



# Sensitivity and specificity of different indexes used to diagnose Temporomandibular Disorders

Sensibilidade e especificidade de diferentes índices utilizados para o diagnóstico de disfunções temporomandibulares

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## ABSTRACT

**Objective:** To verify the level of agreement among different indexes used to achieve the prevalence of Temporomandibular Disorders (TMD). **Material and Methods:** One hundred one dental students were selected by a randomized process. TMD were evaluated by the Fonseca's Anamnestic Index (FAI), Helkimo's Clinical Index (HCI), and the Research Diagnostic Criteria for TMD (RDC/TMD). Data was analyzed using Chi-square and Kappa tests, considering a significance level of 5%. **Results:** HCI showed the highest prevalence of TMD, and the comparison between RDC/TMD, FAI, and HCI showed low agreement ( $k=0.17$  and  $k=0.35$  respectively). Most individuals presented mild TMD for both FAI and HCI indexes. A moderate correlation for TMD severity was obtained ( $k=0.53$ ) between FAI and HCI, and a high sensitivity and low specificity were observed for both diagnosis when compared to RDC/TMD. **Conclusion:** The prevalence of TMD may vary significantly depending on the index used for its diagnosis, which may lead to a large number of false positives and overtreatments.

## KEYWORDS

Epidemiology; Prevalence; Temporomandibular joint; Temporomandibular joint disorders; Young adult.

## RESUMO

**Objetivo:** Verificar o nível de concordância entre diferentes índices utilizados para avaliar a prevalência de disfunções temporomandibulares (DTMs). **Material e Métodos:** Cento e um estudantes de odontologia foram selecionados por um processo randomizado. As DTMs foram avaliadas pelo Índice Anamnético de Fonseca (IAF), pelo Índice Clínico de Helkimo (ICH) e pelo Research Diagnostic Criteria for TMD (RDC / TMD). Os dados foram analisados pelos testes Qui-quadrado e Kappa, considerando um nível de significância de 5%. **Resultados:** A aplicação do ICH levou a uma maior prevalência de DTMs, e a comparação entre o RDC/TMD, IAF e ICH mostrou baixa concordância ( $k = 0,17$  e  $k = 0,35$ , respectivamente). A maioria dos indivíduos apresentou DTMs leves para os índices FAI e ICH. Uma correlação moderada para a gravidade da DTMs foi obtida ( $k = 0,53$ ) entre FAI e HCI, e uma alta sensibilidade e baixa especificidade foram observadas para ambos os diagnósticos quando comparados com o RDC/TMD. **Conclusão:** A prevalência de DTMs pode variar significativamente, dependendo do índice usado para o seu diagnóstico, o que pode levar a um grande número de falsos positivos e sobretratamentos.

## PALAVRAS-CHAVE

Adulto jovem; Articulação temporomandibular; Epidemiologia; Prevalência; Transtornos da articulação temporomandibular.

## INTRODUCTION

Temporomandibular Disorder (TMD) is a term that includes several clinical conditions affecting the temporomandibular joints (TMJ), masticatory muscles and/or associated structures [1–3]. Thus, it can be classified as articular, muscular or mixed, depending on its origin [4]. Among the signs and symptoms involved in TMD, the most cited are pain in the TMJ region, pain or fatigue in the craniocervical and facial muscles (especially masticatory muscles), presence of clicking joint sounds, and limited mandibular movements [5–7].

The etiology of TMD is multifactorial [8], involving systemic and local factors, and is strongly influenced by biopsychosocial aspects. In addition, gender, age and the socioeconomic profile are determinant factors in the development of TMD signs and symptoms. The wide etiologic factors involved in this disorder may hinder a proper diagnosis. Thus, several instruments were developed for screening and diagnosing TMD [9].

Diagnosis tools include clinical indexes, and both anamnestic and diagnostic criteria. These instruments aim to facilitate TMD evaluation for research and clinical purposes. Among the most widely used indexes are the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [10], Helkimo's Clinical Index (HCI) [11], and Fonseca's Anamnestic Index (FAI) [12]. The RDC/TMD and HCI are extensively applied in epidemiological studies [13–15], being the RDC/TMD recognized as the gold standard method for TMD diagnosis [14,16,17]. Both the RDC/TMD and HCI have been used to enable the standardization, validation and replication of studies evaluating TMD [4,8,10].

Otherwise, FAI is a 10 self-reporting questionnaire that has been used globally in order to measure the prevalence and severity of TMD [1–3,7–9,14,18,19]. This instrument is limited to yes/no questions, which makes its application easier, quicker and cheaper

[1,7,8,18]. Additionally, the examiner does not require training [19], exerting no effect on the results [18].

On the other hand, the existence of different tools may render the comparison between different studies more difficult [20] and also results in a wide-ranging variation of TMD prevalence in the literature. All assessment tools with viable applicability in epidemiological studies should be previously tested and validated [4], especially on an international level, in order to allow studies to be compared worldwide. Only a limited number of studies using FAI have investigated its correlation with validated assessments in an attempt to obtain greater diagnostic precision [8]. Therefore, this study aimed to verify the level of agreement between the RDC/TMD, HCI and FAI, by means of the sensitivity and specificity of these methods, considering the RDC/TMD as the gold standard.

## MATERIALS AND METHODS

### *Experimental design*

This research received the approval of the Ethics Committee of the Federal University of Rio Grande do Norte, under protocol #123/2010. Data collection was initiated following explanation of the research objectives and signing of the informed consent.

The prevalence of TMD was evaluated in a convenience sample of dental students of the same university. The selection was conducted based on a random sampling process, using a general outline of systematic sampling. Individuals from the population were ordered and a number between one and three was drawn, defining the random start. Then, the participants were selected by summing the random start number plus three. The total survey sample size was calculated assuming a prevalence rate of 40%, a non-response rate of 10%, and a margin of error of 25%. Thus, considering a population average obtained from prevalence studies found in the literature, the estimated sample size was 101 dental students.

Individuals under medical treatment, who had recently undergone surgical procedures in the orofacial region, or who presented systemic problems, such as neurological disorders, fibromyalgia, headaches and earaches, were excluded.

### *Data collection*

The FAI [12] is composed of ten questions scoring TMD severity, as follows: no TMD, mild TMD, moderate TMD or severe TMD. All volunteers received an explanation regarding the questionnaire and filled it by themselves.

The diagnosis proposed by the HCI [11] consists of five items related to limitation of mandibular movements, as well as pain during mandibular movements, TMJ function and pain, and muscle pain. A single calibrated researcher performed all evaluations. The results were scored ranging from 'no TMD' to mild, moderate or severe TMD.

The Axis I of the RDC/TMD was used to perform the clinical diagnosis. This axis comprises the physical assessment of the patient by 10 items of clinical examination, including muscle and joint palpation, mandibular movements, and three subjective questions. The RDC/TMD offers three diagnoses for TMD: Group I - myofascial pain and myofascial pain with limited opening; Group II - articular disc displacement with reduction, articular disc displacement without reduction, and articular disc displacement without reduction and with limited mouth opening; and Group III - arthralgia, osteoarthritis and osteoarthritis. Individuals belonging to Groups II and III were classified as having articular TMD due to the small sample of individuals set in Group III, which would not allow an adequate statistical analysis. In addition, each volunteer may present more than one diagnosis, even for the right or left side of the face, from different sources.

### *Statistical Analysis*

Statistical analysis was performed by descriptive data with absolute values and

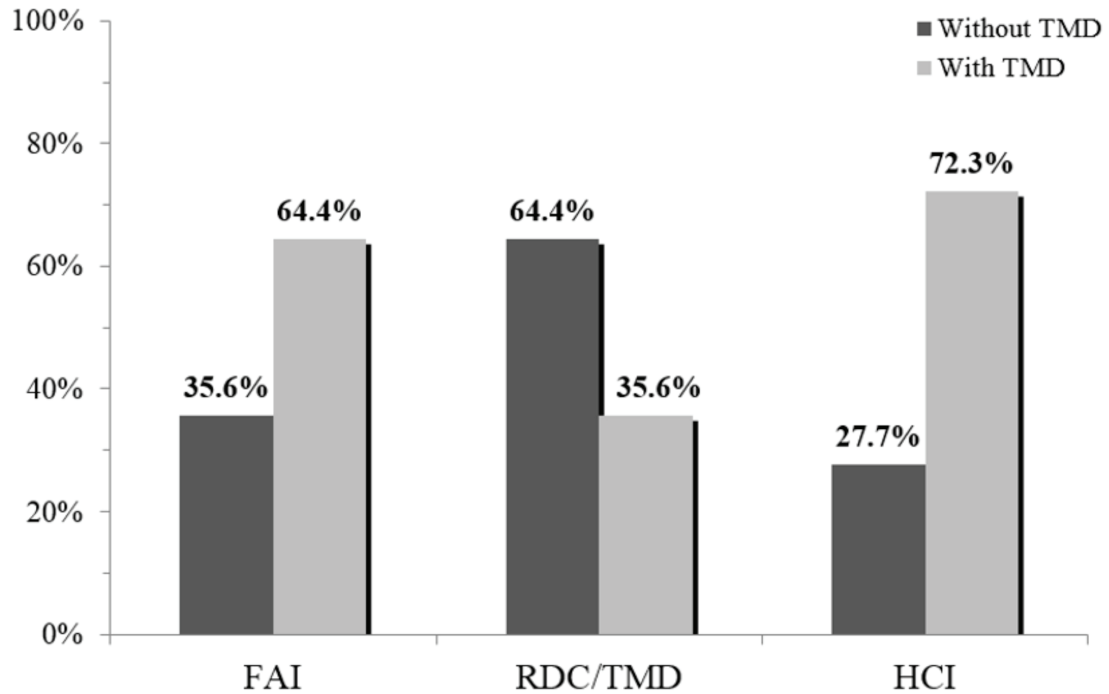
frequencies. Chi-square and Kappa tests were used, considering a significance level of 5%. The kappa ( $k$ ) coefficient quantifies the level of agreement between diagnostic tests according to a pattern. In the present study, RDC/TMD was considered as the gold standard tool for TMD diagnosis. This coefficient is interpreted as follows: values greater than or equal to 0.75 indicate excellent agreement, values between 0.75 and 0.40 indicate good agreement, and values less than 0.40 indicate poor agreement.

In addition, sensitivity and specificity tests were undertaken for the different diagnoses. The sensitivity test indicated the ability to identify true positives (proportion of affected individuals determined by the test in relation to the total number of true positives), and the specificity test is the capacity to recognize true negatives (proportion of non-affected individuals determined by the test in relation to the total number of true negatives) [14].

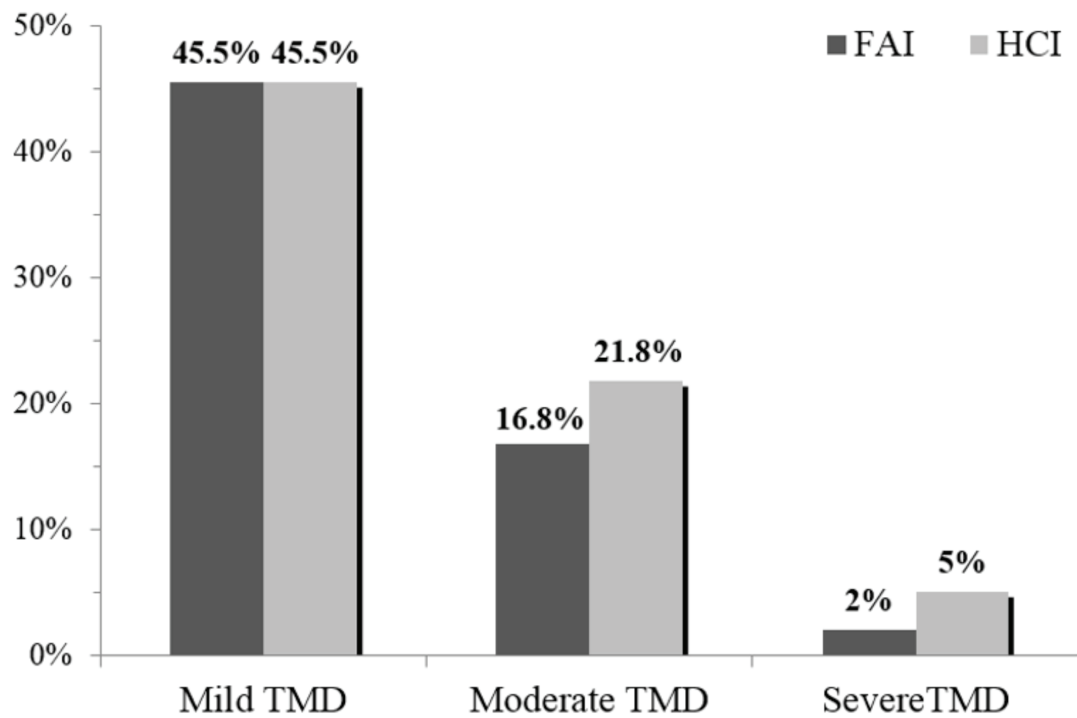
## **RESULTS**

All selected volunteers accepted to participate in the study. Thus, 101 dental students, between 18 and 25 years, were evaluated according to TMD signs and symptoms. The sample was comprised of 36.6% males and 63.4% females. Frequency rates were determined according to TMD diagnosis (Figure 1), TMD severity (Figure 2) and TMD type and subtype (Figure 3).

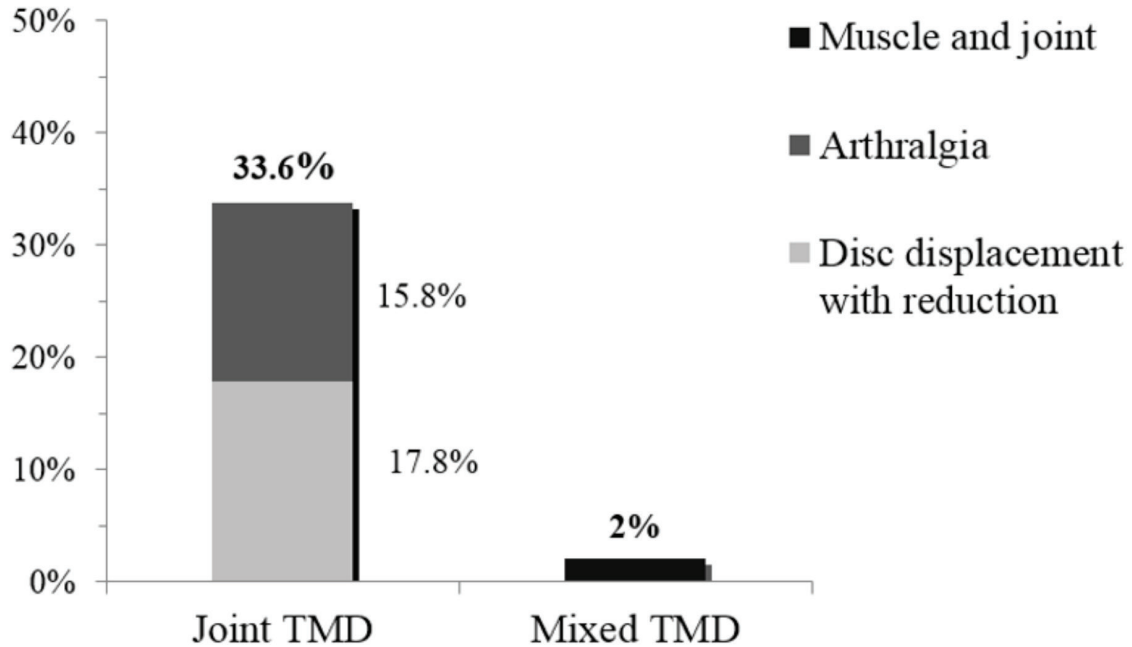
Poor agreement was found between FAI and RDC/TMD (Table I). In fact, only 17% of the diagnosis were correspondents in both indexes. FAI questionnaire showed higher sensitivity (0.78) than specificity (0.43). That is, it was better in detecting cases that actually had TMD than cases that did not. This demonstrates that the FAI may have failed since it detects false positives in excess.



**Figure 1** - Relative frequencies according to TMD diagnosis by Fonseca Anamnestic Index, RDC/TMD and Helkimo's Clinical Index. TMD: Temporomandibular disorder; FAI: Fonseca anamnestic index; RDC: Research diagnostic criteria; HCI: Helkimo's clinical index.



**Figure 2** - Frequencies of TMD severity according Fonseca Anamnestic Index and Helkimo's Clinical Index. TMD: Temporomandibular disorder; FAI: Fonseca anamnestic index; HCI: Helkimo's clinical index.



**Figure 3** - Frequencies of TMD diagnosis divided by types and subtypes, according to the RDC/TMD. TMD: Temporomandibular disorder.

**Table I** - Sample distribution according to TMD diagnosis by RDC/TMD and Fonseca Anamnestic Index

	RDC/TMD						p
	Without TMD		With TMD		Total		
FAI	N	%	n	%	n	%	
Without TMD	28	77.8	8	22.2	36	100.0	0.03
With TMD	37	56.9	28	43.1	65	100.0	

Kappa (k): 0.17; Sensitivity: 0.78; Specificity: 0.43. TMD: Temporomandibular disorder; RDC: Research diagnostic criteria; FAI: Fonseca Anamnestic Index.

**Table II** - Sample distribution according to TMD diagnosis by RDC/TMD and Helkimo's Clinical Index

	RDC/TMD						p
	Without TMD		With TMD		Total		
HCI	N	%	n	%	n	%	
Without TMD	27	99.0	1	1.0	28	100.0	<0.001
With TMD	37	50.7	36	49.3	73	100.0	

Kappa (k): 0.35; Sensitivity: 0.97; Specificity: 0.42. TMD: Temporomandibular disorder; RDC: Research diagnostic criteria; HCI: Helkimo's Clinical Index.

Similarly, Kappa coefficient was poor between the HCI and the RDC/TMD diagnostic methods (Table II). The HCI presented higher sensitivity (0.97) than specificity (0.42), which resulted in only 35% of matched diagnosis between HCI and RDC/TMD indexes.

The correlation between HCI and FAI considering the sample distribution according to TMD severity can be observed in Table III. It was found a coefficient of 0.53, which demonstrates moderate agreement between the methods.

**Table III** - Sample distribution according to TMD severity by Fonseca Anamnestic Index and Helkimo's Clinical Index

		Helkimo's Clinical Index									
		Without TMD		Mild TMD		Moderate TMD		Severe TMD		Total	
		N	%	%	n	%	n	%	n	%	p
Fonseca	Without TMD	25	69.4	6	16.7	4	11.1	1	2.8	36	100.0
Anam- nestic	Mild TMD	3	6.5	34	73.9	7	15.2	2	4.3	46	100.0
Index	Moderate TMD	0	0	6	35.3	10	58.8	1	5.9	17	100.0
	Severe TMD	0	0	0	0	1	50.0	1	50.0	2	100.0

Kappa weighted ( $k_w$ ): 0.53. TMD: Temporomandibular disorder.

## DISCUSSION

The prevalence of TMD proved to be variable according to each diagnostic method used in this study. This highlights the importance of choosing instruments that must have their metric qualities carefully evaluated [9]. In addition, it was showed that HCI and FAI exhibit high sensitivity and low specificity when applied in young adults. These results denote a high capacity for recognizing true positives, while they were not efficient to distinguish true negatives in comparison to the RDC/TMD. This could lead to overtreatment and possibly hinder the diagnosis of other conditions that have similar signs and symptoms. With this in mind, it is crucial use well-defined criteria to diagnose TMD.

Concerning TMD prevalence, the gold standard method resulted in a prevalence of 35.6%, while FAI and HCI results were 64.4 and 72.2%, respectively. These results are similar to previous findings in the literature. Usually, data obtained from RDC/TMD may vary between 20% and 46.1% [21–24], while in studies using FAI or HCI it was found a prevalence ranging from 43.5 to 74.9% [3,7,13,20,25,26]. The highest prevalence rate was found with HCI and may be justified by the fact that a mere clicking joint sound is

enough to classify an individual as having TMD to some degree. Similarly, the FAI consider three affirmative answers to questions on headache, neck pain and the perception of emotional tension as having mild TMD; however, these same symptoms can be related to others comorbidities, and even occur in an isolated manner without being associated to TMD [14].

Data on TMD severity obtained by FAI and HCI showed that milder forms were the most prevalent, followed by moderate and severe TMD. Previous studies have also shown this pattern [1–3,13,20,25]. As for the type of TMD obtained by the RDC/TMD, individuals were classified as having mainly articular TMD. A systematic review [27] demonstrated that myofascial disorders are more common in patients seeking treatment for TMD, and disc displacement with reduction is the major diagnosis for non-patients, as seen in the current research. Similarly, Manfredini et al. [28] reported a higher prevalence of disc displacement in youngest age groups. It is worth mention that FAI and HCI instruments do not offer a diagnostic classification of TMD [14], which can be a disadvantage since TMD treatment is directly related to its source and classification.



Furthermore, the results confirm that the FAI questionnaire is useful for the preliminary prescreening of patients [7,14], but does not allow a definitive diagnosis [14]. Questionnaires, such as FAI, have low specificity because signs or symptoms do not always indicate the presence of TMD. Thus, even healthy subjects may be classified with some degree of TMD. Likewise, despite HCI has been reported to be appropriate to TMD diagnosis, the present results showed that it may not be an absolute truth.

Another important point of this research was the correlation between diagnostic methods (one anamnestic and two clinical indexes). Considering TMD degree obtained by FAI and HCI, the weighted kappa value showed moderate agreement ( $\kappa_w = 0.53$ ). This was expected since HCI served as a reference for creating FAI. On the other hand, both methods showed lower weighted kappa values when correlated with RDC/TMD, reaffirming their low agreement. This finding corroborates with a previous study that stated the necessity of adapting the FAI [1] in order to obtain an accurate diagnosis.

As a final remark, the FAI and HCI are suitable options, but it is mandatory some adaptations to increase the instrument's reliability [1]. Reliable and validated instruments for TMD diagnosis, requiring lower evaluation time and easier understanding, are extremely necessary for epidemiological studies and clinical practice. In addition, studies including the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), which is a new comprehensive version of the RDC/TMD, should be carried out to evaluate the level of agreement with the studied indexes.

## CONCLUSION

Considering the limitations of the present study, it can be stated that the prevalence of TMD varies among young adults when different indexes are used.

## DISCLAIMER STATEMENTS

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### *Disclosure of Interest*

The authors report no conflicts of interest.

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