

Development of a self-report questionnaire designed for population-based surveillance of gingivitis in adolescents: assessment of content validity and reliability

Abstract

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The major infectious diseases in Chile encompass the periodontal diseases, with a combined prevalence that rises up to 90% of the population. Thus, the population-based surveillance of periodontal diseases plays a central role for assessing their prevalence and for planning, implementing, and evaluating preventive and control programs. Self-report questionnaires have been proposed for the surveillance of periodontal diseases in adult populations world-wide. Objective: This study aimed to develop and assess the content validity and reliability of a cognitively adapted self-report questionnaire designed for surveillance of gingivitis in adolescents. Material and Methods: Ten predetermined self-report questions evaluating early signs and symptoms of gingivitis were preliminary assessed by a panel of clinical experts. Eight questions were selected and cognitively tested in 20 adolescents aged 12 to 18 years from Santiago de Chile. The questionnaire was then conducted and answered by 178 Chilean adolescents. Internal consistency was measured using the Cronbach's alpha and temporal stability was calculated using the Kappa-index. Results: A reliable final self-report questionnaire consisting of 5 questions was obtained, with a total Cronbach's alpha of 0.73 and a Kappa-index ranging from 0.41 to 0.77 between the different questions. Conclusions: The proposed questionnaire is reliable, with an acceptable internal consistency and a temporal stability from moderate to substantial, and it is promising for estimating the prevalence of gingivitis in adolescents.

Keywords: Self report. Surveys and questionnaires. Population surveillance. Periodontal diseases. Gingivitis. Adolescent.

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Introduction

Periodontal disease is the most common chronic inflammatory disease detected in humans, affecting nearly 98% of adults over 65 years in Chile¹¹. It is a major public health problem due to its high prevalence, its consequences in terms of social, psychological, and economic impacts on individuals, communities, and health services, and its potential prevention and management in terms of alleviation or cure of the disease².

Comprehensive periodontal examination with full-data registration is the gold standard method designed to detect early signs of periodontal disease, allowing us to prevent the destructive forms of the disease; however, its clinical application is expensive and time consuming⁹. Therefore, one must have inexpensive, safe, and easy-to-perform alternative tools to simplify the periodontal data-collection process, which allow the feasibility of the surveillance of the periodontal diseases.

Self-reporting is frequently used as a recording and surveillance method in several pathological conditions and diseases^{3,19,20,23,30}. In adults, self-report questionnaires have been proposed as an epidemiologic tool to analyze the prevalence and incidence of periodontitis^{10,21,27}. In fact, a periodontal self-reporting with a set of eight questions has been proposed by the Division of Oral Health at the National Center for Chronic Disease Prevention and Health Promotion and, after its validation, it was applied in different populations^{6,8,10,18,24}. With the purpose of evaluating tools that allow the surveillance of periodontal disease at its early stage in younger populations, we analyze the content validity and reliability of a new self-report questionnaire designed to detect gingivitis in adolescents.

Material and methods

Experimental design

This cross-sectional study was conducted among Chilean adolescents (12 to 18 years old), who were invited to participate in the study between April and December 2015. The study design (Protocol #2013/26) was approved by the Institutional Ethics Committee and conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000. The

protocol of the study was clearly explained to all the participants, who agreed to take part in it by signing an informed consent form reviewed and approved by the institutional committee.

Preliminary item selection

An initial self-report questionnaire was developed by selecting items related to gingivitis, after reviewing the relevant literature on existing self-reported periodontal measures. Criteria for selecting the self-report items included: having a recognized association with gingival inflammation as a risk indicator or factor; or having face validity as being associated with early signs and symptoms of periodontal disease. A total of 10 items were identified, written in English, and then adapted and translated into Latin-American Spanish, using a backward-forward translational method by two bilingual periodontists (questionnaire version 1).

Item validation

The validation of the content of each item was performed by a consensus panel of rater experts. This panel consisted of two periodontists, a PhD in public health, a master in pediatric dentistry, and a general dentist expert in adolescents, all of them University Professors and selected considering at least 5 years of clinical expertise, national and international presentations, and research on the referred phenomenon of interest. The analyzed parameters were coherence, relevance, and clarity of each item, as well as whether answer options were appropriate and sufficient. For each parameter, a score of 1 to 9-points was assigned, being 9 very important, 6 important, and 1 unimportant, and when the judges disagreed or an average <5-points was obtained, the item was discarded. After panel consensus and recommendations, questionnaire version 2 was obtained and then pilot tested.

Questionnaire cognitive evaluation

Pilot test was conducted using 20 adolescent respondents from Santiago de Chile, randomly selected. An answer percentage was calculated and then each answer was discussed considering how the participant understood and processed each question in a focus-group consisting of 10 of these adolescents. A discussion of approximately 60 minutes was conducted, audio-recorded, and transcribed, and data were analyzed by qualitative thematic analysis, in line with the framework approach. This process resulted in

8 cognitively tested questions, which were pooled in a new questionnaire (questionnaire version 3).

Reliability

The questionnaire version 3 was then applied to the selected adolescents, who voluntarily accepted to participate and autonomously answered the questionnaire in an average time of 10 minutes, in a classroom within the educational establishment. The adolescents were aged between 12 and 18 years old and attended educational establishments in Santiago de Chile. The educational establishments were selected by convenience from different sources of funding (public and private). The sample size was determined following a recommended calculation method⁵ with a power of 90% and confidence level of 95%. Reliability was determined by evaluating the internal consistency of the whole set of self-report items and of each individual question²⁵. In addition, temporal stability was also assessed by asking the 30% of the total participants to answer the instrument twice, with a 2-week interval between both applications.

Data analysis

The inter-judge agreement was determined by their agreement percentage and Kappa-test. The reliability of the questionnaire was estimated by its internal consistency, measured by Cronbach's alpha, and by its temporal stability, measured by the agreement percentage and by the Kappa-index reached in the test-retest method. Data were analyzed using a statistical software (Stata statistical software v.13, StataCorp, LP, College Station, TX, USA) and a statistical significance was considered when $p < 0.05$.

Results

Design of the instrument

Using as a reference the proposed Eke and Dye questionnaire for their cognitive validity in Spanish, the first version of the questionnaire was made (questionnaire version 1)^{8,18}. It was composed of one dimension with 10 self-reports of early on-set of periodontal disease (gingivitis) items, focused on adolescents instead of adults (Figure 1).

Content validity

The questionnaire version 1 was then evaluated

by an expert panel that agreed (>90%) in rating the 10 items as important or critical in the parameters of adequacy, clarity, consistency, and relevance. Following the experts' written suggestions, items were revised, 2 questions were excluded, and one question was added, obtaining questionnaire version 2 (Figure 1).

Cognitive evaluation of the instrument

Twenty adolescents answered questionnaire version 2 and each question had a response rate >95%. Content analysis of focus group was made and the cognitively adapted questions were included in questionnaire version 3.

Q1; How would you rate your gum health?, Q2; How would you rate your toothbrushing?, and Q3; During toothbrushing, do your gums bleed? No problems were identified with these questions. The adolescents said that "diseased gums" are those that bleed during toothbrushing, smell bad, and are red. They associate a good brushing with brushing all the tooth surfaces, leaving them with a smooth texture: "to pass the tongue over them and feel them soft." Therefore, these items remained in questionnaire version 3.

Q4; In the last month, have you noticed your gums reddish and/or swollen? and Q5; Have you noticed your teeth unaligned or crooked?. The differences in the way respondents answered depended, mostly, on whether they had seen a dentist in the recent past. One of the participants told he did not know "which is the normal color" for gums and, for another participant, a reddish gum is a gum that bleeds. They reported that Q5 is a subjective question, whose answer is determined by personal expectations; some used the comparison with their peers, a dentist's opinion, and/or self-examination to answer. The group of researchers, however, decided to keep both items.

Q6; When you have visited your dentist, have you ever had a deep cleaning? The term "cleaning" seemed confusing; they associate it with caries removal, whitening, or any other activity performed by a dentist and not necessarily related to periodontal treatment. Therefore, the group decided to remove this question for version 3 of the instrument.

Q7; How many times a day do you use dental floss?, Q8; Have you visited the dentist in the last year?, and Q9; How many times a day do you brush your teeth? No problems were identified with these

questions, thus, they remained in questionnaire version 3.

Table 1 shows questionnaire version 3, detailing the frequency response of all options in each item.

Reliability

Table 2 summarizes the variables and the number of individuals by categories. The median age was

16 years, 66.8% were women, and 75.9%, from a public-funded educational institution. In relation to their habits, 41% reported never having smoked and only 23% reported flossing. All participants completed the questionnaire (Table 1), suggesting that the items were readable and comprehensible, thus providing support to face validity. The percentage of missing responses varied from 0.0% to 0.5% across the

Verbatim Questions, Version 1		Response Options	Comment by Experts' Panel	Verbatim Questions, Version 2	
Q1	How would you rate your gum health? ¿Cómo consideras la salud de tus encías?	Very Good Good Regular Bad	-	Q1	How would you rate your gum health? ¿Cómo consideras la salud de tus encías?
Q2	How would you rate your oral hygiene? ¿Cómo consideras tu higiene oral?	Very Good Good Regular Bad	The term "oral hygiene" corresponds to a technicality. It was suggested to be changed by "toothbrushing".	Q2	How would you rate your toothbrushing? ¿Cómo consideras que te lavas tus dientes?
Q3	Do you feel pain or sensitivity in your gums after brushing your teeth? ¿Sientes dolor o sensibilidad en tus encías al cepillarte los dientes?	Always Often Sometimes Never	The term "sensitivity" can be confused with dental hypersensitivity or dental pain, not necessarily related to periodontal disease in adolescents.		The question was removed
Q4	During toothbrushing, do your gums bleed? Durante el cepillado de dientes, ¿Tus encías sangran?	Always Often Sometimes Never	-	Q3	During toothbrushing, do your gums bleed? Durante el cepillado de dientes, ¿Tus encías sangran?
Q5	In the last month, have you felt your gums reddish or swollen? ¿En el último mes has sentido tus encías rojizas e hinchadas?	Always Often Sometimes Never	It was suggested to change the verb "feel" for the verb "notice", as it is consulted for a sign and not a clinical symptom.	Q4	In the last month, have you noticed your gums reddish and/or swollen? ¿En el último mes has notado tus encías rojizas e hinchadas?
Q6	Do you think your teeth are unaligned or crooked? ¿Sientes que tus dientes están en una mal posición o chuecos?	Yes No I don't know	It is considered as an inconsistent item, but it was decided to maintain it after changing the verb, as it considers a local factor for retention of dental plaque that could be predictor of gingivitis.	Q5	Have you noticed your teeth unaligned or crooked? ¿Notas que tus dientes están en una mal posición o chuecos?
Q7	During your dentist's appointment, have you had dental scaling or deep cleaning? En la visita a tu dentista, ¿Te ha realizado destartrajes o limpiezas dentales?	Yes No I don't know	It is considered necessary to add into question the timing of the visits in the statement and remove the technical word "dental scaling".	Q6	When you have visited your dentist, have you ever had a deep cleaning? ¿Cuándo has visitado al dentista, te han realizado limpiezas dentales profundas?
Q8	How many times a day do you use dental floss? ¿Cuántas veces al día usas seda dental?	I don't use Once a day Twice a day	The panel suggested modifying the question's response options.	Q7	How many times a day do you use dental floss? ¿Cuántas veces al día usas seda dental? I don't use/ Every time I brush my teeth/ Once a day/ Once a week.
Q9	Have you visited your dentist during the last year? ¿Has visitado al dentista en el último año?	Yes No	-	Q8	Have you visited your dentist during the last year? ¿Has visitado al dentista en el último año?
Q10	If your answer was YES, did you visit him because of a problem? Si tu respuesta fue SI, ¿asististe por algún problema?	Which?	It is considered confusing to ask for "a problem"; it was necessary to specify the reason for the visit (control, emergency, etc.).		The question was removed.
			The inclusion of a question about brushing frequency was suggested.	Q9	How many times a day do you brush your teeth? ¿Cuántas veces al día te cepillas los dientes? Less than once a day/ Once a day/ Twice a day/ Three or more times a day.

Figure 1- Questionnaire version 1 and version 2 in English and Spanish

Table 1- Questionnaire version 3

Question	Response Options	Individuals	
		n	%
Q1 How would you rate your gum health? ¿Cómo consideras la salud de tus encías?	Very good	6	3.3
	Good	87	48.8
	Regular	81	45.5
	Bad	4	2.2
Q2 How would you rate your toothbrushing? ¿Cómo consideras que te lavas tus dientes?	Very good	25	14
	Good	105	58.9
	Regular	47	26.4
	Bad	1	0.5
Q3 During toothbrushing, do your gums bleed? Durante el cepillado de dientes, ¿Tus encías sangran?	Always	8	4.4
	Often	15	8.4
	Sometimes	99	55.6
	Never	56	31.4
Q4 In the last month, have you noticed your gums reddish and/or swollen? En el último mes has notado tus encías rojizas e hinchadas?	Always	4	2.2
	Often	10	5.6
	Sometimes	57	32
	Never	107	60.1
Q5 Have you noticed your teeth unaligned or crooked? ¿Notas que tus dientes están en una mal posición o chuecos?	Yes	87	48.8
	No	55	30.8
	I don't know	36	20.2
Q6 How many times a day do you brush your teeth? ¿Cuántas veces al día te cepillas los dientes?	Less than once a day	6	3.3
	Once a day	28	15.7
	Twice a day	97	54.4
	Three or more times a day	47	26.4
Q7 How many times a day do you use dental floss? ¿Cuántas veces al día usas seda dental?	I don't use	125	70.2
	Every time I brush my teeth	11	6.1
	Once a day	21	11.7
	Once a week	21	11.7
Q8 Have you visited your dentist in the last year? ¿Has visitado al dentista en el último año?	No	77	43.2
	Yes	101	56.7

items. As seen in Table 3, the reliability measured by its internal consistency (Cronbach's alpha) increased from 0.64 in questionnaire version 3 to 0.73 in the final version. Average inter-item correlation ranged between 0.44 (Q4) and 0.58 (Q1) for the final version of the questionnaire. Test-retest reliability, measured by Kappa-index, ranged from 0.41 to 0.77 for self-report items. Thus, we obtained the final questionnaire with 5 questions, as shown in Figure 2.

Discussion

In this study, a set of self-reported questionnaire items has been tested for its validity of content and reliability. The final questionnaire had five questions able to be used to do a screening of gingivitis in an adolescent population in Chile. In comparison, the proposed questionnaires to predict the prevalence of periodontitis in adults have a greater number

of questions due to the larger amount of signs or symptoms that can be assessed and risk factors that are mostly associated with age, such as the presence of diabetes^{6,8,24}.

The first proposed instrument was subjected to the evaluation of its content validity by a panel of experts. After this instance, the questionnaire underwent changes, by eliminating the question "Do you feel pain or sensitivity in your gums after brushing your teeth?" included within the previously published self-reports^{12,13,27}. This decision came from the recommendation of the expert panel, given that the term "sensitivity" could be confused with dental pain in adolescents and not related to periodontal disease, which is the purpose of the questionnaire. In addition, we noted that the painful symptoms would be mostly associated with the existence of a periodontal pocket or necrotizing forms and therefore, a more advanced stage of the periodontal disease. This could be only slightly prevalent in the target population of

Table 2- Study population

	Individuals n=178	
	n	%
Age (Med[<i>min</i> / <i>max</i>])	16 [12/18]	
Sex		
Male	59	33.2
Female	119	66.8
School		
Private	43	24.1
Public	135	75.9
Do you smoke?		
I smoked	71	39.9
I have never smoked	73	41.0
I smoke	34	19.1
Which of the following do you use to clean your teeth?		
Toothbrush	177	99.4
Toothpaste	178	100
Dental Floss	41	23.0
Mouthwash	59	33.1

Table 3- Data analysis. *The full questions are shown in Table 1. ** $p < 0.05$

Questions*	Questionnaire Version 3		Questionnaire Final Version		Test-retest of Questionnaire Final Version	
	Average inter-item correlation	Cronbach's α	Average inter-item correlation	Cronbach's α	Kappa-index**	Agreement (%)
Q1	0.55	0.55	0.58	0.76	0.61	78.1
Q2	0.44	0.58	0.44	0.66	0.46	72.7
Q3	0.45	0.58	0.53	0.72	0.70	83.6
Q4	0.37	0.60	0.44	0.65	0.41	67.2
Q5	0.05	0.68	-	-	-	-
Q6	0.52	0.56	0.47	0.68	0.77	87.2
Q7	0.08	0.67	-	-	-	-
Q8	0.27	0.62	-	-	-	-
Total		0.64		0.73		

this questionnaire. On the other hand, we decided to include the question "How many times a day do you brush your teeth?," despite the fact that its answer could lead to a bias, given its social desirability. In fact, there are reports that have associated less frequent brushing with gingival inflammation and attachment loss¹⁷. This question remained in the final questionnaire proposed and it showed temporal stability (0.77 Kappa-index). In our sample, 15.7% reported brushing teeth once a day; 54.4%, twice a day; and 26.4%, 3 or more times a day, similar to the percentage reported previously¹⁷.

The value of Cronbach's alpha was 0.73, showing an acceptable reliability. Other self-report questionnaires for periodontal disease have only reported reliability by temporary stability^{7,12,14,15}, unlike our study, which also estimated the internal consistency. In other areas of knowledge that have evaluated behaviors or perceptions about health, however, similar values

of reliability have been reported in studies with a larger number of questions and sample size^{1,29}. Both the number of questions in a questionnaire and the sample size determine a higher final value of internal consistency, so the value determined for our questionnaire could even increase if evaluated in a larger sample size. Nevertheless, the internal consistency obtained for this questionnaire by calculating the Cronbach's alpha is within the expected range, because higher values are not recommended (>0.9), as they may be associated with redundancy between questions, too long instruments, or insufficient representation of the construct to be measured in the instrument²².

On the other hand, the temporal stability of the items varied from moderate to substantial¹⁶, being similar or superior to those reported for other self-report questionnaires^{7,12,14}. However, the time between the test and retest in self-reports for periodontal

Questions	Response options
FQ1.	
How would you rate your gum health? Cómo consideras la salud de tus encías?	Very good/Good/Regular/Bad
FQ2.	
How would you rate your toothbrushing? ¿Cómo consideras que te lavas tus dientes?	Very good/Good/Regular/Bad
FQ3.	
During your toothbrushing, do your gums bleed? Durante el cepillado de dientes, ¿Tus encías sangran?	Always/Often/Sometimes/Never
FQ4.	
During the last month, have you noticed your gums reddish and/or swollen? ¿En el último mes has notado tus encías rojizas e hinchadas?	Always/Often/Sometimes/Never
FQ5.	
How many times a day do you brush your teeth? ¿Cuántas veces al día te cepillas los dientes?	Less than once a day/once a day/twice a day/three or more times a day

Figure 2- Final version of questionnaire in English and Spanish

health has ranged from 14 days¹⁵ to two years^{12,14}, making it difficult to compare. In addition, the way to address some of the themes differs: some authors propose only dichotomous responses to questions of presence or absence of an objective clinical sign^{7,14,15}. In comparison, this study includes questions focused on perceptions about the health-disease process and its related oral hygiene habits, and has more than two response options for each item, involving a more complex mental process. Also, the variation in the temporal stability of the answers could be attributable to increased awareness and perception of signs and symptoms of disease and habits, leading to a shift towards choosing healthier answers in the retest. This could justify its use as a tool for evaluating preventive programs or oral health education, because this cognitive change could generate a different behavior and subsequent clinical improvement²⁶.

Although the question "In the last month, have you noticed your gums red and/or swollen?" showed the lowest Kappa value (0.4), an agreement 72% was obtained. This could be explained because only the few individuals who had severe gingivitis safely responded the same answer in both applications of the questionnaire. This disagreement between the Kappa-index and the percentage of agreement could be the result of a characteristic of the statistic used, which is not appropriate for low prevalence conditions, where stability is attributed to chance and not to an existing real stability between applications²⁸.

Projections of this study are that this instrument can be validated for an adolescent population and thus promptly detect the disease, as those generated to predict periodontitis in adults. Currently, there are self-report questionnaires that have been validated, but

they are designed for an adult population (>18 years) and for signs and consequences of periodontitis or more severe stages of the disease, which would not be useful in a young population and for an early detection of the pathology. In adults, it has been observed that the self-report instrument, with demographic and risk factors items, reached values of sensitivity of 54.6%, specificity of 98%, and an area under the curve (AUC) of 0.93, for predicting severe periodontitis in the observed population⁸ and a sensitivity and specificity of 85% and 58%, respectively, plus an AUC of 0.81, for predicting moderate and severe periodontitis⁹. Indeed, the validation studies of self-report questionnaires conducted so far show good predictive validity for prevalence of severe periodontitis. However, the results and their psychometric properties vary in different populations, needing adaptation and validation for different realities⁴.

The self-report questionnaire designed presented an acceptable reliability for this group of Chilean teenagers. Its criterion validity needs to be assessed on a later stage to determine the correlation of the responses to the questionnaire with the clinical examination (gold standard) and objective signs of gingival inflammation, to validate its use to monitor the prevalence and severity of periodontal diseases at an early age, at population level and at lower cost.

Conclusions

The results of this analysis suggest that the questionnaire here developed is reliable, with an acceptable internal consistency and a temporal stability

from moderate to substantial. In future studies, we recommend researchers to assess its criterion validity and include questions about risk indicators for periodontal disease, to obtain a questionnaire that allows to estimate the prevalence of gingivitis and to evaluate preventive campaigns.

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