

# Validation of the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries”

Begoña Ruiz · Iván Urzúa · Rodrigo Cabello ·  
Gonzalo Rodríguez · Ivar Espelid

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## Abstract

**Objectives** To translate and validate a Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” as a method of collecting information about treatment decisions on caries management in Chilean primary health care services.

**Materials and methods** The original questionnaire proposed by Espelid et al. was translated into Spanish using the forward–backward translation technique. Subsequently, validation of the Spanish version was undertaken. Data were collected from two separate samples; first, from 132 Spanish-speaking dentists recruited from primary health care services and second, from 21 individuals characterised as cariologists. Internal consistency was evaluated by the generation of Cronbach's alpha, test–retest reliability was evaluated by Cohen's kappa, convergent validity was evaluated by comparing the total scale scores to a global evaluation of treatment trends and discriminant validity was evaluated by investigating the differences in total scale scores between the Spanish-speaking dentist and cariologist samples.

**Results** Cronbach's alpha indicated an internal consistency of 0.63 for the entire scale. Cohen's kappa correlation coefficient expressed a test–retest reliability of 0.83. Convergent validity determined a Pearson's correlation coefficient of 0.24

( $p < 0.01$ ). The comparison of proportions (chi-squared) indicated that discriminant validity was statistically significant ( $p < 0.01$ ), using a one-tailed test.

**Conclusions** The Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” is a valid and reliable instrument for collecting information regarding treatment decisions in cariology.

**Clinical relevance** The clinical relevance of this study is to acquire a reliable instrument that allows for the determination of treatment decisions in Spanish-speaking dentists.

**Keywords** Treatment decisions · Caries detection · Validation of questionnaire

## Introduction

Variation in the decision-making associated with the detection and management of dental caries is a very common situation in dental practices. The disparity found among professionals may be due to the use of different diagnostic tools that present varying levels of performance as well as the application of different criteria to the definition of “caries” and the interpretation of those criteria according to personal experiences and beliefs [1].

The different restorative strategies adopted by dentists in their clinical practices have been previously studied in various countries with the use of questionnaires. These studies have revealed a wide disparity in diagnosis and in clinical decision-making [2]. The consequences of this variation are problems for patients, as they will be offered different treatment options for the same pathologic condition.

Of the possible treatments (ranging from non-operative to surgical intervention), not all will lead to equivalent outcomes, and therefore, it may occur that in the diagnostic and

B. Ruiz (✉) · I. Urzúa · R. Cabello · G. Rodríguez  
Department of Restorative Dentistry, Cariology Area,  
Faculty of Dentistry, University of Chile,  
Sergio Livingstone Pohlhammer 943, Independencia,  
Santiago, Chile  
e-mail: begoruiiconrads@gmail.com

I. Espelid  
Department of Paediatric Dentistry and Behavioural Science,  
Faculty of Dentistry, University of Oslo and Public Dental Service  
Competence Centre of Northern Norway,  
Tromsø, Norway

detection processes, a patient will fail to receive appropriate treatment. Moreover, erroneous detection of carious lesions could imply the indication of unnecessary restorations or a lack of treatment when it is required.

The differences regarding the restorative treatment thresholds are likely reflections of differences in dentists' beliefs about what represents the appropriate stage in lesion progression at which intervention should be initiated. These differences might also be related to the patient's level of caries risk, the type of practice, the practice's business model and the dentist's gender [3]. Moreover, other factors such as patients' preferences, access to dental care, enhanced living conditions, personal income and the insurance system also play roles in determining dentists' treatment decisions [4].

The criteria for when to intervene restoratively for approximal and occlusal caries have been discussed extensively [3, 5, 6]. The decision to place the first restoration in a previously unrestored surface is a crucial event in the life of a tooth because permanent restorations do not exist, and once placed, restorations will always require replacement or repair after some length of time [7, 8].

Countries such as Norway, Sweden, Denmark, Australia and France among others have used the implementation of self-administered questionnaires to study dentists' restorative treatment strategies and treatment decisions in cariology [2, 3, 9–12]. These instruments meet the base reliability and validity requirements of any measuring tool; however, their use in a different cultural context is not applicable because literal translations of them do not guarantee their effectiveness and comprehensibility when used in a new target population.

The use of questionnaires is a common practice in research and epidemiology. This popularity is expected as questionnaires have low costs and are relatively easy to create [13]. It is a fast and convenient method, and has the advantage that is not based on evidence prior to the time of the survey (past history) but rather on attitudes and approaches in the present [14]. The “Questionnaire on the treatment of approximal and occlusal caries” was developed in Norwegian and English by bilingual authors [6, 11], and requires translation and validation in other languages if it is to be used in alternative languages. There is an interest in performing such translation work such that the questionnaire can be used to assess restorative treatment trends among Chilean dentists, to make comparisons between countries and also to potentially use the instrument as a tool to evaluate interventions in Chilean health care services.

The aim of the study reported in this paper was to translate the English-language version of the “Questionnaire on the treatment of approximal and occlusal caries” into Spanish and to validate the Spanish-language version so

that it could be used in Spanish-speaking populations. Internal consistency, test–retest reliability, convergent validity and discriminant validity were assessed.

## Materials and methods

### The instrument

The “Questionnaire on the treatment of approximal and occlusal caries” in its original version was developed by Espelid et al. [6, 11]. This questionnaire was used in Norway and Sweden to assess practitioners' restorative strategies [5, 6, 11]. It was then modified by Tubert-Jeannin et al. [2] and Doméjean-Orliaguet et al. [12]. As reported by the authors [2, 12], the questionnaire of Espelid et al. was translated using the forward–backward translation technique [15] and was pilot-tested followed by some minor adjustments. The questionnaire reported by Tubert-Jeannin et al. and Doméjean-Orliaguet et al. was used as the original document. The questionnaire consisted of 17 questions or items grouped into four domains: D1, criteria for restorative treatment of approximal caries; D2, criteria for restorative treatment of occlusal caries; D3, caries diagnosis of questionable occlusal caries and D4, knowledge and beliefs about caries. For example, to assess the stage of lesion progression at which restorative treatment was considered appropriate, different stages of approximal caries were illustrated (Fig. 1). The following question was asked: “The figure (Fig. 1) illustrates different radiographic stages of approximal caries progression. Which lesion(s) do you think requires immediate restorative treatment? That is, indicate the lesion(s) for which you would not postpone restorative treatment under any circumstances, even if the patient has low caries activity and good oral hygiene”. Each item score used a scale with responses receiving from three to six options. Five scores could be obtained from the total questionnaire: one for the total scale and one for each domain.

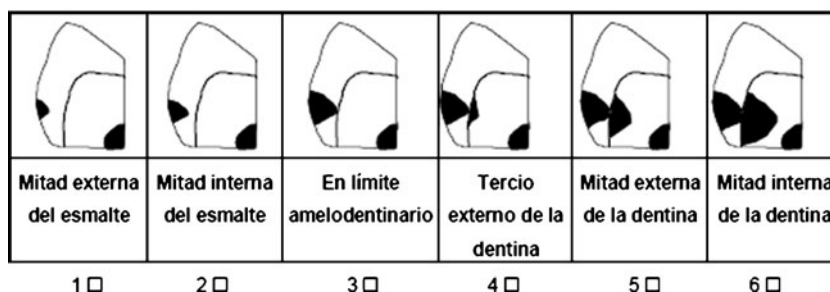
### Weighting of items and measurement scales

To perform the statistical analysis, specific weights were assigned to each of the items and questionnaire domains (Table 1). The total scores of each dimension and of the questionnaire as a whole were expressed in values between 0 and –1. Two categories were created to describe the total score yielded by the questionnaire; the global test GT score was either minimally invasive (those individuals for which the resulting score was less than 0.5) or invasive (those for whom the resulting score was greater than 0.5).

Furthermore, two categories were created to describe the resulting score obtained by the global question GQ score: invasive (those individuals whose global question responses

**Fig. 1** Example of a translated item regarding the restorative threshold for approximal lesion based on diagrams illustrating different radiographic stages of caries progression

**1. a) La figura muestra diferentes estados radiográficos de la progresión de una caries proximal en la superficie distal de un segundo premolar superior. ¿Qué lesión (es) considera Ud. que requiere (n) tratamiento restaurador (operatorio) inmediato? Es decir, aquella (s) lesión (es) en las que Ud. no pospondría el tratamiento restaurador bajo ninguna circunstancia aún cuando el paciente tenga baja actividad de caries y buena higiene oral. (Marque una cruz en todas las que Ud. estime conveniente).**



were scored 1–2) and minimally invasive (those whose responses were scored 3–4).

#### Translation into Spanish

The “Questionnaire on the treatment of approximal and occlusal caries” was translated into Spanish using the well-recognised forward–backward translation technique [15]. The process consisted of several stages. First, there was a forward translation from English into Spanish by two bilingual individuals, whose command of both languages was advanced, and who worked independently of each other. Second, the two initial Spanish versions were compared and revised through a consultation process involving a review committee. The resulting third version was then subjected to the analysis of a board of seven experts skilled in the professional and scientific exercise of dentistry, with the intention of assessing the cultural pertinence of the translations. Additionally, the questionnaire was pilot tested in the target population to investigate the items' and scales' comprehensibility and the performance of the instrument in its initial phase, focusing on the wording of the items and on the responses. This was a qualitative process conducted using a convenience sample

comprised of 16 dentists. The third Spanish version obtained was then back translated by two individuals, whose command of the English language was advanced, again working independently. Finally, the two back-translated English versions were compared with the original English version, and final adjustments to the third Spanish version were made through consultation with all the translators involved, plus the review committee. This process resulted in a fourth and final Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries”.

#### The samples

The study was conducted in Santiago, the capital city of Chile. Data were obtained from two separate samples. First, data were collected from 132 Spanish-speaking dentists recruited from primary health care services, and second, data were collected from 21 individuals characterised as cariologists, based on their certified postgraduate education in cariology. A sub-sample of 30 individuals from the Spanish-speaking dentist group was mailed the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” a second time, 1 week after the initial evaluation to facilitate the assessment of test–retest reliability.

**Table 1** Weight assigned to items and dimensions of questionnaire for validation purposes

Weight		Weight		Weight		Weight	
Restorative treatment of approximal caries	0.25	Restorative treatment of occlusal caries	0.125	Caries diagnosis of questionable occlusal caries	0.125	Knowledge and beliefs about caries	0.5
Item 1a	0.7	Item 2a	0.7	Item 3a	0.075	Item 5	0.2
Item 1b	0.15	Item 2b	0.15	Item 3b	0.35	Item 6	0.2
Item 1c	0.15	Item 2c	0.15	Item 3c	0.075	Item 7	0.2
				Item 4a	0.3	Item 8	0.2
				Item 4b	0.15	Item 9	0.2
				Item 4c	0.05		

## Validation of the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries”

### *Convergent validity*

To examine convergent validity, an extra global question (“Faced to an incipient active caries lesion you always perform a restoration technique based on cavity preparation. With respect to this statement you are:”) was added at the end of the questionnaire. The possible responses to this question were “strongly agree”, “agree”, “disagree” and “strongly disagree”, and scores of 1 to 4, respectively, were assigned to the aforementioned responses. The questionnaire's total score was calculated by the product of differential weight obtained from each of the questionnaire's domains (D1, criteria for restorative treatment of approximal caries: 0.25; D2, criteria for restorative treatment of occlusal caries: 0.125; D3, caries diagnosis of questionable occlusal caries: 0.125 and D4, knowledge and beliefs about caries: 0.5) and the score of the possible responses. Convergent validity was evaluated through investigating the correlation (Pearson's correlation) between the questionnaire's total score (global test) and the rating of the global question. These analyses were performed with data from the Spanish-speaking dentists and the cariologists. Those individuals whose global question response was scored 1–2 were considered “invasive”, and those individuals whose response was 3–4 were considered “minimally invasive”. The underlying hypothesis for this test ( $H_{c1}$ ) was that dentists who were regarded as “minimally invasive” according to the global question would be equally classified in the same manner by the score obtained from the global test.

### *Discriminant validity*

To determine the discriminant validity of the Spanish version of the questionnaire, it was agreed that the “Questionnaire on the treatment of approximal and occlusal caries” should be able to discriminate between dentists who showed a trend towards preventive and less invasive treatments from those who were invasive. Therefore, the hypothesis for this test ( $H_{c2}$ ) was that the proportion of invasive dentists would be lower in the cariologist sample than in the Spanish-speaking dentist sample. For this reason, the analysis was performed using data from both samples, determining a comparison of proportions (chi-squared test).

### *Internal consistency*

Internal consistency was evaluated using data gathered from the Spanish-speaking dentists' and the cariologists' samples and assessed with Cronbach's alpha coefficient. Cronbach's alpha is a summary statistic that captures the extent of agreement

among all possible subsets of items. Values  $\geq 0.7$  were considered acceptable for comparisons between groups [16, 17].

### *Test–retest reliability*

Test–retest reliability was evaluated using data gathered from the sub-sample of the Spanish-speaking dentist group. One week after the initial administration of the questionnaire to the 132 participants, a subgroup of 30 dentists was chosen as a convenience sample to complete the questionnaire for a second time. Cohen's kappa was used to examine intra-observer variability.

After data collection, the questionnaire's codification process was carried out. A Microsoft Excel database was created, and the statistical analysis was performed using Stata 9 statistical software (StataCorp, College Station, TX, USA).

## Results

### Translation into Spanish

The comparisons among the original “Questionnaire on the treatment of approximal and occlusal caries” and the back-translated English versions did not reveal conceptual content differences. There was a high level of correspondence among the three documents.

### Validation of the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries”

#### *Convergent validity*

With respect to the analysis of convergent validity performed using data from the Spanish-speaking dentist and cariologist samples, responses to the global question GQ score were skewed strongly towards the “disagree” (54.5%) and “strongly disagree” (36.6%) responses. Only 8.9% of subjects answered “agree” or “strongly agree” ( $n=153$ ).

Thus, the global question score indicated that the resulting proportions of minimally invasive dentists and invasive dentists were 79.7% and 20.3%, respectively.

The proportions of minimally invasive and invasive dentists, when analysing the total score yielded by the questionnaire GT score, were 69.9% and 30.1%, respectively.

Agreement was found among the 92 subjects who were characterised as minimally invasive and the 16 subjects who were characterised as invasive by both tests (GQ and GT), representing 71% agreement (Table 2).

When investigating Pearson's correlation coefficient for the scores obtained by the global test and global question scores, a weak but significant correlation was observed ( $r=0.24$ ;  $p<0.01$ ).

**Table 2** Number of invasive and minimally invasive individuals who presented agreement in the global question and global test

Individuals' global question	Individuals' global test		
	Minimally invasive	Invasive	Total
Minimally invasive	92	30	122
Invasive	15	16	31
Total	107	46	153

### Discriminant validity

When examining discriminant validity, using data from both samples, the proportions of dentists classified as minimally invasive in the cariologist sample ( $n=21$ ) was 100%. In the Spanish-speaking dentist sample ( $n=132$ ), the proportions of minimally invasive dentists was 65.2% and the proportions of invasive dentists was 34.8%.

The result of the comparison of proportions (chi-squared test) revealed that the difference between the proportions was significant for the one-tailed test ( $p<0.01$ ) for the underlying hypothesis ( $H_{e2}$ ): “The proportion of invasive dentists is lower in the group of cariologists ( $n=21$ ) than in the group of Spanish-speaking dentists ( $n=132$ )”.

### Internal consistency

Cronbach's alpha coefficient was 0.63 for the total scale. Subscales scores were distributed in a heterogeneous manner ranging from 0.54 to 0.69 for the different questionnaire domains, indicating acceptable internal consistency (Table 3).

### Test–retest reliability

Finally, the test–retest reliability of the Spanish version of the questionnaire was examined with a sub-sample from the Spanish-speaking dentist group completing the questionnaire a second time 1 week after the first completion. There were 28 of 30 participants who reported no changes in their responses during the second administration of the questionnaire. These

**Table 3** Reliability statistics for total scale and subscales ( $n=153$ )

Variable	Number of items	Cronbach's alpha
Total scale	17	0.6389
Subscales		
D1: restorative treatment of approximal caries	3	0.5474
D2: restorative treatment of occlusal caries	3	0.5827
D3: caries diagnosis of questionable occlusal caries	6	0.6971
D4: knowledge and beliefs about caries	5	0.6041

two administrations resulted in two sets of independent scores, which were then correlated with each other. The kappa coefficient was 0.83 ( $p<0.01$ ).

### Discussion

The aim of this study was to validate a Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” by examining its internal consistency, test–retest reliability, convergent validity and discriminant validity. The results of this validation process indicated that Cronbach's alpha was 0.63 for the whole scale, Pearson's correlation coefficient was 0.24, total questionnaire scores correlated with a global evaluation of treatment trends, and the Spanish version was able to discriminate between dentists from primary health care services (the Spanish-speaking dentist sample) with no manifest instruction in preventive skills and dentists from an acknowledged group of cariologists. Therefore, in all validation tests to which the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” was subjected, it performed adequately. This result indicates that it is a valid instrument when used by Spanish-speaking dentists to describe treatment decisions on caries management in the primary health care services in Chile and when used to discriminate among groups of dentists whose levels of instruction and knowledge on preventive matters are expected to be different.

The original questionnaire was developed by Espelid et al. [6], was modified by Tubert Jeannin [2] and by Domejéan-Orliaguet and was subjected to a validation process, as reported by the authors [12]. Comparisons among the original and the translated versions were made, and the final questionnaire was tested on students and teachers at a dental school, followed by some minor adjustments. This questionnaire and its sections have been widely used to assess dentists' restorative treatment decisions on approximal and occlusal caries lesions, including treatment threshold and restorative methods and materials [2, 5, 6, 9, 11, 18–21].

Having made this inference, it is important to recognise the limitations of the work in terms of the methodology and analytic strategies used to assess the performance of the Spanish version of the questionnaire and the extent of the validation tests.

The translation and validation methodology reported in this paper is a standardised form of cross-cultural adaptation. It is a technique widely used in epidemiology and in medical, psychological and sociological research [15, 22–25], as it provides a methodological basis for a context in which, as yet, there are no common universal protocols.

In the present study, the translation process from English to Spanish began after a series of steps, two back translations that when compared with the original version revealed no

differences in content. Except for literal distinctions in word morphology and syntax, the three versions expressed conceptual equivalence, and this similarity revealed a high level of correspondence reached in the process.

Although semantic and idiomatic equivalence were maintained across the different versions, it should be noted, however, that experiential equivalence was not entirely achieved. The hypothetical clinical situations presented by the questionnaire in its original version were adjusted for the context of the culture to which it was first administered [6, 11]. A mismatch, in this respect, may have led to the modification of an item, if deemed appropriate. The “hypothetical patient, 20 years old, who visits the dentist annually, has low caries activity and good oral hygiene” presented in the questionnaire fits only partially with the average patient who attends Chilean primary health care services regularly. Despite this inconsistency, the translation was not altered to preserve the characteristics of the original document. The idea that, in the future, certain items could be modified to represent the characteristics of the Chilean cultural environment better should not be rejected.

The assessment of reliability, validity and sensitivity to change, as mandatory aspects considered in cross-cultural adaptation processes, is still a matter of controversy today. On one hand, it could be conceived that the translated questionnaire maintained its psychometric properties, while on the other hand, during the adaptation process, the instrument could have acquired unknown reliability and validity in the new application context.

The two samples used in this study were selected by convenience and thus cannot be said to represent any particular population. However, this limitation is of secondary importance when the aim of the study is the validation of instruments, for which sampling should be related to the needs of the validation process [23].

It is important to acknowledge that whenever a questionnaire is applied, individuals tend to answer according to prevailing social norms. Responses agree with what is socially expected on behalf of the cultural models. The interpretation of the information obtained in this validation process should consider the existence of social desirability bias as it may disguise the true responses of individuals; therefore, the results should be interpreted carefully.

The item–dimension/weight assignments allotted to each of the items and the domains of the questionnaire were determined according to the review committee's consensus. The highest value assigned to domain number 4 can be explained based on this domain having greater influence compared with the responses to the questions contained in the other three domains. This determination was based on prior knowledge according to the scientific literature on this matter [26]. The possibility exists that the original item's

weighted values were different from those proposed in this validation study. A future application of the instrument may require the assistance of expert judges or the original authors to resolve these matters.

This issue also applies to the definition of the categories “minimally invasive” and “invasive” into which the total score of the questionnaire (global test) was dichotomised:  $<0.5$  = “minimally invasive” and  $>0.5$  = “invasive”. Apparently, much information was lost when performing this procedure; however, the statistical analysis became easier and less cumbersome. In future research, a larger number of categories should be identified to allow the instrument to determine more sensitively the boundary between the invasive and minimally invasive groups.

The Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” exhibited acceptable convergent validity. The total score on the questionnaire and the global question score showed a positive and statistically significant ( $p < 0.01$ ) correlation. It has been suggested that modification of the global question may improve the correlation found in this study. The authors of the original version did not report on the validation process: therefore, convergence validity reference values to compare with our results were unavailable. However, the interpretation of this coefficient indicates that a value of 0.24 denotes a weakly positive correlation [23]. The underlining hypothesis was confirmed ( $H_{e1}$ ).

The results for the assessment of discriminant validity revealed that the Spanish version of the questionnaire was capable of distinguishing between invasive and minimally invasive dentists when comparing the Spanish-speaking dentist and the cariologist samples. The proportion of minimally invasive dentists turned out to be 100% within the sample of cariologists but only 65.2% in the sample of Spanish-speaking dentists. The comparison of proportions (chi-squared test) indicated that there was a statistically significant difference ( $p < 0.01$ ) and thus confirmed the hypothesis proposed for this test ( $H_{e2}$ ).

The value for internal consistency estimated with Cronbach's alpha indicated that the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” approached the validation requirements. While the recommendation states that the alpha should be equal to or greater than 0.7 for standard reliability in research studies [16], the value obtained suggests that the scale shows acceptable homogeneity and reliability but does not perform optimally. The estimation included scale–scale correlations for each dimension. Higher values would be expected when examining item–item and item–scale correlations. Reliability improves as the number of observations increases; therefore, the greater the number of items that are present in an instrument, the greater its reliability [27]. One way to improve the Cronbach's alpha values and, thus,

the reliability of the questionnaire, would be to increase the number of questions on the questionnaire.

The assessment of the test–retest reliability of the Spanish version of the questionnaire demonstrated a high correlation between the responses to the first and second applications of the instrument. The kappa coefficient of 0.83 indicated an excellent level of agreement and excellent performance of the scale under different application conditions [28]. The reported variations could have been due to differences in clinical diagnosis, treatment indication or the use of restorative materials, as we have observed how a large series of factors influence the decision making of dentists [29].

The second application of the questionnaire took place 1 week after the initial evaluation. Other studies have administered the retest 2 weeks after the initial application [23]. Variation in outcomes can be found by delaying the second application, as it contributes further to the respondents forgetting their answers. The sub-sample of 30 Spanish-speaking individuals was a convenience sample in nature. Random sampling techniques are recommended in future research.

In conclusion, the findings suggest that the Spanish version of the “Questionnaire on the treatment of approximal and occlusal caries” has adequate internal consistency, convergent and discriminant validity, and excellent test–retest reliability. It is, therefore, an appropriate instrument to use when collecting information about treatment decisions on caries management in Spanish-speaking dentist populations.

The Spanish version of the questionnaire was supported by this validation process, and as a result, the methodological tool developed in this research is a valid and reliable instrument for collecting information on treatment decisions for managing carious lesions.

**Conflicts of interest** The authors declare that they have no conflicts of interest and/or any financial interests to be reported in the realisation of this investigation.

## References

1. Fejerskov O, Kidd E (eds) (2008) Dental caries: the disease and its clinical management, 2nd edn. Blackwell Munksgaard, Oxford
2. Tubert-Jeannin S, Doméjean-Orliaguet S, Riordan P, Espelid I, Tveit AB (2004) Restorative treatment strategies reported by French university teachers. *J Dent Educ* 68:1096–1103
3. Gordan VV, Garvan CW, Heft MW, Fellows JL, Qvist V, Rindal DB, Gilbert GH, Collaborative Group DPBRN (2009) Restorative treatment thresholds for interproximal primary caries based on radiographic images: findings from the Dental Practice-Based Research Network. *Gen Dent* 57:654
4. Bader JD, Shugars DA (1997) What do we know about how dentists make caries-related treatment decisions? *Commun Dent Oral Epidemiol* 25:97–103
5. Tveit AB, Espelid I, Skodje F (1999) Restorative treatment decisions on approximal caries in Norway. *Int Dent J* 49:165–172
6. Espelid I, Tveit AB, Mejåre I, Sundberg H, Hallonsten AL (2001) Restorative treatment decisions on occlusal caries in Scandinavia. *Acta Odontol Scand* 59:21–27
7. Elderton RJ (1990) Clinical studies concerning re-restoration of teeth. *Adv Dent Res* 4:4–9
8. Mjör IA, Holst D, Eriksen HM (2008) Caries and restoration prevention. *J Am Dent Assoc* 139:565–570
9. Espelid I, Tveit A, Haugejorden O, Riordan PJ (1985) Variation in radiographic interpretation and restorative treatment decisions on approximal caries among dentists in Norway. *Commun Dent Oral Epidemiol* 13:26–29
10. Espelid I, Tveit AB, Fjelltvæit A (1994) Variations among dentists in radiographic detection of occlusal caries. *Caries Res* 28:169–175
11. Mejåre I, Sundberg H, Espelid I, Tveit AB (1999) Caries assessment and restorative treatment thresholds reported by Swedish dentists. *Acta Odontol Scand* 57:149–154
12. Doméjean-Orliaguet S, Tubert-Jeannin S, Riordan P, Espelid I, Tveit A (2004) French dentists' restorative treatment decisions. *Oral Health Prev Dent* 2:125–131
13. Sjöström O, Holst D (2002) Validity of a questionnaire survey: response patterns in different subgroups and the effect of social desirability. *Acta Odontol Scand* 60:136–140
14. Nuttall NM, Pitts NB, Fyffe HE (1993) Assessment of reports by dentists of their restorative treatment thresholds. *Commun Dent Oral Epidemiol* 21:273–278
15. Guillermin F, Bombardier C, Beaton C (1993) Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol* 46:1417–1432
16. Cronbach LJ (1951) Coefficient alpha and the internal structure of tests. *Psychometrika* 16:297–334
17. Schmitt N (1996) Uses and abuses of coefficient alpha. *Psychol Assess* 8:350–353
18. Riordan PJ, Espelid I, Tveit AB (1991) Radiographic interpretation and treatment decisions among dental therapists and dentists in Western Australia. *Commun Dent Oral Epidemiol* 19:268–271
19. Sundberg H, Méjare I, Espelid I, Tveit AB (2000) Swedish dentists' decisions on preparation techniques and restorative materials. *Acta Odontol Scand* 58:135–141
20. Baraba A, Anic I, Doméjean-Orliaguet S, Espelid I, Tveit A, Miletic I (2010) Survey of Croatian dentists' restorative treatment decisions on approximal caries lesions. *Croat Med J* 51:509–514
21. Vidnes-Kopperud S, Tveit AB, Espelid I (2011) Changes in the treatment concept for approximal caries from 1983 to 2009 in Norway. *Caries Res* 45:113–120
22. López R, Baelum V (2006) Spanish version of the Oral Health Impact Profile (OHIP-Sp). *BMC Oral Health* 6:11
23. Allison PJ (2008) Validation of a French language version of the Early Childhood Oral Health Impact Scale (ECOHIS). *Health Qual Life Outcomes* 6:9
24. Torres C, Paiva S, Vale MP, Pordeus IA, Ramos-Jorge ML, Olivera AC, Allison P (2009) Psychometric properties of the Brazilian version of the Child Perceptions Questionnaire (CPB 11–14)-short forms. *Health Qual Life Outcomes* 7:43
25. Goursand D, Paiva SM, Zarzar PM, Ramos-Jorge ML, Cornacchia GM, Pordeus IA, Allison PJ (2008) Cross-cultural adaptation of the Child Perceptions Questionnaire 11–14 (CPQ11-14) for the Brazilian Portuguese language. *Health Qual Life Outcomes* 6:2
26. Clark TD, Mjör IA (2001) Current teaching of cariology in North American dental schools. *Oper Dent* 26:412–418
27. Hernández Sampieri R, Fernández Collado C, Baptista Lucio P (2006) Metodología de la Investigación, 4th edn. Mc Graw Hill, Mexico
28. Dawson B, Trapp RG (2004) Basic & clinical biostatistics. LANGE medical books, Chapter 5. McGraw-Hill, New York, pp 115–117
29. Bader JD, Shugars DA (1995) Variation in dentists' clinical decisions. *J Publ Health Dent* 55:181–188

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