Biopsychosocial aspects of sleep bruxism in children

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8 Chapter
Discussion

General aspects

There is an emerging evidence that SB may be better viewed as a behavior instead of a disorder, as commonly believed in the past[1,2].

Sleep bruxism (SB) is considered to have a multifactorial etiology, that includes currently poorly defined aspects of central nervous system function and behavioral factors[3]. Some motor activities included within the SB spectrum could even be physiological or protective. For instance, some studies have shown positive correlation of SB with upper airway patency maintenance and esophageal lubrication[4,5]. On the other hand, a number of psychological and social factors, among which quality of life (QoL) indicators, stressors, mood, sociodemographic characteristics, and sleep conditions, seem to play a role in the etiology of additive SB, with possible pathological relevance[6,7]. In children, those issues are not yet fully explored[6,7]. Thus, the assessment of SB yields new challenges for researchers and clinicians in the pediatric field.

In the attempt to get deeper into the complexity of SB phenomena, finding reliable methods to quantify the intensity and frequency of masticatory muscle activity (MMA) is a compelling need. This issue is particularly important in children, since the parental report, which is the most commonly used strategy to approach SB evaluation, seems to have a poor agreement with quantitative data of MMA[8]. Nonetheless, such an approach is hard to replace for large epidemiological studies and might still be helpful to identify possible associated factors, especially as far as the biopsychosocial frame of SB in children is concerned.

On the way toward an improvement of knowledge in this field, QoL and sleep behaviors are factors that may influence the presence of SB in children. On the other hand, the relationship with tooth wear, which has been frequently seen as a pathognomonic sign of SB, is still to be elucidated.

Based on these premises, the focus of this thesis was to get deeper into the complexity of the above topics, which cover several aspects of the epidemiology, assessment, associated factors, and consequences of SB in children. The findings will be discussed separately for each topic, based on the contents of the chapters.

Epidemiology

As a first step, a systematic review of literature on bruxism was performed to determine the prevalence of SB in children **(Chapter 2)**[9]. The search identified more than 40 papers dealing with the review topic, but despite the apparently overwhelming amount of studies, the quality of the assessed investigations was less than optimal. The main concern is the variety of criteria adopted to evaluate and/or quantify SB itself and the lack of MMA measurement. However, as a common feature, all the studies included in the systematic review were based on parental report, by using instruments such as interviews and questionnaires.

The high variability in the prevalence of SB in children that was found in the systematic review (between 3.5 and 40.6%) prevents from supporting any reliable estimate. The key shortcoming, which was strictly related to the adoption of single- item parental-reported instruments, was the very low specificity for bruxism detection in all studies. Therefore, the internal validity of each investigation is poor. Meta- analysis of data could not be performed, due to the non-homogeneous methods and different questions that were used to collect information in the various investigations. Despite these issues, a trend for a decline with age and a lack of gender differences in SB prevalence were common findings to all the reviewed studies[9].

Such observations are already supported by another systematic review[10], which also included investigations using single-item questions for the assessment of SB.

In the light of the current construct of SB as a behavior[1], parental reported SB may be considered the mirror of other conditions. Thus, for further studies on the epidemiology of SB, it is important to evaluate SB within a multifaceted framework and in association with several other conditions, both concerning sleep phenomena and clinical disorders.

Assessment

The measurement of SB is a challenge, both for adults and children. Polysomnography (PSG) recordings, obtained in adequately equipped sleep laboratories, represent the standard of reference for its quantification[4]. PSG is used for the diagnosis and evaluation of different sleep disorders and behaviors, based on the recording of physiological events throughout an entire night of sleep, using electrodes and sensors to monitor neurovegetative parameters[11]. However, high economical costs, availability, technical requirements, and the lack of validated criteria and indications for use in children[12], have limited the number of available PSG/SB studies in children[8,13]. Most data came from questionnaires, as discussed above, as far as the findings of the systematic review on prevalence are concerned.

Therefore, the objective of the study described in **Chapter 3** was to assess the validity of parental-reported SB in children by comparing it with PSG, as based on criteria available from studies in adults[14,15]. The correlation of PSG recordings with two strategies of parental-reported SB, viz., a single-report and a multiple- observation report with a 5-day diary, was evaluated. Good negative predictive values (NPV) were found for the multiple-observation report, even if only a moderate correlation and agreement were observed. The good NPV means that when a multiple-observation report with a 5-day diary is negative for SB, such prediction is of good value with respect to the reference standard (i.e., actual absence of SB, as measured with PSG). The single-report was not correlated with PSG/SB.

An important recommendation for the future is the need to establish PSG criteria for SB in children. Emerging data on MMA in adults could help refining the SB criteria and expand their adoption to children. On this purpose, it must be remarked that, according to the results described in this thesis, as well as those from another investigation[16], the amount of MMA is higher in children than in adults[14,15].

Due to the technical and economic difficulties to perform PSG, the adult literature describes studies in which some portable devices for EMG recording have been compared to PSG for the assessment of sleep-time MMA[17,18]. In those studies, agreement with PSG was acceptable. Since children are less compliant to full PSG than adults, portable EMG could be a good option for the assessment of SB and MMA in a child's natural sleep environment. For that purpose, it is important to select a portable EMG device that accomplishes the objectives of being comfortable for children and easy to set up by parents.

The single-channel assembly of the GrindCare Measure™ (GCM) [19], that is applied on the skin over the right temporalis muscle, may offer advantages in terms of children's compliance, and was thus chosen as the test device in the investigation included in this thesis (Chapter 4).

The objectives of the investigation were to determine the night-to-night variability of EMG episodes within the five nights of measurements with the GCM device and to assess the agreement between the measurements of MMA using GCM for five nights and a single-night PSG study.

The EMG detection algorithm was the same as in the original device for adults. It compares the EMG amplitude to a threshold level, which is set to 20% of the of the maximum voluntary contraction (MVC). Setup of the threshold level is done every night before sleep, during which the user is required to set the MVC for calibration[18]. According to the results of the investigation included in this thesis, the algorithm was not useful to quantify the EMG activity in children, when compared with the PSG results. Such finding may be explained with the fact that the GCM uses a single electrode, placed on the skin area over the anterior temporalis, while PSG/SB episodes are measured in the traces of masseter EMG activity1[4,15]. Obtaining the EMG information from two different masticatory muscles could limit the level of correlation that can be expected from EMG measurements with GCM and PSG.

To our knowledge, this was the first study that assessed SB with portable-EMG in children, so comparisons with similar studies were not possible. New projects are necessary to find alternatives to PSG for measuring the frequency and intensity of MMA in the sleep environment of children. Strategies should be based on the search for EMG normality values for MMA in children and the development of a new algorithm for portable EMG devices, which could be used in children.

Some authors showed an association of parental reported SB with a decrease of stress-related cortisol levels in children[20]. Thus, as a new challenge to improve the knowledge in the etiology as well as the measurability of SB in children, a future focus might be the correlation between MMA and all the physiological changes that are potentially correlated with SB and with other markers of biopsychological conditions, such as cortisol or dopamine levels.

Associated factors

Many factors have been associated with SB in children. Among them, psychological and sleep variables are the most commonly found in the literature[21,22,23].

Personality and many psychological aspects have been related to QoL and SB[24,25,26]. Colombia is full of nuances regarding the psychological characteristics of the population. Many years of violence, war, and drugs-traffic, left deep marks in the society and, consequently, QoL of children[27]. Additionally, Colombia is the first country of South America regarding socioeconomic inequity (http://povertydata.worldbank.org/poverty/region/LAC). Indeed, the society is divided into six layers, according to not only economical income, but also cultural, educational, and work opportunities (www.dane.gov.co/files/geoestadistica; 2013). Thus, Colombian children may be more susceptible of having factors associated to SB.

To accomplish the objective of evaluating the association of SB and QoL in Colombian children from different social layers, the sample of the study included in Chapter 5 of this thesis was stratified according to gender, age, and socioeconomic layers. The sample size was calculated based otn the data of the Colombian statistics agency (DANE). To improve the internal and external validity of the results, compared with previous investigations, validated instruments were used, both for the assessment of SB and QoL.

Even though correlations of SB with physical and psychological health, and with emotional, social, and school functioning were statistically significant, the correlation coefficients were low. This means that statistical significance was likely due to the high number of subjects that were evaluated, but true clinically relevant correlations were not found between SB and QoL in Colombian children.

The results of the study described in Chapter 5 agree with recent findings of an investigation in children, which reported no associations between SB and sociodemographic conditions as well as between SB and health QoL[26]. From our results, it could be inferred that other factors, different to socioeconomic, physical and psychological conditions, must be explored in association to SB., to evaluate its role as risk factors for other disorders.

Another issue that was assessed in this thesis, is the relationship of SB with sleep behaviors. A study evaluating sleep behaviors of Colombian children aged 8- 12 years old from different socioeconomic layers was performed (Chapter 6). The assessment was carried out using the Children´s Sleep

Habits Questionnaire (CSHQ). In a sample of 1475 children, sleep disorders and parasomnias increased with the frequency of parental-reported SB, independently on the socioeconomic layer. Significant differences were found between children with different SB frequency as for the prevalence of some sleep disorders (sleep anxiety, night waking, and sleep disordered breathing) and all parasomnias.

Sleep disorders have been previously related to SB in children, as assessed with parental report of sleep tooth grinding[28,29]. More specifically, snoring, mouth breathing, and restless sleep, have been described as associated factors for SB in children[30], which is in agreement with the results of this investigation.

According to the American Academy of Sleep Medicine (AASM), SB is not considered a parasomnia related to REM and/or No-REM sleep, but it is included in the group of "other disorders" (http://www.esst.org/adds/ICSD.pdf)[28,29]. According to the correlations with parasomnias that were found in the above investigation, it could be inferred that SB may act as a comorbidity or a symptom of parasomnias.

Regarding sleep patterns, features such as having a continuous sleep until morning, total sleeping time, time going to bed, and time taken to fall asleep, have been observed to be different between subjects with and without self-reported SB in adults[31] and parental-reported SB in children[32]. In the investigation, those sleep patterns were not related to SB in children.

An association of SB with some sleep disorders and with parasomnias in children, was shown in this thesis. The clinical relevance of such association is yet to be studied, to clarify if SB is a symptom or a comorbidity of parasomnias or sleep disorders.

SB has been correlated to the central nervous system, particularly to sympathetic neurotransmission and dopamine levels. Most of the aminoacids involved in the production of catecholamines are not produced by the human body, but from the food that is ingested[33]. However, studies evaluating the correlation of SB with food containing high content of enzymes that are important for the synthesis of dopamine (e.g., tyrosine and tryptophan) are scarce[34].

Consequences

Tooth wear has been considered a pathognomonic symptom and/or consequence of SB, even in children[35,36]. The literature commonly suggests that the assessment of tooth wear is important to determine the presence of probable SB[4].

The aim of the investigation described in Chapter 7 was to assess the association of dietary habits and parental-reported SB with tooth wear in children with mixed dentition. Findings did not show any correlation between SB and tooth wear in the mixed dentition. Furthermore, dietary habits appear to influence the progression of tooth wear in the permanent dentition, while age was the only factor associated with wear of deciduous teeth.

The main clinical implication of these findings is that tooth wear has a multifactorial etiology, and is not exclusively related to SB. The inclusion of an evaluation of dietary habits in the study protocol led to the suggestion that, as a general remark, tooth wear should be assessed within a multiple-variable framework[37]. The evaluation of possible causative conditions, such as dietary habits, soft-drink intake[38,39], and oral habits like tooth grinding[40], must be performed[41].

On the other hand, quality and consistency of food has changed over time, becoming more processed and softer than in the past[42]. There is a need of solid and fibrous food to wear the teeth naturally. When the food is not hard enough, there might be an insufficient growth of the alveolar base in children[42]. Lacking the adequate stimuli, it has been speculated that arch size is not sufficient for the eruption of permanent teeth[43]. Additionally, in bruxist children, the higher muscular activity[44] and the supposed tooth wear related to SB, could influence the normal development in the palatal shape, which has been found to be bigger and wider in children with parental-reported SB, compared with children whose parents do not report SB[45]. Whilst these putative associations might also have an ever more plausible explanation calling into cause the possible link of SB with respiratory disturbances in children with an ogival palate, the argument is surely worthy of further investigation.

Despite the amount of literature hypothesizing a correlation of tooth wear with SB in children[35,36], findings of this investigation diminished the purported importance of tooth wear as a marker of SB in children. Nevertheless, this investigation also gave additional inputs for providing information to parents about the importance of maintaining adequate oral hygiene habits. Additionally, the dietary habits should be taken into account in the dental

history of every patient as far as an observation of tooth wear is related. For further studies, the multiple-variable assessment of tooth wear should include the evaluation of ingested medications and reflux disease (GERD).

Conclusion

Even though the biological, psychological, and social aspects studied in this thesis, are the factors that are most frequently related to SB in the literature; there did not yield enough elements to suggest that certain sleep behaviors or quality of life issues are determinants of the presence of SB in children. According to the results of this thesis, there is a need for a better definition of the amount of MMA in children. Furthermore, the association of parental reported SB in children with sleep disorders and parasomnias deserves to be explored in further investigations.

References

1. Raphael KG, Santiago V, Lobbezoo F. Is bruxism a disorder or a behaviour? Rethinking the international consensus on defining and grading of bruxism. J Oral Rehabil. 2016;43:791-798.

2. Raphael KG, Santiago V, Lobbezoo F. Bruxism is a continuously distributed behaviour, but disorder decisions are dichotomous (Response to letter by Manfredini, De Laat, Winocur, & Ahlberg). J Oral Rehabil. 2016;43:802-803.

3. Lavigne GJ, Khoury S, Abe S, Yamaguchi T, Raphael K. Bruxism physiology and pathology: an overview for clinicians. J Oral Rehabil. 2008 Jul;35(7):476-94.

4. Lobbezoo F, Ahlberg J, Glaros AG, Kato T, Koyano K, Lavigne GJ et al. Bruxism defined and graded: an international consensus. J Oral Rehabil. 2013; 402-404.

5. Lavigne GJ, Kato T, Kolta A, Sessle BJ. Neurobiological mechanisms involved in sleep bruxism. Crit Rev Oral Biol Med. 2003;14:30-46.

6. Insana SP, Gozal D, McNeil DW, Montgomery-Downs HE. Community based study of sleep bruxism during early childhood. Sleep Med. 2013;14:183-188.

7. van Selms MK, Visscher CM, Naeije M, Lobbezoo F. Bruxism and associated factors among Dutch adolescents. Community Dent Oral Epidemiol. 2013;41:353- 363.

8. Huynh NT, Desplats E, Bellerive A. Sleep bruxism in children: sleep studies correlate poorly with parental reports. Sleep Med. 2016;19:63-68.

9. Manfredini D, Restrepo C, Diaz-Serrano K, Winocur E, Lobbezoo F. Prevalence of sleep bruxism in children: a systematic review of the literature. J Oral Rehabil 2013; 40: 631–642.

10. Machado E, Dal-Fabbro C, Cunali PA, Kaizer OB. Prevalence of sleep bruxism in children: a systematic review. Dental Press J Orthod. 2014;19:54-61.

11. Thomas SJ. Basic principles of polysomnography including electrical concepts. Respir Care Clin N Am. 2005;11:587-595

12. Aurora RN, Lamm CI, Zak RS, Kristo DA, Bista SR, Rowley JA, Casey KR. Practice parameters for the non-respiratory indications for polysomnography and multiple sleep latency testing for children. Sleep. 2012;35:1467-1473.

13. Herrera M, Valencia I, Grant M, Metroka D, Chialastri A, Kothare SV. Bruxism in children: effect on sleep architecture and daytime cognitive performance and behavior. Sleep. 2006;29:1143-1148.

14. Lavigne GJ, Rompré PH, Montplaisir JY. Sleep bruxism: validity of clinical research diagnostic criteria in a controlled polysomnographic study. J Dent Res. 1996;75:546-552.

15. Rompré PH, Daigle-Landry D, Guitard F, Montplaisir JY, Lavigne GJ. Identification of a sleep bruxism subgroup with a higher risk of pain. J Dent Res. 2007;86:837- 842.

16. Huynh NT, Desplats E, Bellerive A. Sleep bruxism in children: sleep studies correlate poorly with parental reports. Sleep Med. 2016;19:63-68.

17. Manfredini D, Ahlberg J, Castroflorio T, Poggio CE, Guarda-Nardini L, Lobbezoo F. Diagnostic accuracy of portable instrumental devices to measure sleep bruxism: a systematic literature review of polysomnographic studies. J Oral Rehabil. 2014;41:836-842.

18. Stuginski-Barbosa J, Porporatti AL, Costa YM, Svensson P, Conti PC. Diagnostic validity of the use of a portable single-channel electromyography device for sleep bruxism. Sleep Breath. 2016;20:695-702.

19. Jadidi F, Castrillon E, Svensson P. Effect of conditioning electrical stimuli on temporalis electromyographic activity during sleep. J Oral Rehabil. 2008;35:171- 183.

20. Castelo PM, Barbosa Tde S, Pereira LJ, Fonseca FL, Gavião MB. Awakening salivary cortisol levels of children with sleep bruxism. Clin Biochem. 2012;45:651-654.

21. Restrepo CC, Vásquez LM, Alvarez M, Valencia I. Personality traits and temporomandibular disorders in a group of children with bruxing behaviour. J Oral Rehabil. 2008; 35:585-593.

22. Ferreira-Bacci Ado V, Cardoso CL, Díaz-Serrano KV. Behavioral problems and emotional stress in children with bruxism. Braz Dent J. 2012;23:246-251.

23. Guo H, Wang T, Li X, Ma Q, Niu X, Qiu J. What sleep behaviors are associated with bruxism in children? A systematic review and meta-analysis, Sleep Breath. 2017. https://doi.org/10.1007/s11325-017-1496-3.

24. Serra-Negra JM, Paiva SM, Flores-Mendoza CE, Ramos-Jorge ML, Pordeus IA. Association among stress, personality traits, and sleep bruxism in children. Pediatr Dent. 2012;34:30-34.

25. Serra-Negra JM, Ramos-Jorge ML, Flores-Mendoza CE, Paiva SM, Pordeus IA. Influence of psychosocial factors on the development of sleep bruxism among children. Int J Paediatr Dent. 2009;19:309-317.

26. de Alencar NA, Leão CS, Leão ATT, Luiz RR, Fonseca-Gonçalves A, Maia LC. Sleep Bruxism and Anxiety Impacts in Quality of Life Related to Oral Health of Brazilian Children and their Families. J Clin Pediatr Dent. 2017;41:179-185.

27. Gaviria SL, Alarcón RD, Espinola M, Restrepo D, Lotero J, Berbesi DY, Sierra GM, Chaskel R, Espinel Z, Shultz JM. Socio-demographic patterns of posttraumatic stress disorder in Medellin, Colombia and the context of lifetime trauma exposure. Disaster Health. 2016;3:139-150.

28. International Classification of Sleep Disorders 3rd Ed. Darien, IL USA: American Academy of Sleep Medicine. 2014.

29. Sateia M. International classification of sleep disorders-third edition: highlights and modifications. Chest. 146: 1387–1394.

30. Drumond CL, Souza DS, Serra-Negra JM, Marques LS, Ramos-Jorge ML, Ramos-Jorge J. Respiratory disorders and the prevalence of sleep bruxism among schoolchildren aged 8 to 11 years. Sleep Breath. 2017;21:203-208.

31. Shokry SM, El Wakeel EE, Al-Maflehi N, RasRas Z, Fataftah N, Abdul Kareem E. Association between Self-Reported Bruxism and Sleeping Patterns among Dental Students in Saudi Arabia: A Cross-Sectional Study. Int J Dent. 2016;2016:4327081. doi: 10.1155/2016/4327081.

32. Ng EG, Ng DK, Chan CH. Sleep duration, wake/sleep symptoms, and academic performance in Hong Kong Secondary School Children, Sleep Breath. 2009;13: 357–367.

33. Bjork JM, Grant SJ, Chen G, Hommer DW. Dietary tyrosine/phenylalanine depletion effects on behavioral and brain signatures of human motivational processing. Neuropsychopharmacology. 2014;39:595-604.

34. Etzel KR, Stockstill JW, Rugh JD, Fisher JG. Tryptophan supplementation for nocturnal bruxism: report of negative results. J Craniomandib Disord. 1991;5:115- 120.

35. Restrepo C, Peláez A, Alvarez E, Paucar C, Abad P. Digital imaging of patterns of dental wear to diagnose bruxism in children. Int J Paediatr Dent. 2006;16:278- 285.

36. Serra-Negra JM, Paiva SM, Auad SM, Ramos-Jorge ML, Pordeus IA. Signs symptoms, parafunctions and associated factors of parent-reported sleep bruxism in children: a case-control study. Braz Dent J. 2012;23:746-752.

37. Kontaxopoulou I, Alam S. Risk Assessment for Tooth Wear. Prim Dent J. 2015;4:25-9.

38. Milosevic A, Lennon MA, Fear SC. Risk factors associated with tooth wear in teenagers: a case control study. Community Dent Health. 1997;14:143-147.

39. Murakami C, Oliveira LB, Sheiham A, Nahás Pires Corrêa MS, Haddad AE, Bönecker M. Risk indicators for erosive tooth wear in Brazilian preschool children. Caries Res. 2011;45:121-129.

40. El Aidi H, Bronkhorst EM, Huysmans MC, Truin GJ. Multifactorial analysis of factors associated with the incidence and progression of erosive tooth wear. Caries Res. 2011;45:303-312.

41. Wetselaar P, Lobbezoo F. The tooth wear evaluation system: a modular clinical guideline for the diagnosis and management planning of worn dentitions. J Oral Rehabil. 2016;43:69-80.

42. Maki K, Nishioka T, Shioiri E, Takahashi T, Kimura M. Effects of dietary consistency on the mandible of rats at the growth stage: computed X-ray densitometric and cephalometric analysis. Angle Orthod. 2002;72:468-475.

43. Simões WA. Selective grinding and Planas' direct tracks as a source of prevention. J Pedod. 1981;5:298-314.

44. Karakis D, Dogan A. The craniofacial morphology and maximum bite force in sleep bruxism patients with signs and symptoms of temporomandibular disorders. Cranio. 2015;33:32-37.

45. Restrepo CC, Sforza C, Colombo A, Peláez-Vargas A, Ferrario VF. Palate morphology of bruxist children with mixed dentition. A pilot study. J Oral Rehabil. 2008;35:353-360.