The Reliability and Validity of Self-reported Temporomandibular Disorder Pain in Adolescents

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Aims: *To evaluate the reliability and validity of self-reported pain associated with temporomandibular disorders (TMD) in adolescents and to determine how this validity may change over time. The authors' hypothesis was that self-reported pain can be used to reliably and accurately detect adolescents with TMD pain.* **Methods:** *One hundred twenty adolescents, 60 with self-reported TMD pain and 60 age- and gender-matched controls without TMD pain, were examined twice. At the first examination at a Public Dental Service clinic, self-reported TMD pain was recorded for each patient. At the second examination, a clinical examination was completed, blind to the patients' self-report of pain symptoms, after which self-reported TMD pain was again recorded. The clinical examination was based upon the Research Diagnostic Criteria for TMD (RDC/TMD). Self-reported TMD pain in this investigation was based upon the subjects' responses to 2 questions:* (1) *Do you have pain in your temples, face, temporomandibular joint (TMJ), or jaws once a week or more? and* (2) *Do you have pain when you open your mouth wide or chew once a week or more?* **Results:** *Test-retest reliability of .83 (kappa) was found for the 2 questions. The sensitivity was .98 (95% CI, .90 to 1.0) and specificity was .90 (95% CI, .81 to .95) for comparison of assessments made on the same day. Sensitivity was .96 (95% CI, .85 to .99) and specificity .83 (95% CI, .72 to .90) for assessments made 2 to 4 weeks apart.* **Conclusion:** *Very good reliability and high validity were found for the self-reported pain questions. A short time interval between the screening question and examination slightly increased the accuracy of the measure. In adolescent populations, the questions in this study can be used to screen for TMD pain.* J OROFAC PAIN 2006;20:138–144

Key words: adolescents, diagnosis, reliability, sensitivity, specificity, temporomandibular pain

Pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" by the International Association for the Study of Pain (IASP).[1] Measuring this experience and deciding upon a definitive diagnosis usually requires asking people about their pain, examining them, and performing diagnostic tests. Comprehensive examinations and tests, however, are time-consuming and expensive; they are rarely feasible in large-scale epidemiologic studies. Instead, self-reported responses to questions about pain are commonly used.

In large-scale epidemiologic surveys of orofacial pain and temporomandibular disorders (TMD), differing "key questions" have

been used to collect data from the population to be studied. For example, in a large national survey in the United States, Lipton et al[2] asked in personal interviews: "During the past 6 months, did you have more than once…: pain in the jaw-joint or in front of the ear; a dull, aching pain across your face or cheek (excluding sinus pain)?" They reported that of a population of 42,370 individuals, 6.7% had self-reported TMD pain more than once during the past 6 months.[2] Dworkin and collaborators[3] found in a population-based study in Washington state that 12% of the population had TMD. In their study, a telephone or mailed questionnaire was used to ask the main question: "Have you had facial ache or pain in the jaw muscles, the joint in front of the ear or inside the ear (other than infection) in the previous 6 months?"[3] However, the reliability and validity of these various self-reported TMD pain entities, when compared to a clinical diagnoses of pain, were not well characterized.

To increase the overall understanding of these questions among adolescents, word simplification and other methods have been used as potential aids. For example, when asking adolescents about TMD pain, 1 of the questions used above has been altered to: "Do you have pain in your temple, face, TMJ or jaws once a week or more?" or "Do you have pain when you open your mouth wide, once a week or more?" This time-frame, "once a week or more," has been used in several studies concerning TMD and tension-type headache in adolescents.[4–6] Use of a more narrow time limit seems to improve the reliability of self-reported pain.[5]

These questions are modifications of those used in a previous study among adolescents.[7] A commonly used classification scheme for TMD is the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). This diagnostic system has been tested for reliability concerning clinical measurements and has been found to have good reliability among adults[8] and adolescents.[7] It has also shown to be a repeatable and consistent instrument for cross-cultural studies on TMD.[9] Its measures of psychosocial distress, Axis II, have also been evaluated among adults and been found to have good reliability.[10]

To allow the screening of patients for TMD pain, the TMD-*Smärta* (TMD-S) was introduced into the routine examinations of children and adolescents in Östergötland County in Sweden. The epidemiologic registration TMD-S is based on 2 questions regarding the patient's self-report of pain in the masticatory system. In a previous epidemiological study of 28,899 adolescents, 4.2% reported pain related to the masticatory system once a week or more often.[11]

Since self-reported facial pain does not necessarily correspond to a TMD diagnosis, it was decided to investigate the reliability and validity of TMD-S (self-reported TMD pain) compared to a standardized clinical examination. Thus, the purpose of this investigation was to evaluate the reliability and validity of self-reported TMD pain in adolescents and to determine how this validity may change over time. The authors' hypothesis was that self-reported pain can be used to accurately detect adolescents with TMD pain in a repeatable fashion.

Materials and Methods

Participants

One hundred twenty adolescents, 60 with self-reported TMD pain (according to the TMD-S) and 60 individuals without TMD pain, participated in the investigation. The healthy individuals were age- and sex-matched with the TMD-S patients. All subjects were either consecutive cases or consecutive noncases (controls), depending upon matching criteria, from 5 Public Dental Service (PDS) clinics in the region of Norrköping, Sweden. The published guidelines listed in the Standards for Reporting of Diagnostic Accuracy were followed.[12] The RDC/TMD examination was used as the reference standard, which may be better described in this instance as a criterion variable, since the examination has limited strength as a true reference standard. The study was approved by the ethics committee at the Faculty of Health Sciences of Linköping University.

Design

On the first visit to the PDS clinic, the patient's self-report of pain (TMD-S) was registered as 0 or 1. On the second visit 2 to 4 weeks later, a clinical examination was performed by an examiner blind to the results of the TMD-S questions at the first visit. The second TMD-S was conducted 15 minutes after the TMD clinical examination. Patients with a diagnosis of TMD after the examination were not informed of the clinical findings until after they gave answers to the self-reported questions. After the examination, TMD-S and tension-type headache were registered once again for the subjects (Fig 1). The clinical examination was based upon the RDC/TMD.[13] RDC/TMD diagnoses are based on the self-report of pain and clinical signs. The single examiner who performed the clinical investigation had undergone comprehensive calibration in the method during a 1-

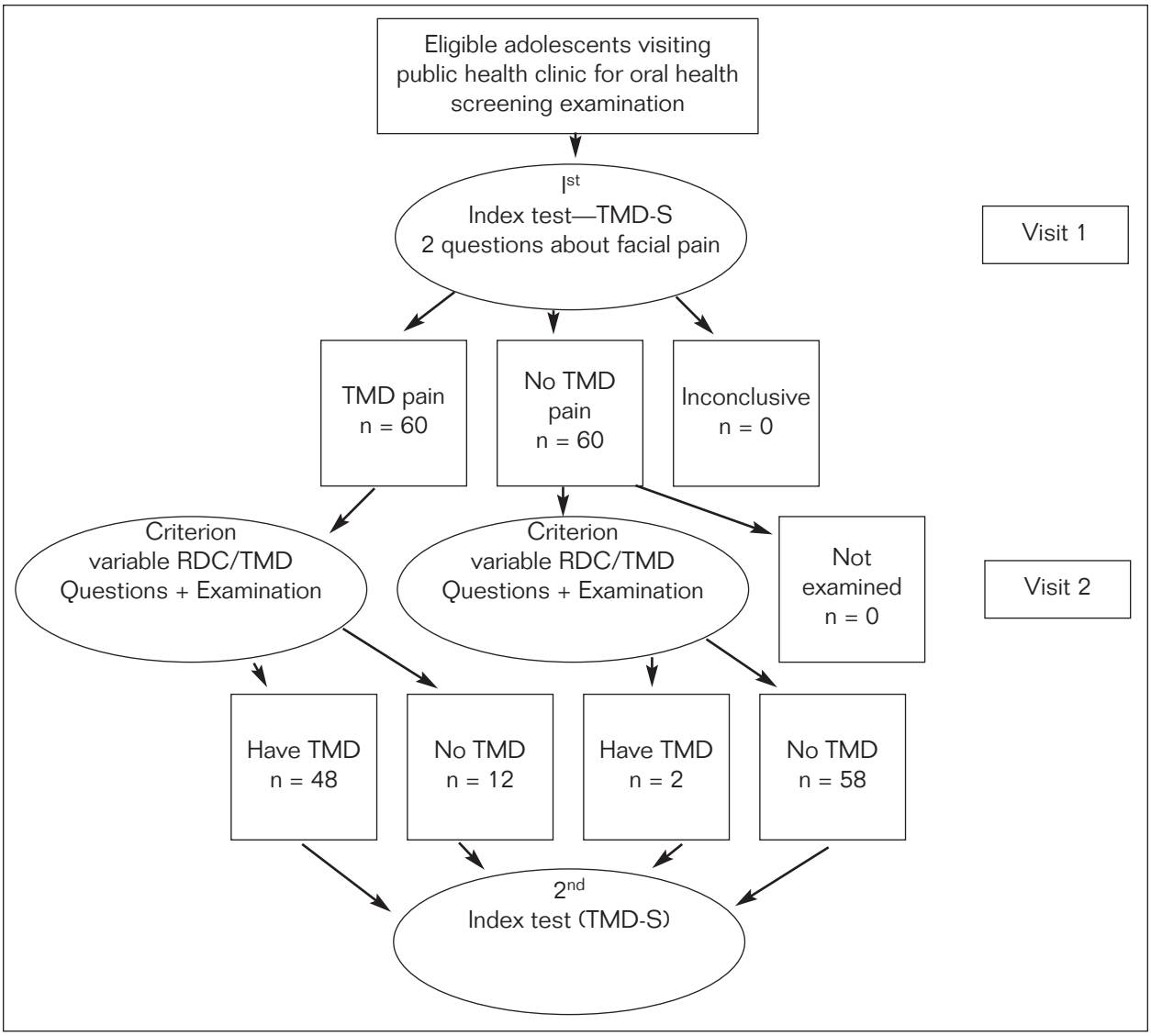

Fig 1 Flow of subjects through the study. Each subject was first seen in the public health clinic for routine oral health screening. They were then examined 2 to 4 weeks later by a calibrated examiner who was blind to the initial test result. Finally, all subjects completed the 2-question test after their examination. The study design was in accordance with the recommendations of the Standards for Reporting of Diagnostic Accuracy.

week calibration and training course in examination methods prior to the start of the study. The training and calibrating of examiners have been found to improve the reliability of clinical measures considerably.[7,14] During calibration training prior to the study, reliability was tested, and good reliabilities (kappa values) were found for the diagnoses myofascial pain (.65), disc displacement (.71), and arthralgia (.74) in 24 patients and control subjects.

Variables

TMD-S. All adolescents aged 12 to 19 years were asked 2 questions: *(1)* "Do you have pain in your temple, face, TMJ, or jaws once a week or more?" and *(2)* "Do you have pain when you open your mouth wide or chew once a week or more?" To facilitate comprehension, the therapist pointed to the anatomic regions mentioned so that the patient could better understand the question. If the patient answered "yes" to at least 1 of the questions, TMD pain was registered as "1." If the patient answered no to both questions, TMD pain was registered as "0."

Pain Intensity. The intensity of pain was recorded on a 0-to-10 cm visual analog scale (VAS) with anchors of "no pain" and "worst pain imaginable."[15]

Analgesic Consumption. A 5-point rating scale was used to measure the frequency of use of pain

medication: daily, 3 to 4 times a week, 1 to 2 times a week, every month, never, or almost never.

School Absence. The number of days of absence during the last month because of TMD pain was reported.

Perceived Treatment Need. A question was asked: "Would you like to have treatment for your pain or ache in the temples, face, jaws, or jaw joint?"

Clinical Examination. The following signs and symptoms were assessed using the RDC/TMD examination form: pain site, mandibular range of motion (mm), associated pain (jaw opening pattern, unassisted opening without pain, maximum unassisted opening, maximum assisted opening, mandibular excursive and protrusive movements), sounds from the TMJ, and tenderness induced by muscle and joint palpation.[13]

The RDC/TMD classifies the most common forms of TMD into 3 diagnostic categories and allows multiple diagnoses to be given for a single patient. The RDC/TMD diagnostic groups are as follows: group I, myofascial pain; group II, disc displacements; and group III, arthralgia, arthritis, and arthrosis. The RDC/TMD specifies distinct operational criteria for each TMD subtype; for example, a myalgia diagnosis is made if a person reports pain in the face or muscles of mastication at rest or during function and pain upon palpation of 3 or more muscle sites is also present.[13]

Tension-type headache was diagnosed according to the criteria of the International Headache Society (IHS). Subjects were assigned the diagnosis episodic tension-type headache if they had headache < 15 days/month for at least 10 previous episodes; a diagnosis of chronic tension-type headache was made if they had headache at least 15 days/month and for at least 6 months.

Statistical Analysis

To assess the correlation between variables, eg, between TMD-S and a diagnosis of TMD according to RDC/TMD, or between TMD-S and a diagnosis of tension-type headache, the chi-square test was used. The Kappa statistic (Cohen's kappa, *k*) was used to assess reliability for clinical variables measured with a categorical scale. The *k* statistic reflects the percentage of agreement between the patient's self-report of pain and the TMD pain diagnosis, corrected for chance. The *k* values vary from 0 to 1, and according to Altman's guidelines, the reliability ranges from poor to very good. Values of *k* above 0.6 indicate that examiners are using the same response categories at acceptable levels of reliability. Measures of test accuracy—sensitivity, specificity, likelihood ratio of a positive test, likelihood ratio of a negative test—were calculated according to standard formulas.[16] Confidence intervals were calculated according to the efficient-score method (corrected for continuity) as described by Newcombe.[17]

The data were analyzed with the statistical program SPSS version 12.0.1 for Windows. The level of significance used was $P < .05$.

Results

The mean age in both groups was 16.2 years (SD 2.2), and the range was 12 to 19 years. The sex distribution was also identical in both groups, with 43 girls (71.7%) and 17 boys (28.3%) in each group. There were no significant differences in age or sex between the groups. None of the participants dropped out of the study, and no subject complained of any adverse events after the RDC/TMD examination.

At visit 2, the clinical examination revealed that most of the participants in the TMD pain group had an RDC/TMD diagnosis: 80% had myofascial pain compared to 3.3% in the control group, 30% had uni- or bilateral disc displacements, compared to 10% in the control group, and 38.3% were diagnosed with arthralgia, compared to none in the control group (Table 1). All but 2 subjects who reported pain, or 97%, had pain duration of 3 months or more (median, 2 years; range, 1 month to 6 years).

In the TMD pain group, 63.3% had episodic tension-type headache according to IHS criteria. Among the controls, 43.3% had episodic tension-type headache. In the TMD pain group, 15% had chronic tension-type headache. No one in the control group had chronic tension-type headache (Table 1). The differences between the groups were significant for all of the diagnoses.

Using the time-frame "once a week or more often," in the TMD pain and control groups, 31.7% and 11.7% of the subjects, respectively, reported headaches while 53.3% and 10%, respectively, had pain in the temples. Of the 6 control subjects who reported pain in the temples, 3 had self-reported pain once a week or more often at visit 2, and 1 of them received a TMD diagnosis. Sixty percent of the individuals in the TMD group had pain in the face, TMJ, or jaws, compared to 0% in the control group. All differences between the case and control groups were statistically significant ($P < .014$).

Seven subjects who reported pain at visit 1 had no pain at visit 2. Five of them were boys (two 19-year-olds and an 18-, a 16-, and a 13-year-old) and 2 were girls (18 and 19 years old). On the

Table 1 Diagnoses in the TMD-S and Control Groups

Diagnosis	TMD pain group No.	TMD pain group (%)	Control group No.	Control group (%)	*P*
RDC/TMD					
Myofascial pain	48	80.0	2	3.3	<.001
Disc Displacements	18	30.0	6	10.0	.011
Arthralgia	23	38.3	0	0	<.001
Tension-type headache					
Episodic	38	63.3	26	43.3	.044
Chronic	9	15.0	0	0	.003

Table 2 Reliability of Self-reported TMD Pain

	First visit: No self-reported TMD pain	First visit: Self-reported TMD pain
Second visit		
No self-reported TMD pain	57	7
Self-reported TMD pain	3	53

Kappa = 0.83 (95% CI, 0.74 to 0.93).

Table 3 Validity of Self-reported TMD Pain, 2- to 4-week Time-frame

	RDC/TMD Group 1or 3 diagnosis	No RDC/TMD Group 1 or 3 diagnosis
Self-reported TMD pain	48	12
No self-reported TMD pain	2	58

Likelihood ratio of a positive report of TMD pain = 5.6 (95% CI, 3.3 to 9.4).
Likelihood ratio of a negative report of TMD pain = 0.05 (95% CI, 0.01 to 0.19).

Table 4 Validity of Self-reported TMD Pain, 15-minute Time-frame

	RDC/TMD Group 1or 3 diagnosis	No RDC/TMD Group 1 or 3 diagnosis
Self-reported TMD pain	49	7
No self-reported TMD pain	1	63

Likelihood ratio of a positive report of TMD pain = 9.8 (95% CI, 4.8 to 20.0).
Likelihood ratio of a negative report of TMD pain = 0.02 (95% CI, 0.003 to 0.16).

other hand, 3 individuals in the control group, all girls, reported pain at visit 2 but not at visit 1. Seven of the individuals who reported pain once a week or more did not receive an RDC/TMD diagnosis since they did not report pain upon palpation. Six of these had tension-type headaches. The kappa value of .83 for the 2 questions demonstrated very good reliability (Table 2).

The sensitivity of self-reported TMD pain was .98 (95% CI, 0.90 to 1.0) with the time-frame of 15 minutes and 0.96 (95% CI, 0.85 to 0.99) with the time-frame of 2 to 4 weeks. The specificity of self-reported TMD pain was 0.90 (95% CI, 0.81 to 0.95) with the time-frame of 15 minutes and 0.83 (95% CI, 0.72 to 0.90) with the time-frame of 2 to 4 weeks. The positive predictive value (PPV) at these respective time-frames was 0.88 and 0.80, and the negative predictive value (NPV) was 0.98 and 0.97. The likelihood ratios are shown in Tables 3 and 4. With the time frame of 15 minutes, when boys alone were analyzed, sensitivity was 1.0 and specificity was 0.81. When girls alone were analyzed, sensitivity was 0.98 and specificity was 0.95. Analysis only of younger adolescents (ages 12 to 15 years) resulted in a sensitivity of 0.95 and a specificity of 0.88. In the analysis of only older adolescents (ages 16 to 19 years), the sensitivity was 1.0 and the specificity was 0.93.

The mean VAS for pain intensity in the temples in the TMD pain group was 3.80 (SD 2.815). The mean VAS for pain intensity in the face, TMJs, or jaws in the TMD pain group was 3.42 (SD 2.872). Twenty percent of subjects in the TMD pain group took analgesics once a week or more often because of their pain. Twelve percent of the TMD pain group had stayed home from school between 1 and 6 days during the last month because of the pain. Of those who reported TMD pain, 65% reported that they felt they needed treatment.

Discussion

The main finding of the study was that it was possible to detect the majority of adolescents who had TMD pain with 2 self-report questions. Very good reliability, along with high sensitivity and specificity, was found for the screening TMD questions.

The participating adolescents with TMD pain were all consecutive patients from 5 PDS clinics in Norrköping, as were the sex- and age-matched controls. The sex and age distribution among these adolescents was identical to that of the population of the county, and to the samples of other clinical studies on adolescents.[4,11] Compared with a previous study, analgesic consumption, days absent from school because of TMD pain, and perceived treatment need were similar.[18] The group can be regarded as representative of the adolescents with self-reported TMD pain in the community of Östergötland County, Sweden.

Very good reliability was found for the screening questions. This finding is in agreement with a previous study where almost identical questions were asked and very good agreement was also found.[7] The time period was intended to be 2 to 4 weeks, but in some cases a longer interval, more than a month, was accepted. Reliability was high probably because the questions were simply formulated, a relatively short time-frame was used, and the examiner asked the questions out loud and pointed to the pain locations with their hands in person while sitting a short distance from the subject. Wahlund et al[7] found a reliability of 0.92 for the question "Do you have pain in the facial area, the jaws, or the jaw joint, once a week or more?" in their study. For the question "Do you have pain in the temple regions, once a week or more?" the kappa score was 0.84, which is in line with the findings of the present study.[7]

Different classification schemes, based primarily on clinical findings and aimed at classifying the physical pathology or measuring psychological factors, have been developed.[13] The RDC/TMD was chosen as the gold standard, since this system is operationalized, well defined, and described in measurable terms. In agreement with other studies,[3,4,9] the majority of subjects with TMD were diagnosed with myofascial pain.

The most common pain locations among the adolescents in this study were the face, the jaws, and the TMJs, closely followed by pain in the temples and the head. Several studies have shown that tension-type headache is common in adolescents.[19,20] In studies assessing TMD and tension-type headache, it has been shown that both entities coexist with each other.[4,21,22] This was observed in the present study, where episodic tension-type headache was found in both groups but chronic tension-type headache was seen only in the TMD group. The prevalence in this study was, however, lower than that reported in another study of tension-type headache in a TMD population.

To the authors' knowledge, only 1 other study has reported the accuracy of self-reported TMD, and this work was done in adults. Locker and Slade[23] had difficulties in evaluating their questionnaire, as they had no commonly accepted case definition of TMD for use in epidemiologic studies. They chose to classify those with moderate or severe dysfunction according to Helkimo's clinical dysfunction index as cases. The sensitivity of the screening test was 0.814 and the specificity was 0.483. The positive predictive value was 0.511 and the negative predictive value was 0.796. Sensitivity and specificity (0.735 and 0.705) were maximized when the diagnostic criterion was changed and the new criterion was "a positive response to 2 or more questionnaire items" and only those with severe dysfunction according to Helkimo's clinical index were defined as cases.[23]

The present study had substantially higher sensitivity and specificity than this previous study. The sensitivity and specificity did not differ markedly between sexes and age groups. The fact that the second self-report and the RDC/TMD examination were performed on the same day may have contributed to the high levels of sensitivity and specificity in the present study. The fact that the self-report questions were administered in person by an observer and accompanied by a demonstration of the anatomic region may also have contributed to the sensitivity and specificity levels achieved. In addition, since half of the subjects did not have pain, the clinical spectrum of subjects differed from the population with which the self-report questions would be used clinically. Inclusion of a broad spectrum of other orofacial pain conditions in the sample would likely decrease the sensitivity and specificity.[12] Using new guidelines for diagnostic studies, this investigation would be classified as a phase III study, with phase IV being studies of the highest quality.[24] A phase III study answers the question "Does the test result distinguish patients with and without the target disorder among patients in whom it is clinically reasonable that the disease is present?"

The study subjects underwent RDC/TMD examination before performing the self-report part of the questionnaire. It is possible that subjects reporting pain on palpation to the muscles of mastication or TMJ during this examination helped to remind some subjects that they had ongoing TMD pain, even if they were not informed of the meaning of these findings. However, an important aspect in the assessment of a method is the blinding of the examiner. In the present study, the examiner was blind to the grouping and did not know in advance if the subject was a case or a control subject. This is in contrast to a previous study where the examiners were aware of the symptomatic status of subjects prior to the clinical examination.[7]

In the present study, the majority of adolescents with self-reported pain were found to have a perceived need for treatment. The time limit of "once a week or more" seems reasonable to use since less frequent pain has previously been shown to detect only marginally those individuals in need of treatment. We have previously varied the question of frequency of symptoms ("from once a month or more" to "once a week or more") and found that

the more frequent symptoms correspond better to actual utilization of treatment for TMD.[4]

Given this present research approach, data-related refinements to the questions used in this study are possible and should be considered. The most common reason for false positives was a small group of adolescents who suffered from tension-type headache. Better differentiation of the anatomic location of the pain from the temple or frontal region of the face may help to decrease these false positives. Ninety-seven percent of those reporting TMD pain reported a pain duration of 3 months or more. To use TMD-S as an epidemiologic variable that measures the prevalence of chronic pain conditions, a third question could be added: "During the last 3-month period, have you had [any such pain]?"

Conclusions

The results of the present study showed that TMD-S has high values for sensitivity, specificity, PPV, and NPV, and that the reliability of self-reported temporomandibular pain was very good. A short time interval between the screening question and examination slightly increased the accuracy of the measure. The instrument can be recommended for use with adolescents to detect those who have TMD pain during general screening.

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