Self-reported Bruxism - associations with perceived stress, motivation for control, dental anxiety and gagging*

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SUMMARY To examine possible associations between self-reported bruxism, stress, desirability of control, dental anxiety and gagging. Five questionnaires were distributed among a general adult population (402 respondents): the Perceived Stress Scale (PSS), Desirability of Control Scale (DC), Dental Anxiety Scale (DAS), Gagging Assessment Scale (GAS), and Bruxism Assessment Questionnaire. A high positive correlation between DAS and GAS ($R = 0{\cdot}604$, $P < 0{\cdot}001$) was found. PSS was negatively correlated with DC ($R = -0{\cdot}292$, $P < 0{\cdot}001$), and was positively correlated with GAS ($R = 0{\cdot}217$, $P < 0{\cdot}001$) and DAS ($R = 0{\cdot}214$, $P < 0{\cdot}001$). Respondents who reported bruxing while awake or asleep showed higher levels of GAS, DAS and PSS than those who did not. There were no differences between the bruxers and the non-bruxers (sleep and aware) with regard to the DC scores. The best predictors of awake bruxism were sleep bruxism (OR = 4·98, CI 95% 2·54–9·74) and GAS (OR = 1·10, CI 95% 1·04–1·17). The best predictors of sleep bruxism were awake bruxism (OR = 5·0, CI 95% 2·56–9·78) and GAS (OR = 1·19; CI 95% 1·11–1·27). Self-reported sleep bruxism significantly increases the odds for awake bruxism and vice versa. Tendency for gagging during dental care slightly increases the odds of both types of self-reported bruxism, but desirability of control is not associated with these phenomena.

KEYWORDS: bruxism, dental anxiety, gagging, motivation for control, perceived stress

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Introduction

Bruxism is defined as the actions of clenching the teeth, bracing the jaws without actual tooth contact, gnashing and grinding the teeth while awake or while asleep (1). Once categorised as a parasomnia, sleep bruxism was redefined in 2005 by the American Academy of Sleep Medicine as a movement disorder taking place during sleep (2). The aetiology of sleep bruxism has not been completely determined to date. In the past, the general opinion was that bruxism occurs because of peripheral causes, such as occlusal interferences and problematic anatomy, whereas current research points to causes in the central nervous system (3). Risk factors for the development of bruxism include disturbances in neurotransmitters, drug use, smoking, alcohol, disease processes, trauma and psychological processes, such as stress (4).

''Awake bruxism'' is defined as the clenching of teeth and jaws while awake, of which the individual is aware (5). It is not usually expressed as tooth grinding but rather as clenching of the teeth and jaws in the absence of neuroleptic medications and certain medical conditions. Its pathophysiology remains unknown, but stress and anxiety are considered to be risk factors, even in the absence of scientific proof (5).

Other conditions which are closely associated with stress related to oral activities are dental fear, anxiety and phobia. These emotional states interfere with dental treatment, are deleterious to oral health and can cause a great deal of needless suffering (6). Epidemiological research studies have shown that 5%–19% of the worldwide adult population suffers to some extent from

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dental anxiety (7–9). and express this anxiety during dental treatment verbally and through body language (10). It has been suggested that excessive gagging during dental care in some subjects, possibly those with a high motivation for control, may be an indirect expression of their resistance to undergoing routine dental care because of stress and anxiety (11).

Apparently, bruxism, dental anxiety and gagging are all associated with stress, which in turn is often associated with control issues (10, 12). Therefore, it was our assumption that bruxism may be associated with both dental anxiety and gagging and that this association will be mediated by motivation for control. The current study aims to examine these issues.

Materials and methods

Study population

Five questionnaires were distributed among a general population of 600 individuals aged ≥18, living in an urban area in central Israel. The questionnaires were handed out by one of the authors (TL), and the respondents were requested to fill out the questionnaires independently, usually at home. They were guaranteed anonymity and encouraged to contact the author for further assistance, if necessary. All subjects who consented to participate in the study (n = 402) returned the completed questionnaires, in person, within 1 week.

This study was approved by the Committee for Approval of Medical Research in Humans (The Helsinki Accord Committee) of Tel Aviv University.

Questionnaires

Emotional stress The level of emotional stress was measured by using the Perceived Stress Scale (PSS), developed by Cohen *et al.* in 1983 (13). This questionnaire consists of 14 items and examines stressful feelings and thoughts which the respondent experienced during the past month. The respondent is asked to rate with what frequency he/she felt/thought them on a scale of four ranging from ''never'' to ''very often'', with a resulting total score ranging between 0 and 56 (a higher score indicating a higher level of emotional stress).

Desirability of control The individual's desire to control was measured by the Desirability of Control Scale (DC) which evaluates the motivation to control the events in one's life. The scale was developed in 1979 by Burger and Cooper (14) and includes 20 items ranked on a 7-point scale (ranging from ''not at all'' to ''always''). The total score ranges from 20 to 140, with a higher score indicating a person with a greater motivation for control.

Dental anxiety Dental anxiety was measured by the Dental Anxiety Scale (DAS). The DAS was developed by Corah (15) as a specific measure of anxiety related to dental issues. It includes items in which subjects are asked to rate their fear of four specified dental situations on a 5-point scale. It is one of the major and most widely used self-reported questionnaires of dental anxiety. Since its development, the DAS has been used extensively in research conducted on anxious dental patients (11). The sum of the scores falls in a range from 4 to 20, with higher scores indicating higher levels of dental anxiety.

Gagging Under the assumption that gagging during dental care might be an indirect expression of dental anxiety, we evaluated the extent of the gag reflex by designing and using a questionnaire based on the principles of the DAS. The gagging assessment scale (GAS) is specific to feelings of nausea or gagging evoked by various situations associated with dental care. It includes four questions, presented in order of an increasing potential for provoking nausea and gagging: ''How do you feel when (1) You brush your back teeth?; (2) You are waiting in the dentist's waiting room and thinking about the anticipated dental treatment?; (3) You are sitting in the dental chair and the dentist is checking your teeth with a mirror and other instruments?; (4) The dentist is working on your back teeth?'' The score for each answer is: 1 = I experience no nausea whatsoever, 2 = I feel slightly nauseated, 3 = I am afraid I will vomit, 4 = I can't do it because I immediately feel nauseated and feel like vomiting; 5 = I experience actual spasms in my throat and sometimes actually vomit. The total GAS score ranges from 4 to 20, with the higher score indicating a greater tendency to gag.

The questionnaire was used in a population of 448 subjects who applied for treatment at the Sheba Medical Center, Israel, and showed a good internal consistency (Cronbach's α of 0·67) and a positive correlation with dental anxiety (DAS, r = 0·282, P < 0·0001).

Bruxism The questions used in the present study to evaluate self-reported awake and sleep bruxism were constructed according to the recommendations of Pintado *et al.* (16) and Lavigne *et al.* (17) The diagnosis of awake bruxism depended solely on the respondent's awareness (''Have you ever been aware of clenching or grinding your teeth during wakefulness in the past 6 months?'' yes/no). Subjects were defined as suffering from awake bruxism if they responded affirmatively to this question.

Sleep bruxism was evaluated by a questionnaire based on the diagnostic criteria of the American Academy of Sleep Medicine (2005) (2) The questionnaire refers to events during the past 6 months as follows:

1 Are you aware, or has anyone heard you, grinding your teeth frequently during sleep? (yes/no)
2 Are you aware that your dentition is worn down more than it should be? (yes/no)
3 Are you aware of any of the following symptoms upon awakening? (yes/no):
   (i) Sensation of fatigue, tightness or soreness of your jaw upon awakening?
   (ii) Feeling that your teeth are clenched or that your mouth is sore upon awakening?
   (iii) Aching of your temples upon awakening?
   (iv) Difficulty in opening your mouth wide upon awakening?
   (v) Feeling of tension in your jaw joint upon awakening and feeling as if you have to move your lower jaw to release it?
   (vi) Hearing or feeling a ''click'' in your jaw joint upon awakening that disappears afterwards?

Respondents were scored as suffering from active sleep bruxism if their answer was positive to question 1 and/or question 2, in addition to at least one positive answer to a symptom listed in question 3.

Analysis of the results

Data were analysed using the computer program for statistical analyses SPSS version 11.[†] Pearson correlation coefficients were used to analyse continuous variables, and *t*-tests were used to analyse categories of continuous variables. A two-way ANOVA test was used to analyse the effects and interaction between a continuous variable and two categorical variables, while the Chi-square test was used to determine the relationships between two categories of variables. Finally, stepwise logistic regressions were used to evaluate the variables which affect the odds ratios (ORs) for awake and sleep bruxism.

[†]SPSS 11AE0 statistical software; SPSS Inc., Chicago, IL, USA.

Results

Study population

Of the 600 individuals who were approached, 402 agreed to sign an informed consent waiver and completed the questionnaire (67% response rate). They included 151 men and 251 women whose average age was 35 ± 13·71 (range 18–70). There was no significant gender-based difference in age ($P = 0{\cdot}315$).

Reproducibility of the tools

The internal consistency of the questionnaires (Cronbach's alpha) was DAS = 0·91, GAS = 0·94, DC = 0·80 and PSS = 0·77.

Gender-based differences (Table 1)

The mean values (± standard deviation) of the study variables are summarised in Table 1. There were no gender-based differences in dental anxiety or gag reflex. Men showed a greater motivation for control (DC) than women ($P < 0{\cdot}001$), while women showed a higher level of perceived emotional stress than the men ($P < 0{\cdot}001$).

Correlations among DAS, GAS, PSS and DC

A high positive correlation between DAS and GAS (Pearson correlation coefficient, $R = 0{\cdot}604$, $P < 0{\cdot}001$) was found. PSS was negatively correlated with DC ($R = -0{\cdot}292$, $P < 0{\cdot}001$), and was positively correlated with GAS ($R = 0{\cdot}217$, $P < 0{\cdot}001$) and DAS ($R = 0{\cdot}214$, $P < 0{\cdot}001$).

Comparisons between subjects reporting/denying awake bruxism (t-test) (Table 2)

Slightly less than one-third of the respondents (31%, $n = 126$ of 402) reported clenching their teeth while awake (28% of the women and 36% of the men). There was no significant age difference between the

Table 1. Differences between males and females

Parameter	Males Mean ± s.d. (*n*)	Females Mean ± s.d. (*n*)	*t*-test	Total Mean ± SD (*n*)
Dental anxiety (DAS)	10·15 ± 4·13 (151)	10·58 ± 4·01 (251)	N.S.	10·42 ± 4·06 (402)
Gag reflex (GAS)	6·54 ± 4·13 (151)	6·25 ± 3·88 (251)	N.S.	6·36 ± 3·97 (402)
Desirability of control (DC)	90·15 ± 9·70 (150)	86·36 ± 10·06 (249)	$P < 0.001$	87·78 ± 10·08 (399)
Emotional stress (PSS)	23·33 ± 7·57 (151)	25·77 ± 6·17 (251)	$P < 0.001$	24·85 ± 6·82 (402)

DAS, dental anxiety scale; GAS, gagging anxiety scale; DC, desirability of control questionnaire; PSS, perceived stress scale; N.S., non-significant.

Table 2. Comparison between subjects according to bruxing while awake

Parameter	Bruxing while awake Mean ± s.d. (*n*)	No bruxing while awake Mean ± s.d. (*n*)	*t*-test
Age (in years)	34·35 ± 13·41 (126)	35·48 ± 13·77 (275)	N.S.
Dental anxiety (DAS)	11·45 ± 4·54 (126)	9·95 ± 3·74 (275)	$P < 0.001$
Gag reflex (GAS)	8·01 ± 5·23 (126)	5·61 ± 2·96 (275)	$P < 0.001$
Desirability of control (DC)	88·73 ± 9·74 (126)	87·26 ± 10·15 (272)	N.S.
Emotional stress (PSS)	25·76 ± 6·61 (126)	24·49 ± 6·85 (275)	$P < 0.05$

DAS, dental anxiety scale; GAS, gagging anxiety scale; DC, desirability of control; PSS, perceived stress scale; N.S., non-significant.

awake bruxers and the non-bruxers (Chi-square test). The respondents who reported bruxing while awake showed higher levels of gagging (GAS) of dental anxiety (DAS) and emotional stress (PPS) than those who did not (Table 2). There were no differences between the bruxers and the non-bruxers with regard to the desirability of control (DC) scores. The two-way ANOVA for evaluating the effect of DAS, GAS, DC and PSS on gender and on awake bruxism confirmed the above findings.

There were significant gender-based differences in the variables of control and PSS, with women presenting higher PSS scores than men and men presenting higher control scores than women (Table 3). There were no interactions between gender and awake bruxism for the variables investigated in the study.

Table 3. Two-way ANOVA analyses for evaluating the effect of DAS, GAS, DC and PSS on awake bruxism (AB) and on sex

Variables*	AB*	Gender	Interaction (AB × Sex)
DAS	$F = 13·60$, $P < 0·001$ df = 1·397		N.S.
GAS	$F = 32·23$, $P < 0·001$ df = 1·394		N.S.
DC		$F = 13·45$, $P < 0·001$ df = 1·397	N.S.
PSS	$F = 5·34$, $P < 0·05$ df = 1·397	$F = 8·34$, $P < 0·005$ df = 1·397	N.S.

DAS, dental anxiety scale; GAS, gagging anxiety scale; DC, desirability of control; PSS, perceived stress scale; N.S., non-significant; Df, degree of freedom.
*Comparison between subjects reporting awake bruxism vs. subjects denying awake bruxism

Comparison between subjects reporting/denying sleep bruxism (t-test) (Table 4)

Of 104 (25·9%) subjects that reported being sleep bruxers (question 1), only 55 participants (14%) were finally scored as performing sleep bruxism according to the study criteria (13% of the women and 15% of the men). It was found that 39 (70·9%) of these subjects also reported clenching their teeth while awake.

Table 4. Comparison between subjects according to bruxing during sleep

Parameter	Sleep bruxism Mean ± s.d. (*n*)	Without sleep bruxism Mean ± s.d. (*n*)	*t*-test
Age (in years)	37·4 ± 14·23 (55)	34·85 ± 3·49 (347)	N.S.
Dental anxiety (DAS)	13·47 ± 4·69 (55)	9·93 ± 3·78 (347)	$P < 0·001$
Gag reflex (GAS)	10·45 ± 5·24 (55)	5·71 ± 3·28 (347)	$P < 0·001$
Desirability of control (DC)	88·63 ± 10·24 (55)	87·65 ± 9·97 (344)	N.S.
Emotional stress (PSS)	27·16 ± 6·81 (55)	24·49 ± 6·82 (347)	$P < 0·005$

DAS, dental anxiety scale; GAS, gagging anxiety scale; DC, desirability of control questionnaire; PSS, perceived stress scale; N.S., non-significant.

There was no significant age difference between the groups (sleep bruxers versus non-bruxers). The bruxers during sleep showed significantly higher levels of dental anxiety (DAS), gagging (GAS) and emotional stress (PSS) than the non-bruxers (Table 4). There was no difference between the two groups regarding the desire for control (DC). The two-way ANOVA for evaluating the effect of DAS, GAS, DC and PSS on sleep bruxism and on gender confirmed the above findings. There were significant gender differences in the variables of control and PSS, with women presenting higher PSS scores than men and men presenting higher control scores than women (Table 5).

Predictors of sleep and awake bruxism (Tables 6 and 7)

Logistic stepwise regression models were performed with sleep bruxism and awake bruxism as dependant variables. The variables examined with relation to sleep bruxism were GAS, DAS. PSS, DC, age and awake bruxism. The variables examined with relation to awake bruxism were GAS, DAS, PSS, DC, age and sleep bruxism. Gender was not examined because no significant correlation had been found between gender and either type of bruxism.

Table 5. Two-way ANOVA analyses for evaluating the effect of DAS, GAS, DC and PSS on sleep bruxism (SB) and on sex

Variables	SB*	Gender	Interaction (SB × Sex)
DAS	$F = 41·09$, $P < 0·001$	N.S.	N.S.
GAS	$F = 77·16$, $P < 0·001$	N.S.	N.S.
DC	N.S.	$F = 7·94$, $P < 0·005$	N.S.
PSS	$F = 9·68$, $P < 0·005$		N.S.

DAS, dental anxiety scale; GAS, gagging anxiety scale; DC, desirability of control questionnaire; PSS, perceived stress scale; N.S., non-significant.
*Comparison between subjects reporting sleep bruxism vs. subjects denying sleep bruxism.

Table 6. Logistic regression: final model with awake bruxism as dependant variable

Variable	Coefficient s.e.	df	*P* value	OR	CI (95%)
Sleep bruxism	0·342	1	<0·001	4·98	2·54–9·74
GAS	0·03	1	<0·005	1·10	1·04–1·17

GAS, gagging anxiety scale; OR, odds ratio; CI, confidence interval; df, degree of freedom.

Table 7. Logistic regression: final model with sleep bruxism as dependant variable

Variable	Coefficient s.e.	df	*P* value	OR	CI (95%)
Awake bruxism	0·342	1	<0·001	5·00	2·56–9·78
GAS	0·032	1	<0·001	1·19	1·11–1·27

GAS, Gagging Anxiety Scale; OR, odds ratio; CI, confidence interval; df, degree of freedom.

The best predictors of awake bruxism were sleep bruxism (OR = 4·98, CI 95% 2·54–9·74) and GAS (OR = 1·10, CI 95% 1·04–1·17) (Table 6). The best predictors of sleep bruxism were awake bruxism (OR = 5·0, CI 95% 2·56–9·78) and GAS (OR = 1·19; CI 95% 1·11–1·27) (Table 7). These results persisted when awake and sleep bruxism were removed from the equations. Specifically, GAS significantly increased the odds for both sleep and awake bruxism (OR = 1·23, CI 95% 1·16–1·31 and OR = 1·15 CI 95% 1·09–1·22, respectively). There were no interactions between sex and awake bruxism for the variables investigated in the study.

Discussion

Earlier investigations into the relationship between bruxism (sleep and/or awake) and general anxiety levels yielded contradictory results. While numerous studies have reported that anxious people of all ages are more likely to exhibit bruxing behaviour (3, 18–20), other studies failed to confirm such correlations (5, 21). The prevalence of self-reported sleep and awake bruxism in the present study was 14% and 31%, respectively. This is higher than the respective 8% and 20% reported in a review by Lavigne *et al.* (22). In two other studies that investigated bruxism in subjects routinely exposed to high levels of stress, the prevalence was 50% for Brazilian police officers and 69% for Israeli air force pilots (23, 24). Thus, the higher prevalence levels in the present study might reflect the higher level of daily stress in the Israeli population compared to the populations reviewed by Lavigne *et al.* (22). However, one must bear in mind that the definition of bruxism (awake and sleep) in the present study was based on self-reports and was not clinically verified. Lavigne *et al.* (5) pointed out that questionnaires may be subjected to bias, such as the natural fluctuation in bruxism motor activity over time, the risk of poor or imprecise recall regarding bruxism or anxiety and the lack of awareness of the current behaviour. The gold standard for the diagnosis of sleep bruxism is polysomnographic evaluations, but as these are quite expensive, large sample studies on bruxism can be only performed by adopting clinical diagnosis methods (25). In a recent systematic review, Manfredini and Lobbezoo (26) reported that the majority of data about associations between psychological symptoms and bruxism come from studies that adopted clinical and/or self-reported diagnosis of bruxism. Interestingly, these studies found some associations between bruxism and psychological findings, in contrast to polysomnographic studies that did not show such associations. Manfredini and Lobbezoo hypothesised that clinical studies are more adapted to detect awake bruxism while sleep laboratory studies focus on sleep bruxism. In the present study, sleep bruxism was evaluated by a self-report questionnaire based on the diagnostic criteria of the American Academy of Sleep Medicine (2005) (2) and adapted from the questionnaires of Pintado *et al.* (16) and Lavigne *et al.* (17), two questionnaires that joined together appear to serve the purpose. In the present study, respondents were scored as suffering from sleep bruxism if they answer positively to at least one question regarding self-awareness of sleep bruxing (question 1 and/or 2), in addition to their self-report of at least one symptom on awakening, as listed in question 3. Symptoms on awakening are indicative that bruxing is active at present and may improve the validity of the questionnaire. It was found that of 104 (25·9%) subjects that were aware of being sleep bruxers, only 55 participants (14%) were finally scored as actively performing sleep bruxism, according to the study criteria. Taking into consideration, the practical impossibility of performing sleep laboratory tests, or even clinical examinations of a large population sample, we are of the opinion that the self-report questionnaires used in the present study are of adequate validity. Nevertheless, the validity of the self-report questionnaires needs to be proven further by comparing them to polysomnographic study in the case of sleep bruxism and to a portable electromyographic registration in the case of awake bruxism.

In the present study the prevalence of self-reported active sleep bruxism was 14%. This in accordance with Ahlberg *et al.* (27) who found a prevalence of 13·5% of subjects who perform sleep bruxism ''sometimes''. It should be taken into consideration that the study by Ahlberg *et al.* (27) referred to self-report of subjects with regard to ''how frequently they grind their teeth'' only, while the present study also refers to the presence of symptoms on awakening which indicate that the bruxism is active.

In accordance with other studies (28–30), women reported higher levels of perceived stress than men. The finding that men showed higher levels of the desirability for control than women agrees with the study by Kent (10) but not quite with that of Liddel and Locker (31), who reported that women showed a higher desire for control combined with a lower perception of control than men.

Another intriguing issue is the association between self-reported bruxism and dental anxiety and gagging. Dental anxiety, as measured by the DAS, was initially developed as a trait anxiety measure, but was later shown to also serve also as a measure of the state of anxiety in reference to the sort of dental situation encountered (32). The association between dental anxiety and bruxism (an oral activity) may be an indirect manifestation of stress specifically related to the oral cavity.

This is one of very few studies that actually show a positive association between dental anxiety and a

tendency for gagging during dental care. While dental anxiety is the most prevalent and most studied oro-related behavioural dysfunction, an excessive gag reflex is another commonly recognised obstacle to dental care. The comorbidity between gagging and dental anxiety described by Moore *et al.* (33) may be indirect evidence of gagging behaviour as an expression of dental anxiety in individuals who are reluctant to admit to being anxious about undergoing dental care. There is no accepted scale for the evaluation of, or abundance of evidence about, the gag reflex as there is about dental anxiety [such as the DAS developed by Corah in 1969 (14)]. A Gagging Severity Index proposed by Rosted *et al.* (34) is a measure which may be useful in clinical settings, but it is less appropriate for research because it includes a descriptive scale relating to the severity of gagging during actual dental treatment. More recently, Van Linden van den Heuvell *et al.* (35) proposed a new method for measuring dental gagging, the Gagging Problem Assessment (GPA), which consists of a battery of 32 questions on the actual occurrence of gagging when thinking of specific situations, such as brushing teeth and sitting in the dental chair. However this tool has not been tested yet in wide populations. Our evaluation of the gag reflex (GAS) is shorter, easier to use and showed positive associations with DAS and PSS, indicating that stress plays a role in the syndrome. In the future, GAS and the GPA could be compared to check which one is more efficient as a clinical and/or research tool.

Apparently, stress plays a role not only in dental anxiety and gagging but also in sleep and awake bruxism. Respondents who reported bruxism claimed to have higher levels of emotional stress than non-bruxing subjects. This confirms former studies which showed that stress and personality traits contribute to the aetiology of bruxism (3, 36, 37). The exact contribution of these factors to the phenomenon of sleep bruxism is, however, still unclear, and the literature presents contradictory reports (5, 21, 38). One of the proposed explanations is that emotional stress disturbs the quality of sleep, (25) leads to more transitions between deep sleep and lighter sleep and that bruxism is a side-effect of these micro-arousals (22, 39). Data from clinical studies must be interpreted cautiously, because odds ratios considered as ''not high'' clinically, can be statistically significant (40). Thus, another possible explanation for the statistically significant differences between sleep bruxers and non-bruxers may originate in the large sample size and the different sizes of the compared groups (55 sleep bruxers vs. 347 non-bruxers), which could have led to a false positive result.

Our initial hypothesis that dental anxiety and gagging will be associated with desirability of control was not confirmed in the present study. While both awake and sleep bruxism were positively associated with dental anxiety and gagging, this association was not mediated by the subjects' motivation for control. The DC scale developed by Burger and Cooper (14) claims to reflect a stable personality characteristic not affected by the given situation that involves the temporary relinquishing of control and it does not represent the ability and the perceived control in a specific situation. This personality characteristic is apparently not necessarily associated with dental conditions, such as bruxing, gagging and dental anxiety.

Finally, logistic regressions showed that self-reported sleep bruxism increases the odds for awake bruxism and vice versa. Sleep and awake bruxism are recognised as different entities, with different aetiologies. (5) While awake bruxism has been associated with psychological factors (26), the role of a psychological aetiology in sleep bruxism is still controversial. (3) The findings that awake bruxism increases the odds for sleep bruxism 5-fold (and vice versa) suggest that both entities have much in common. This in accordance with Manfredini and Lobbezoo (26), who stated that awake and sleep bruxism seem to be of different pathogenesis, but are difficult to clinically distinguish. Possibly, individuals perceive them as a single entity not enabling proper diagnosis through self-reported questionnaires. In the present study, it was found that 70·9% of those responders classified as sleep bruxers also reported clenching their teeth while awake. We recommend that individuals who are aware of clenching their teeth during wakefulness should be also examined for sleep bruxism.

The tendency to gag also increases the odds for both types of bruxism, although its effect is small and might be clinically non-significant. While an increased gag reflex can be an expression of emotional distress (11, 41), the aetiology may also be somatic. Possible causes of gagging include anatomical changes (e.g. in the soft palate) and medical conditions (e.g. nasal obstruction), etc (42). Lavigne *et al.* suggested that sleep bruxism plays a role in improving airway patency during sleep (22). If so, it is possible that both bruxism and gagging

are owing to either partial obstruction of the airway or to sleep apnea. Obstruction of the airway may not only lead to an increased gag reflex but it could also stimulate the subject to clench the teeth as an unconscious attempt to relieve the obstruction. This interesting possibility warrants further research.

Conclusions

1 Awake bruxism significantly increases the odds for sleep bruxism and vice versa.
2 A subject's tendency to gag during dental care increases the odds for both types of bruxism. Although the odd ratios are relatively low, and may be clinically non-significant, the result calls for further research in this direction.
3 Tendency for gagging during dental care is closely associated with dental anxiety.
4 Desirability of control is not necessarily associated with dental conditions, such as bruxing, gagging and dental anxiety.

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