Australian Dental Journal
The official journal of the Australian Dental Association

Australian Dental Journal 2024; 0: 1–7

doi: 10.1111/adj.13036

Relationship between sleep bruxism and obstructive sleep apnoea: A population-based survey

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ABSTRACT

Objective: Sleep bruxism (SB) and obstructive sleep apnoea (OSA) seem to be mutually associated. This study investigates the relationship between current SB and OSA-related symptoms and the difference in OSA-related symptoms between groups based on a history of SB.
Methods: An online survey was drafted to report the presence of SB and OSA in sample of 243 individuals (M = 129; F = 114;mean(SD)age = 42.4 ± 14.4 years). The Subject-Based Assessment strategy recommended in the 'Standardized Tool for the Assessment of Bruxism' (STAB) was adopted to assess SB. To evaluate OSA-related symptoms, Epworth Sleepiness Scale (ESS) and STOP-BANG questionnaires were adopted. Correlations between current SB and OSA-related symptoms were evaluated by Spearman test. ESS and STOP-BANG scores were compared by Mann–Whitney *U* test in individuals with and a without positive SB history.
Results: Current SB and SB history were reported by 45.7% and 39.1% of the sample, respectively. 73.7%, 21% and 5.3% of the responders showed a low, intermediate and high risk of OSA, respectively. Neither significant correlations between current SB and OSA nor significant differences between SB groups emerged.
Conclusions: This study did neither find any significant correlation between self-report of current SB and OSA nor significant differences in ESS and STOP-BANG scores between groups based on SB history.

Keywords: Sleep bruxism, obstructive sleep apnoea, STAB, STOP-BANG.

Abbreviation and acronym: DSM = dental sleep medicine; OSA = obstructive sleep apnoea; SB = sleep bruxism.

(Accepted for publication 14 August 2024.)

INTRODUCTION

In 1999, Lavigne and colleagues introduced the concept of Dental Sleep Medicine (DSM) as the discipline that studies several sleep-related conditions (e.g. snoring, obstructive sleep apnoea (OSA), sleep bruxism (SB), xerostomia), which are of interest for the dentist.[1] Lobbezoo et al. have later partially redefined DSM as 'the discipline concerned with the study of the oral and maxillofacial causes and consequences of sleep-related problems'.[2] Sleep-related conditions have been reclassified into five different categories, such as sleep-related breathing conditions (e.g. OSA), sleep-related orofacial pain, sleep-related oral-moistening conditions, sleep-related gastroesophageal reflux conditions and sleep-related mandibular movement conditions (e.g. SB).[3] However, all these conditions should be considered as inter-dependent phenomena and potentially associated with other sleep disorders (e.g. insomnia, depression).[4,5]

The relationship between SB and OSA has been a hot topic for years.[1] According to the bruxism consensus definition by Lobbezoo et al. that was published in 2018, SB is a masticatory muscle activity during sleep that is characterized as rhythmic (phasic) or non-rhythmic (tonic) and is not a movement disorder or a sleep disorder in otherwise healthy individuals.[6] SB might be part of a cascade of events that occur during sleep arousal, viz., an abrupt shift in electroencephalography (EEG) frequency, for at least 3 s, with at least 10 s of stable sleep prior to the event.[7–9] Arousal onset has several causes,[10] with respiratory events featuring OSA being one of them. OSA is a sleep-related breathing disorder featuring a repeated collapse of the upper airway, often resulting in oxygen desaturation and arousals from sleep. The collapse can determine a total (i.e. apnoea event) or partial (i.e. hypopnoea event) closure of the upper airway.[11] OSA influences nearly 1 billion adults worldwide and is a serious public health problem, since it is a risk factor for cardiovascular diseases, diabetes mellitus and neurocognitive disorders, among the others.[12–14] Nonetheless, a huge number of patients remain undiagnosed or receives a diagnosis only after the manifestation of the long-term consequences.[13]

The relationship between SB and OSA is supported by the fact that, in patients with OSA, the prevalence of SB is reportedly higher (26%–53.7%) than in the general population (12.8% ± 3.1%).[15–17] An early hypothesis by Manfredini et al. was that SB might have a protective role in patients with OSA. In fact, the activation of masseter muscles might contribute to pull the mandible forward and determine an increase in upper airway patency, with the subsequent interruption of the respiratory event.[18]

However, there is still not strong support for this positive effect in the scientific literature. Many papers investigating the occurrence of SB activity in relationship with the timing of respiratory events have reported the lack of a constant temporal correlation.[7–9,19,20] Nonetheless, due to its higher prevalence in patients with OSA than in general population and due to its relationship with respiratory arousals, the detection of SB can be potentially useful as a sentinel sign of underlying OSA in some individuals. Thus, the assessment of SB might play a role in the early recognition of patients with OSA.[21]

For these reasons, despite the inconsistent findings that have been drawn from the literature so far, the relationship between SB and OSA is worthy of further exploration. The aim of this study is to evaluate this relationship with the use of validated questionnaires in a general population of Italian individuals. The first study hypothesis is that current SB activity is higher in individuals with symptoms related to OSA. The second study hypothesis is that individuals with a history of SB report more symptoms related to OSA than individuals without a history of SB.

MATERIAL AND METHODS

A self-administered online survey was drafted for anonymous compilation by general population individuals to investigate the presence of current SB in the last month, a history of SB and signs and symptoms related to OSA. The study enrolled volunteer participants who accepted the privacy policy and provided informed consent. The recruitment was carried out by spreading word from social networks, text message, email and verbally. The research protocol was approved by the Advisory Board of the School of Dentistry of the University of Siena, Italy (#00012-Z22). Strengthening the reporting of observational studies in epidemiology (STROBE) Checklist for cross-sectional study was compiled.[22] The survey was administered by an online form service (Google Form Service, Google, USA).

The survey was available from November 2022 to January 2023 and was organized in three sections. The first section focused on sociodemographic data considering age, gender, nationality and employment. The second section examined SB behaviour, in accordance to the Subject-Based Assessment strategy recommended in the 'Standardized Tool for the Assessment of Bruxism' (STAB) Axis A, Domain A1.[23] In particular, the frequency of clenching and grinding during sleep in the last month (i.e. current SB) was asked, indicating one of the following answers: 'never','less than one night/month', 'from one to three nights/month', 'from one to three nights/week', 'from four to seven nights/week', and 'I don't know'. In addition, the participants were asked to indicate whether they used to clench or grind their teeth (true/false question) during sleep in the past (i.e. a history of SB). The third section was based on the signs and symptoms related to OSA. Participants completed two validated questionnaires, viz., 'Epworth Sleepiness Scale' (ESS) and 'STOP-BANG' (Snoring, Tiredness, Observed apnoea, high blood Pressure, Body mass index, Age, Neck circumference, Gender) questionnaire.[24,25] ESS investigates the risk of falling asleep in eight different situations with a scale from 'absence of risk' (i.e. 0 point) to 'mild' (i.e. 1 point), 'moderate' (i.e. 2 points) and 'high' (i.e. 3 points) risk of sleepiness. The cut-off for pathological excessive daytime sleepiness is a sum score of 11 points.[24] The STOP-BANG questionnaire consists of a series of eight true–false questions about several signs, symptoms and risk factors related to OSA. Based on the sum score, the risk of OSA is classified as 'low' (i.e. 0–2 points), 'moderate' (i.e. 3–4 points) and 'high' (i.e. 5–8 points).[25] Since ESS and STOP-BANG investigate different factors related to OSA, both questionnaires were adopted.

After data collection, a descriptive analysis was performed for all items. To assess the correlation between current SB and OSA (first aim), Spearman test was performed. The null hypothesis was that a correlation does not exist, and a threshold of $P < 0.05$ was set to reject the null hypothesis. Both the ESS score and the STOP-BANG score were analysed in relation to current SB. Based on the presence/absence of a history of SB, the sample was divided into two groups. Kolmogorov–Smirnov test was performed to verify the normality of the data. The null hypothesis was that the ESS and the STOP-BANG scores were normally distributed. If the null hypothesis was rejected for both ESS and STOP-BANG scores, then they would be compared between groups using Mann–Whitney *U* test (second aim). The null hypothesis was that the distributions of the variables

Table 1. Current SB and a history of SB data of the study population expressed in percentage

Current SB	Never	Less than one night/ month	From one to three nights/ month	From one to three nights/ week	From four to seven nights/ week	I don't know	Total
	36.6%	11.5%	13.2%	10.7%	10.3%	17.7%	100%
History of SB	Yes	No	I don't know				
	39.1%	45.3%	15.6%				100%

Table 2. STOP-BANG and ESS data of the study population expressed in percentage

STOP-BANG items	Snoring	Tiredness	Obstruction	Pressure	BMI	Age	Neck	Gender
Yes	27.2%	37.9%	11.5%	11.5%	7.0%	38.3%	4.5%	51.4%
No	72.8%	62.1%	88.5%	88.5%	93.0%	61.7%	95.5%	48.6%
Risk of OSA	Low risk 73.7%	Moderate risk 21.0%	High risk 5.3%					
ESS	ESS≥11 14.4%	ESS < 11 85.6%						

were equal in the two independent groups and a threshold of $P < 0.05$ was set to reject the null hypothesis. All statistical procedures were performed with the software SPSS 28.0 (IBM Corp, Armonk, NY, USA).

RESULTS

The questionnaire was completed by 243 individuals (M = 129, F = 114, mean age = 42.4 ± 14.4 years, age range = 16–74 years). 94.2% of participants were Italians. Concerning work duties, 79.7%, 16.9% and 3.4% of participants were workers (self-employed and dependent), students and unemployed, respectively.

Current SB was reported as follows: 36.6% 'never', 11.5% 'less than one night/month', 13.2% 'from one to three nights/month', 10.7% 'from one to three nights/week', 10.3% 'from four to seven nights/week' and 17.7% 'I don't know'. Positive response to a history of SB was reported by 39.1% of participants (Table 1).

Excessive daytime sleepiness was referred by 14.4% of the sample. From the STOP-BANG questionnaire, it emerged that 73.7% of the responders showed a low risk of OSA, 21% an intermediate risk of OSA, and 5.3% a high risk of OSA. In details, high blood pressure and class II obesity were reported by 11.5% and 7.0% of the sample, respectively. All data from the STOP-BANG questionnaire are reported in Table 2. In relation to the risk of OSA, the prevalence of SB was 57.6% in the individuals with low risk of OSA and 49% in those with moderate to high risk of OSA (Table 3).

Table 3. Prevalence of self-report current SB in relation to the risk of OSA in percentage

		Risk of OSA	
		Low	Moderate to high
Current SB	No	42.4	51.0
	Yes	57.6	49.0
Total		100	100

As regards correlation analysis, no statistical significance was found between current SB and ESS score, nor between current SB and STOP-BANG score ($P > 0.05$; Table 4). Considering the groups comparison based on a history of SB, no difference in the ESS or STOP-BANG score between two groups was found ($P > 0.05$; Table 5).

DISCUSSION

In the last decade, several studies have been carried out to gain a deeper understanding about the relationship between different sleep-related conditions that might have consequences in the oral and maxillo-facial region.[1,3] Knowing how these conditions interact would allow the clinician to better recognize and appropriately manage them, minimizing or eliminating their potential negative consequences.

In this paper, the focus was on the assessment of the relationship between self-report SB and OSA, performed with the use of validated questionnaires at the general population level. The sample (F = 46.9%; M = 53.1%) reflected the Italian general population, as it was uniformly distributed for gender and age

Table 4. Spearman correlation coefficient test used to evaluate the existence of correlation between current SB and ESS score and STOP-BANG score

			Current SB	ESS score
Rho Spearman	Current SB	Correlation coefficient	1.000	0.61
		Sig. (two-tailed)		0.347
	ESS score	Correlation coefficient	0.61	1.000
		Sig.(two-tailed)	0.347	

			Current SB	STOP-BANG score
Rho Spearman	Current SB	Correlation coefficient	1.000	0.57
		Sig. (two-tailed)		0.380
	STOP-BANG score	Correlation coefficient	0.57	1.000
		Sig.(two-tailed)	0.380	

Table 5. Comparison of ESS score and STOP-BANG score between groups basing on the presence (1) and absence (0) of a history of SB (Mann–Whitney *U* test)

	History of SB	*N*	Mean rank	Sum of ranks	Sig. (two-tailed)
ESS score	0	95	100.22	9521.00	0.531
	1	110	105.40	11 594.00	
STOP-BANG score	0	95	89.43	7065.00	0.987
	1	110	89.56	8866.00	

(age range = 16–74 years). More than 94% of participants were Italians. The questionnaires that were adopted in the investigation referred to the recent Standardized Tool for the Assessment of Bruxism (STAB), which is first multidimensional evaluation system for bruxism and includes a careful selection of items to collect data on multiple bruxism issues.[26,27] The STAB consists of 66 items for the evaluation of bruxism status as well as the potential comorbidities, aetiology and its consequences.[23] Both the current SB and a history of SB have been evaluated in relation to the ESS and STOP-BANG scores. The statistical analysis showed no significant correlation between the current SB and ESS and STOP-BANG scores. Moreover, considering groups comparison based on a history of SB, no difference in ESS and STOP-BANG scores between two groups emerged.

Prevalence of SB in patients with OSA and its potential role as sentinel sign for OSA

As widely reported in literature, the conceptualization of SB has changed from being a movement or sleep disorder to a sign of some underlying conditions that is just a behaviour in otherwise healthy individuals and might even have a protective effect in some individuals.[6,28–31] According to a review by Manfredini et al., the prevalence of SB was estimated at 9.7–15.9% in the general population.[17] Similar results were subsequently presented by Gonzalez et al. who reported a prevalence of 8% in the adult population (age range = 19–45 years).[21] On the other hand, prevalence of SB showed a considerable increase when OSA is present. In this study, self-reported SB was found in 45.7% of the sample. In particular, considering the low and moderate-to-severe risk of OSA, self-report SB was referred by 57.6% and 49% of individuals, respectively. Only another study carried out a self-report assessment of SB and reported a prevalence of 26% among individuals with OSA.[32] Most papers investigated the prevalence of SB in populations of patients with OSA by adopting objective assessment tools of SB (i.e. electromyography (EMG) and polysomnography (PSG), thus relying on the arousal-based criteria). Tan et al. concluded that one third (33.3%) of patients with OSA had SB.[33] Hosoya et al. reported similar results.[34] Li et al., in a prospective study of 914 individuals evaluated with polysomnography (PSG), concluded that the prevalence of SB in patients with OSA was 49.7%.[16]

The pathophysiological connection between SB and OSA is still an open debate. However, the present study, which was carried out at a general population level, did not help to clarify these aspects. In 2015, Manfredini et al. proposed a potential temporal correlation between SB events and respiratory events, as they noted the occurrence of SB events immediately after apnoea events in some individuals. Since masticatory muscle contraction, causing forward movement of the mandible and tongue, resulted in increased patency of the airways, the authors suggested a potential protective role of SB in patients with OSA.[18] Lobbezoo et al. in the expert consensus paper remarked this aspect.[35] However, there is lack of data to show this positive relationship. Pauletto et al. carried out a scoping review examining the temporal relationship and prevalence of SB and OSA both in adults and children and did not confirm a correlation between these two conditions.[20] Colonna and colleagues supported these findings stating that in a sample of patients with OSA the majority of SB events (66.8%) occurred without a temporal relationship with apnoea events.[7]

Considering instead the relationship between SB and respiratory arousals from sleep, many studies have shown stronger evidence. Sjoholm et al. stated that SB events are part of cascade of events occurring during respiratory arousals, rather than being a direct consequence of apnoea events.[8] Kato et al. supported these results by claiming that masseter muscle contractions were rarely activated after apnoea events without arousals.[9] Moreover, masseter muscle contraction after apnoea events seemed more influenced by the duration of arousal than the occurrence of respiratory events per se.[9] Similar results were confirmed by Aarab et al.[36]

Therefore, even in the absence of a certain temporal and/or causal relationship, evidence seems to confirm an association between SB and OSA, as the prevalence of SB in populations of patients with OSA is generally higher (26–53.7%) than in general population (12.8%).[15] Pathophysiology, however, is not entirely clear and the potential protective role of SB in patients with OSA remains uncertain. Nevertheless, the simultaneous manifestation of SB and OSA in some individuals sets the basis for considering SB as a potential sentinel sign of OSA. To better understand this correlation, more studies are recommended.

The present study was carried out with the use of validated questionnaires for the report of the two conditions. Statistical analysis produced no significant results. The use of regression analysis could have been a potential option to further mine the data on the interactions between the variables. However, since an objective diagnosis for SB and OSA was missing, we preferred not to perform statistics that combine tools through non validated calculations.

This study has some limitations. First, the sample has a bias due to the self-selection of the participants, which might have led to the inclusion of a representative population of individuals with clinically relevant conditions. Second, the sample consists of individuals from general population without an objective diagnosis of OSA. The use of self-reported questionnaires only (i.e. ESS and STOP-BANG) makes difficult to compare the results with other studies that used PSG as a diagnostic tool. PSG is the gold standard for diagnosing OSA, but in the clinical setting, it is not easy to perform as a screening strategy because of the long waiting list, high costs and the labour-intensive equipment required.[16,37] Recently, there has been an increasing interest in portable recording devices, which might play a role in the reducing the number of undiagnosed patients.[11,21,34] Third, self-report assessment of SB has a risk of bias due to the potential altered esteem of the prevalence. According to some authors, the use of questionnaires can underestimate the number of individuals with SB and OSA.[11] However, it is worth bearing in mind that self-report and questionnaires are considered important tools to assess SB.[6,21] In this perspective, the STAB supported the usefulness and the necessity of a standardized assessment of SB and related conditions (e.g. OSA) in order to reach an earlier diagnosis.[20,21,38] As a suggestion for future studies, Axis B items related to SB (e.g. use of medications, tobacco and caffeine intake) should be included in data collection for a more exhaustive evaluation.

CONCLUSION

With the use of validated questionnaires at the general population level and within the limitations of this study, this investigation did neither find any significant correlation between self-report current SB and OSA nor significant difference between ESS and STOP-BANG scores of groups based on a history of SB. Larger-scale studies in representative samples are needed to further explore this topic.

AUTHOR CONTRIBUTIONS

M Pollis: Conceptualization; data curation; formal analysis; investigation; methodology; resources; visualization; writing – original draft. **F Lobbezoo:** Conceptualization; methodology; project administration; supervision; validation; visualization. **A Colonna:** Conceptualization; formal analysis; investigation; methodology; resources; writing – original draft. **D Manfredini:** Conceptualization; data curation; investigation; project administration; supervision; validation; visualization.

ACKNOWLEDGEMENT

Open access publishing facilitated by Universita degli Studi di Siena, as part of the Wiley - CRUI-CARE agreement.

CONFLICTS OF INTEREST

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

FUNDING INFORMATION

No funding was received for this research.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the IRB of the University of Siena (Siena, Italy; #00012-Z22) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

DATA AVAILABILITY STATEMENT

The data underlying this article will be shared on reasonable request to the corresponding author.

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