Taiwan aged 4–9 years. The study found a significant association between emotional and behavioral syndromes, somatic complaints, and bruxism, which was also observed in the present study.

In a recent systematic review of the literature, including 45 papers about the role of psychosocial factors in the etiology of bruxism, the authors suggest that clenching seems to be associated with psychosocial factors and a number of psychopathological symptoms, while there is no evidence to relate grinding with psychosocial disorders (38);

Table 6. Multivariable analysis of the factors associated with teeth grinding at night in the birth cohort studies in Ribeirão Preto, 1994, and São Luís, 1997/98, Brazil

	Ribeirão Preto		São Luís	
Variables	PR	95% CI	PR	95% CI
Model with the SDQ subscales				
Sex of children				
Male (ref)	1.00			
Female	**0.76**	0.63–0.93		
Preterm birth				
No (ref)	1.00			
Yes	1.21	0.99–1.48		
Maternal smoking during pregnancy				
No (ref)	1.00			
Yes	1.34	0.97–1.85		
Maternal schooling				
5–9 (ref)			1.00	
9+			1.18	0.96–1.44
0–4			0.83	0.60–1.15
Emotional symptoms (SDQ)				
No (ref)	1.00		1.00	
Yes	**1.47**	1.18–1.83	**1.31**	1.07–1.62
Peer problems (SDQ)				
No (ref)	1.00		1.00	
Yes	1.20	0.98–1.48	1.19	0.98–1.46
Model with the total SDQ score				
Sex of children				
Male (ref)	1.00			
Female	**0.80**	0.66–0.98		
Preterm birth				
No (ref)	1.00			
Yes	1.21	1.00–1.48		
Maternal schooling				
5–9 (ref)			1.00	
9+			1.20	0.98–1.47
0–4			0.82	0.60–1.13
Total score (SDQ)				
Normal (ref)	1.00		1.00	
Abnormal	**1.52**	1.25–1.84	**1.30**	1.08–1.57

PR, prevalence ratio; 95% CI, 95% confidence interval; ref, reference category; SDQ, Strength and Difficulties Questionnaire. Bold values represent statistically significant associations ($p<0.05$).
The variables for adjustment for both cities were sex, weight, preterm birth, type of delivery, maternal age, maternal schooling, occupation of family head, maternal smoking, marital status, family income, mother's job, and number of household dwellers. The variables shown in the table were those that presented a *P*-value < 0.10.

however, some neurological and psychiatric disorders, sensory factors on motor control, and some mechanisms related to sleep arousal are pointed for other authors (6). Besides, children with grinding seem to have an increased incidence of attention-behavior problems (39).

The majority of data about the association between psychosocial disorders and bruxism included in the systematic review came from studies adopting a clinical and/or self-report diagnosis criteria (38). These studies showed some association of bruxism with anxiety, stress sensitivity, depression, and other personality characteristics, apparently in contrast with sleep laboratory investigations. An explicative hypothesis is given by the authors – clinical studies are more suitable to detect awake bruxism, while polysomnographic studies focused on sleep bruxism only.

The peer problem subscale showed an association only with a high prevalence of clenching during daytime in both cities. Interestingly, clenching was associated with a higher number of psychological disorders. According to Carlsson et al. and Huynh et al., it is important to distinguish the awake from sleep bruxism owing to its different etiology and pathophysiology (6, 26).

In RP, statistically significant sex differences in the prevalence of bruxism, clenching only, and grinding at night only were detected in both the subscales and the total score models. Female sex, instead of being a risk factor for bruxism as reported by Mahendran et al. (14), was a protective factor. Thus, the female children in this city presented a lower prevalence of bruxism (22.1%) than the male children (34.5%), which is in agreement with data reported by others (10, 19). This result is probably due to the fact that girls are less inclined to aggressiveness, competition, and agitation. Owing to social impositions and requirements, boys may be unable to show their emotions and feelings, and this favors the occurrence of involuntary movements and habits, whereas girls may be able to discharge their emotions by crying. However, female sex proved to be a protective factor against bruxism only in the wealthier city. This may be due to the fact that RP, with its socioeconomic characteristics, may have greater social requirements to which the children react in a different manner.

In RP, only VLBW children had a higher prevalence of bruxism compared to their NBW counterparts, which disagrees with a study by Petit et al. (15) that found no association between birthweight and bruxism in children aged 2.5–6 years in Quebec (Canada).

Ohayon et al. (4) conducted a large epidemiological study on 13 057 individuals aged 15 years or more recruited in the United Kingdom, Germany and Italy in which depression were found to be associated with bruxism in that population. In our study, however, we found no association between depression and bruxism, neither clenching during daytime only or grinding at night only

in children. We could not find association between depression and bruxism probably because depression is a psychological disorder that does not trigger the state of tension in the body that leads to tooth clenching/grinding. The decision to study a possible association of depression with bruxism in children was based on studies in adults that have shown this association (4, 31, 40, 38).

The present investigation is important because it consisted of the use of two large prospective cohorts, such that the investigation was population-based in two centers. Additionally, there are relatively few studies investigating bruxism and mental health problems that use validated instruments while considering confounding effects in a multivariable analysis, and even with the subjective diagnosis of bruxism, we could analyze clenching during daytime separately from grinding at night, what is a relative improvement to bruxism definitions in relation to other studies. Despite the low PR and CI close to 1.0, there is biological plausibility and consistency in the associations found. In addition, small amplitudes of the CI demonstrate the high accuracy of the estimates. Finally, the findings are strengthened by the fact that samples from two cities of very different socioeconomic levels both revealed an association between mental health problems and bruxism.

The interpretation of our results may be affected by the losses from the original sample that occurred due to migration and the failure to locate some children. As questions other than birth weight and gestational age from the supplementary sample were collected retrospectively, recall bias may have affected some estimates. To reduce the likelihood of this occurrence, only objective perinatal questions that were less susceptible to recall bias were included. However, models excluding the supplementary sample showed similar results (data not shown, available on request). The only important difference was that in SL, high family income remained associated with a high prevalence of bruxism in the adjusted analysis in the model with SDQ subscales. In addition, some measures of association (PR) showed weak or medium effect size (below 2.4) and some CI approach the null hypothesis value (i.e., 1.0). However, the PR may have been biased toward the null hypothesis, owing to possible underreporting of the outcome – pointed in such kind of subjective definition – (34, 35), especially among those exposed. One possible explanation is that parents increasingly work outside the home and spend little time in contact with their children. In turn, the absence of parents has been linked to emotional problems in children/adolescents (15). Thus, there may have been underreporting of bruxism among children with psychological disorders.

Bruxism was found to be a highly prevalent parafunctional habit in both cohorts, thus representing a public health problem of epidemiological relevance. There was a consistent association of bruxism with some of the mental health problems studied, but not with depression. The magnitude of the associations was similar in the two cities. Results were fairly consistent comparing current bruxism, tooth clenching during daytime, and/or tooth grinding at night. But it is necessary to be cautious regarding the inferences from some of our results.

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