

Qualitative suggestions for the further development of the Standardized Tool for the Assessment of Bruxism (STAB)

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Abstract

Background. The Standardized Tool for the Assessment of Bruxism (STAB) has recently been published. It contains Axis A for evaluating bruxism status and its potential consequences, and Axis B for bruxism risk, etiological factors and comorbid conditions. Suggestions from daily clinical practice can contribute to the further development of the STAB.

Objectives. The study aimed to investigate the experiences and attitudes of general dentists, dentists specialized in Orofacial Pain and Dysfunction (OPD) and Disability Care (DC) regarding the assessment and etiology of sleep and awake bruxism and to examine the concordance of their experiences and attitudes with the respective STAB axes and its domains.

Material and methods. Semi-structured interviews were conducted with 11 dentists. The main themes included bruxism assessment and etiology. Thematic analysis identified subthemes. The concordance between main themes, subthemes, and the corresponding STAB axes and domains was examined.

Results. Overall, there was a good correspondence between the experiences and attitudes of the interviewees and the respective STAB axes and domains. Some discrepancies were identified, but they were mainly related to the lack of appropriate tools for the DC setting.

Conclusions. It is suggested that future versions of the STAB include appropriate tools for the assessment of bruxism in DC settings.

Keywords: interview, bruxism, qualitative research

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Introduction

Bruxism is defined as a masticatory muscle activity (MMA) with 2 distinct circadian manifestations: sleep bruxism, which occurs during sleep and is characterized as rhythmic (phasic) or non-rhythmic (tonic); and awake bruxism, which occurs during wakefulness and is characterized by repetitive or sustained tooth contact and/or by bracing or thrusting of the mandible.¹ In addition, a diagnostic grading system has been proposed for the assessment of bruxism by an international expert group and identified the entities of “possible”, “probable” and “definite” sleep or awake bruxism.¹ The diagnosis of possible sleep and awake bruxism is based on a positive self-report. The probable sleep and awake bruxism diagnosis is based on a positive clinical inspection, with or without a positive self-report. The definite sleep and awake bruxism diagnosis is based on a positive instrumental assessment, with or without a positive self-report and/or a positive clinical inspection.^{1,2} Clinicians usually base their bruxism assessments on self-reports and/or clinical examination.^{3,4} Ideally, bruxism assessments in the clinic should be based on standardized tools.⁵ The Standardized Tool for the Assessment of Bruxism (STAB) is a crucial part of the successful implementation of the bruxism diagnostic grading system,⁵ allowing for consistent assessments in clinical practice and research. The investigation of which signs and symptoms are examined by clinicians in their daily practice may provide valuable suggestions for the design and further development of such a tool by ensuring that it captures clinically relevant domains.

The etiology of bruxism is a complex and highly debated issue. The evidence supports a pivotal role of the central and autonomic nervous systems in the regulation of both sleep and awake bruxism. This is in contrast to older theories which considered peripheral factors, such as occlusal and anatomical, to be important.⁶ Over the years, a considerable number of other variables have been identified as risk factors for bruxism.⁷ However, the exact etiology of sleep and awake bruxism remains unclear. A comprehensive assessment of factors presumed to be associated with bruxism is recommended to facilitate future research on the topic.⁵ The experience gained by clinicians from their daily work may be used to better understand the etiology of bruxism and the assessment of etiological factors in the clinic.

Finally, it is important to emphasize the importance of bruxism in the field of special dental care. Although the available data is limited, bruxism appears to be highly prevalent in individuals with developmental disabilities (DD). For example, the prevalence rates are 42% in children with Down syndrome⁸ and 69.4% in children with cerebral palsy.⁹ At the same time, the assessment of bruxism can be challenging in these populations. Self-report instruments for the assessment of bruxism have not been validated in populations with DD, and clinicians and

researchers often have to rely on clinical observation and/or proxy reports by the caregiver.^{8–10} Overall, the assessment of bruxism in populations with DD is largely understudied.¹¹ These populations, however, should not be overlooked in studies on the design and further development of bruxism assessment tools.

A comprehensive STAB has recently been published.⁵ The STAB consists of 2 main axes: an evaluation axis (Axis A), which consists of 3 assessment domains, namely subject-based, clinically-based and instrumentally-based assessments; and risk/etiological factors axis (Axis B) for the assessment of psychosocial factors, concurrent sleep and non-sleep conditions, drug and substance use or abuse, and additional factors.⁵ In addition to the STAB, a brief bruxism screener (BruxScreen) was published. The BruxScreen is intended for use in general dental practices and large-scale epidemiological research projects, pending validity testing.¹² This study aimed to contribute to the further development of the recently published STAB by providing suggestions from daily clinical practice. More specifically, the objective of this study was to investigate the experiences and attitudes of general dentists as well as dentists specialized in Orofacial Pain and Dysfunction (OPD) and Disability Care (DC) regarding the assessment and etiology of sleep and awake bruxism. Additionally, this study aimed to examine the concordance of these experiences and attitudes with the axes and domains of the STAB.

Material and methods

Study design

A qualitative study was designed, and semi-structured interviews were conducted to address the aim of this study. Semi-structured interviews allow for the collection of a wide range of information about personal attitudes and experiences in the field of healthcare.¹³ In this interview model, the interviewer specifies the topics through open-ended key questions. It allows the interviewee to discuss these subjects while also providing the opportunity to raise novel points that were not considered by the research team beforehand.¹³ Thus, unique insights into the views, opinions, knowledge, and attitudes of clinicians can be collected.

Interviewee sampling

In this study, the purposive sampling method was employed to select the interviewees. Purposive sampling refers to the selection of interviewees based on specific criteria.¹⁴ The determination of which criteria to adopt depends on a variety of factors, including the principal aims of the study.¹⁴ This study aimed to contribute to the further development of the recently published STAB in general and specialized dental practices.⁵ Therefore,

general dental practitioners were selected, as well as dentists specialized in fields where bruxism is an important part of daily practice, namely OPD and DC. General dentists with more than 2 years of experience and specialized dentists with their certificates approved by the relevant Dutch professional associations, i.e., the Dutch Association for Orofacial Pain and Prosthetic Dentistry (Nederlandse Vereniging voor Gnathologie en Prothetische Tandheelkunde (NVGPT)) for the OPD specialists, and the Association for the Promotion of Dental Healthcare for People with Disabilities (Vereniging Mondzorg voor Bijzondere Zorggroepen (VMBZ)) for the DC specialists, were included. The two-year criterion was chosen to ascertain experience in this field. Personal or professional affiliations between the authors and the interviewees were not an exclusion criterion. However, interviews were designed in such a way that each interviewer had no personal or professional affiliation with the person they interviewed.

To recruit participants, an advertisement was published on the LinkedIn page of the Department of OPD at the Academic Centre for Dentistry in Amsterdam (ACTA). Additionally, general dentists were approached through the personal networks of dentists who were employed at the Department of OPD. Specialized dentists were approached through the personal networks of the authors, as well as via the networks of the respective professional associations, i.e., NVGPT and VMBZ, after written permission from these associations had been obtained. The recruitment of participants took place from June to September 2020, with interviews conducted during the same period. The study was approved by the Ethics Committee of the ACTA (approval No. 2020219).

Interviewee background information

Prior to each interview, a digital questionnaire (<https://www.qualtrics.com>) was used to collect information about the participants' gender, number of years practicing dentistry, number of years as a specialized dentist, and postgraduate education in the field of bruxism completed within the past 5 years.

Interview method and data analysis

Two of the authors, AF ($n = 7$) and MT ($n = 4$), conducted the interviews. MT is a researcher and dentist with expertise in the fields of orofacial pain, oral movement disorders, tooth wear, and dental sleep medicine. The author has the experience in conducting qualitative research. AF is a sixth-year dental student with no experience in the field of qualitative research. Prior to conducting the first interview, an interview topic guide was designed based on the aims of this study, relevant scientific literature, the expertise and experience of 2 authors (MT and FL), and the results of pilot interviews. The topic guide served

as a memory assistant during the interview process.¹⁴ The topic guide included 4 domains, i.e., assessment, etiology, consequences, and the treatment of bruxism. The domains of consequences and treatment were included for different purposes than the present study and will be presented in future publications.

Six pilot interviews were conducted. The first two interviews were conducted between 2 authors, MT and AF, with the objective of providing training to author AF. The latter 4 interviews were conducted between AF and dentists from the professional networks of the authors (AF and MT), both for training purposes and to further refine the topic guide. These 6 interviewees were not included in the final group of interviewees.

The setting for the interview was selected by the participating dentist and could be either physical or conducted via Skype video call (Microsoft Corporation, Redmond, USA). Each interview was allotted a time frame of up to 30 min. All interviews were audio-recorded using a tape recorder and subsequently transcribed verbatim by AF. During this process, any information that could potentially reveal the identity of the interviewee was removed. All transcriptions were reviewed by MT. The transcriptions were not returned to the interviewees for comments or corrections, and no interviews were repeated.

Thematic analysis was performed by AF and MT shortly after the acquisition of each interview. This analytical method was conducted in a series of steps, as outlined below, to identify subthemes for each main theme.¹⁵ For this study, the main themes were predefined and included the assessment and etiology of bruxism.

In the first stage of the thematic analysis, the researchers identified and coded the initial themes by reviewing the transcribed interviews line by line. For each main theme, all initial themes that were conceptually related to one another were grouped into subthemes. Next, a thematic chart was constructed, in which the main themes were positioned in the top row. Below the main themes, each subtheme was assigned a single column, which contained all relevant textual data from the interviews. At the bottom of each column, the textual data was summarized according to the respective subtheme and, subsequently, per the main theme.¹⁴

The data was analyzed and the results were synthesized using ATLAS.ti (Scientific Software Development GmbH, Berlin, Germany) and Microsoft Excel (Microsoft Corporation) software. The coding and synthesis of the data were conducted by AF and MT independently, and any conflicts were resolved through discussion.

The interviewing process continued until information saturation was reached. This was the case when no new or secondary information was obtained from the data. Saturation was confirmed by 2 additional interviews.¹⁴ After the thematic analysis was completed, the concordance between the main themes and subthemes from this study and the respective STAB axes and their domains was examined.

Results

This section presents the results of the thematic analysis of interviews and their concordance with the respective STAB axes and domains.

Interviewees

A total of 12 individuals were registered for participation in this study. One interviewee was unable to participate in the study due to unknown reasons. Consequently, 11 dentists participated in the study, of whom 7 were specialized dentists, and 4 were general dentists. The background information of the interviewees is presented in Table 1.

Thematic analysis

From the thematic analysis, 6 subthemes were obtained, 3 of which were related to the main theme of assessment (Table 2) and 3 to etiology (Table 3). All subthemes and items per subtheme are presented in the left columns of the tables. The concordance between the data derived from the interviews and the respective STAB items is presented. To facilitate a clear overview of this concordance, the STAB axes and domains are presented in the right columns of the tables.

Assessment

The main theme of assessment was subdivided into 3 categories, namely, anamnesis, clinical examination and additional diagnostics (Table 2).

Anamnesis

Topics reported by the interviewees in the anamnesis subtheme were related to the content of self-reports, challenges encountered during the anamnesis process and information from previous dental history, as described in the patient's health record (Table 2). Overall, there was a substantial degree of overlap between the content of these topics and Axis A of the STAB (Subject-Based Assessment (SBA)) (Table 2). However, certain issues emerged during the interviews that are not specifically addressed in the STAB. First, some interviewees described that self-reported awareness of bruxism is not a single time-point process. Rather, it can be a process that requires time in some cases, as individuals may become increasingly aware of their bruxism activity after their dentist has brought the issue to their attention. Second, it was reported that in individuals with communication disabilities, self-reporting may solely rely on proxy reports by caregivers. Third, some interviewees indicated that they use information from the patient's health record, such as reports of previous use of oral

Table 1. Characteristics of the interviewees

Characteristics	Values
Sample size, <i>N</i>	11
General dentists/specialized dentists*, <i>n</i>	4/7
Male/female, <i>n</i>	0/11
Practicing dentistry [years] <i>M</i> (range)	22 (6–38)
Being a specialized dentist [years] <i>M</i> (range)	10 (7–13)
Interviewees who attended a lecture on bruxism within the past 5 years, <i>n</i>	7
Interviewees who attended a congress on bruxism within the past 5 years, <i>n</i>	4
Interviewees who attended a course on bruxism within the past 5 years, <i>n</i>	1
Interviewees who read professional literature about bruxism within the past 5 years, <i>n</i>	9

* Orofacial Pain and Dysfunction (OPD) (*n* = 4) and Disability Care (DC) (*n* = 3); *M* – mean.

appliances. On the other hand, the questionnaires, which are mentioned as a means of current bruxism reporting on the STAB, were not mentioned by the interviewees.

Clinical examination

Topics that were reported in the clinical examination subtheme were grouped into 4 categories, namely extra-oral signs, intraoral signs, pain, and others. A significant degree of overlap was observed with Axis A of the STAB (Clinically Based Assessment (CBA)) (Table 2). Two issues that emerged from the interviews but were not encountered in the STAB include the clinician's intuition, which refers to the situation in which clinicians partially rely on their intuition to guide them in the assessment of bruxism, and the issue of when to collect more information. In the course of the interviews, some respondents contended that in the absence of complaints in the history, no additional diagnostics are necessary.

Additional diagnostics

The additional diagnostics subtheme involves a discussion of imaging, specifically the acquisition of a panoramic radiograph to evaluate potential changes in the shape of the condylar bone, which could be indicative of bruxism. This topic is not addressed in the STAB. Moreover, a discrepancy between the findings of this study and the topics included in Axis A of the STAB (Instrumentally Based Assessment (IBA)) was found. The instrumental assessments proposed by the STAB for sleep bruxism, awake bruxism and additional instruments were not reported in the interviews of the present study.

Table 2. Thematic analysis of interviews for the assessment theme, and the comparison of interview results with Axis A of the Standardized Tool for the Assessment of Bruxism (STAB) (Assessment of Bruxism Status and Consequences)⁵

Study interviews		STAB Axis A	
subthemes	description	categories	domains
Anamnesis	Content of self-reports: – ask about complaints such as: headache, muscle cramps upon awakening, orofacial pain, grinding sounds, awareness of tooth wear – grinding sounds reported by caregiver in people with DD – grinding sounds reported by a bed partner	Subject-Based Assessment (SBA)	A1 (Sleep Bruxism Report) A2 (Awake Bruxism Report) A3 (Patient's Complaints)
	Challenges in anamnesis: – not a single time-point process: patients can become gradually aware of their bruxism activity – limited self-reporting in people with communication disabilities – validity of self-report		–
	Previous dental history: – bruxism-related complaints, as documented in the patient's health record – history of wearing a splint		A1 (Sleep Bruxism Report) A2 (Awake Bruxism Report)
Clinical examination	A. Extraoral signs Muscle and jaw volume: – voluminous masseter muscle – prominent jaws/jaw angles Temporomandibular joint sounds	Clinically Based Assessment (CBA)	A4 (Joints and Muscles)
	B. Intraoral signs Tooth wear: – wear facets – chipping of teeth – cervical lesions – fractures of teeth – fractures of restorations (fillings, crowns) – bruxopositions: pattern of antagonist teeth fitting exactly into each other – wear on splint – wear on removable denture Signs in soft tissues: – linea alba in the cheeks – tongue scalloping – red spots on the palate Endodontic treatment on one side		A5 (Intraoral and Extraoral Tissues) A6 (Teeth and Restorations)
	C. Pain No pain Dental pain Orofacial/TMD pain not related to the dentition Other issues, including difficulty in reporting pain in patients with disabilities		A4 (Joints and Muscles)
	D. Others Clinician's intuition/feeling When to perform more diagnostic procedures: – no complaint, no clinical examination and no treatment		–
Additional diagnostics	Imaging: – panoramic radiograph to evaluate the shape (changes) of the mandibular condyle	Instrumentally Based Assessment (IBA)	– A7 (Sleep Bruxism) A8 (Awake Bruxism) A9 (Additional Instruments)

TMD – temporomandibular disorders; DD – developmental disabilities.

Etiology

The main theme of etiology was subdivided into 3 categories, namely psychosocial and behavioral factors, physical and dental factors, and the assessment of comorbidities (Table 3).

Psychosocial and behavioral factors

The interviewees acknowledged that stress was broadly associated with bruxism and it was also encountered in Axis B of the STAB (Psychosocial Assessment) (Table 3). Interestingly, the topic of processing or seeking stimuli arose from

the interviews, in which environmental over- or understimulation might be an etiological factor of bruxism in people with severe DD. Moreover, the interviews indicated that bruxism may be an acquired habit or occur in moments of concentration. These topics were not specifically addressed in the STAB. However, with regard to the psychological factors that may be related to bruxism, the STAB authors do mention that there may be many others, thus allowing space for topics such as those reported in the present interviews to be considered in the assessment of bruxism.

Physical and dental factors

Physical factors reported by the interviewees exhibited a high degree of concordance with Axis B of the STAB (Concurrent Non-Sleep Conditions Assessment and Prescribed Medications and Use of Substances Assessment). Discrepancies include the addressing of specific syndromes, such as Down syndrome and Rett syndrome, in the interviews, but not in the STAB. Moreover, there was some doubt expressed in the interviews as to

Table 3. Thematic analysis of interviews for the etiology theme, and the comparison of interview results with Axis B of the STAB (Risk and Etiological Factors and Comorbid Conditions)⁵

Study interviews		STAB Axis B
subthemes	description	
Psychosocial and behavioral factors	Psychosocial factors: <ul style="list-style-type: none"> – stress – life events – aggravation of spasticity in cerebral palsy – lack of awareness of stress Processing or seeking stimuli in severe DD: <ul style="list-style-type: none"> – environmental overstimulation: in people unable to communicate, bruxism may be the result of expressing the tension caused by overstimulation due to external stressors that cannot be communicated otherwise – environmental understimulation: seeking for stimulation through oral stimuli which are under one's own control due to a lack of stimuli from the environment Habits: <ul style="list-style-type: none"> – awake bruxism is a learned behavior, especially in individuals with DD Concentration: <ul style="list-style-type: none"> – bruxism occurring during moments of concentration, which may not be immediately apparent 	B1 (Psychosocial Assessment)
	Physical and dental factors	Age: <ul style="list-style-type: none"> – bruxism might be related to growth in children – age-related stress: the prevalence of bruxism is highest during the working years Neurological disorders: <ul style="list-style-type: none"> – patients with cerebral palsy and spasticity present with severe bruxism – relationship between neurological disorders and bruxism remains uncertain Medication: <ul style="list-style-type: none"> – antidepressants – antipsychotics – polypharmacy – uncertain whether bruxism is related to medication Substance use: <ul style="list-style-type: none"> – caffeine – smoking – drugs, particularly ecstasy, and previous drug addiction Syndromes: <ul style="list-style-type: none"> – Down syndrome – Sanfilippo syndrome – Rett syndrome – Others Anatomical/occlusal factors: <ul style="list-style-type: none"> – do not play a role – less important than psychosocial factors – iatrogenic, i.e., restorations with occlusal contacts that are too high
Assessment of comorbidities		Differential diagnosis of other oral parafunctions: <ul style="list-style-type: none"> – biting on objects – tongue pressing Sleep bruxism comorbidities: <ul style="list-style-type: none"> – reflux – snoring, obstructive sleep apnea – sleepiness

whether neurological disorders are related to bruxism, even though such disorders are specifically mentioned in the STAB. Endocrine disorders and certain items in Axis B of the STAB (Additional Factors Assessment) were not mentioned at all in the interviews. Finally, dental factors, such as iatrogenic high occlusal contacts, were mentioned by the interviewees, but are not reported in the STAB (Table 3).

Assessment of comorbidities

The subjects discussed in the assessment of the comorbidities subtheme were related to the differential diagnosis of other oral parafunctions and the assessment of sleep bruxism comorbidities. More specifically, the interviewees argued that bruxism should be distinguished from other parafunctions with comparable consequences for the masticatory system, such as biting on objects and tongue pressing. This topic is not specifically addressed in the STAB. On the other hand, there was an overlap between the subject “sleep bruxism comorbidities”, as it arose from the interviews, and Axis B of the STAB (Concurrent Sleep-Related Conditions Assessment) (Table 3).

Discussion

The present qualitative study aimed to contribute to the further development of the STAB by providing suggestions based on daily clinical practice. More specifically, the objective was to investigate the experiences and attitudes of general dentists, dentists specializing in OPD, and dentists specializing in DC regarding the assessment and etiology of sleep and awake bruxism and to examine the concordance of these experiences and attitudes with the respective axes of the STAB. Taken together, the items that emerged from the interviews had a high degree of overlap with those described in both axes of the STAB. The following sections will present the suggestions for each axis.

Axis A: Assessment of Bruxism Status and Consequences

Anamnesis

In the present study, interviewees reported that patients may become increasingly aware of their bruxism activity after discussing the topic with their dentist. To date, there is limited evidence to support this clinical observation. Kaplan and Ohrbach demonstrated that self-reporting of oral parafunctional behaviors, as assessed by the Oral Behaviors Checklist (OBC), exhibited substantial reliability over a 7-day period.¹⁶ The study participants were made aware of their parafunctional behavior by being prompted

8 times per day to report their oral parafunctions, in accordance with the Ecological Momentary Assessment (EMA) paradigm.¹⁶ On the other hand, with regard to sleep bruxism, it has been suggested that self-reports may be influenced by reporting bias, particularly in patients with painful temporomandibular disorders (TMD)¹⁷ and non-painful jaw-muscle symptoms of the masticatory muscles.¹⁸ However, longitudinal data on how both awake and sleep bruxism reporting can change over time under the influence of repeated assessments is generally lacking. One of the recommendations for the further development of the STAB would be to allow for repeated assessments of self-reported awake and sleep bruxism at certain intervals, such as regular dental check-ups. It is recommended that neutral questioning be employed, especially when assessing sleep bruxism in patients with TMD pain or other jaw-muscle symptoms,^{17,18} in order to prevent reporting bias. As described below, instruments such as the BRUX scale¹⁹ and the OBC²⁰ may prove valuable for this purpose.

Moreover, the present study demonstrated the necessity of proxy reports for individuals who are unable to self-report their bruxism activity due to certain disabilities. Interviewees in the present study described how caregivers of these individuals might report audible and visible sleep and awake bruxism activity and how, sometimes, this activity can be observed by dentists during dental appointments. However, to date, no instrument exists for the standardized assessment of such directly observed or proxy-reported bruxism activity. It is recommended that future studies work on the development of such an instrument, which may follow the paradigm of other fields, such as the assessment of pain based on the observation of behavior.^{21,22} In the meantime, the developers of the STAB⁵ and the BruxScreen¹² are encouraged to include a proxy-report field in these tools. A final remark on the topic of observing bruxism activity in a clinical setting is that this finding has implications for the bruxism diagnostic grading system.²³ Indeed, it may be argued that a definite awake bruxism diagnosis can be established if bruxism activity is directly observed, irrespective of instrumental assessments on which a definite diagnosis is currently based.²³

Lastly, with regard to the anamnestic part of the bruxism assessment, the study showed that questionnaires were not employed as a means of assessing bruxism in the clinic. It remains plausible that such questionnaires are nevertheless used by some dentists, although they appear to be a relatively minor source of information in clinical practice. The use of diagnostic questionnaires as part of standard care is common in some tertiary clinical settings,²⁴ but it remains unknown whether encouraging the use of such questionnaires would be beneficial for general dental practices. Based on the results of the present study, it is recommended that future versions of the STAB provide a concise description of how these interviews and/or questionnaires should be implemented

in clinical practice. Currently, the OBC²⁰ is recommended by the Diagnostic Criteria for TMD (DC/TMD)²⁵ for the assessment of sleep and awake bruxism and is a freely available tool on the website of the International Network for Orofacial Pain and Related Disorders Methodology (INFORM).²⁶ The full OBC is included in the STAB. The recently developed BruxScreen¹² uses the BRUX scale, derived from the Oral Parafunctions Scale,¹⁹ for the assessment of self-perceived clenching and grinding during wakefulness and sleep. Moreover, 2 additional questions were derived and slightly modified to assess the presence of light tooth contact and firm mandible bracing during wakefulness. The initial pilot testing of the BruxScreen in a population of dentists and patients at the University Clinics of Helsinki, Finland, and Sienna, Italy, yielded positive results regarding the comprehensiveness, feasibility and validity of the tool.¹² Thus, the BruxScreen is a promising tool for widespread use in regular dental care and large-scale epidemiological studies, provided further validity testing is completed.¹² The developers of the STAB and BruxScreen recommend performing validity testing in patient populations from all spectrums of abilities to ensure that no one is excluded based on disability.

Clinical examination

As shown in the Results section, there was a substantial degree of overlap between the topics reported by interviewees and those described in Axis A of the STAB (CBA). The assessment of bruxism based on intra- and extraoral clinical signs has also been described in other practice-based studies.^{3,4} Recently, the BruxScreen presented a brief tool for the standardized assessment of extra- and intraoral signs that may be associated with bruxism.¹² Alongside the clinical signs that are assessed in the BruxScreen, the results of the present study provide suggestions for the development of a comprehensive instrument for the wider assessment of clinical signs of sleep and awake bruxism in future versions of the STAB.

Additional diagnostics

Discrepancies were identified between the additional diagnostic procedures described in the interviews of the present study and Axis A of the STAB (IBA). Radiographic evaluation of the condylar bone was reported in the present study, but not included in the STAB. Scientific evidence to support the radiographic features of the condylar bone as signs of bruxism is extremely scarce.^{27–29} To date, it has not provided sufficient support for this notion. Other potential radiographic features of bruxism have been investigated in a very limited number of studies. Tassoker found no relationship between sleep bruxism and pulpal calcifications in a group of young women,³⁰ while Türp et al. observed increased bone apposition at the mandibular angles of adult bruxers

compared to an adolescent control group.³¹ Consequently, no strong recommendations can be made regarding the integration of radiographic findings in the STAB, and further research on this topic is required. The use of instrumental approaches, such as EMA, electromyography (EMG) and polysomnography (PSG), was not reported by the interviewees. Ecological momentary assessment (also known as the experience sampling method (ESM)) is a technique that has been used in previous research settings.³² Recently, a smartphone-based application that allows low-key, widespread implementation has been developed.³³ It is possible that the dentists in the present study were unaware of the existence of this application. Electromyography devices for the assessment of awake bruxism have been used in research settings,³⁴ and a significant variety of ambulatory EMG devices for the assessment of sleep bruxism exists.³⁵ However, to the best of the authors' knowledge, these devices are not available or feasible for regular care, at least not in the Netherlands, where the present study was performed. Moreover, it is necessary to achieve consensus on the most appropriate method to assess MMA using EMA methods and ambulatory EMG devices.^{5,35} Further research on this topic is strongly recommended. It is also important to consider the commercial availability of smartphone applications and ambulatory EMG devices, as well as their accessibility for people with disabilities.

Axis B: Risk and Etiological Factors and Comorbid Conditions

Psychosocial and behavioral factors

In the present study, the participants acknowledged that psychological stress is associated with bruxism. However, they also reported that other factors, such as processing or seeking stimuli, habits and concentration, may play a role. The authors of the STAB aimed to evaluate the full spectrum of psychological and social factors that may be associated with bruxism.⁵ In that context, the key question is: which of these psychological and social factors are associated with bruxism? It is beyond the scope of the present study to address this question. Instead, a recommendation will be made as to how to incorporate the views of the interviewed clinicians in future versions of the STAB.

In the interviews, clinicians referred to their patients experiencing and reporting stress mainly in the context of daily stress and life events. The interviewees did not perform further probing to specify the concept of stress, which represents a limitation of the present study. In scientific literature, psychological stress is reported to occur when environmental demands challenge or exceed an individual's adaptive capacity, as perceived by the individual.³⁶ Stress can be expressed through a wide spectrum

of adverse emotional states, including depression, anxiety, distress, and lack of well-being.³⁶ The translation of this knowledge into daily practice necessitates the use of appropriate tools and questionnaires to assess the emotional states. Examples of such tools are the Generalized Anxiety Disorder-7 (GAD-7)³⁷ to evaluate anxiety, and the Patient Health Questionnaire-9 (PHQ-9)³⁸ to evaluate depression. These questionnaires are already incorporated into the DC/TMD evaluation process. Their incorporation into the STAB (the PHQ-9 is already part of the ToolKit of the STAB) could be considered to promote homogeneity of measurements in populations of patients who are assessed for the presence of TMD and bruxism. The inclusion of the brief PHQ-4 for the assessment of anxiety and depression, which is currently included in the STAB, will possibly hamper such homogeneity of measurements. For populations in which stress cannot be assessed through questionnaires due to certain disabilities,³⁹ it is necessary to include appropriate tools in the STAB, e.g., the Disability Distress Assessment Tool (DisDAT).⁴⁰

What is more, clinical reports of bruxism being associated with states of concentration, and, in individuals with DD, with overstimulation or seeking of stimuli, require further research. Regarding the topic of concentration, evidence for an association with bruxism is extremely limited. In a study by Major et al., sleep bruxers were found to have no greater mental or physical alertness than the control group.⁴¹ Conversely, other masticatory muscle activities, such as chewing, have been shown to be positively associated with attention.⁴² Based on the findings of the present study, no specific recommendations can be made regarding the incorporation of concentration into the STAB.

With regard to the topic of stimuli processing, the authors are unaware of any evidence that would suggest an association with bruxism. However, studies can be found on the interplay between stimuli processing and oral function. Little et al. observed distinct sensory processing patterns, i.e., responses to environmental stimuli, such as avoiding and seeking behavior, in children with autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) compared to children with typical development (TD).⁴³ In the same study, the authors examined the differential processing of sensory stimuli across various modalities, including auditory, visual, tactile, etc. Significant differences were observed in the processing of oral stimuli in children with ASD and ADHD compared to children with TD.⁴³ These differences in sensory processing may be associated with eating difficulties,^{43,44} although a possible association with sleep and/or awake bruxism is unknown. Moreover, Kirby et al. studied sensory interests, repetitions, and seeking (SIRS) behaviors, i.e., behaviors that occur in interaction with sensory stimuli.⁴⁵ The authors of this study found that children with ASD displayed significantly more SIRS behaviors than children with other

DD or TD.⁴⁵ However, no significant differences were observed between children with ASD, DD and TD in terms of oral SIRS behaviors of mouthing (bringing objects to the open mouth, placing them in the mouth and/or licking them) and biting (biting objects with teeth).⁴⁵ Based on the findings of the present study and relevant literature, no specific recommendation can be made regarding the topic of stimuli processing and the STAB. However, it is recommended that further studies investigate the extent to which bruxism activity occurs as a reaction to environmental stimuli, taking into account differences in sensory processing. The findings of such studies may shed light on the etiology of bruxism and could be incorporated into future versions of the STAB.

Physical and dental factors

The present study showed a high degree of overlap between the physical factors reported by the interviewees and Axis B of the STAB (Concurrent Non-Sleep Conditions Assessment and the Prescribed Medications and Use of Substances Assessment). Specific syndromes, such as Down syndrome and Rett syndrome, were mentioned by the interviewees, yet they are not included in the STAB. Indeed, a high prevalence of bruxism has been reported for these syndromes,^{8,46,47} but the prevalence, etiology, consequences, and treatment of sleep and awake bruxism in these populations are largely understudied. To facilitate research and clinical care in populations with DD and neurodevelopmental conditions, it is recommended that these conditions be added to the STAB.

Finally, regarding the dental factors, the present study identified iatrogenic high occlusal contacts as a potential etiological factor for bruxism activity. However, the literature does not support a causal association between occlusal factors and bruxism.⁶ Therefore, it is not recommended to introduce these factors into the STAB.

Assessment of comorbidities

In the present interviews, it was argued that other oral parafunctions should be assessed and distinguished from bruxism. Another clinical practice-based study revealed that only 39.1% of respondents considered other oral parafunctions when assessing and interviewing a patient with suspected bruxism.³ The STAB conceptualizes the assessment of concurrent non-sleep conditions, which may be associated with increased MMA.⁵ Oral parafunctions could be a source of loading for the masticatory system, with consequences similar to those of bruxism, such as temporomandibular disorder (TMD) pain.²⁴ Therefore, it is recommended that oral parafunctions be included in the differential diagnostic procedure when assessing an individual with suspected bruxism. For this purpose, the STAB has adopted the OBC.²⁰ Furthermore, comorbid conditions with sleep bruxism, such as reflux,

snoring, obstructive sleep apnea, and sleepiness, were described in the interviews. These are the items that are also described in Axis B of the STAB (Concurrent Sleep-Related Conditions Assessment),⁵ and to some extent in the practice-based study by Guillot et al.³

Conclusions

The findings of this study indicate a high degree of concordance between the experiences and attitudes of general dentists and dentists specialized in OPD and DC regarding the diagnosis and etiology of sleep and awake bruxism, and both axes of the STAB. This concordance indicates that the proposed STAB generally captures the items that dentists deem relevant to their clinical practice. Nevertheless, some issues were identified with regard to both STAB axes. The main issue involved the lack of appropriate tools for the DC setting. Based on the study results, the recommendations for the further development of the STAB, derived from interviews with 11 dentists, are summarized as follows:

1. Ensure that the STAB includes appropriate tools for the assessment of bruxism and related factors in individuals across the entire spectrum of abilities;
2. Allow for repeated assessment of self-reported awake and sleep bruxism at certain intervals, with brief, neutral questioning;
3. Allow for standardized assessment of directly observed or proxy-reported bruxism activity;
4. Provide a concise description of the methodology for implementing self-report interviews and/or questionnaires in clinical practice;
5. Develop a standardized tool for the wider assessment of clinical signs of bruxism;
6. Provide guidance on the use of instrumental approaches for the assessment of bruxism, with a particular focus on the scoring of MMA;
7. Include DD and neurodevelopmental conditions in the assessment of concurrent non-sleep conditions.

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Academic Centre for Dentistry in Amsterdam (ACTA) (approval No. 2020219).

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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