Validity of a Self-Reported Periodontal Disease Questionnaire among Jordanians
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Abstract

Objectives: To develop and validate a self-reported questionnaire to be used for the assessment of periodontal status among Jordanian adults.

Methods: A total 288 Jordanian adults responded to the self-reported periodontal questionnaire (18 questions) and underwent periodontal examination. Individual questions were studied in relation to periodontal disease definitions and extent, and severity of periodontal disease. Of the 18 questions, 6 questions were significantly associated with at least one clinical definition of the periodontal disease and were used to develop the periodontal disease questionnaire/scale. Receiver-operating characteristic (ROC) curve analyses were used to examine the overall discriminatory power, sensitivity and specificity, and corresponding cut-off points of the self-reported periodontal disease scale.

Results: The calculated AUCs in the Receiver-Operating Characteristic (ROC) curve analyses showed that the self-reported periodontal disease scale had an excellent performance to discriminate between those with and without periodontal disease regardless the clinical definition used. As defined by selected clinical criteria, the optimum cutoff value for the self-reported periodontal disease scale to detect clinically defined periodontal disease was 2 (scale score ranges from 1 to 6). Significant associations were observed between self-reported definition and all clinical definitions. The strength of the association in the regression analysis varied (OR ranged between 8.31 and 18.96) according to the clinical definition to be predicted.

Conclusion: the self-reported periodontal disease scale is a valid instrument to be used for surveillance and monitoring periodontal diseases in large populations.

Keywords: Periodontitis; Self-reported; Questionnaire; Clinical attachment; Pocket depth

Introduction

The assessment of periodontal conditions requires collection of clinical data that are resource-intensive and are requiring trained and calibrated dental examiners, sterilized instruments, dental equipments, and infection control protocols. Thus, periodontal status is not commonly assessed in major population-based health and behavioral surveys and the surveillance for periodontal diseases is nearly lacking. To monitor periodontal diseases in populations, there should be alternative approaches to the primary collection of clinical data. One alternative is the use of valid self-reported measure of periodontal diseases.

The development of valid, low-cost, and low-resource self-reported measures of periodontal disease would be of great benefits to facilitate epidemiological studies of periodontal disease on a much larger scale, allow for surveillance of the periodontal condition of populations over time, link periodontal diseases with other diseases and conditions in major surveys, and obtain data that would support the development of oral health programs.

Studies evaluating the validity of self-reported measures for periodontal diseases are few and have reported inconsistent results [1-14]. Previous studies varied in the sample size, population characteristics, data collection methods, gold standard measures, type of the questions included, and validity measures and statistical procedure used. Some of the researchers assessed the validity of each question alone, others grouped the related questions and studied them in groups, while others used and validated total scale score. Questions used in the previous questionnaires and scales were formulated to assess the disease awareness and perception, knowledge of doctors’ diagnosis of periodontal disease, severity of periodontal disease, symptoms of periodontal disease (tooth mobility, recession), and treatment. A systematic review by Blicher et al. mentioned examples of a good measure of periodontal disease such as “Has any dentist/hygienist told you that you have deep pockets?”, which had a sensitivity of 55%, a specificity of 90%, positive predictive value of 77%, and negative predictive value of 75% against clinical pocket depth [15]. Self-reported incident tooth loss was strongly predictive of attachment loss incidence in the remaining teeth especially if the loss was due to periodontal reasons [6]. Self reported history of periodontal surgery was also a good surrogate for bone loss which had a predictive value positive 78%, and 71% negative predictive value [16]. Higher validity could be improved by the use of combinations of several self reported questions [15].

In this study we aimed to develop and validate a self-reported questionnaire to be used for the assessment of periodontal status among Jordanian adults.

Methods

Study design and sampling

This cross-sectional study was conducted among Jordanian adults...
agreement in the answers to the self-reported questions over the two
occasions. The exact agreements for PPD and CAL measurements were
98% and 97%, respectively.

Periodontal disease definitions

A number of periodontal disease definitions were used to test the
predictive power of the self-reported questionnaire because there is no
consensus on the best definition. The definitions that were based on
periodontal examination included: Hujoel et al. [at least 1 site with PPD
≥ 4 mm] [19]; Beck et al. 1990 [four or more sites with CAL ≥ 5 mm
and at least 1 site with PPD ≥ 4 mm] [20]; Machtei, 1992 [two or more
with CAL ≥ 6 mm and one site with PPD ≥ 5 mm] [21]; Lopez et
al. 2002 [four or more teeth with at least one site with CAL ≥ 3 mm
and four or more teeth with at least one site with PD ≥ 4 mm] [22]; Page
and Eke, 2007 (a) [two or more sites with inter-proximal CAL ≥ 4 mm
not on the same tooth, or two or more sites with inter-proximal PPD ≥ 4 mm
not on the same tooth]; Page and Eke, 2007 (b) [two or more sites
with inter-proximal CAL ≥ 6 mm not on the same tooth, and one or more
sites with inter-proximal PPD ≥ 6 mm] [23]; and Borrell et al. 2005 [three or
more sites with CAL ≥ 4 mm and at least two sites with PPD ≥ 3 mm]
[24]. The validity of the questionnaire was examined in relation to each
of these definitions.

Statistical analysis

Data were analyzed using the Statistical Package for Social
Sciences software, SPSS (SPSS Inc., Chicago, IL, USA) version 15. Means
and standard deviations were used to describe continuous variables and
percentages were used to describe categorical variables. The differences
in periodontal parameters according to age were analyzed using One
Way ANOVA. Kappa statistics was used to assess the agreement between
clinical definitions of periodontal diseases. Individual questions were
studied in relation to periodontal disease definitions and extent, and
severity of periodontal disease using chi-square test and independent t
test wherever appropriate. Of the 18 questions, 12 were not significantly
associated with all clinical definitions, extent, and severity of periodontal
disease. The remaining 6 questions were significantly associated with at
least one clinical definition of the periodontal disease. Therefore, the
six questions were used to develop the periodontal disease questionnaire/
scale. The self-reported periodontal disease scale score was computed
by counting the number of “yes” responses over the number of questions
selected after validation. Receiver-operating characteristic (ROC)
curve analyses were used to examine the overall discriminatory power,
sensitivity and specificity, and corresponding cut-off points of the self-
reported periodontal disease scale on each clinical periodontal disease
definition. The overall performance of the self-reported periodontal
disease scale for detecting clinical periodontal disease was assessed by
computing the area under the curve (AUC). The best cut-off point for
the self-reported periodontal disease scale was determined at the point
on the curve where the sum of sensitivity and specificity was the highest.
The self-reported periodontal disease scale was dichotomized based on
the cutoff value established in this study. Multivariate logistic regression
analyses were performed to evaluate the associations between the self-
reported periodontal disease scale and clinical definitions after adjusting
for other important variables. A p-value of less than 0.05 was considered
statistically significant.

Results

Participants’ characteristics

A total 288 (107 males and 181 females) dentate subjects were
included in this study. The socio-demographic and relevant characteristics

Participants’ age, gender, occupation, education, smoking status, total family income, tooth brushing and use
of oral hygiene auxiliary aids were collected using another questionnaire. Other questions were included to describe the previous dental visits
and the type of previous treatments provided, and if the patient had a
prosthetic replacement.

Periodontal examination

After they filled the self-administered self-reported periodontal
questionnaire, all participants were examined by the same examiner,
on the dental chair in a semi-supine position using dental light and in a
dry field, to assess oral health parameters. Examination procedures were
done using a sterilized examination kit consisting of mouth mirrors and
standardized periodontal probes with Williams’s markings (Hu-Friedy).
The examiner who performed the periodontal examination was blinded
to the responses of participants on the self-reported questionnaire. The
oral hygiene and the periodontal status of all teeth, excluding third
mongers, were assessed using plaque index (PII) of Löe [17], gingival index
(GI) of Löe and Silness [18], probing pocket depth (PPD), and clinical
attachment loss (CAL). Sterile dental mirrors and explorers were used
to assess plaque accumulation and gingival status while standardized
periodontal probes were used to measure PPD and CAL. The parameters
were measured at six sites (mesio-facial, mid-facial, disto-facial, mesio-
lingual, mid-lingual, and disto-lingual) per tooth. Data were recorded on
a special examination form. Disease extent was defined by the percentage
of sites with specific cutoff values for PPD and CAL. The percentage of
sites meeting the severity criteria for PPD and CAL was calculated for
each subject by dividing the number of sites meeting the criteria by the
total number of sites measured. The severity of the disease was calculated
by averaging PPD measurements (average PPD) and CAL measurements
(average CAL).

Reliability of the self-reported questionnaire and periodontal
examination

Periodontal examinations and filling the self-reported questionnaire
were repeated for 40 participants within 14 days. There was 100% agreement in the answers to the self-reported questions over the two
of participants are shown in Table 1. All subjects were 20 years of age or older with about half (45.1%) were older than 40 years.

**The severity and extent of periodontal disease**

The severity and extent of periodontal disease according to age is shown in Table 2. The severity and extent of periodontal disease, as measured by most of the periodontal parameters, increased significantly with increasing age.

**Agreement between the clinical periodontal disease definitions**

Table 3 presents the Kappa agreement between the different clinical definitions used to define periodontal disease. The Kappa statistics ranged from 0.25 to 0.98, indicating moderate to strong agreement between the most definitions. The agreement between Machtel, 1992 and Page and Eke, 2007 was almost perfect (Kappa=0.98). The Hujoel et al. [19] 2006 definition had high agreement with other definitions.

**Self-reported periodontal disease questionnaire**

Of the 18 questions in the self-reported periodontal disease questionnaire, only 6 questions were significantly associated with at least one clinical definition and/or extent and severity of the periodontal disease in the univariate and multivariate models and were subjected for further analysis. The frequency distribution for the responses to these questions is shown in Table 4. The most frequent positive response was for the question "Do you have food impaction between your teeth?" where 75% of the participants reported "yes". The six questions were used to develop the periodontal disease questionnaire/scale and compute the

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**Table 1: The socio-demographic and relevant characteristics of participants.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>107 (37.2)</td>
</tr>
<tr>
<td>Female</td>
<td>181 (62.8)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>&lt;30</td>
<td>97 (33.9)</td>
</tr>
<tr>
<td>30-39.9</td>
<td>60 (21.0)</td>
</tr>
<tr>
<td>≥ 40</td>
<td>129 (45.1)</td>
</tr>
<tr>
<td>Monthly income (JD)*</td>
<td></td>
</tr>
<tr>
<td>≤ 300</td>
<td>124 (51.2)</td>
</tr>
<tr>
<td>&gt;300</td>
<td>118 (48.8)</td>
</tr>
<tr>
<td>Years of education</td>
<td></td>
</tr>
<tr>
<td>≤ 12</td>
<td>170 (59.9)</td>
</tr>
<tr>
<td>&gt;12</td>
<td>114 (40.1)</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>216 (75.0)</td>
</tr>
<tr>
<td>past</td>
<td>3 (1.0)</td>
</tr>
<tr>
<td>Current</td>
<td>69 (24.0)</td>
</tr>
<tr>
<td>Brushing</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>35 (12.2)</td>
</tr>
<tr>
<td>Regular</td>
<td>166 (57.6)</td>
</tr>
<tr>
<td>Irregular</td>
<td>87 (30.2)</td>
</tr>
<tr>
<td>Use of auxiliary aids</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>238 (82.6)</td>
</tr>
<tr>
<td>Regular</td>
<td>24 (8.3)</td>
</tr>
<tr>
<td>Irregular</td>
<td>26 (9.1)</td>
</tr>
<tr>
<td>Use of mouthwash</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>200 (69.4)</td>
</tr>
<tr>
<td>Regular</td>
<td>32 (11.1)</td>
</tr>
<tr>
<td>Irregular</td>
<td>56 (19.4)</td>
</tr>
<tr>
<td>Last visit to dentist</td>
<td></td>
</tr>
<tr>
<td>&lt;6 months</td>
<td>135 (46.9)</td>
</tr>
<tr>
<td>6-12 months</td>
<td>39 (13.5)</td>
</tr>
<tr>
<td>&gt;12 months</td>
<td>105 (36.5)</td>
</tr>
<tr>
<td>Didn’t visit</td>
<td>9 (3.1)</td>
</tr>
<tr>
<td>Dental prosthesis</td>
<td></td>
</tr>
<tr>
<td>Fixed</td>
<td>113 (39.2)</td>
</tr>
<tr>
<td>Removable</td>
<td>10 (3.5)</td>
</tr>
<tr>
<td>None</td>
<td>165 (57.3)</td>
</tr>
</tbody>
</table>

*US dollar = 0.71 JD

**Table 2: The severity and extent of periodontal disease according to the age.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD) P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average percent of sites</td>
<td></td>
</tr>
<tr>
<td>PPD ≥ 3</td>
<td>2.74 (11.91)</td>
</tr>
<tr>
<td>PPD ≥ 4</td>
<td>1.37 (6.36)</td>
</tr>
<tr>
<td>PPD ≥ 5</td>
<td>0.33 (2.16)</td>
</tr>
<tr>
<td>PPD ≥ 6</td>
<td>0.03 (0.20)</td>
</tr>
<tr>
<td>CAL ≥ 3</td>
<td>3.33 (12.32)</td>
</tr>
<tr>
<td>CAL ≥ 4</td>
<td>1.55 (6.49)</td>
</tr>
<tr>
<td>CAL ≥ 5</td>
<td>0.43 (2.21)</td>
</tr>
<tr>
<td>GR ≥ 1</td>
<td>0.68 (2.57)</td>
</tr>
<tr>
<td>GR ≥ 2</td>
<td>0.14 (0.66)</td>
</tr>
<tr>
<td>GR ≥ 3</td>
<td>0.097 (0.56)</td>
</tr>
<tr>
<td>Bleeding on probing</td>
<td>32.17 (44.49)</td>
</tr>
</tbody>
</table>

**Table 3: The agreement (kappa statistics) between different periodontal disease definitions.**

<table>
<thead>
<tr>
<th>Periodontal disease definition</th>
<th>Kappa statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beck et al., 1990</td>
<td>0.69* 0.56* 0.88* 0.53* 0.55* 0.85*</td>
</tr>
<tr>
<td>Machtei, 1992</td>
<td>1.00 1.24 1.50 1.00 1.24 1.50</td>
</tr>
<tr>
<td>Lopez et al., 2002</td>
<td>1.00 1.24 1.50 1.00 1.24 1.50</td>
</tr>
<tr>
<td>Page and Eke, 2007 (a)</td>
<td>1.00 1.24 1.50 1.00 1.24 1.50</td>
</tr>
<tr>
<td>Page and Eke, 2007 (b)</td>
<td>1.00 1.24 1.50 1.00 1.24 1.50</td>
</tr>
</tbody>
</table>

*P-value < 0.05

**Table 4: The responses to the individual questions in the periodontal disease self-reported questionnaire.**

<table>
<thead>
<tr>
<th>Question</th>
<th>n %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Do you have periodontal disease or gum disease?</td>
<td>164 (56.9)</td>
</tr>
<tr>
<td>2 Have you ever been told by a dentist that you have periodontal/gum disease with bone loss?</td>
<td>194 (67.4)</td>
</tr>
<tr>
<td>3 Do you find any area redder than it should be?</td>
<td>211 (73.3)</td>
</tr>
<tr>
<td>4 Do you have mobility in your teeth?</td>
<td>241 (83.7)</td>
</tr>
<tr>
<td>5 Do you have food impaction between your teeth?</td>
<td>71 (24.7)</td>
</tr>
<tr>
<td>6 Do you notice that your teeth getting longer?</td>
<td>237 (82.3)</td>
</tr>
</tbody>
</table>
Self-reported periodontal disease and periodontal clinical parameters

The differences in the dental and periodontal clinical parameters according to self-reported periodontal disease as defined by the self-reported periodontal disease scale are shown in Table 6. Subjects who met the criteria for self-reported periodontal disease had significantly higher extent and severity of periodontal disease as measured by periodontal clinical parameters compared to those who did not meet the self-reported definition.

The self-reported periodontal disease definition was tested in separate logistic regression models as main predictor variable for each outcome variable (clinical periodontal disease definitions) after adjusting for age, income, education, smoking, tooth brushing, and use of auxiliary aids (Table 7). Significant associations were observed between self-reported definition and all clinical definitions. The strength of the association in the regression analysis varied (OR ranged between 8.31 and 18.96) according to the clinical definition to be predicted. Of all definitions used, the self-reported definition had the strongest association with Machtei (1992) (OR=18.87), Page and Eke (2007 b) (OR=18.96), and Lopez (2002) (OR=15.33) definitions.

Discussion

Clinical and radiographic measures of periodontal status are commonly used in dental research to estimate the prevalence, extent, and severity of periodontal diseases. However, these measures are not practical in terms of cost, time, and convenience to be used for monitoring periodontal diseases and to be used in large study populations. The evidence of the link between periodontal diseases and systemic diseases may require that assessment of periodontal status is done by non-dentists health professionals who lack the experience in performing periodontal clinical examination. For these reasons, self-reported measures of periodontal disease are cost efficient alternatives for periodontal disease surveillance and periodontal disease assessment by non-dental health professionals.

A number of self-reported questionnaire items have been tested for their validity to detect periodontal disease. No single question has been identified to correctly reveal whether an individual has periodontitis or not. However, the use of combinations of several self-reported questions might improve the sensitivity and specificity of that approach.

In our study, the questionnaire was self-administered and filled by the participants. In other studies, the methods of data collection varied and included self-administered questionnaire, questionnaires distributed by mail, phone interview, and face to face interview.

Receiver-operating characteristic (ROC) curve analyses

The calculated AUCs of self-reported periodontal disease scale for distinguishing subjects with periodontal disease according to different clinical definitions are summarized in Table 5. The AUC values varied between 0.77 and 0.83 according to the clinical definition used. The values of AUCs indicate that the self-reported periodontal disease scale had an excellent performance to discriminate between those with and without periodontal disease regardless the clinical definition used. As defined by selected clinical criteria, the optimum cutoff value for the self-reported periodontal disease scale to detect clinically defined periodontal disease was 2. The score 2 has the highest sensitivity and specificity to detect periodontal disease when defined by all studied criteria. The sensitivity ranged between 0.61 and 0.83 and the specificity ranged between 0.68 and 0.83 according to the clinical definition used.
In this study we used 18 questions to assess periodontal disease. These questions were used to assess self-reported symptoms, diagnosis of health professional, or treatment provided for them. After testing the individual questions, only 6 questions were associated with periodontal disease clinical definitions in the univariate and multivariate models. These questions were scored and summed to develop periodontal disease score. The self-reported periodontal disease scale score was computed by counting the number of “yes” responses over the six questions and the total score ranged from 1 to 6. In earlier studies, individual items in separate or combinations of items were tested for their validity.

In some other studies periodontal examination was used to validate self-reported measures [5,25-27], while in other studies, radiographs was used as a method of validation [6,28]. Because of the lack of consensus on the definition of periodontal disease, different definitions were used in this study as outcome variables to assess the overall discriminatory power of the self-reported periodontal disease scale. The measure of agreement (Kappa statistics) between the selected clinical definitions ranged from 0.25 to 0.98, indicating moderate to strong agreement between most of the used definitions. The use of different definitions allowed us to assess the self-reported periodontal disease scale against clinical periodontal disease definitions that reflect different disease severities.

The calculated AUCs of self-reported periodontal disease scale for distinguishing subjects with periodontal disease ranged between 0.77 and 0.83 indicating that self-reported periodontal disease scale had an excellent performance to discriminate between those with and without periodontal disease regardless the clinical definition used. As defined by selected clinical criteria, the optimum cutoff value for the self-reported periodontal disease scale to detect clinically defined periodontal disease was 2. The score 2 has the highest sensitivity and specificity to detect periodontal disease when defined by all studied criteria. The sensitivity ranged between 0.61 and 0.83 and the specificity ranged between 0.68 and 0.83 according to the clinical definition used. This cutoff-value was shown in further analysis to be accurate to discriminate between those with and without periodontal disease. Subjects who met the criteria for self-reported periodontal disease, score of 2 or more, had significantly higher extent and severity of periodontal disease as measured by most of the parameters compared to those who did not meet the self-reported definition.

The self-reported periodontal disease definition was tested in separate logistic regression models as main predictor variable for each outcome variable (clinical periodontal disease definition) after adjusting for age, education, income, smoking, tooth brushing, and use of auxiliary aids. Significant associations were observed between self-reported definition and all clinical definitions. The strength of the association in the regression analysis ranged from 8.31 to 18.96, according to the clinical definition. It was noted that the association was stronger with clinical definitions that reflect a higher severity of periodontal disease such as Machtei, 1992 [two or more teeth with CAL ≥ 6 mm and one site with PPD ≥ 5 mm] [20] and Page and Eke, 2007 (b) [two or more sites with inter-proximal CAL ≥ 6 mm not on the same tooth, and one or more sites with inter-proximal PPD ≥ 6 mm] [23]. The strength of the association was almost the same for these two definitions and this is expected because Kappa statistic (Kappa=0.98) showed an almost perfect agreement between these two definitions. This finding might indicate that our self-reported periodontal disease scale has a higher predictive power to predict sever periodontal diseases characterized by CAL ≥ 6 mm rather than periodontal disease with lower severity.

Results of this study should be interpreted with cautious. When periodontal disease is asymptomatic, people with this disease may be unaware of their periodontal status. Moreover, self-reported measures based on whether patients were told by their dentists that they have periodontal disease likely would underestimate disease prevalence among a group of patients who are less likely to utilize the dental services.

In conclusion, the self-reported periodontal disease scale is a valid instrument to be used for surveillance and monitoring periodontal diseases in large populations. Use of self-reported periodontal health questionnaire must be considered as an effective and economical tool for large epidemiological studies. Self-reported periodontal health questionnaire can be added to ongoing systemic health studies to match the relation of periodontal disease to other systemic diseases.

References


