Sleep Bruxism and Sleep-Disordered Breathing: A Systematic Review

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Aims: To carry out a systematic review to consolidate current knowledge on the potential association between sleep bruxism (SB) and sleep-disordered breathing (SDB). **Methods:** For this systematic review, articles were retained only if they reported studies using full ambulatory polysomnography as "the gold standard" reference test to determine SDB and the international diagnostic criteria proposed by the American Association of Sleep Medicine to determine SB. Detailed individual search strategies from MEDLINE, PubMed, Embase, the Cochrane Library, and LILACS databases were developed. The references cited in the selected articles were also checked, and a partial literature search was undertaken. The selection was completed independently by two reviewers in two phases. The methodology of selected studies was evaluated using the seven-item quality-assessment tool for experimental bruxism studies. **Results:** During the initial search, 333 different citations were identified across the six electronic databases. After a comprehensive evaluation of the abstracts, and the full papers when considered necessary, only one study was finally selected for the qualitative/quantitative synthesis. This study did not support the putative association between SB and SDB, since SB was not observed during or in temporal conjunction with snoring or apneic events in any of the evaluated patients. In addition, masseter activity was not observed during apneic episodes. **Conclusion:** There is not sufficient scientific evidence either to confirm or discredit the association between SB and SDB. *J Oral Facial Pain Headache 2014;28:299–305. doi: 10.11607/ofph.1294*

Key words: *bruxism, sleep apnea, sleep bruxism, sleep-disordered breathing, systematic review*

Sleep bruxism (SB) is an oral habit characterized by rhythmic activity of the masticatory muscles that results in recurrent friction between teeth surfaces during sleep.[1] According to the American Academy of Sleep Medicine (AASM), SB is defined as a stereotyped movement disorder characterized by grinding or clenching of the teeth during sleep.[2] Although SB is not a life-threatening condition, it can adversely influence the quality of life.[3]

In a recent systematic review, the prevalence of SB was estimated to be around 12.8% (± 3.1%) of the adult population.[4] However, in a study exclusively relying on polysomnography (PSG), the prevalence was 7.4%.[5] Complaints of tooth grinding occurring during sleep decline over time,[6,7] from 14% in children to 8% in adults to 3% in patients over 60 years of age.[6] As a result of periodic mechanical grinding, SB may lead to tooth wear, tooth mobility, and other clinical findings such as tongue/cheek indentation, masticatory muscle hypertrophy, pain in the temporomandibular joint, headaches, and pain or fatigue of the masticatory muscles.[3] Disruption of the bed partner's sleep due to grinding sounds has also been reported.[8,9] Although tooth wear is widely acknowledged in the literature as the classic dental sign of bruxism, arguments against the use of tooth wear as an absolute criterion to assess SB severity have been advanced.[10,11]

The diagnosis of SB is often challenging.[10] The clinical diagnosis of SB should be based on the international diagnostic criteria proposed by AASM.[2] The minimal criteria for the diagnosis of SB include positive questionnaire data identifying the presence of grinding or clenching of

the teeth and at least one of the following signs: abnormal tooth wear, sounds associated with grinding or clenching during sleep, or jaw-muscle discomfort. Additional polysomnographic recordings are also recommended to confirm the diagnosis.[2]

Sjoholm et al[12] proposed that SB could function as an autonomic motor reflex in response to a nocturnal arousal. Since then, several cross-sectional studies have suggested that SB might be associated with other sleep disturbances.[1,10,13–16]

Sleep-disordered breathing (SDB) is a broad term used to describe the presence of abnormal respiratory events during sleep.[17] SDB reflects a spectrum ranging from snoring at the low end of the spectrum to upper airway resistance syndrome and then rising to obstructive sleep apnea (OSA), the latter classified as mild, moderate, and severe.[18] The clinical diagnosis of sleep apnea is established when apnea (complete cessations of airflow) and hypopnea (significant reductions in airflow beyond a specific cutoff, eg, 50%) are present in conjunction with excessive daytime somnolence. The etiology of apnea and hypopnea is frequently anatomical; it involves a narrowing or collapse of the pharyngeal upper airway when an individual is asleep.[17] SDB prevalence ranges widely, from 14.7% to 36.5%, depending on gender and ethnicity.[19] It is higher in males (34.2%) than in females (14.7%).[19] Prevalence in Hispanics (36.5%) is similar to that in white Americans (33.3%) and higher than in Japanese (18.4%).[19] A recent systematic review reported that OSA prevalence ranges from 3.7% to 97.3% in Asian adults.[20] Similar to SB, the standard testing procedure for establishing the presence of SDB is the overnight PSG.[10,21,22]

SDB is associated with increased health care utilization and costs.[23] It has therefore always been recognized as a major public health issue with potential societal consequences: accidents, increased morbidity, and cognitive deficits that impair work efficiency.[24] Health care costs are not normally distributed, that is, the costliest and the sickest upper third of patients consume 65% to 82% of all medical costs.[25] All sleep disorders have been suggested as underlying an estimated 9.1% of work-related injuries when both direct and indirect costs were estimated.[26] Indeed, the overall cost of sleep disorders in Australia (with a population of 20.1 million at the time of the study) was calculated as US$ 7,494 million.[26]

SDB is a disorder of significant relevance to the practicing dentist, as it has been associated not only with SB[1,13–16] but also with a variety of oral and craniofacial problems, such as retrusive chin, tendency toward Class II malocclusion, vertical growth direction, and steep mandibular plane.[27]

Although previous studies have supported an association between SB and SDB,[1,13–16] no systematic analysis of published studies has been pursued to shed light on the strength of the data available to support this association. Therefore, the main goal of this systematic review was to consolidate current knowledge on the potential association between SB and SDB.

Materials and Methods

This systematic review was carried out by closely adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Checklist.[28] It reviewed human studies that evaluated the association between SB and SDB. Reviews, letters, and personal opinions were not considered. No registration of the systematic review protocol was completed.

Eligibility Criteria

Retained articles included only those reporting studies using *(1)* full ambulatory PSG as "the gold standard" reference test to determine SDB[10,21,22] and *(2)* the international diagnostic criteria proposed by AASM[29] to determine SB. A complete ambulatory PSG with an apnea-hypopnea index ≥ 5 was considered diagnostic of SDB. A positive questionnaire identifying the presence of grinding or clenching and at least one of the following signs—abnormal tooth wear, sounds associated with grinding or clenching during sleep, or jaw-muscle discomfort—was considered diagnostic of SB.

Studies from any language or peer-reviewed source were considered.

Information Sources

Detailed individual search strategies for each of the following bibliographic databases were developed: MEDLINE, PubMed, Embase, the Cochrane Library, and LILACS. The references cited in the selected articles were also checked for any references that could have been missed in the electronic database searches. A partial grey (not indexed) literature search was taken using Google Scholar. This search was limited to the first 100 most relevant articles published in the last 5 years.

Search and Study Selection

Appropriate truncation and word combinations were selected with the help of a health sciences librarian and were adapted for each database search (Table 1). All references were managed by reference manager software (RefWorks, RefWorks-COS, ProQuest) and duplicate hits were removed. The end search date was October 25, 2013 across all databases.

The selection was completed in two phases. In phase 1, two reviewers (GL and VS) independently

reviewed the titles and abstracts of all identified electronic database citations. Any studies that did not appear to fulfill the inclusion criteria were discarded. In phase 2, the same selection criteria were applied to the full articles to confirm their eligibility. This additional step was needed, as some abstracts may have been misleading by partially or incorrectly representing study details. The same two reviewers independently participated in phase 2. Any disagreement in either phase was resolved by discussion and mutual agreement between the two reviewers. A third author (CF) was involved when required to make a final decision.

Data Collection Process

Two authors (GL and VS) collected the required information independently from the selected articles, after which cross-checking procedures ascertained the completeness of the retrieved information. Any disagreement was resolved again by discussion and mutual agreement between the authors. A third author (CF) was involved, when required, to make a final decision.

For the included studies, the following information was recorded: author, year of publication, country, sample size, demographic features of the sample, and results pertaining to the association between SB and SDB. If the required data were not complete, attempts were made to contact the authors to retrieve the missing information.

Risk of Bias in Individual Studies

The methodology of selected studies was evaluated using the seven-item quality-assessment tool for experimental bruxism studies (Qu-ATEBS).[30] Items are phrased as questions and rated on a five-point Likert scale. The maximum attainable score was 70 points; a score between 0 and 50 was considered low quality and a score between 51 and 70 was considered high quality. Two reviewers (GL and VS) independently scored each item from "strongly disagree" to "strongly agree" while assessing the quality of the included study. Disagreement between both reviewers was resolved by a third author (CF).

Summary Measures

The frequency of SB (diagnosed by international diagnostic criteria proposed by AASM)[29] in patients with SDB diagnosed at PSG (apnea-hypopnea index ≥ 5) was evaluated. A meta-analysis was planned if the data from the different studies were relatively homogeneous.

Table 1 List of Search Terms*

Search	Query
#10	Search (#6 AND #9)
#9	Search (#7 OR #8)
#8	Search SLEEP BRUXISM
#7	Search BRUXISM
#6	Search (#1 OR #2 OR #3 OR #4 OR #5)
#5	Search UPPER AIRWAY RESISTANCE SYNDROME
#4	Search SDB
#3	Search SLEEP DISORDERED BREATHING
#2	Search SLEEP APNOEA
#1	Search SLEEP APNEA

*These terms were used in PubMed and adapted to the other databases. More information about the other database searches can be provided by the corresponding author.

Table 2 Excluded Studies

Authors	Reason for exclusion
Boutros et al[31]	No determination of the association between SB and SDB
Camargo et al[32]	Minimum criteria for SB diagnosis not met
Gold et al[33]	Minimum criteria for SB diagnosis not met
Gregorio et al[34]	Minimum criteria for SB diagnosis not met
Inoko et al[35]	No determination of the association between SB and SDB
Kato et al[36]	No PSG for SDB diagnosis; different target condition*
Khoury et al[37]	No PSG for SDB diagnosis
Lucchesi et al[38]	No determination of the association between SB and SDB
Okeson et al[39]	No determination of the association between SB and SDB; minimum criteria for SB diagnosis not met
Okeson et al[40]	Minimum criteria for SB diagnosis not met
Oksenberg and Arons[41]	Case report
Phillips et al[42]	Minimum criteria for SB diagnosis not met
Rossetti et al[43]	No determination of the association between SB and SDB
Silvestri et al[44]	Different target condition
Wong[45]	Review article

*Not initially designed to investigate the association between sleep bruxism (SB) and sleep-disordered breathing (SDB), but rather the association between jaw symptoms and obstructive sleep apnea (OSA).
PSG = polysomnography.

Results

Study Selection

In the initial search (phase 1), 333 different citations were identified across the 6 electronic databases. After a comprehensive evaluation of the abstracts, 317 were excluded. Therefore, only 16 articles were finally selected for phase 2 assessments. From these, 15 were later excluded (Table 2). No additional study that might have been inadvertently missed by the search procedures was identified in the review of the references cited by these 16 studies. Thus, the stringent criteria enabled retention of only one study for the qualitative/quantitative synthesis. A flow diagram of the process of identification, inclusion, and exclusion of studies is shown in Fig 1.

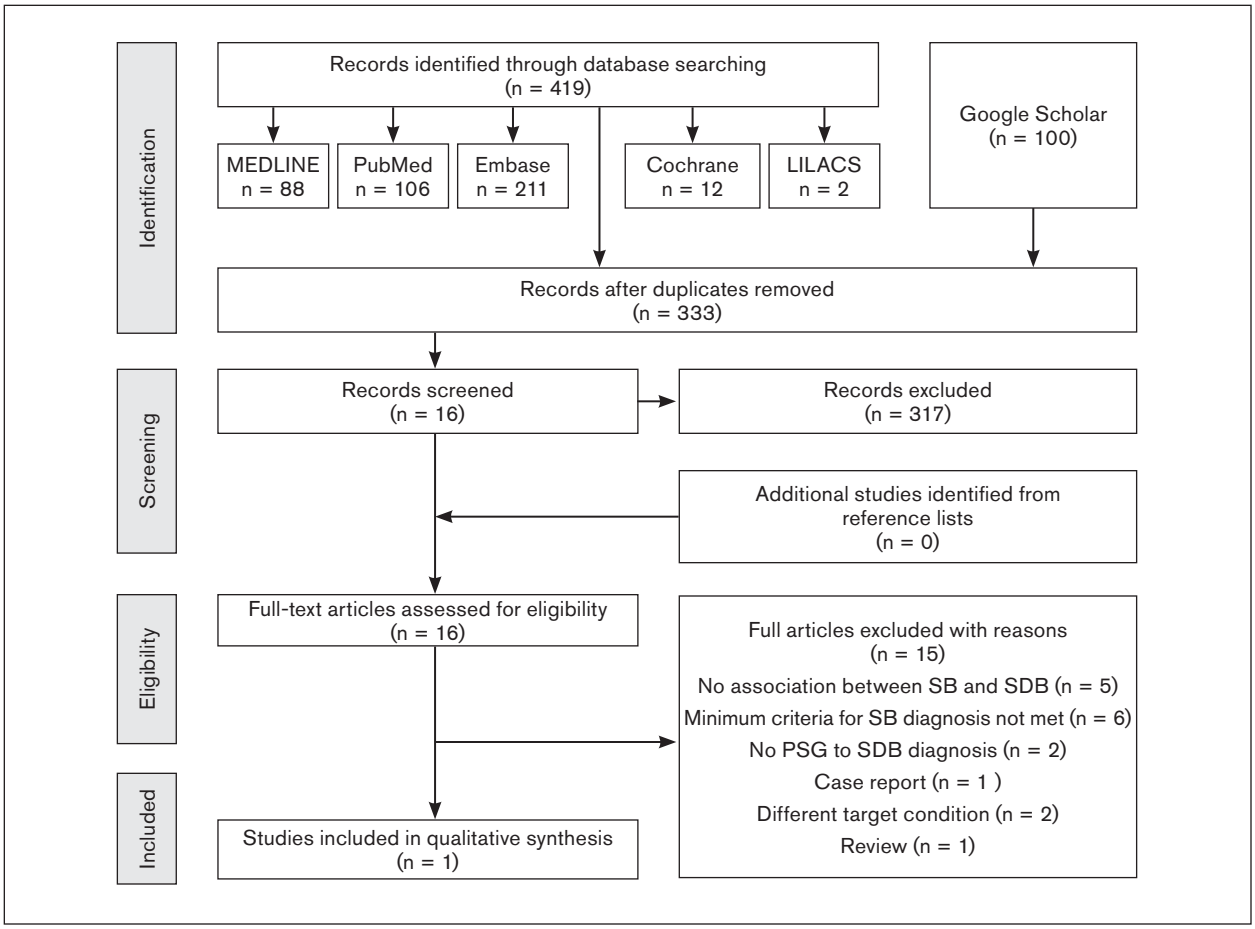

Fig 1 Flow diagram of literature search and selection criteria.[2] PSG = polysomnography; SB = sleep bruxism; SDB = sleep-disordered breathing.

Table 3 Summary of Descriptive Characteristics of Included Article

Authors (year)	Country	Sample	Mean age, y	Findings	Main conclusion
Sjoholm et al[13] (2000)	Canada	21 patients (19 male, 2 female)	40 (SD 9.2)	SB was diagnosed in 54% of patients with mild OSA and 40% of patients with moderate OSA	SB was not observed during or in temporal conjunction with snoring or apneic events in any of the evaluated patients; masseter activity was not observed during apneic episodes

SB = sleep bruxism; OSA = obstructive sleep apnea.

Study Characteristics

The selected study[13] was conducted in Canada and consisted of a sample size of 21 participants. This study used PSG for SDB diagnosis and PSG and AASM criteria[29] for SB diagnosis. A summary of the study's descriptive characteristics can be found in Table 3.

Risk of Bias

The reported methodological quality of the included study was high (score of 53). The main methodological limitations were related to poor reporting of items 3 (control group) and 6 (insufficient statistical reporting) (Table 4).

Synthesis of Results of Included Study

In the included study,[13] the difference between the groups was analyzed by Student *t* test at the 5% level of significance. Sleep-stage comparisons were made with an unpaired Student *t* test with Bonferroni correction. The study[13] concluded that SB was rarely associated with apneic events. SB was diagnosed in 54% of patients with mild OSA and 40% of patients with moderate OSA. SB was not observed during snoring or apnea in any of these patients. Masseter activity was not observed during apneic episodes. Standard deviation was used as an index of variability.

Table 4 Quality-Assessment Tool for Experimental Bruxism Study (Qu-ATEBS) Scores*

	Question		Strongly disagree ←				→ Strongly agree
1	Quality of reporting:	Were the study's aims or hypotheses clearly described?	N/A	1	2	3	4	(5)
	Quality of design:	Were the aims or hypothesis based on relevant theory?	N/A	1	2	3	(4)	5
2	Quality of reporting:	Were the eligibility criteria, used to select participants, sufficiently described?	N/A	1	2	3	4	(5)
	Quality of design:	Were the eligibility criteria appropriate for the objectives of this study?	N/A	1	2	3	4	(5)
3	Quality of reporting:	Was it clearly described whether a control group, control condition, or an experimental condition was used?	(N/A)	1	2	3	4	5
	Quality of design:	Were the control group, control condition, or experimental condition appropriate for this study?	(N/A)	1	2	3	4	5
4	Quality of reporting:	Was the study design described in sufficient detail to permit replication?	N/A	1	2	3	4	(5)
	Quality of design:	Was the study design appropriately selected for the objectives of this study?	N/A	1	2	3	4	(5)
5	Quality of reporting:	Was the experimental bruxism task described in such detail that replication is possible?	N/A	1	2	3	4	(5)
	Quality of design:	Was the experimental bruxism task appropriately selected for the objectives of this study?	N/A	1	2	3	4	(5)
6	Quality of reporting:	Were statistical methods and data sufficiently described?	N/A	1	2	(3)	4	5
	Quality of design:	Were statistical methods and data appropriate for the objectives of this study?	N/A	1	2	(3)	4	5
7	Quality of reporting:	Were the study's conclusions appropriately formulated?	N/A	1	2	3	(4)	5
	Quality of design:	Were aims and hypothesis clearly addressed in the conclusions and relevant to the objectives?	N/A	1	2	3	(4)	5
	Total					53		

*Two reviewers scored and circled each item from "strongly disagree" to "strongly agree." Items were phrased as questions and rated on a five-point Likert scale. The maximum attainable score was 70 points; a score between 0 and 50 was considered low quality, and a score between 51 and 70 was considered high quality. NA = not applicable.

Discussion

Summary of Evidence

This systematic review investigated the potential association between SDB and SB. The major reason for addressing this subject was predicated on several studies suggesting that SB can occur concomitantly with SDB and could therefore reciprocally interact to increase their severity.[1,10,14–16,42] However, due to a variety of methodological limitations, only 1 study[13] of 333 was ultimately selected for this systematic review. This study did not support the association between SB and SDB, since SB was not observed during or in temporal conjunction with snoring or apneic events in any of the evaluated patients; in addition, masseter activity was not observed during apneic episodes. It should be noted, however, that this study[13] involved a small sample size, provided limited statistical analysis details, and did not include a control group.

The assessment of SB has been generally based on reports of tooth-grinding sounds during sleep and the clinical presence of signs (tooth wear, tooth mobility, tongue/cheek indentation, masticatory muscle hypertrophy) and symptoms (pain in the temporomandibular joint, headaches, pain or fatigue of the masticatory muscles).[3] Grinding sounds caused by tooth contacts are the pathognomonic sign of SB and are usually reported by patients, bed partners, siblings, or parents.[10] However, not all recurrent episodes of rhythmic masticatory muscle activity of the masseter are accompanied by tooth grinding or sounds, so a large proportion of patients or family members may not be aware of the presence of SB. Moreover, it was recently demonstrated that tooth wear cannot be used as a single absolute criterion to assess SB severity.[11] The clinical diagnosis of SB in research settings should at least closely follow the international diagnostic criteria proposed by the AASM[29] to enable more reliable and accurate assessments of outcomes or associations with other conditions. Similarly, the standard testing procedure for diagnosing SDB should be the overnight PSG.[10,21,22] Except for a priori consensus, as stated in more than 200 articles in PubMed when searching for "sleep disordered breathing AND polysomnography AND gold standard," the authors were unable to

identify the original publication that validated the use of overnight PSG as the gold standard in the SDB diagnosis. Furthermore, the current practice standard is predicated on a one-night PSG. If the PSG is negative, the diagnosis of sleep apnea is usually discarded. However, a significant group of these patients remain symptomatic despite negative testing. If the clinical suspicion for OSA exists and the PSG is negative, the physician faces a true dilemma with regard to further patient management.[46]

It is noteworthy that the findings reported by Sjoholm et al[13] agree with those of Okeson et al,[40] who found that control subjects experienced an average of 26.2 bruxism events and 1.3 SDB episodes per night, while the SDB subjects experienced 16.1 bruxism events and 175.8 SDB episodes per night of sleep. The average duration of bruxism events ranged only from 3.82 to 6.68 seconds and did not correlate to the severity of SDB. Large standard deviations were present in both groups, resulting in no statistically significant differences in the number, duration, and association of bruxism events between SDB and control groups. It should be noted that in both groups there was a strong association between sleep arousals and bruxism events. This would suggest that although bruxism events are commonly associated with SDB arousals, they are even more commonly associated with body movement and isolated arousals.[40] Physiological evidence supports the presence of SB as a downstream consequence of transient spontaneous arousal events. However, although apneic-hypopneic events will induce arousals, they do not appear to be followed by SB tooth grinding, suggesting that an apneic event, per se, or induced arousal does not seem to be a direct cause of a SB tooth-grinding episode.[47]

The results from the single study[13] are also in close agreement with statements from the International Classification of Sleep Disorders, version 2 (ICSD-2).[48] According to this classification, OSA is a sleep-related breathing disorder, eg, a disorder of altered breathing patterns during sleep. In contrast, SB is a parasomnia, a disorder of arousal or sleep-stage transition, which does not cause a primary complaint of insomnia or excessive sleepiness. Parasomnias are disorders that affect the sleep process and are not primarily disorders of sleep and awake status. These disorders reflect manifestations of the central nervous system activation, which is usually transmitted through the activation of skeletal muscle or autonomic nervous system channels.[48] Parasomnias consist of abnormal sleep-related movements, behaviors, emotions, perceptions, dreaming, and autonomic nervous system functioning.[48]

In summary, although SB and SDB are both sleep disorders, they are unlikely to share any pathophysiological similarities. It is important to emphasize that although bruxism is not a life-threatening condition, dental problems such as tooth wear, frequent fractures of dental restorations, and pain in the orofacial region may markedly deteriorate the quality of life.[3] Furthermore, SDB is a disorder of significant relevance to the practicing dentist, regardless of its association with SB, because SDB is frequently accompanied by a variety of oral and craniofacial problems, such as retrusive chin, tendency toward Class II malocclusion, vertical growth direction, and steep mandibular plane.[27]

Conclusions

There is not sufficient scientific evidence to either confirm or discredit the association between SB and SDB, and therefore more research on this topic is needed.

Acknowledgments

The authors report conflicts of interest related to this study.

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