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Review Article

Diagnostic criteria for bruxism: A scoping review

Padrós-Augé Jordi[1,2*], Zayane Nouhaila[1], Cano Miquel[3], Morales-Vigo Albert[1,2], Castro Sebastién[1], Parathias Laurine[1]

[1]Department of Physiotherapy, Universitat Central de Catalunya – Universitat de Manresa, Manresa, Barcelona, Spain
[2]Faculty of Medicine, Universitat Autònoma de Barcelona, Barcelona, Spain
[3]Master of Medicine, Surgery and Oral Implantology – Universitat de Barcelona, Campus Bellvitge, Hospitalet de Llobregat, Spain

Abstract

Background: A scoping review was conducted to explore all the methods and criteria used in primary research on bruxism diagnosis.

Methods: A pre-defined and validated search was carried out in the PubMed, CINAHL, PsycInfo, Scopus, PeDro, LILACS, and Epistemonikos databases. Primary studies conducted on bruxism as primary condition in the adult population were included. The selection phases were carried out by peers, and conflicts were resolved by a third reviewer or by consensus. Data extraction and manual tracing were done in order to identify the relevant studies.

Results: The search and selection strategy identified 472 publications, and after manual tracing, 423 studies were selected for analysis. The results on diagnostic methods were grouped into 10 categories. Different subcategories were described within these categories, resulting in a total of 73 diagnostic methods: physical examination (n=11), questionnaires (n=12), polysomnography (n=13), electromyography (n=5), the International Classification for Sleep Disorders from the American Association of Sleep Medicine (ICSD-AASM) (n=3), intraoral devices (n=10), history (n=7), audio-video recordings (n=3), smartphone applications (n=2), and others (n=7). In addition, the combinations of methods used in the primary research were also analyzed. The prevalence of use was calculated for all diagnostic categories and subcategories, as well as for the combinations.

Conclusion: There was high heterogeneity in primary research regarding the diagnosis of bruxism. There is evidence that not all diagnostic methods are properly validated. Future research should focus on validating these methods and developing the best tool in terms of reliability and cost-effectiveness for the diagnosis of bruxism.

Keywords: Bruxism, Scoping review, Bruxism diagnosis

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Introduction

Bruxism comes from the Greek expression "brychein odontas" which means grinding teeth. It has been redefined over the years by several authors and academic associations as a "movement disorder," "behavior disorder," and "sleep disorder." The interest in bruxism is supported by the idea of its influence on oral health and its role on temporomandibular disorders (TMD) [1]. Actually, there is no complete agreement about the last question. Many systematic reviews have assessed the relationship between bruxism and TMD, but their results remain controversial.[2-4] One of the main limitations reported by these systematic reviews is that the association between bruxism and TMDs is dependent on the diagnostic criteria employed in bruxism diagnosis.

The first review about the diagnostic criteria was conducted by Koyano et al in 2008, identifying five ways to arrive at a bruxism diagnosis: questionnaires, clinical findings, intra-oral appliances, masticatory muscle electromyography, and polysomnography.[5]

Since the consensus reached in 2012, an effort has been made to establish common criteria for the diagnosis of bruxism.[6] In 2017, another international consensus was held with the purpose of establishing a common diagnostic algorithm, as well as to update the definition of bruxism. A noteworthy development was providing separate definitions for sleep bruxism (SB) and awake bruxism (AB).[7]

The agreements reached in the consensus on the diagnosis of bruxism were made by a panel of experts. Agreement on the diagnosis of any condition is a necessity for both clinicians and researchers, but health decisions must be made on solid arguments based on multiple factors, not just expert opinion.

The purpose of this work was to provide a broad vision of the existing possibilities for the diagnosis of bruxism to identify all the tools used, alone and in combination with other methods, and determine to what extent the official criteria published by the reference associations are followed.

*Corresponding Author: Padrós-Augé Jordi, Email: jpadros@umanresa.cat

In order to explore the proposed variables, it is believed that the scoping review is the most appropriate methodological tool to identify the possible diagnostic criteria to detect bruxism. For the elaboration of this work the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) checklist and recommendations from Peters et al 2020 were used as a guide.[8,9]

Methods

A five-step process divided into three phases was developed to obtain the articles of interest. This process is represented in the flow chart (Figure 1). The five-steps were: identify, select, screen, include, and adjust data. Each step is explained below.

Search strategy

A predefined search strategy was used on May 13, 2021 to identify the sources (Table 1). The assessed databases included PubMed, CINAHL, PsyInfo, Scopus, PeDro, LILACS, and Epistemonikos. The search strategy was adapted for each database, e.g. in PubMed, the most suitable strategy was used to identify data.[10] For this review, all available Spanish or English publications in the mentioned databases were searched without a time filter.

Inclusion and exclusion criteria

The interest was focused on selecting the diagnostic methods used for detection of primary bruxism in the adult population. We accepted that diagnostic accuracy studies did not necessarily have an age filter. Publications that were not primary studies, did not treat bruxism as a primary condition, or had children as their study population were excluded. When publications were not available online and the full text was not available either, they were excluded.

Evidence screening and selection

A free web platform for systematic reviews was used for this phase (http://www.rayyan.ai/).[11] All of the selection and screening process was blinded. After duplicates were removed, inclusion and exclusion criteria were applied by five reviewers (JP, ZN, MC, CS, and PL), and at least two decisions were applied for each record. When decision about a record was unanimous, it was resolved by consensus, or by a third reviewer (AM). The main author (JP) searched and read the full text. Because a single primary study can result in more than one publication, in order to avoid overestimating the diagnostic methods for bruxism, manual tracing was carried out by the main author to adjust the number of publications to the number of investigations carried out.

Data extraction

Data from each record was entered into a Microsoft Excel document. Publication year, type of study design, type of bruxism assessed, number of methods used for bruxism diagnosis, methods or criteria used for diagnosis, and sequence of methods or criteria used for detection of bruxism were extracted. The categories assigned for the study designs were clinical trials, case-control studies, longitudinal observational studies, accuracy tests, and

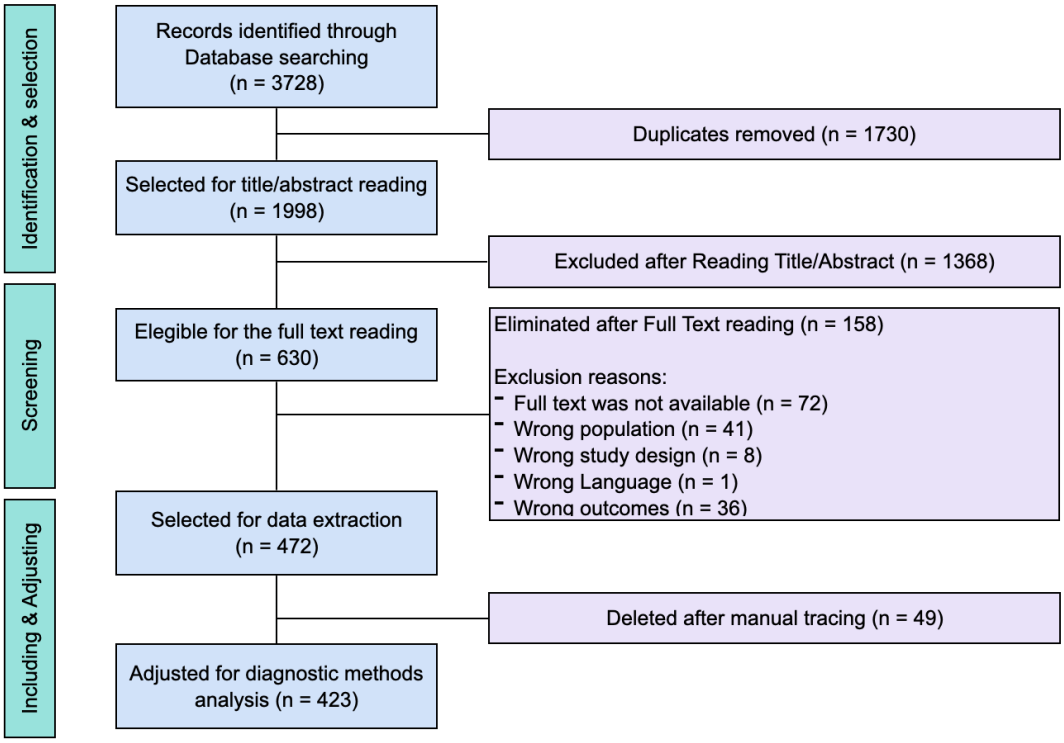

Figure 1. Flowchart of the study

Table 1. Search strategy

Sources	Search Strategy
PubMed	**#1** Randomized controlled trial [pt] **#2** Controlled clinical trial [pt] **#3** Randomized [tiab] **#4** Placebo [tiab] **#5** Therapy [sh] **#6** Randomly [tiab] **#7** Trial [tiab] **#8** Groups [tiab] **#9** Case* AND control* [tiab] **#10** Match [tiab] **#11** Cohort* [tiab] **#12** Prospective* [tiab] **#13** Propensity [tiab] **#14** Diagnosis* OR sensitivity AND specificity [tiab] **#15** #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 **#16** Animals [mh] NOT humans [mh] **#17** #15 NOT #16 **#18** Bruxism [tiab] **#19** #17 AND #18
CINAHL	Bruxism in title or abstract
PsyInfo	Bruxism in title or abstract
Scopus	TITLE (bruxism) AND LIMIT-TO- (DOCTYPE, "ar")) AND LIMIT-TO (LANGUAGE "English" OR LIMIT-TO, "Spanish"))
PeDro	Bruxism Filter: Clinical Trial
LILACS	Bruxism AND NOT child* in title
Epistemonikos	Bruxism in title or abstract Filter: Primary study

cross-sectional studies without control groups. The types of bruxism were classified into SB, AB, both non-differentiated, and both differentiated. Diagnostic methods were divided into ten categories: physical examination (tooth wear, impregnations on mucosa or tongue, etc), questionnaires, polysomnography, electromyography, and the International Classification of Sleep Disorders (ICSD) of the American Academy of Sleep Medicine (AASM). Studies where ICSD follow-up was explicitly reported were included in this category. The other categories included intraoral devices, history of bruxism (self-reported bruxism, signs or symptoms, such as orofacial pain or presence of TMDs, sleep partner reporting, etc), audio-video recordings, mobile apps, etc. Instruments used for bruxism detection and diagnosis, scales, and other intrinsic variables of each method such as number of nights of polysomnography, the name of questionnaires used, or edition of ICSD were also extracted for future analysis.

Data adjusting

In order to avoid overestimating the bruxism diagnostic methods, manual tracing was carried out by the main author (JP) to adjust the number of publications to the number of investigations conducted. Once manual tracing was done, those publications that used the same sample with the same diagnostic methods to identify bruxism were adjusted. The aim was to minimize the risk of overestimating the diagnostic criteria, because a single primary study can result in more than one publication. No restrictions about quality of evidence were applied in this study.

Data analysis

The extracted data was reported using descriptive statistical methods. Variables such as the type of bruxism used, the diagnostic methods found, and the subcategories found for each method were summarized in descriptive tables.

Results

A total of 472 publications were found. After adjusting the data, a total of 423 records remained. The most used study design was cross-sectional (44.9%), followed by controlled trial (25.1%), case-control studies (16.1%), diagnostic accuracy studies (9.7%), and longitudinal observational studies (4.2%).

A total of nine specific diagnostic methods were identified, and an extra category was created for unspecific methods (Supplementary file 1, Table 3j). The prevalence of the use of different diagnostic methods when they were used as a single method, in combination with another method, or in combination with several methods are shown in Table 2. Each identified method could be divided into subcategories. Table 3 describes the number of subcategories found for each method (expanded in Supplementary file 1). Up to 11 different types of measurements were found for the physical examination variables. Those considered were tooth wear and lingual or mucosal impregnations. For the questionnaires, a total of 12 modalities were identified, ranging from isolated questions to complete instruments. In the polysomnographic examinations, the examined variability focused on the place where the examination was conducted (sleep laboratory or home), the number of nights studied, and whether or not these nights were consecutive. A total of thirteen subcategories were identified for polysomnography based on the identified variables. For electromyography, three standardized procedures were identified (Bitestrip®, Grindcare®, and Bruxoff®), and the number of channels used was also considered (single or multichannel). Variables such as electrode position or recording side were not considered in unilateral electromyography. Under these conditions, five subcategories were identified.

The ICSD was published on 2001 (ICSD-1).[12] The classification was updated on 2005 (ICSD-2),[13] and finally, the last actualization was published in 2014 (ICSD-3)[14] by the AAMS. These are the three subcategories identified for this method. Separating the different editions of the ICSD allowed us to explore the adherence of the research to the official criteria.

Another method found was the use of splints and

Table 2. Prevalence of methods used for bruxism diagnose

Method/criterion	Times used as single method for diagnose		Times used in combination with another method		Times combined with several methods	
	No.	%	No.	%	No.	%
Physical Examination	17	10.0	78	25.2	61	21.9
Questionnaire	65	38.5	44	14.2	25	9.0
Polysomnography	9	5.3	32	10.3	53	19.0
Electromyography	16	9.5	36	11.6	31	11.1
ICSD–AASM	28	16.6	43	13.9	29	10.4
Intraoral devices	10	5.9	7	2.3	3	1.1
History	11	6.5	62	20.0	40	14.3
Audio-video recordings	0	0.0	1	0.3	27	9.7
Apps	4	2.4	1	0.3	0	0.0
Others	9	5.3	6	1.9	10	3.6
Total	169	100.0	310	100.0	279	100.0

Table 3. Number of subcategories for each diagnostic method/criterion

Method/Criterion	Subcategories
Physical examination	11
Questionnaire	12
Polysomnography	13
Electromyography	5
ICSD – AASM	3*
Intraoral devices	10
History	7
Audio-video recording	3
Apps	2
Others	7

*The ICSD has been revised twice since the first edition.

other instruments that were placed in the oral cavity for the purpose of diagnosing bruxism. A total of eleven subcategories were identified, including Brux Checker®, piezoelectric splints, biofeedback splints, etc.

Sometimes bruxism is diagnosed through clinical history, based on self-reporting, the presence of signs and symptoms in the orofacial region (orofacial pain, fatigue, or TMDs), and the confirmation of bruxism by a bed partner or roommate in the case of SB. Six subcategories were identified after considering these factors.

When a polysomnography or electromyography are chosen to assess bruxism, audio and video records can be used in order to avoid confusing bruxism with other orofacial activities such as swallowing. In that sense, the use of audio, video or both constitute the three subcategories identified for this method.

Finally, two apps were used to assess AB, and seven other methods were found in some studies; these include accelerometers, ultrasound, radiography, brain computer interface, or through announcements in local newspapers or university campuses.

The type of bruxism and the diagnostic methods used for each of the types of bruxism were also analyzed. Bruxism was divided into four categories: SB, AB, both differentiated, and both non-differentiated (Table 4).

However, 26.5% of the studies did not specifically report the type of bruxism they studied. For diagnosing SB the most used criterion was the combination between two methods (39.3%) and the methods more frequently used in combination were physical examination, polysomnography, electromyography, history of bruxism, or criteria proposed by the AASM. As a single method, the ICSD was the most used for bruxism diagnosis (28.4% of the single method group and 8.3% of overall studies on SB). If all methods used for SB diagnosis were included (single or combined), the most used method was physical examination (37.7% of studies, n = 252).

For AB diagnosis, the use of apps was the most used single method (23.5%) followed by questionnaires (17.6%), but if all methods used were taken into consideration (single or combined), the most used method was electromyography (35.3%). Of the 423 studies included, 26.5% did not report the type of bruxism studied while 9.9% of the studies included both types of bruxism (SB and AB) and reported it. A total of 29 different three method-combinations were found for bruxism diagnosis in the 69 identified records. The most used combinations of three methods for the diagnosis of bruxism were explored (Table 5).

Discussion

The validity of some studies on validation of diagnostic accuracy (n = 41) and the number of subcategories identified in the diagnostic methods (n = 73) are questionable. Therefore, there is evidence that not all diagnostic methods are correctly validated. In addition, if combinations are counted, at least a total of 174 methods were found (73 subcategories + 31 combinations of two methods + 29 combinations with 3 + 36 combinations with more than 3 methods). These results suggest high

Table 4. Types of bruxism studied matched with diagnostic methods used

Method/Criterion	Sleep bruxism			Awake bruxism			Both difference			Both non- difference		
No. of methods used	**1**	**2**	**3+**	**1**	**2**	**3+**	**1**	**2**	**3+**	**1**	**2**	**3+**
Physical examination	2	39	54	-	-	2	1	7	2	14	32	3
Questionnaire	11	19	19	3	2	-	22	11	2	29	12	4
Polysomnography	9	30	51	-	-	-	-	1	-	-	1	2
Electromyography	14	31	28	2	2	2	-	-	1	-	3	-
ICSD – AASM	21	34	26	-	-	-	2	3	1	7	4	2
Intraoral devices	6	7	3	-	-	-	-	-	-	4	-	-
History	5	34	35	-	1	2	-	5	2	6	22	1
Audio-video recording	-	1	26	-	-	-	-	-	1	-	-	-
Apps	-	-	-	4	-	-	-	1	-	-	-	-
Others	6	3	9	1	1	-	-	-	-	2	2	1
Not reported		3			2			0			10	
Total	74	99	76	10	3	2	25	14	3	62	38	4

1: Single method; 2: Combination of two methods; 3+: Combination of three or more methods.

Table 5. Combination of three methods to assess bruxism diagnosis

Combination	Total	%
History/anamnesis + physical examination + polysomnography	13	28.2
History/anamnesis + physical examination + electromyography	11	23.9
ICSD + polysomnography + audio-video recordings	8	17.4
ICSD + physical examination + electromyography	6	13.0
Questionnaire + polysomnography + audio-video recordings	3	6.5
Questionnaire + physical examination + polysomnography	2	4.4
Questionnaire + physical examination + electromyography	2	4.4
Questionnaire + ICSD + physical examination	2	4.4
History/anamnesis + electromyography + audio-video recordings	2	4.4
Other combinations	20	2.2

heterogeneity in bruxism diagnosis, a limitation identified in some systematic reviews.[1-4]

Bruxism is a complex process related to involuntary human behavior and in relation to perceived stress or anxiety, among other factors.[15,16] Not all of the diagnostic methods found directly analyze bruxism as an event. For example, physical examination is the evaluation of the possible damage caused by bruxism to the oral cavity. Although it would not explain the current presence of the event, it detects its presence in the past, so its use as a diagnostic method has important limitations. On the other hand, the use of techniques that can potentially assess bruxism directly, is nowadays still considered too invasive. Analyzing muscle activity through electromyography or polysomnography requires the modification of the usual environment of patients. In addition, laboratory tests are mostly performed with only one night of adaptation, and this time may not be enough for the patient to adapt. Also, in the case of testing patients in their home, the impact of electrodes and the sleep monitoring system on bruxism is still unknown.

The number of nights required to provide good reliability is high due to the variability of bruxism in subjects.[17,18] In addition, even without doing an in-depth analysis, they are the most expensive methods in economic terms.

The smartphone applications that perform the diagnosis of AB (self-monitoring) based on periodic notifications on the smartphone have not achieved sufficient adherence,[19] and they also require time and attention.

The splints used to evaluate nocturnal bruxism provide information about the presence of bruxism and an approximation of the intensity. Their greatest utility is the identification of bruxism patterns, which would be useful for preventive treatment.[20]

Diagnosis based on self-report seems to be a good tool in economic terms, but patients may not be aware of the occurrence of bruxism, so the sensitivity of this method could be insufficient. On the other hand, the presence of bruxism has been identified in healthy subjects, and in relation to the new definition of bruxism, it is not considered a pathology in otherwise healthy subjects.[7] The conflict would exist with those patients with signs of bruxism but without symptoms and self-report.

Finally, in terms of cost-effectiveness, it seems that questionnaires would be the most useful method. The present work has identified a total of twelve questionnaires; therefore, future research should focus on assessing the reliability of these questionnaires and if they are faithful to the existing definition and, if necessary, develop an instrument from the existing ones that allows the inclusion of probability subscales on the presence of bruxism as well as the type of bruxism (SB or AB).

Currently, some work has already been carried out in this regard, although the number of methods analyzed does not include all the methods found in this study, questionnaires, physical examination, and portable devices have been analyzed in comparison with polysomnography with audio-video recordings, which is the accepted gold standard method at present.[21] Future research should be devoted to works with similar designs.

Finally, if a consensus about bruxism diagnosis is reached, researchers and clinicians are expected adhere to the agreed-on guidelines. It is remarkable that only 25.3% of the included studies reported that they followed the ICSD criteria. Regardless of the validity of the methodology used to reach a consensus, if it exists, research on bruxism should take a common direction as far as the diagnosis of bruxism is concerned.

This study is not without limitations. Manual tracing might not have detected studies using the same samples, retrospectively. Secondly, some studies may have followed the ICSD but not explicitly reported having followed it. Thus, they may have been counted as using different methods than those proposed by the AASM. Finally, as the study did not receive financial support, it was not possible to access all the full texts that had been selected for full reading. These losses comprised 11.4% of the identified papers. However, this project has been carried out with a search strategy validated by other investigations[22–24] and reported with transparency of criteria, facilitating its replicability and future updates.

Conclusion

The results of this research should be considered in future investigations on diagnostic methods for bruxism as primary condition. The number of methods used as well as the number of subcategories found for the diagnosis of bruxism is remarkable. The difficulty in comparing the studies can be explained by the number of categories and subcategories found in these works. Future research on the diagnosis of bruxism should focus on evaluating existing methods and proposing a diagnostic method faithful to the current definition.

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Authors' Contribution

Conceptualization: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.
Data curation: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.
Investigation: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.
Formal analysis: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.
Methodology: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.
Writing–original draft: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.
Writing–review & editing: Padrós-Augé Jordi, Zayane Nouhaila, Cano Miquel, Morales-Vigo Albert, Castro Sebastién, Parathias Laurine.

Competing Interests

None.

Data Availability Statement

Data will be available by request to the corresponding author.

Ethical Approval

Not applicable.

Funding

Not applicable.

Supplementary Files

Supplementary file 1 contains expanded version of Table 3 describing the number of subcategories found for each method.

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