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ORIGINAL ARTICLE

Reproducibility and validity of self-perceived oral health conditions

Camila Pinelli · Leonor de Castro Monteiro Loffredo

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Abstract The reproducibility and validity of self-perceived periodontal, dental, and temporomandibular joint (TMJ) conditions were investigated. A questionnaire was applied in interview to 200 adults aged from 35 to 44, who were attending as casual patients at Araraquara School of Dentistry, São Paulo State University, São Paulo, Brazil. Clinical examination was based on the guidelines of the World Health Organization manual. The interview and the clinical examination were performed in two occasions, by a calibrated examiner. Reproducibility and validity were, respectively, verified by kappa statistics (κ) and sensitivity (Sen) and specificity (Spec) values, having clinical examination as the validation criterion. The results showed an almost perfect agreement for self-perceived TMJ (κ=0.85) and periodontal conditions (κ=0.81), and it was substantial for dental condition (κ=0.69). Reproducibility according to clinical examination showed good results (κ=0.73 for CPI index, κ=0.96 for dental caries, and κ=0.74 for TMJ conditions). Sensitivity and specificity values were higher for self-perceived dental (Sen=0.84, Spec=1.0) and TMJ conditions (Sen=1.0, Spec=0.8). With regard to periodontal condition, specificity was low (0.43), although sensitivity was very high (1.0). Self-perceived oral health was reliable for the examined conditions. Validity was good to detect dental conditions and TMJ disorders, and it was more sensitive than specific to detect the presence of periodontal disease.

C. Pinelli (✉) · L. de Castro Monteiro Loffredo
Department of Social Dentistry, Araraquara School of Dentistry,
São Paulo State University,
Rua Humaitá, 1680,
Araraquara, São Paulo 14801-903, Brazil
e-mail: cpinelli@foar.unesp.br

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Introduction

Traditionally, measurements in health and in oral health epidemiology have been predominantly clinical [8]. Several indices have been validated and used routinely in the medical and dental literature [15, 22]. The study of patient's self-perceived health has received increasing attention in medicine and dentistry [14]; however, few information is available regarding the reproducibility and validity of self-perceived oral health measures [7, 19].

The effectiveness of measuring subjective oral health could result in improved understanding of oral health problems, allowing oral health promotion to be appropriately planned [8] and offering opportunities to measure oral health in populations and groups in a way many people could find more acceptable than undergoing clinical examination, with less cost of a traditional epidemiological dental survey and with potentially less bias [6].

When self-assessment and professional assessment were compared, accurate estimates of self-perceived oral health were verified for the dentition status [18], number of remaining teeth, and the presence of dentures [23]. A fairly good self-assessment was also observed for periodontal conditions [6, 9], although it was less accurate for measures of decayed teeth [19]. Other studies suggested that patients underestimate their gingival disease [1, 6, 19, 20] but had good reproducibility to report dental caries [23]. Another study [21] showed that self-assessment and professional assessment identified identical numbers of people with dental caries.

Temporomandibular joint (TMJ) disorders were also investigated [16] with the aim of comparing self-assessment with the professional assessments. Reproducibility and validity of a craniomandibular index (CMI) were also reported [3, 4], although no previous study verified the reproducibility and the validity of self-perceived TMJ disorders by means of the World Health Organization (WHO) protocol [17].

Validity and reproducibility are important aspects to consider when comparing the effectiveness of self-perceived measures, as they must reproduce the subjective states that they are designed to represent and the extent to which self-report items measure what they purport to measure [8].

Therefore, the aim of the present study was to verify the reproducibility and validity of self-perceived oral health condition related to periodontal status, dental condition, and TMJ disorders in adults.

Materials and methods

Two hundred subjects who reached for dental service at the Department of Documentation, Clinical Trial and Emergency at Araraquara School of Dentistry, São Paulo State University were invited to participate in the research. The inclusion criterion was done according to free demand for the service. People in the 35–44 age bracket were included because most adults at this age would have experienced dental disease and had some impacts on daily living [11], and information about oral conditions in such group is lacking. Another reason was the recommendation of the WHO that considers this age bracket as a monitoring group for oral health patterns [17].

The local Ethics Committee in Research approved the project, and informed consent of all human subjects who participated in the study was obtained after the procedures had been fully explained.

Each volunteer was firstly interviewed to determine his/her self-perceived oral health, and the questions were related to having or not having gum disease, dental caries, and TMJ symptoms (Fig. 1).

The possible answers 1 and 2 for the question about dental condition were grouped in one category to represent the presence of dental caries. The same grouping procedure was done to the answers 1, 2, and 3 for the question about TMJ problems.

Afterward, a previously calibrated dentist clinically examined oral conditions, based on the guidelines for periodontal, dental, and TMJ index proposed by the WHO [17] because they standardize data collection and serve as a reference.

To obtain the clinical examination results, periodontal conditions were recorded by means of the worst score of the community periodontal index (CPI) for each volunteer among all the examined sextants [6]. The CPI codes were grouped into two categories: the first one, "absence of disease," composed by codes for the presence of bleeding and calculus (that means light levels of periodontal disease) and the second one, "presence of disease," included codes

Fig. 1 Questionnaire of self-perceived oral health conditions

Periodontal Condition
Q1 – Do you believe your gums are healthy?
(0) Yes, they don't bleed when toothbrushing or flossing
(1) No, I have bleeding gums when toothbrushing or flossing
(2) No, sometimes I feel a taste of blood, even when not toothbrushing
(3) No, some teeth are moving and I feel pain as they move
(4) I don't know

Dental Condition
Q2 – Do you think you have caries lesions now?
(0) No, I don't think so
(1) Yes, I have pain in teeth with hot/cold foods
(2) Yes, I have a huge cavity and toothache
(3) I don't know

TMJ Condition
Q3 – Do you have jaw joint problems to open your mouth widely, or when you are chewing?
(0) No, no problem at all
(1) Yes, I have clicking/ grating in jaw joint
(2) Yes, I have pain in jaw joint, temples, face or in front of the ear
(3) Yes, I have difficulty opening mouth wide or chewing
(4) I don't know

Table 1 Reproducibility of self-perceived periodontal condition

	Periodontal condition	Exam 2					
		Healthy	Bleeding after brushing	Spontaneous Bleeding	Painful, with tooth mobility	Unknown	Total
Exam 1	Healthy	49	3	1	–	–	53
	Bleeding after brushing	12	96	2	–	1	111
	Spontaneous Bleeding	–	2	10	–	–	12
	Painful, with tooth mobility	-	1	–	22	–	23
	Unknown	–	1	–	–	–	1
	Total	61	103	13	22	1	200

p_o=0.88; p_e=0.38; κ=0.81 ($CI_{95\%}$=0.72–0.90); s=0.047; p=0.000

for pockets of 4 to 5 mm and deep pockets of greater than 6 mm (most severe levels of periodontal disease).

Dental conditions were examined through the number of decayed, missing, and filled teeth, and then the data for each patient were grouped as "presence of dental caries" or "absence of dental caries."

TMJ area was examined bilaterally in search of clicking, pain in the muscles after digital palpation, or difficulty in opening the mouth widely. The presence of one or more of these signals was taken as indicative of the "presence" of the TMJ disorder.

A pilot study was developed with the aim of calibrating the examiner previously to the final study. Twenty patients that were not included in the present study were examined. The intraexaminer results ranged from almost perfect to substantial agreement ($\kappa_{periodontal}$=0.73, κ_{dental}=0.95, and κ_{TMJ}=0.73).

Within a 1-week interval, another interview based on self-reported oral health and another clinical examination were done to check the reproducibility. Kappa statistic [12] was estimated by point (κ) and by confidence interval ($CI_{95\%}$). The level of agreement was classified according to the standards proposed by Landis and Koch [10].

Measures of validity such as sensitivity (Sen) and specificity (Spec) were determined for periodontal, dental, and TMJ conditions. A 2×2 table was obtained, and each validation criterion was classified according to the dichotomous nature of the oral variables (periodontal, dental, and TMJ conditions). The results were expressed as "presence of disease" and "absence of disease."

Results

Reproducibility

Tables 1 to 3 show the reproducibility results according to self-perceived oral health.

Tables 1 shows the reproducibility of self-perceived periodontal condition.

When the results of the first exam were compared to the results of the second exam, it was verified that 177 patients had the same opinion when asked about their periodontal condition. On the other hand, 23 had a different opinion, in which 12 volunteers scored their condition as "bleeding after brushing" in the first assessment and as "healthy" in the second. Other three subjects classified as "healthy" in the first and then as "bleeding after brushing" in the second assessment. It is possible to note that three other people scored a worst condition in the second interview, when compared to the first answer. Furthermore, three subjects had an improvement in their opinion in the second exam. Two volunteers scored as "unknown" condition in one of the interviews, while in the other exam, they scored as "bleeding after brushing." Regarding reproducibility of periodontal condition, it was observed an almost perfect agreement (κ=0.81, $CI_{95\%}$=0.72–0.90) for self-perceived periodontal condition, according to the standards proposed by Landis and Koch [10].

Measurements of self-perceived dental condition are shown on Table 2.

Analyzing Table 2, it is possible to see that 178 people agreed in the classification about presence or absence of dental caries in both examinations. Regarding the disagree-

Table 2 Reproducibility of self-perceived dental condition, according to the presence of dental caries

	Dental caries	Exam 2			
		Absence	Presence	Unknown	Total
Exam 1	Absence	11	2	1	14
	Presence	6	149	4	159
	Unknown	3	6	18	27
	Total	20	157	23	200

p_o=0.89; p_e=0.65; κ=0.69($CI_{95\%}$=0.59–0.79); s=0.05; p=0.000

Table 3 Reproducibility of self-perceived TMJ symptoms

	TMJ symptoms	Exam 2			
		Absence	Presence	Unknown	Total
Exam 1	Absence	108	6	–	114
	Presence	9	77	–	86
	Unknown	–	–	–	–
	Total	117	83	–	200

p_o=0.92; p_e=0.51; κ=0.85($CI_{95\%}$=0.71–0.99); s=0.07; p=0.000

ments (22 subjects), six volunteers scored dental caries as present in the first exam, but in the second, it was classified as absent. On the other hand, two participants scored as absence of dental caries in the first assessment but changed their minds to a different opinion in which teeth were with dental caries in the second approach. Furthermore, five volunteers that scored dental caries even as absent or present in the first exam changed their opinion to "unknown" condition, indicating uncertainty about their own perception. Other nine people scored as "unknown" in the first exam, and in the second, they chose even "presence" or "absence" of dental caries. It was observed a substantial agreement (κ=0.69, $CI_{95\%}$=0.59–0.79), according to the reports about the presence or absence of dental caries.

Table 3 shows the reproducibility for self-reported TMJ symptoms.

Only 15 volunteers disagreed about their TMJ symptoms, in which nine of them classified as "presence" of TMJ symptoms in the first assessment and "absence" in the second. Other six had an inverse judgment. No volunteer scored his TMJ condition as "unknown," indicating a high subjective opinion. An almost perfect agreement (κ=0.85, $CI_{95\%}$=0.71–0.99) was found for self-perceived TMJ conditions.

When Tables 1 to 3 are analyzed in relation to the answers classified as "unknown," it is possible to verify that volunteers had more doubt to classify their dental condition (18 subjects), than they were to classify periodontal or TMJ conditions.

Table 4 Reproducibility of clinical examination of periodontal condition, according to CPI codes

	CPI codes	Exam 2						
		0	1	2	3	4	Excluded	Total
Exam 1	0	–	–	–	–	–	–	–
	1	–	20	6	1	–	–	27
	2	–	4	84	8	–	–	96
	3	–	–	4	43	7	–	54
	4	–	–	–	6	16	–	22
	Excluded	–	–	–	–	–	1	1
	Total	–	24	94	58	23	1	200

p_o=0.82; p_e=0.33; κ=0.73 ($CI_{95\%}$=0.65–0.81); s=0.04; p=0.000

Table 5 Reproducibility of clinical examination according to the presence or absence of dental caries

	Dental caries	Exam 2		
		Absence	Presence	Total
Exam 1	Absence	13	–	13
	Presence	1	186	187
	Total	14	186	200

p_o=0.99; p_e=0.87; κ=0.96 ($CI_{95\%}$=0.82–1.0); s=0.07; p=0.000

Tables 4 to 6 represent the results of reproducibility according to clinical examination of periodontal (Table 4), dental (Table 5), and TMJ conditions (Table 6).

It is possible to see that when disagreements occurred in Table 4, they were established in the immediately subjacent categories, above or under the score initially registered. Kappa values showed a substantial agreement (κ=0.73, $CI_{95\%}$=0.65–0.81) for clinical evaluation of periodontal condition.

Almost all volunteers were classified in the same category, regarding the classification criteria of presence or absence of dental caries shown in Table 5. Only one individual was initially classified as dental caries present in the first exam and as not having it in the second appointment. It was observed an almost perfect agreement (κ=0.96, $CI_{95\%}$=0.82–1.0) for the clinical evaluation of dental caries condition.

Table 6 shows that 13 volunteers were classified as having absence of TMJ signals in the first exam, but in the second evaluation, they were registered in a different condition. Other nine subjects were classified as having presence of TMJ signals but without them in the second exam. This could have happened because of the subjective perception of the clinical examiner to detect TMJ problems, as the evaluation is conducted only by means of digital palpation of the TMJ region. Although, a substantial agreement to evaluate this clinical condition was observed (κ=0.74, $CI_{95\%}$=0.60–0.88).

Analyzing Tables 4 to 6, it is possible to see that the kappa value was substantial for the clinical examination of

Table 6 Reproducibility of clinical examination of TMJ condition

	TMJ signals	Exam 2		
		Absence	Presence	Total
Exam 1	Absence	129	13	142
	Presence	9	49	58
	Total	138	62	200

p_o=0.89; p_e=0.58; κ=0.74 ($CI_{95\%}$=0.60–0.88); s=0.07; p=0.000

Table 7 Validity of self-perceived periodontal condition

	Periodontal condition	Clinical examination		
		Presence of disease	Absence of disease	Total
Self-report	Presence of disease	76	70	146
	Absence of disease	–	54	54
	Total	76	124	200

Sensitivity=1.0; Specificity=0.43

periodontal and TMJ conditions, and it was almost perfect for the clinical examination of dental caries. Good intra-examiner agreement based on clinical examination can be used as a proxy for accuracy to evaluate the diagnostic performance under in vivo conditions [5], and it was established as the validation criterion for self-perceived oral health conditions.

Validity

To evaluate the validity of self-perceived oral health, any interview and any clinical examination could be chosen, as the results were reproducible. The validation criterion was based on the data of the first clinical examination. Regarding the judgment about dental caries, the subjective result scored by volunteers as "unknown" had to be rearranged in the category of absence of disease, to attend the dichotomous variables required in the study of validity.

Table 7 shows the validity of self-perceived periodontal conditions.

Among 124 subjects clinically classified as healthy, only 54 participants perceived their condition as not having the periodontal disease. This result had an influence in the specificity value that was low (Spec=0.43). Furthermore, a very high sensitivity was found (Sen=1.0), indicating that patients were able to better identify the presence of periodontal disease.

Table 8 shows the validity of self-reports in dental caries:

Table 8 Validity of self-perceived dental conditions, according to the presence or absence of dental caries

	Dental caries	Clinical examination		
		Presence	Absence	Total
Self-report	Presence	159	–	159
	Absence	28	13	41
	Total	187	13	200

Sensitivity=0.85; Specificity=1.0

Table 9 Validity of self-perceived TMJ conditions

	TMJ problems	Clinical examination		
		Presence	Absence	Total
Self-report	Presence	58	28	86
	Absence	–	114	114
	Total	58	142	200

Sensitivity=1.0; Specificity=0.8

Among 187 participants clinically classified as having dental caries, 28 judged their condition as "absence" of dental caries. Other 13 subjects clinically classified as not having dental caries classified their condition in a correct way. This finding corroborates to the high sensitivity (0.85) and maximum specificity value (1.0). It means that volunteers who reported absence of dental caries were without cavities indeed, and the ones who reported such presence clinically showed caries lesions.

Table 9 shows the validity of self-perceived TMJ conditions.

Among the disagreements, it is possible to see that only 28 subjects perceived some TMJ symptoms as present, but in fact, the clinical examiner did not find any signal of clicking or pain in muscles or even limitation while opening the mouth widely. Table 9 indicates a high specificity (0.80) and maximum sensitivity (1.0), showing that patients were able to give correct information about their TMJ conditions.

In general, self-reports predicted dental and TMJ conditions in a high level of validity, and in relation to periodontal condition, a better performance was found to detect the presence of the disease.

Discussion

The authors' hypothesis was that self-reported oral health could be used to reliably and accurately detect periodontal, dental, and TMJ conditions. Therefore, the present study verified the reproducibility and validity of such self-perceived oral conditions.

In relation to self-perceived periodontal health, good reproducibility was observed, showing reliability of self-reports. In relation to validity, the sensitivity was 100%, but the specificity value was low. The sensitivity result for periodontal condition (Sen=1.0) disagrees with the findings that self-perceived periodontal condition underestimated the prevalence of gingival disease [1, 6, 19, 20] and with studies [1, 19] that showed low sensitivity values for bleeding gums (Sen=0.42) and periodontal pockets (Sen=0.55 [1] and Sen=0.39 [19]). This might have happened

because the clinical cutoff point for the absence of disease took into account the codes from 0 to 2 of the CPI index, which represent light levels of disease.

With regard to self-perceived dental caries, a good reproducibility result was observed, which agrees with a previous study [23]. In relation to the validity of self-reported dental condition, the present findings showed that volunteers were correct about their judgments, as high specificity and sensitivity values were obtained.

This might be explained by a correct judgment of the need, which was based on the individual's previous experience in dental caries. Such result is against the one [19] that found high specificity (0.85) and low sensitivity (0.59) for self-reported dental caries.

Reproducibility and validity of self-reported TMJ disorders measured by means of the WHO protocol has not been described. However, inter-rater and intrarater reliability of a CMI [3] was observed in the literature, with good reliability results.

The TMJ index proposed by the WHO protocol has some similarity with CMI, although its items are reduced, and its items evaluate the presence or absence of clicking, pain in the muscles after palpation, and difficulty in opening the mouth widely [17]. Such index was applied in the present study, as it provides objective measures of problems in mandibular movement, joint noise, and muscle and joint tenderness, using clearly defined criteria, simple clinical methods, and ease in scoring.

A very good reliability and high validity results were previously observed for self-reported pain questions, and it was concluded that they could be used to screen for TMJ pain in the adolescent population [16]. The present study also found good reproducibility and validity results for self-reported TMJ conditions. Therefore, such question can be used to detect temporomandibular disorders in adults.

Based on the present findings and on previous studies [8, 13, 14], it is possible to assume that patients' self-reports can be considered as possible screening instruments. By using the WHO protocol, examiners can possibly assign diagnostic meanings with satisfactory level of reliability.

The traditional use of oral health data collected under the pathfinder protocol, by means of clinical examination as the only source of information to develop and plan policies for dental services, show some restriction as they do not always help people demand dental services [2]. The combined clinical and subjective indicators define a multidimensional assessment of the oral condition. It is important to consider patients' complaints as part of the diagnostic assessment.

Disease is not just a pathophysical process, but it is something that most people experience [14]. Patients are critically important partners in preventing disease, copying with treatment, and in deciding on whether or not to use a certain health service.

In conclusion, the results of the present study showed that self-reported oral health was reliable and valid to detect periodontal, dental, and TMJ conditions, and it was more sensitive than specific to detect periodontal condition among adults.

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