The incidence of parasomnias in child bruxers versus nonbruxers

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Abstract

Bruxism in children has been reported to occur in association with certain parasomnias (i.e., sleep talking, bed wetting). Various dental, medical, neurological, and psychological risk factors also have been correlated with bruxism. A case-control study was therefore conducted to test the null hypothesis that there is no difference between bruxers and nonbruxers in the occurrence rate of other parasomnias and these reported risk factors. A 54-item survey questionnaire was developed and mailed to 342 pediatric patients, half of whom were avowed to be bruxers by their parents. These patients were selected randomly from a private pediatric practice in Northern California. One-hundred fifty-two subjects (77 bruxers and 75 controls) returned the questionnaire, and stepwise logistic regression analysis revealed that five of the 54 factors (nocturnal muscle cramps, bed wetting, colic, drooling while sleeping, and sleep talking) showed significant differences between bruxers and controls (odds ratios ranged from 3.11 to 1.95). These findings strongly suggest the possibility of a common sleep disturbance underlying these nonsleep-stage specific parasomnias. (Pediatr Dent 18:456–60, 1996)

Bruxism is defined as the habitual, nonfunctional grinding of the teeth and is characterized by forceful, rhythmic contact of the occlusal tooth surfaces with mandibular movement.[1] Although bruxism occurs during the awake and sleep states, the latter is more common. This behavior in children is of particular interest to the pediatric dentist. Parents commonly report that while their children sleep, they produce a loud, grinding noise that can be heard by other family members. Reported consequences of bruxism include headaches, temporomandibular joint dysfunction, masticatory soreness, and attrition of the teeth. The literature suggests various dental, physical, psychological, and sleep-related factors associated with bruxism.

Risk factors implicated in bruxism are heredity, general health, and central nervous system disorders. A study on genetic predisposition reported that parents who demonstrated tooth grinding in childhood more frequently have children who grind their teeth.[2] An individual's general health status may also determine propensity to grind. For instance, children grind more frequently when they are suffering from allergic rhinitis or asthma.[3] Neurological disabilities such as autism and cerebral palsy also have been strongly indicated as risk factors for bruxism.[4] The most consistently mentioned etiology of nocturnal bruxism is psychological stress. Studies suggest that bruxism is positively related to emotional tension, anxiety, and the anticipation or actual experience of life stresses.[5]

The relationship between bruxism and a patient's sleep stage has been investigated. Generally most jaw muscle activity occurs during light phases of sleep and has been observed to take place in connection with bodily movement.[6] The Association of Sleep and Arousal Disorders classifies bruxism as a parasomnia. Parasomnias are defined as undesirable physical events that occur exclusively or predominantly during sleep, usually taking the form of motor or autonomic phenomena often associated with variable degrees of arousal.[7] Normal transitions between the awake state, rapid eye movement (REM), and nonrapid eye movement (NREM) sleep occur in an orderly manner. The primary sleep parasomnias are disorders of this sleep/wake cycle and present as unusual and sometimes dramatic behaviors. They are classified as NREM, REM, and non-sleep stage specific depending on when the behavior takes place during the sleep cycle. Bruxism is categorized as nonsleep-stage specific (Table 1). Although it may occur at any stage of sleep, bruxism is most likely to take place during stage 2 of NREM sleep or during REM sleep.[8]

The common feature of all of the parasomnias is association with abnormal sleep arousal patterns. Ware and Rugh reported that 85% of bruxism occurrences are associated with limb muscle activity that results in an arousal from sleep. They subsequently found a group

TABLE 1. PARASOMNIAS IN CHILDREN

I. Primary Sleep Parasomnias

- A. NREM parasomnias
  - 1. Sleep starts
  - 2. Disorders of arousal
  - 3. Sleep drunkenness
- B. REM parasomnias
  - 1. Dream anxiety attacks
  - 2. Hypnagogic hallucinations and/or sleep paralysis
  - 3. REM sleep behavior disorder
- C. Nonsleep-stage specific parasomnias
  - 1. Bruxism
  - 2. Enuresis
  - 3. Rhythmic movement disorder
  - 4. Periodic movements of sleep
  - 5. Posttraumatic stress disorder
  - 6. Somniloquy

II. Secondary Sleep Parasomias

- A. Central nervous system
  - 1. Seizures
  - 2. Headaches
- B. Cardiopulmonary
  - 1. Sleep-related arrythmias
  - 2. Nocturnal asthma
  - 3. Miscellaneous
  - 4. Sleep apnea
- C. Gastrointestinal
  - 1. Gastroesophageal reflux
  - 2. Diffuse esophageal spasm
- D. Miscellaneous
  - 1. Panic attacks
  - 2. Nocturnal muscle cramps
  - 3. Psychogenic dissociative states

From Mahowald & Rosen, 1990.

of patients who complained of both sleep problems and frequent bruxism and speculated that bruxism was correlated with other sleep disorders such as insomnia or excessive daytime sleepiness.[9] Some parasomnias are thought to occur simultaneously. For example, children commonly have a history of both sleep walking and night terrors.[10] Fisher and McGuire found sleep talking to be associated significantly with unrecalled nightmares, sleep walking, and sitting up in bed. Through factor analysis, they discovered a group of associated sleep behaviors that occurred in close association with the parasomnias and concluded that an individual with one parasomnia was likely to exhibit more than one.[11]

It has not been proven whether bruxism occurs in association with other parasomnias, but such knowledge would be useful since bruxism is more easily detected than some of the other parasomnias. Although parasomnias in childhood usually represent a normal variation in the developmental process of the central nervous system, unfavorable consequences from these behaviors are possible.[12] Their sleep disturbance may cause excessive daytime sleepiness and result in poor school performance. Children can injure themselves while engaged in parasomnia behaviors. If sleep disturbances are frequent or persistent, psychological trauma may be indicated as a causal factor. Lastly, sexual abuse has been linked to sleep disorders.[12]

Diagnosis of bruxism and other parasomnias is obviously difficult since these behaviors all occur during sleep. Recognition of these events requires verification by parents because children have no subjective awareness of their nocturnal behaviors. Based on parental confirmation, this paper investigates the factors associated with bruxism and the relationship between bruxism and other parasomnias.

Materials and methods

Sample selection

The original sample selected for the case-control study consisted of 346 boys and girls, 173 bruxers and 173 nonbruxers, between the ages of 2 and 18. A private pediatric dental practice located in Northern California provided 2,750 active patient records from which the subjects were selected. The children in this practice are middle or upper middle class and reside in a district outside of Sacramento.

Potential subjects were called in alphabetical order until a member of the family—usually one of the child's parents—confirmed that the child was a bruxer. A bruxer was described as a child whose parents or other family members have heard unmistakably loud, repetitive, grinding sounds coming from the sleeping child's teeth.

The control subjects were recruited by selecting the patient who was closest alphabetically and of similar age to the chosen tooth grinder. A telephone call to the subjects' parents confirmed they did not brux. A potential control child found to be a bruxer was added to the case dataset and the next two records were used as controls. A total of 1,396 parents were called in order to find the desired sample size of 346 subjects (an equal number of bruxers and nonbruxers) necessary to have sufficient size for statistical analysis.

Exclusion criteria for the 1,396 parents telephoned included parents who did not speak English, were unwilling to participate, or failed to understand the study.

If at least two unsuccessful attempts were made to contact the family, the next appropriate chart was located. The number of parents who were called and who fit the exclusion criteria was 772, of which 278 were never reached.

Each of the 346 potential subjects agreed to participate. They were listed separately as bruxers and nonbruxers and the parents were sent an anonymous questionnaire with a self-addressed, stamped envelope.

This study was exempt from the Human Subject Protection Committee and did not require informed consent for the following reasons: 1) this research presents no more than minimal risk of harm to subjects and involves no procedures for which consent is normally required outside of the research context, and 2) the only record linking the subject and the research would be the consent document.[13]

TABLE 2. FACTORS RELATED TO BRUXING ($P < 0.15$)*

	Yes (%)		
Variable	*Bruxers*	*Controls*	*P-value*
1. Lip biting	6 (7.7)	0	0.014
2. Drooling while sleeping	45 (57.7)	29 (38.2)	0.015
3. Colic	18 (23.4)	7 (9.7)	0.026
4. Jaw soreness upon waking	7 (9)	1 (1.3)	0.034
5. C-section delivery	11 (14.3)	20 (28.2‡)	0.038
6. Sleep talking	55 (70.5)	42 (55.3)	0.05
7. Gum chewing	8 (10.3)	2 (2.6)	0.055
8. Nocturnal muscle cramps	15 (19.2)	7 (9.2)	0.076
9. Poor health during school years	40 (55.6)	42 (72.4‡)	0.076
10. Child opens eyes while sleeping	33 (42.3)	22 (29)	0.084
11. Bed wetting	14 (18)	7(9.2)	0.114
12. Age child slept through the night	12.5†	8.6†	0.117
13. Induced labor	20 (26)	11 (15.5)	0.117
14. Sleep walking (wake up in a different room)	11(14.1)	18 (23.7‡)	0.128
15. Siblings have similar sleep problems	21 (26.9)	29 (38.2‡)	0.137
16. Child awakens irritable	39 (50)	29 (38.2)	0.139
17. Quick jerks of arms or legs when sleeping	29 (37.2)	20 (26.3)	0.148
18. Child moves around while sleeping	49 (62.8)	39 (51.3)	0.149

*Chi-square analysis of the percentage of "yes" responses between bruxers and controls.

† Mean values of the age (in months) at which child first slept through the night.

‡ Response higher in controls—Protective Factor.

Means for numerical values compared via T-tests. $N = 152$ (77 bruxers and 75 controls).

Questionnaire development

Specialists in dental research (oral motor disorders), pediatric dentistry, pediatric medicine, pediatric neurology, and sleep disorders helped develop a questionnaire. The following source materials were also used in the development process:

1. The Children's Sleep Behavior Scale[14]
2. The Pediatric Questionnaire[15]
3. Teeth grinding questionnaire and Standardized Questionnaire[16]
4. Mail and Telephone Surveys: The Total Design Method.[17]

The questionnaire was developed to be completed easily by parents or others most knowledgeable about a child's sleep habits. The term "tooth grinding" replaced "bruxism" in the questionnaire to facilitate its completion. Six categories divided the 54 items included in the survey: general tooth grinding information, night-time behavior, morning behavior, daytime behavior, family history, and general medical history.

The first draft of the questionnaire was piloted with a small sample of staff members ($N = 3$) of the pediatric dental office who were parents and parents ($N = 7$) who were selected at random during an office visit with their children. After the pilot study, the questionnaire was modified, approved by the team, and mailed to the selected sample.

Data analysis

Of the 346 subjects available, 132 initially responded to the survey. To confirm that the respondents were representative of the entire sample, 20 of the 194 nonrespondents (equal number of bruxers and nonbruxers) were contacted randomly by phone and the questionnaire completed by these nonrespondents by phone interview. The responses of the initial 132 subjects were compared to the group of 20 using a chi-square test. Because there were no significant differences ($P < 0.15$), the two subsamples were combined to form a total sample of 152 (77 bruxers and 75 nonbruxers).

Analysis of difference in the proportions of yes responses between the bruxer and nonbruxer groups for each yes/no question then was performed using a chi-square methodology. For questions in which numerical means were available, a *t*-test for significant differences was performed. All *P* values given are two-sided.

The yes/no questions that were shown to be strongly related to bruxing via chi-square analysis were included in a stepwise multiple logistic regression where bruxism (yes or no) was the outcome (Y variable). This model allowed us to determine which of these factors were still associated after controlling for all the other factors. The *P* value to enter for this stepwise procedure was set at $P = 0.15$. A liberal alpha level was chosen since this is an exploratory study, not a confirmatory study. Odds ratios and their corresponding 95% confidence intervals are reported based on this logistic model.[18]

Results

A total of 152 questionnaires from 77 tooth bruxers (39 females and 38 males) and 75 control subjects (34

TABLE 3. FACTORS SIMULTANEOUSLY SIGNIFICANT BY STEPWISE LOGISTIC REGRESSION

Variant	*Odds Ratio*	*Lower Limit*	*Upper Limit*
1. Nocturnal muscle cramps	3.11	0.99	9.75
2. Bed wetting	2.62	0.57	11.97
3. Colic	2.57	0.91	7.26
4. Drooling while sleeping	2.0	0.98	4.08
5. Sleep talking	1.95	0.94	4.05
6. Age child slept through the night (years)	1.22	1.19	1.26
7. C-section*	0.4	0.17	0.97

*This is a protective value (OR < 1).

females and 41 males) was returned. Of the 52 questions, 45 required a yes/no response. Seventeen of these yes/no questions and a single numerical response question were found to be strongly related to bruxing in children ($P < 0.15$). The number of "yes" responses, the percentage of positive responses, and the mean value for each of these questions are seen in Table 2.

These 18 questions were analyzed by stepwise logistic regression which determined that six of the 18 questions (Table 2) were still associated with bruxism after controlling for the other factors. Table 3. reports the odds ratio and the upper and lower limits (based on a 95% confidence interval) for each of these questions. For example, bed wetting had an odds ratio of 2.62 and therefore the bruxing child had a 2.62 times higher likelihood of wetting the bed than the nonbruxer. According to the reported upper and lower limits, 95% of the bruxing children had an odds ratio for bed wetting between 0.57 and 11.97. Caesarean-section showed an odds ratio less than 1 and is thus a protective factor. Caesarean-section delivery was more prevalent among the nonbruxers than among the bruxers.

Discussion

Results from the logistic regression analysis suggest that a total of six night-time behaviors and physical conditions occurred in association with bruxism. Overall, the data reject the null hypothesis and the findings support the idea that bruxism and other parasomnias occur together in children predisposed to these sleep-related events. These data agree with a prior report that demonstrated that children commonly have a history of multiple parasomnias. Our findings disagree with Fisher and McGuire's factor structure of the Children's Sleep Behavior Scale, which showed no behavioral factor that corresponded exactly to the parasomnias. They also reported that enuresis (bed wetting) was not related to any of the sleep behaviors assessed.[11]

This study has several advantages over prior studies. First, the questionnaire was carefully designed in accordance with the standards outlined by Dillman and the previously described team. The items were easy to read and organized into a continuous and logical format. They were ordered in degree of difficulty and most of them required a yes or no response. Second, pretesting was conducted prior to the actual study and bias was minimized. Third, this was a case-control study in which subjects were selected as randomly as possible.

We are confident that the data collected in this study are reflective of a true association between these behaviors. The limitations of our data include restricted generalization of the sample and reliance on audible reports of bruxism sounds to identify bruxers instead of actually measuring bruxism. Bruxers who do not make noise may not have been identified.

When the statistically related predictors of bruxism were combined, the following composite picture of a child bruxer was developed. The child begins bruxing at a mean age of 3.7 years and has a 2.57 times higher likelihood of experiencing colic as an infant. The bruxer first slept through the night at a later age (12.5 months) than the nonbruxer (8.6 months), suggesting that bruxism was preceded by an earlier disturbed sleep pattern. The bruxing child also has a 3.11 times higher likelihood of skeletal muscle cramping and 2.0 times higher likelihood of drooling during sleep. Finally, the child who bruxes has a greater tendency to sleep talk (1.95) and wet the bed (2.62). We speculate that these findings suggest the possibility of a common sleep disturbance underlying these nonsleep-stage specific parasomnias.

The questions that showed no group difference are also of importance. Specifically, only 14% of the parents in this study reported their child's bruxing began or worsened after a traumatic life event (i.e., death, divorce, or physical or psychological abuse). Additionally, only 34% of parents responded that their child's bruxing started or was accentuated after a certain event in their child's life (i.e., toilet training, birth of a new sibling, or starting school). The true occurrence of these stressful events, which children do not remember and parents may not observe, is difficult to measure. Discrepancies among reported rates of parasomnias in correlation with stressful events should not be overlooked.

Researchers claim that one's general health status may prompt bruxing. Marks implied that children who suffer from allergic rhinitis or asthma brux more frequently. Our data dispute the idea that the poorer an individual's health, the more likely the display of nocturnal tooth grinding. Parents in our study actually reported that nonbruxing children tended to have a significantly poorer health status than bruxers during their school years. Another question revealed that bruxers and nonbruxers were reported to have the same incidence of asthma and ear infections. Bruxers and controls showed equal proportions of sleepiness during the day, dispelling speculation about the relationship between daytime sleepiness and bruxism. Stepwise logistic regression analysis revealed that caesarean-section delivery had an odds ratio of less than 1 and is thus considered to be a protective factor. There-

fore, caesarean-section delivery was more prevalent among the control subjects than the bruxers. The only physical finding that showed a positive correlation with bruxism was infantile colic. Colic is sudden benign abdominal pain during the first 3 months of life, a medical condition that has been associated with insomnia. Colic is a common cause of major sleep disruptions.[19]

In conclusion, these results may serve as an informational tool for the pediatric dentist. Concerned parents of a bruxing child in the dental setting need to be reassured and educated by the clinician. Bruxism, bed wetting, sleep talking, and nocturnal muscle cramping may occur simultaneously. Current evidence suggests that these related sleep disturbances take place in normal children with no underlying physical or psychological disorders. If these behaviors do occur simultaneously and become disruptive to the family, referral to a pediatrician, pediatric psychologist or pediatric neurologist for further evaluation and treatment may be indicated.

Conclusions

1. Chi-square analysis revealed that 18 questions were strongly associated with bruxism in children (Table 1).
2. Stepwise logistic analysis determined that six of these 18 factors (nocturnal muscle cramps, bed wetting, colic, drooling while sleeping, sleep talking, and the age at which the child first slept through the night) were still associated with bruxism after controlling for the other factors. Caesarean-section delivery was found to be more prevalent among the nonbruxers.
3. The child bruxer:
   a. Begins bruxing at a mean age of 3.7 years
   b. Has 2.57 times higher likelihood of experiencing colic as an infant
   c. First slept through the night later (12.5 months) than the nongrinder (8.6 months)
   d. Has 3.11 times higher likelihood of experiencing nocturnal muscle cramps
   e. Has 2 times higher likelihood of drooling during sleep
   f. Has 2.62 times higher likelihood of wetting the bed
   g. Has 1.95 times higher likelihood of sleep talking.

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1. Leung AK, Robson WL: Bruxism: how to stop tooth grinding and clenching. Postgrad Med 89:167–68, 1991.
2. Abe K, Shimakawa M: Genetic and developmental aspects of sleeptalking and teethgrinding. Acta Odontologica Scandinavica 32:291–356, 1974.
3. Marks MB: Bruxism in allergic children. Am J Orthod 77:48–59, 1980.
4. Rugh JD, Harlan J: Nocturnal bruxism and temporomandibular disorders. Adv Neurol 49:329–41, 1988.
5. Funch DP, Gale EN: Factors associated with nocturnal bruxism and its treatment. J Behav Med 3:385–97, 1980.
6. Ahmad R: Bruxism in children. J Pedodontics 10:105–26, 1986.
7. Thorpy MJ, Govinsky PB: Parasomnias. Psychiatr Clin North Am 10:623–39, 1987.
8. Mahowald MW, Rosen GM: Parasomnias in children. Pediatrician 17:21–31, 1990.
9. Ware JC, Rugh JD: Destructive bruxism: sleep stage relationship. Sleep 11:172–81, 1988.
10. Clore ER, Hibel J: The parasomnias of childhood. J Pediatr Health Care 7:12–16, 1993.
11. Fisher BE, McGuire K: Do diagnostic patterns exist in sleep behaviors of normal children? J Abnorm Child Psychol 18:179–86, 1990.
12. Kales A, Soldatos CR, Kales JD: Sleep disorders: insomnia, sleep walking, night terrors, nightmares and enuresis. Ann Int Med 106:582–92, 1987.
13. Human Subject Protection Committee, University of California, Los Angeles: Human Subject Protection Committee Application. Los Angeles, 1990.
14. Fisher BE, Pauley C, McGuire K: Children's Sleep Behavior Scale: normative data on 870 children in grades 1 to 6. Percept Mot Skills 68:227–36, 1989.
15. Minnesota Regional Sleep Disorders Center, Hennepin County Medical Center: Pediatric Questionnare. Hennepin, MN, 1991.
16. Lindquist B: Bruxism and emotional disturbance. Odontol Revy 23:231–42, 1972.
17. Dillman D: Mail and Telephone Surveys: The Total Design Method. Washington: John Wiley & Sons, Inc, 1977.
18. Fisher L, VanBelle G: Biostatistics: A Methodology for the Health Sciences. Washington: John Wiley & Sons, Inc, 1993.
19. Ferber R: Dependent causes of insomnia and sleepiness in middle childhood and adolescence. Pediatrician 17:13–20, 1990.