ASSESSING ORAL HEALTH-RELATED QUALITY OF LIFE IN CHILDREN AND ADOLESCENTS: A SYSTEMATIC REVIEW AND STANDARDIZED COMPARISON OF AVAILABLE INSTRUMENTS

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ABSTRACT

Objectives: To obtain a systematic and standardized evaluation of the current evidence on development process, metric properties and administration issues of oral health-related quality of life instruments available for children and adolescents.

Materials and Methods: A systematic search until October 2016 was conducted in PubMed, Embase, Lilacs, SciELO and Cochrane databases. Articles with information regarding the development process, metric properties, and administration issues of pediatric instruments measuring oral health-related quality of life were eligible for inclusion. Two researchers independently evaluated each instrument applying the EMPRO (Evaluating Measures of Patient-Reported Outcomes) tool. An overall and seven attribute-specific EMPRO scores were calculated (range 0–100, worst to best): measurement model, reliability, validity, responsiveness, interpretability, burden and alternative forms.

Results: We identified 18 instruments evaluated in 132 articles. From five instruments designed for preschoolers, Early Childhood Oral Health Impact Scale (ECOHIS) obtained the highest overall EMPRO score (82.2). Of 9 identified for schoolchildren and adolescents, the best rated instrument was Child Perceptions Questionnaire 11-14 (82.1). Among the four instruments developed for any age, Family Impact Scale (FIS) obtained the highest scores (80.3).

Conclusion: The evidence supports the use of ECOHIS for preschoolers, while the age is a key factor when choosing among the four recommended instruments for schoolchildren and adolescents. Instruments for specific conditions, symptoms or treatments need further research on metric properties.

Clinical Relevance: Our results facilitate decision-making on the correct oral health-related quality of life instrument selection for any certain study purpose and population during the childhood and adolescence life cycle.

INTRODUCTION

Oral diseases are highly prevalent worldwide despite the improvement in oral health indices initiated in the last decades of the XX century [1-4]. It is well known that their consequences on children are serious and can affect their quality of life [5-10]. Patient-reported outcomes, together with clinical indicators, can jointly provide a more comprehensive assessment of the patient's oral health [11]. The oral health-related quality of life has been defined as a multidimensional concept which includes a subjective evaluation of the individual's oral health, functional well-being, expectations and satisfaction with care, and sense of self [11].

As the increase in the development of patient-reported outcomes is a general phenomenon, several attempts have been made to systemize evaluation criteria. One of the first approximations was performed by the Medical Outcome Trust, which published an exhaustive series of recommendations regarding the ideal attributes of patient-reported outcomes [12]. Nowadays, the most established tools are the Evaluating Measures of Patient-Reported Outcomes (EMPRO) [13], based on the Medical Outcome Trust proposal [12], and the Consensus-based Standards for the selection of health status Measurement Instruments (COSMIN) [14]. While the latter was originally developed as a checklist for evaluating the methodological quality of each study focused on measurement properties, the EMPRO was designed to carry out an overall assessment of each instrument by taking into account both the methodology applied and the results obtained, based on all the available evidence. The EMPRO is a valid and reliable tool that has proven its usefulness in comparing the performance of generic [13], and disease-specific patient-reported outcomes [15-19].

In the last decade, a large number of oral health-related quality of life questionnaires have been developed for children and adolescents. Unfortunately, information about their development process, metric properties and administration issues is disperse. To the best of our knowledge, only one systematic review has been published and it was centered on the three instruments currently most used for children, [20] the Child Perceptions Questionnaire, the Child Oral Impacts on Daily Performances and the Child Oral Health Impact Profile. Therefore, an extended systematic review of all the available instruments to

assess oral health-related quality of life during childhood and adolescence is necessary in order to know the characteristics, pros and cons of each one, and to facilitate selection according to clinical or research requirements.

Accordingly, the research question to answer is: To what extent is each instrument metrically robust and suitable to assess children's and adolescents' oral health-related quality of life? The aim of our study was to obtain a systematic and standardized evaluation of the current evidence on the development process, metric properties and administration issues of the oral health-related quality of life instruments available for population aged 0-18 years, by applying the EMPRO tool.

METHODS

Protocol

We used Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines for the reporting of this systematic review [21].

Eligibility Criteria

Articles presenting information on the development process, the psychometric properties and the administration of oral health-related quality of life instruments in children and adolescents were eligible for inclusion. Articles written in English, Spanish, Portuguese, French, German and Italian were eligible, including both studies of original instruments as well as those of other country versions. Studies were excluded if they had used generic instruments to measure oral health, or applied oral health-related quality of life tools developed for the adult population in studies with children. Articles describing protocols, conference summaries, and case studies, as well as letters to the editor, were also excluded.

Information Sources and Search

A systematic search until October 2016 was conducted, initial dates depending on database: from 1966 in Medline, 1974 in Embase, 1982 in Lilacs, 1998 in SciELO and 2008 in Cochrane Library. It was complemented by a manual review of the references of the included articles and in two online databases of patient-reported outcome instruments: Patient-Reported Outcomes and Quality of Life Instruments Database (<https://eprovide.mapi-trust.org>), and BiblioPRO (www.bibliopro.org). The details of the search strategy used in Medline are listed in supplementary data (Online Resource 1).

Study Selection

Titles, abstracts, and full-text articles were selected independently by two investigators (CZ and either PM or GE) to verify their eligibility. In cases of discrepancy, the decision was made by a third reviewer (YP).

Data collection process

Each oral health-related quality of life instrument was evaluated independently by two reviewers, which is the minimum recommended when assessing information that involves subjective interpretation [22]. Concordance between pairs of reviewers was examined by calculating the one-way random effects intraclass correlation coefficient (ICC) for absolute agreement. In case of evaluation discrepancies, they were first resolved through consensus and then, if necessary, by a third reviewer. Experts were identified and invited because of their knowledge and experience in patient-reported outcomes measurement: fourteen belonged to the team that developed the EMPRO, and eighteen were researchers who participated in a training course focused on how to support selection of the most adequate patient-reported outcome through a standardized assessment of metric properties and issues related to its administration with the EMPRO system.

Evaluating Measures of Patient-Reported Outcomes (EMPRO)

The EMPRO tool is composed of 39 items divided into 8 attributes: “conceptual and measurement model” (concepts and population intended to assess); “reliability” (to what degree an instrument is free from random error); “validity” (to what degree an instrument measures what it intends); “responsiveness” (ability to detect change over time); “interpretability” (assignment of meanings to instrument scores); “burden” (time, effort and other demands for administration and response); “alternative modes of administration” (i.e., self- or interviewer-administered, telephone or computer-assisted interview); and “cross-cultural and linguistic adaptations” (equivalence across translated versions) [13]. The last attribute was not completed because it was beyond the scope of this study.

All EMPRO attributes and items are accompanied by a short description, to facilitate understanding and to guarantee a standardized application during the evaluation process. Agreement with each item can be answered on a four-point Likert scale, from 4 (strongly agree) to 1 (strongly disagree), and there is also a “no information” option. Five items allow a “not applicable” reply. Items for which the response option was “no information” were assigned a score of 1 (lowest possible score).

Statistical analysis

Attribute-specific scores and an overall score were calculated for each instrument. The mean of the applicable items was calculated for each attribute when at least 50% of

them were rated. Mean responses were linearly transformed into a range from 0 (worst possible score) to 100 (best possible score). Separate subscores for the “reliability” and “burden” attributes were calculated, as they are composed of two components each: “internal consistency” and “reproducibility” for reliability, as well as “respondent” and “administrative” for burden. For reliability, as the two components represent different approaches to examine one same attribute, the highest subscore was chosen. For burden, however, as the two components assess different aspects of the same attribute, the final score was calculated as their mean.

In addition, an overall score was computed by calculating the mean of the five metric-related attributes: “conceptual and measurement model,” “reliability,” “validity,” “responsiveness to change” and “interpretability.” The overall score was only calculated when at least three of these five attributes had a score.

EMPRO scores were considered reasonably acceptable if they reached at least 50 points (half of the 100 maximum theoretical points). This threshold was chosen based on the global recommendations made by the reviewers in the first two EMPRO studies [15,13].

Oral health-related quality of life instruments were examined separately according to the target population: preschoolers (<6 years old), schoolchildren and adolescents (6-18 years old) and the whole childhood and adolescence life cycle (0-18 years old).

RESULTS

Results of the search

The search identified 3,832 references (**Fig. 1**). After excluding 577 duplicates and reviewing titles and abstracts, 146 articles were read in full text. Subsequently, 25 were excluded, 21 because they included only adult samples and 4 due to their lack of metric property information. Eleven articles were identified by hand search and online patient-reported outcomes databases. Thus, a total of 132 full text articles were considered at the EMPRO evaluation of 18 instruments (see list of references in Online Resource 2). The number of articles found per instrument ranged from 1 to 54, with some articles providing information on more than one instrument. [The intraclass correlation coefficient for the overall EMPRO score between pairs of reviewers was 0.84 indicating a high agreement before consensus process.](#)

--- Fig. 1, about here ---

Characteristics of instruments

Table 1 shows in alphabetic order the 5 instruments applicable to preschoolers, which were published between 2002 and 2014. All were designed for oral diseases in general, proxy-administration, and developed in English-speaking countries, except for the Dental Discomfort Questionnaire (DDQ) symptom-specific scale, focused on discomfort and/or pain, and the Oral Health-related Early Childhood Quality Of Life (OH-ECOQOL) developed in India. Only two, the Michigan Oral Health-Related Quality of Life scale (Michigan-OHRQoL) and the Scale of Oral Health Outcomes for 5-year-old children (SOHO-5), also have a version for child self-administration.

---Table 1, about here ---

For schoolchildren and adolescents, 9 instruments were identified (**Table 2**): 4 were generic, 2 condition-specific (for hypodontia and malocclusion), 1 symptom-specific for pain, 1 treatment-specific for fixed appliances, and 1 econometric. They were developed between 1998 and 2016, in English, and to be self-administered, with the exception of the Child-Oral Impact on Daily Performance Index (Child-OIDP), developed in Thai to be interviewer-administered.

---Table 2 about here ---

Four instruments designed for children and adolescents of any age (0-18 years) were published after 2002 (**Table 3**). They were all designed in English, adapted to different cultures and administered through a parent or caregiver, although Pediatric Quality of Life Inventory™ Oral Health Scale™ (PedsQL-OH™) and Pediatric Oral health-related Quality of Life (POQL) had also a self-administered version for specific children's ages.

It is important to clarify that four of the above-mentioned instruments form part of the Child Oral Health Quality of Life, which considers not only the children's perception measured with Child Perceptions Questionnaires (CPQ8-10 or CPQ11-14), but also that of the parents with the Parental-Caregiver Perceptions Questionnaire (P-CPQ), and the impact of the child's oral problems on the family with the Family Impact Scale (FIS). Each one of these four instruments has been evaluated separately within their target population group.

--- Table 3, about here---

Results of the EMPRO ratings

The instrument with the highest overall score in preschoolers (Fig. 2) was the Early Childhood Oral Health Impact Scale (ECOHIS) with 82.2 points, in schoolchildren it (Fig. 3) was the CPQ11-14 with 82.1, and for children and adolescents of any age (Fig. 4) the FIS with 80.3 points. Detailed EMPRO results for any specific criteria and attributes are presented in supplementary material (Online Resource 3).

--- Fig. 2, 3, and 4 about here---

All the questionnaires were scored over 50 in the conceptual model attribute, except for the Michigan-OHRQoL (Fig. 2), Oral Health-Related Quality of Life for patients with Hypodontia (OHRQoL-Hypodontia), Impact of Fixed Appliances Questionnaire (IFAQ) and Dental Freetime Trade-Off Scale (DFTO) (Fig. 3). Reliability scores ranged from 16.7 to 66.7 with eight instruments below 50. Regarding validity, the SOHO-5 (Fig. 2) and the Child Dental Pain Questionnaire (Child-DPQ) (Fig. 3) did not reach this threshold, while insufficient information was found for the IFAQ and DFTO (Fig. 3) to calculate this score. Only in half the instruments was it possible to calculate an EMPRO responsiveness score, as the information was insufficient in the other nine. Interpretability scores were high for

ECOHIS (66.7 in Fig. 2), CPQ11-14 (88.9 in Fig. 3), FIS and POQL (77.8 and 66.7 in Fig. 4), below 50 for eight instruments, and it was not possible to calculate them for six instruments.

The interview-administration version of the CPQ11-14 and CPQ8-10, as well as versions for telephone interview-administration of CPQ11-14 and self-administration of Child-OIDP, obtained 83 points in the EMPRO evaluation of the 'Alternative forms of administration' (Online Resource 4) because most metric properties were evaluated and scores were similar to those from the original administration versions. Similarly, short forms derived from Child Oral Health Impact Profile (Child-OHIP with 19 items), CPQ11-14 (with 16 and 8 items), FIS (with 8 items) and P-CPQ (with 16 items) were well rated, with scores over 80. The DDQ, with 8 items, is the only short form which has not yet demonstrated suitable metric properties nor enough comparability with the original instrument scores.

DISCUSSION

This review provides exhaustive information about the oral health-related quality of life instruments designed for preschoolers, schoolchildren, adolescents, and for the whole childhood and adolescence cycle, in order to facilitate an informed decision about the optimum instrument for a specific study according to metric properties and purpose of application. The most highly rated ones, according to the EMPRO tool's standard criteria, were the ECOHIS in preschoolers and the CPQ11-14 in schoolchildren. The FIS was shown to be an excellent instrument to measure the impact of oral health on the family. Results obtained by Child-OIDP and Child-OHIP in schoolchildren, as well as POQL and P-CPQ for any age, also make them recommendable. The SOHO-5 in preschoolers and CPQ8-10 in schoolchildren scored just above the threshold, indicating reasonably acceptable results, while instruments specific for malocclusion and hypodontia are only slightly below this.

In preschoolers, the five identified questionnaires showed generally an adequate process in their development and were valid; however, only the ECOHIS presented good reliability, responsiveness, and interpretability. SOHO-5, despite its high responsiveness (100 points), would need more research on reliability and interpretability. Furthermore, ECOHIS is the only questionnaire that has been culturally adapted to 14 languages or countries (allowing international studies), and has a section assessing the impact of oral problems on the family, making it the most complete instrument. Although ECOHIS and SOHO-5 were originally developed to assess the impact of dental caries, they have both been widely used to evaluate several oral pathologies [5,23] and are currently considered generic oral health-related quality of life instruments.

Among the nine instruments developed for schoolchildren and adolescents, the CPQ 11-14, Child-OIDP, and Child OHIP scored the highest in the overall EMPRO assessment, and also obtained good results for conceptual model, reliability, validity and responsiveness. Furthermore, the CPQ11-14 presented a high EMPRO score for interpretability (88.9), and has been validated for a number of dental and oro-facial pathologies, such as caries [24], enamel defects [25], dental fluorosis [26], malocclusion [27,28] and craniofacial disorders [29,30]. Although the CPQ11-14 is long (37 items), its short versions (8 and 16 items) allow to minimize administration burden and facilitate its

applicability. Unexpectedly, the CPQ 11-14 and the CPQ 8-10, developed by the same research group using the same strategy for each age stratum, presented substantially different EMPRO overall scores (82.1 vs 55.2). However, the worse results obtained by CPQ8-10 are mostly explained by the lack of studies on its interpretability, which penalizes substantially the overall EMPRO score since it is 1 of the 5 components. Finally, the two condition-specific instruments designed for malocclusion and hypodontia were well rated for conceptual model, reliability, and validity, but needed further research for responsiveness and interpretability

In children and adolescents of any age, the FIS, P-CPQ and POQL were those with the best EMPRO evaluation. However, it is important to remember that FIS measures the impact on the family, P-CPQ measures the impact on the child from the parent's perspective, and POQL has been validated only for dental caries. FIS and P-CPQ were developed for children between 6 and 14 years old, but their psychometric properties have been evaluated on children from 3 years of age onwards. Both instruments have derived short versions (8 and 16 items respectively) validated for several conditions, such as caries [31,32], oro-facial conditions [33,34], dental fluorosis [31] or orthodontic treatment [33,34], and have been adapted in 5 languages.

Our results are consistent with those reported by the previous systematic review [20] of Child-OIDP, Child-OHIP and P-CPQ showing acceptable evidence on validity. However, our EMPRO results in reliability, responsiveness and interpretability are more favorable for these instruments. These differences could be explained by the larger number of studies analyzed in our review than in theirs [20]: 54 studies vs 7 for CPQ11-14, 17 vs 2 for CPQ8-10, 21 vs 2 for Child-OIDP, and 16 vs 4 for Child OHIP. Furthermore, EMPRO uses several criteria covering different aspects of methods and the quality of the results for each evaluated attribute (from 3 criteria in responsiveness or interpretability to 7 in measurement model) [13]. The previous review, instead, synthesized the evaluation of each attribute's quality in a single criterion [14].

Age is a key issue in the assessment of patient-reported outcomes in children: it determines the direct or proxy sources of information, but also the way they experience oral health-related quality of life [35], which generates the need to develop instruments for each age strata. Only the PedsQL-OH has specific age versions [36] allowing to measure with

the same instruments the whole childhood and adolescence cycle without missing age-specific information. Proxy reporting is the standard in preschoolers [35] due to their difficulties in fully comprehending and/or communicating their perceptions. In this sense, the self-reported versions of the SOHO-5, and Michigan-OHRQoL are especially valuable, providing the children's own perspective in preschoolers [37]. A SOHO-5 study [38] obtained similar oral health-related quality of life results from parents and their children. Children usually start abstract thinking and compare their physical features and personality traits with their peers at the age of six, which allows self-reporting from this age on [39]. In general, evidence shows that parents underestimate the impact of children's oral problems, since they have a different perspective and limited knowledge, particularly related to social and emotional well-being [40]. Oral health-related quality of life domains directly observable by parents, such as physical complaints and functionality, concur better with children's perceptions [41,42]. In this sense, it is noteworthy that self-reporting was chosen for all instruments identified for schoolchildren and adolescents in our review.

In general, specific instruments scored worse than generic instruments according to the EMPRO evaluation. Then again, their potential advantages for certain study purposes or populations makes them worthy of further comment. Condition-specific instruments for malocclusion and hypodontia, symptom-specific for pain (DDQ and Child-DPQ), and treatment-specific for fixed appliances (IFAQ) have in common not reporting any information on responsiveness and presenting poor results on interpretability. This is important for longitudinal studies and clinical trials, where responsiveness and reproducibility are key attributes, as it cannot be assumed that a measure shown to be reliable and valid in cross-sectional studies will necessarily be sensitive to changes over time in a clinical intervention. Therefore, if responsiveness is not demonstrated prior to its application, it is not sure whether this change is real or generated by measurement error [43,44]. On the other hand, developing strategies to facilitate the interpretation of scores (such as estimating the minimal important difference by using anchor-based or distribution-based strategies) may help to extend the use of these instruments. Finally, it is also noteworthy that the Dental Freetime Trade-Off (DFTO) scale is the only econometric instrument identified in our search, designed as a preference-based health index [45]. However, its poor results in our metric quality evaluation indicate the need of future

research, mainly to confirm validity, reliability and responsiveness of the utilities for economic evaluation of oral health interventions.

The main strengths of this study are that the information regarding development process, metric properties, and administrative issues of oral health-related quality of life instruments in children and adolescents was obtained in a systematic review of the literature and was evaluated by experts using a standardized tool. The EMPRO combines two fundamental aspects: well-described and established criteria for the assessment of attributes, taking into account the quality of the methodology as well as the results obtained; and scores that allow for a direct comparison of attributes and overall performance among the evaluated instruments.

Our findings should be interpreted taking into account some limitations that deserve to be addressed. Firstly, we may have failed to identify all oral health-related quality of life instruments or relevant articles. However, to minimize this, we applied a sensitive search strategy, an additional hand search of references along with two online databases of patient-reported outcomes, and a double independent review process. Secondly, the EMPRO evaluation is based on the quantity and quality of published evidence on each instrument. A lack of information for a few EMPRO items or attributes penalizes the EMPRO scores, because the scoring algorithm counts any missing information as the worst possible rating. Nevertheless, to minimize such penalization, the EMPRO score was not calculated if information on half or more items/attributes was missing. For example, IFAQ and DFTO reported information only for conceptual model and reliability; therefore their overall EMPRO score was not calculated. This should be interpreted as the need to produce such information before an evidence-based decision can be made. Thirdly, EMPRO ratings may be biased by evaluators. It is important to notice that, to avoid this bias, each item of the EMPRO tool includes a comprehensive description which facilitates rating standardization; and we carried out a double independent evaluation followed by a consensus, as in the majority of previous EMPRO studies [46,16,17,47]. Fourthly, selecting the cut-off point of 50 as the threshold to consider the EMPRO scores acceptable for any purpose and setting is questionable. This threshold was obtained with data from the first two EMPRO studies [13,15]: the area under the Receiver Operating Characteristic (ROC) curve evaluating the agreement between EMPRO attribute scores and the reviewers' global recommendations

was of 0.87 (data not shown but available upon request). Therefore, this cut-off point should be used only as a guide to identify potential gaps. Fifthly, studies on the metric properties of the original instrument and the country versions derived from it were considered in our EMPRO evaluation. These studies contribute with information and provide valuable data about the generalization of the instruments' psychometric data. Finally, although clinical trials can provide indirect evidence on some metric properties such as validity, sensitivity to change or interpretability, none were included in our study, because they were not specifically designed for the assessment of metric properties nor included this as a secondary objective.

CONCLUSIONS

This is the first study to provide a systematic and reliable expert-based evaluation of all available oral health-related quality of life instruments in preschoolers, schoolchildren and adolescents. Our results support the selection for preschoolers of the Early Childhood Oral Health Impact Scale (ECOHIS), or the Scale of Oral Health Outcomes for 5-year-old (SOHO-5) in the case of preferring the children reporting themselves. When evaluating schoolchildren and adolescents, the age of the target population is a key factor in choosing among the following recommended instruments: CPQ11-14, Child OIDP (11-15 years), Child-OHIP (8-15 years), or CPQ8-10. The administration of Child Perceptions Questionnaires (CPQ11-14 or CPQ8-10) together with Parental-Caregiver Perceptions Questionnaire (PCPQ) and Family Impact Scale (FIS) can provide a complete evaluation of the patient's oral health-related quality of life, by measuring both the parents' and children's perceptions and also the impact on the family. The Pediatric Oral Health-Related Quality of Life (POQL) is also recommended for ages 2-16 years, both with proxy and self-completion. However, the instruments designed to assess a specific condition, symptom or treatment, as well as the only questionnaire developed for economic evaluation, need further research on their metric properties before taking advantage of their specificity. Our results may facilitate the decision-making process regarding the correct instrument selection and its use for each study purpose.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: The authors declare that they have no conflict of interest.

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REFERENCES

1. Zaror C, Pineda P, Orellana J (2011) Prevalence of early childhood caries and associated factors in 2 and 4 year-old Chilean children. *Int J Odontostomatol* 5:171-177
2. Aldrigui JM, Jabbar NS, Bonecker M, Braga MM, Wanderley MT (2014) Trends and associated factors in prevalence of dental trauma in Latin America and Caribbean: a systematic review and meta-analysis. *Community Dent Oral Epidemiol* 42:30-42. doi:10.1111/cdoe.12053
3. Do LG (2012) Distribution of caries in children: variations between and within populations. *J Dent Res* 91:536-543. doi:10.1177/0022034511434355
4. Kassebaum NJS, A.G.C.; Bernabé, E.; Fleming T.D.; Reynolds, A.E.; Vos, T.; Murray, C.J.L.; Marcenes, W. ; GBD 2015 Oral Health Collaborators (2017) Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990–2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *J Dent Res* 96:380-387
5. Abanto J, Carvalho TS, Mendes FM, Wanderley MT, Bonecker M, Raggio DP (2011) Impact of oral diseases and disorders on oral health-related quality of life of preschool children. *Community Dent Oral Epidemiol* 39:105-114. doi:10.1111/j.1600-0528.2010.00580.x
6. Antonarakis GS, Patel RN, Tompson B (2013) Oral health-related quality of life in non-syndromic cleft lip and/or palate patients: a systematic review. *Community Dent Health* 30:189-195
7. Bendo CB, Paiva SM, Varni JW, Vale MP (2014) Oral health-related quality of life and traumatic dental injuries in Brazilian adolescents. *Community Dent Oral Epidemiol* 42:216-223. doi:10.1111/cdoe.12078
8. Kragt L, Dharmo B, Wolvius EB, Ongkosuwito EM (2016) The impact of malocclusions on oral health-related quality of life in children-a systematic review and meta-analysis. *Clin Oral Investig* 20:1881-1894. doi:10.1007/s00784-015-1681-3

9. Zaror C, Martinez-Zapata MJ, Abarca J, Diaz J, Pardo Y, Pont A, Ferrer M (2018) Impact of traumatic dental injuries on quality of life in preschoolers and schoolchildren: A systematic review and meta-analysis. *Community Dent Oral Epidemiol* 46:88-101. doi:10.1111/cdoe.12333
10. Zhou Y, Wang Y, Wang X, Voliere G, Hu R (2014) The impact of orthodontic treatment on the quality of life a systematic review. *BMC Oral Health* 14:66. doi:10.1186/1472-6831-14-66
11. Sisco L, Broder HL (2011) Oral health-related quality of life: what, why, how, and future implications. *J Dent Res* 90:1264-1270. doi:10.1177/0022034511399918
12. Aaronson N, Alonso J, Burnam A, Lohr KN, Patrick DL, Perrin E, Stein RE (2002) Assessing health status and quality-of-life instruments: attributes and review criteria. *Qual Life Res* 11:193-205
13. Valderas JM, Ferrer M, Mendivil J, Garin O, Rajmil L, Herdman M, Alonso J, Scientific Committee on "Patient-Reported Outcomes" of the IRYSS Network (2008) Development of EMPRO: a tool for the standardized assessment of patient-reported outcome measures. *Value Health* 11:700-708. doi:10.1111/j.1524-4733.2007.00309.x
14. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM, de Vet HC (2010) The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Qual Life Res* 19:539-549. doi:10.1007/s11136-010-9606-8
15. Garin O, Herdman M, Vilagut G, Ferrer M, Ribera A, Rajmil L, Valderas JM, Guillemin F, Revicki D, Alonso J (2014) Assessing health-related quality of life in patients with heart failure: a systematic, standardized comparison of available measures. *Heart Fail Rev* 19:359-367. doi:10.1007/s10741-013-9394-7
16. Schmidt S, Ferrer M, Gonzalez M, Gonzalez N, Valderas JM, Alonso J, Escobar A, Vrotsou K, Group E (2014) Evaluation of shoulder-specific patient-reported outcome measures: a systematic and standardized comparison of available evidence. *J Shoulder Elbow Surg* 23:434-444. doi:10.1016/j.jse.2013.09.029

17. Schmidt S, Garin O, Pardo Y, Valderas JM, Alonso J, Rebollo P, Rajmil L, Garcia-Forero C, Ferrer M, Group E (2014) Assessing quality of life in patients with prostate cancer: a systematic and standardized comparison of available instruments. *Qual Life Res* 23:2169-2181. doi:10.1007/s11136-014-0678-8
18. Gibbons CJ, Bee PE, Walker L, Price O, Lovell K (2014) Service user- and carer-reported measures of involvement in mental health care planning: methodological quality and acceptability to users. *Front Psychiatry* 5:178. doi:10.3389/fpsy.2014.00178
19. Maratia S, Cedillo S, Rejas J (2016) Assessing health-related quality of life in patients with breast cancer: a systematic and standardized comparison of available instruments using the EMPRO tool. *Qual Life Res* 25:2467-2480. doi:10.1007/s11136-016-1284-8
20. Gilchrist F, Rodd H, Deery C, Marshman Z (2014) Assessment of the quality of measures of child oral health-related quality of life. *BMC Oral Health* 14:40. doi:10.1186/1472-6831-14-40
21. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 6:e1000097. doi:10.1371/journal.pmed.1000097
22. Higgins JPT, Green S (editors) (2011). *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*. The Cochrane Collaboration. Available from www.handbook.cochrane.org.
23. Gomes MC, Pinto-Sarmento TC, Costa EM, Martins CC, Granville-Garcia AF, Paiva SM (2014) Impact of oral health conditions on the quality of life of preschool children and their families: a cross-sectional study. *Health Qual Life Outcomes* 12:55. doi:10.1186/1477-7525-12-55
24. Shin HS, Han DH, Shin MS, Lee HJ, Kim MS, Kim HD (2015) Korean version of child perceptions questionnaire and dental caries among Korean children. *PloS One* 10:e0116011. doi:10.1371/journal.pone.0116011
25. Marshman Z, Rodd H, Stern M, Mitchell C, Locker D, Jokovic A, Robinson PG (2005) An evaluation of the Child Perceptions Questionnaire in the UK. *Community Dent Health* 22:151-155

26. Kumar S, Kroon J, Lalloo R, Johnson NW (2016) Psychometric Properties of Translation of the Child Perception Questionnaire (CPQ11-14) in Telugu Speaking Indian Children. *PloS One* 11:e0149181. doi:10.1371/journal.pone.0149181
27. O'Brien C, Benson PE, Marshman Z (2007) Evaluation of a quality of life measure for children with malocclusion. *J Orthod* 34:185-193. doi:10.1179/146531207225022185
28. O'Brien K, Wright JL, Conboy F, Macfarlane T, Mandall N (2006) The child perception questionnaire is valid for malocclusions in the United Kingdom. *Am J Orthod Dentofacial Orthop* 129:536-540. doi:10.1016/j.ajodo.2004.10.014
29. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G (2002) Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res* 81:459-463
30. Wogelius P, Gjørup H, Haubek D, Lopez R, Poulsen S (2009) Development of Danish version of child oral-health-related quality of life questionnaires (CPQ8-10 and CPQ11-14). *BMC Oral Health* 9:11. doi:10.1186/1472-6831-9-11
31. Kumar S, Kroon J, Lalloo R, Johnson NW (2016) Validity and reliability of short forms of parental-caregiver perception and family impact scale in a Telugu speaking population of India. *Health Qual Life Outcomes* 14:34. doi:10.1186/s12955-016-0433-7
32. Marshman Z, Rodd H, Stem M, Mitchell C, Robinson PG (2007) Evaluation of the Parental Perceptions Questionnaire, a component of the COHQoL, for use in the UK. *Community Dent Health* 24 (4):198-204
33. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G (2003) Measuring parental perceptions of child oral health-related quality of life. *J Public Health Dent* 63:67-72
34. Locker D, Jokovic A, Stephens M, Kenny D, Tompson B, Guyatt G (2002) Family impact of child oral and oro-facial conditions. *Community Dent Oral Epidemiol* 30:438-448
35. Wallander JL, Schmitt M, Koot HM (2001) Quality of life measurement in children and adolescents: issues, instruments, and applications. *J Clin Psychol* 57:571-585

36. Steele MM, Steele RG, Varni JW (2009) Reliability and Validity of the PedsQL Oral Health Scale: Measuring the relationship between child oral health and health-related quality of life. *Child Health Care* 38:228-244. doi:10.1080/02739610903038818
37. Piovesan C, Batista A, Ferreira F, Ardenghi TM (2009) Oral health-related quality of life in children: Conceptual issues. *Rev Odonto Cienc* 24 (1):81-85
38. Abanto J, Tsakos G, Paiva SM, Raggio DP, Celiberti P, Bonecker M (2014) Agreement between children aged 5-6 years and their mothers in rating child oral health-related quality of life. *I Int J Paediatr Dent* 24:373-379. doi:10.1111/ipd.12081
39. Barbosa TS, Gavião MB (2008) Oral health-related quality of life in children: part I. How well do children know themselves? A systematic review. *Int J Dent Hyg* 6:93-99. doi:10.1111/j.1601-5037.2007.00276.x
40. Barbosa TS, Gavião MB (2008) Oral health-related quality of life in children: part III. Is there agreement between parents in rating their children's oral health-related quality of life? A systematic review. *Int J Dent Hyg* 6:108-113. doi:10.1111/j.1601-5037.2007.00271.x
41. Theunissen NC, Vogels TG, Koopman HM, Verrips GH, Zwinderman KA, Verloove-Vanhorick SP, Wit JM (1998) The proxy problem: child report versus parent report in health-related quality of life research. *Qual Life Res* 7:387-397
42. Reissmann DR, John MT, Sagheri D, Sierwald I (2016) Diagnostic accuracy of parents' ratings of their child's oral health-related quality of life. *Qual Life Res* 26:881-891. doi:10.1007/s11136-016-1427-y
43. Lee GH, McGrath C, Yiu CK, King NM (2011) Sensitivity and responsiveness of the Chinese ECOHIS to dental treatment under general anaesthesia. *Community Dent Oral Epidemiol* 39:372-377. doi:10.1111/j.1600-0528.2010.00604.x
44. Locker D, Jokovic A, Clarke M (2004) Assessing the responsiveness of measures of oral health-related quality of life. *Community Dent Oral Epidemiol* 32:10-18. doi:10.1111/j.1600-0528.2004.00114.x
45. Fyffe HE, Deery C, Nugent Z, Nuttall NM, Pitts NB (1999) The reliability of two methods of utility assessment in dentistry. *Community Dent Health* 16:72-79

46. Khurana V, Sharma H, Afroz N, Callan A, Medin J (2017) Patient-reported outcomes in multiple sclerosis: a systematic comparison of available measures. *Eur J Neurol* 24:1099-1107. doi:10.1111/ene.13339
47. Sinclair S, Russell LB, Hack TF, Kondejewski J, Sawatzky R (2017) Measuring Compassion in Healthcare: a comprehensive and critical review. *Patient* 10:389-405. doi:10.1007/s40271-016-0209-5
48. Versloot J, Veerkamp JS, Hoogstraten J (2004) Dental Discomfort Questionnaire: predicting toothache in preverbal children. *Eur J Paediatr Dent* 5:170-173
49. Pahel BT, Rozier RG, Slade GD (2007) Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). *Health Qual Life Outcomes* 5:6. doi:10.1186/1477-7525-5-6
50. Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR (2003) Early childhood caries and quality of life: child and parent perspectives. *Pediatr Dent* 25:431-440
51. Mathur VP, Dhillon JK, Logani A, Agarwal R (2014) Development and validation of oral health-related early childhood quality of life tool for North Indian preschool children. *Indian J Dent Res* 25:559-566. doi:10.4103/0970-9290.147078
52. Tsakos G, Blair YI, Yusuf H, Wright W, Watt RG, Macpherson LM (2012) Developing a new self-reported scale of oral health outcomes for 5-year-old children (SOHO-5). *Health Qual Life Outcomes* 10:62. doi:10.1186/1477-7525-10-62
53. Barretto ER, Paiva SM, Pordeus IA, Ferreira e Ferreira E (2011) Validation of a child dental pain questionnaire instrument for the self-reporting of toothache in Children. *Pediatr Dent* 33:228-232
54. Broder HL, McGrath C, Cisneros GJ (2007) Questionnaire development: face validity and item impact testing of the Child Oral Health Impact Profile. *Community Dent Oral Epidemiol* 35 Suppl 1:8-19. doi:10.1111/j.1600-0528.2007.00401.x
55. Gherunpong S, Tsakos G, Sheiham A (2004) Developing and evaluating an oral health-related quality of life index for children; the CHILD-OIDP. *Community Dent Health* 21:161-169

56. Jokovic A, Locker D, Tompson B, Guyatt G (2004) Questionnaire for measuring oral health-related quality of life in eight- to ten-year-old children. *Pediatr Dent* 26:512-518
57. Mandall NA, Vine S, Hullah R, Worthington HV (2006) The impact of fixed orthodontic appliances on daily life. *Community Dent Health* 23:69-74
58. Patel N, Hodges SJ, Hall M, Benson PE, Marshman Z, Cunningham SJ (2016) Development of the Malocclusion Impact Questionnaire (MIQ) to measure the oral health-related quality of life of young people with malocclusion: part 1 - qualitative inquiry. *J Orthod* 43:7-13. doi:10.1080/14653125.2015.1114712
59. Akram AJ, Jerreat AS, Woodford J, Sandy JR, Ireland AJ (2011) Development of a condition-specific measure to assess quality of life in patients with hypodontia. *Orthod Craniofac Res* 14:160-167. doi:10.1111/j.1601-6343.2011.01517.x
60. Huntington NL, Spetter D, Jones JA, Rich SE, Garcia RI, Spiro A, 3rd (2011) Development and validation of a measure of pediatric oral health-related quality of life: the POQL. *J Public Health Dent* 71:185-193

Table 1: Summarized characteristics of instruments designed for preschoolers, in alphabetical order.

Instrument	Purpose of Development (Age)	Administration mode	Dimensions (No. of items)	Response options	Scores (range)	Original & adapted languages
1.Dental Discomfort Questionnaire (DDQ) [48]	Dental Discomfort/ Dental Pain (2-5 years)	Proxy-administered	Occurrence of toothache (3) Behavior associated discomfort (12)	1 st part: 4-point Likert scale 2 nd part: 3-point Likert scale	Global score (0-24)	English Netherland Portuguese
2.Early Childhood Oral Health Impact Scale (ECOHIS) [49]	Oral diseases (0-5 years)	Proxy-administered	Symptom (1) Function (4) Psychology(2) Social (2) Parental distress (2) Family function (2)	5-point Likert scale	Global score (0-52) Scores by dimension	English Chinese Spanish Portuguese (Portugal, Luanda) French Persian Arabic Turkish Lithuanian Kiswahili Kannada Malayalam Malay
3.Michigan Oral Health-Related Quality of Life (Michigan-OHRQoL) [50]	Oral diseases (1-5 years)	Self-administered Proxy-administered	Unidimensional Child version (9) Parent version (10)	Child version: yes/no Parent version: 5-point Likert scale	No information	English
4.Oral Health-related Early Childhood Quality of Life (OH-ECQOL) [51]	Oral diseases (2-5 years)	Proxy-administered	Unidimensional - Child Impact (12) - Family Impact (4)	3-point Likert scale	Global score (16-48)	Hindi
5.Scale of Oral Health Outcomes for 5-year-old children (SOHO-5) [52]	Oral diseases (5 years)	Self-administered Proxy-administered	Unidimensional (7)	Child version: 3-point Likert scale Parental version 5-point Likert scale	Global Score (Child version 0-14) (Parental version 0-28)	English Portuguese (Brazil)

Table 2: Summarized characteristics of instruments designed for schoolchildren and adolescents, in alphabetical order.

Instrument	Purpose of Development (Age)	Administration mode	Dimensions (No. of items)	Response options	Scores (range)	Original & adapted languages
1. Child dental pain questionnaire (Child-DPQ) [53]	Dental pain (8-9 years)	Self-administered	Prevalence (2) Severity (2) Impact (2)	Different types of responses	Global score (0- 15)	English
2.Child Oral Health Impact Profile (Child-OHIP) [54]	Oral diseases (8-15 years)	Self-administered	Oral health (10) Functional (6) Social-emotional Well-being (8) School environment (6) Self-images (4)	5-point Likert scale	Global Score (34-170)	English Persian Dutch Chinese German Korean French
3.Child-Oral Impact on Daily Performance Index (Child-OIDP) [55]	Oral diseases (11-15 years)	Self-administered Interviewer-administered	Physical (4) Psychological Social (4)	3-point Likert scale	Global Score (0-100)	10*
4.Child Perceptions Questionnaire 8-10 (CPQ8-10) [56]	Oral diseases (8-10 years)	Self-administered Interview administered	Oral symptoms (5) Functional limitations (5) Emotional well-being (5) Social well-being (10)	5-point Likert scale	Global Score (1-55)	English Spanish Portuguese Bosnian Cambodian Danish Korean Japanese
5.Child Perceptions Questionnaire 11-14 (CPQ11-14) [29]	Oral diseases (11-14 years)	Self-administered Interview administered Telephone interview	Oral symptoms (6) Functional limitations (9) Emotional well-being (9) Social well-being(13)	5-point Likert scale	Global Score (1-80)	12**
6.Dental Freetime Trade-Off scale (DFTO) [45]	Utility (14-19 years)	Self-administered	Unidimensional (5)	Different types of responses	Global score (minutes)	English
7.Impact of Fixed Appliances Questionnaire (IFAQ) [57]	Fixed orthodontic appliances (10-18 years)	Self-administered	No information	5-point Likert scale	Global score (0-34)	English
8.Malocclusion Impact Questionnaire (MIQ) [58]	Malocclusion (10-16 years)	Self-administered	Appearance of teeth Effect on social interactions Oral health and function Global (28)	3-point Likert scale	Global score (0-64)	English
9.Oral Health Related Quality of Life for patients with Hypodontia (OHRQoL Hypodontia) [59]	Hypodontia-Anodontia (11-18 years)	Self-administered	No information	No information	No information	English

*Child-OIDP is in 10 languages: **Thai**, English, Kannada, Spanish, Portuguese, Kiswahili, Arabic, French, Malay, and Hindi

CPQ11-14 is in 12 languages: **English, Spanish, Portuguese, German, Arabic, Malay, Thai, Italian, Cambodian, Danish, Korean, and Telugu.

Table 3: Summarized characteristics of instruments designed for the whole childhood and adolescence cycle

Instrument	Purpose of Development (Age)	Administration mode	Dimensions (No. of items)	Response options	Scores (range)	Original & adapted languages
1.Family Impact Scale (FIS) [34]	Family impact Oral disease (2-14 years)	Proxy-administered	Parental/family activity (5) Parental emotions (4) Family conflict (4)	5-point Likert scale	Global score (0-33)	English Portuguese Chinese Telugu
2.Parental-Caregiver Perceptions Questionnaire (P-CPQ) [33]	Oral diseases (2-14 years)	Proxy-administered	Oral symptoms (6) Functional limitations (8) Emotional well-being (7) Social well-being(10)	5-point Likert scale	Global score (0-124)	English Spanish Portuguese Chinese Telugu
3.Pediatric Quality of Life Inventory™ Oral Health Scale™ (PedsQL™ Oral Health Scale™) [36]	Oral diseases (2-18 years)	Self-administered Proxy-administered	Unidimensional (5)	5-point Likert scale	Global score (0-100)	English Portuguese (Brazil) Persian
4.Pediatric Oral Health-Related Quality of Life (POQL) [60]	Oral diseases (2-16 years)	Self-administered Proxy-administered	Physical functioning Role functioning Emotional impact Social impact Global (10)	4 and 5-point Likert scale	Global score (0-100)	English Spanish

FIGURE LEGENDS

Fig. 1. Flowchart of the systematic literature review, instruments identified. [Total number of articles per instrument (articles evaluating cross-cultural versions in brackets)].

Fig. 2. Overall EMPRO ranking and attribute-specific scores of instruments designed for preschoolers (Age 0-6 years).

Figure legend: The grey line on 50 (half of the 100 maximum theoretical points) represents the reasonably acceptable cut-off defined for EMPRO scores.

Abbreviations: Dental Discomfort Questionnaire (DDQ), Early Childhood Oral Health Impact Scale (ECOHIS), Michigan oral health-related QoL scale (Michigan-OHRQoL), Oral Health-related Early Childhood Quality of Life tool (OH-ECQOL), and Scale of Oral Health Outcomes for 5-year-old children (SOHO-5).

Fig. 3. Overall EMPRO ranking and attribute-specific scores of instruments designed for schoolchildren and adolescents (Age 7-18 years).

Figure legend: The grey line on 50 (half of the 100 maximum theoretical points) represents the reasonably acceptable cut-off defined for EMPRO scores.

Abbreviations: Child Dental Pain Questionnaire (Child-DPQ), Child Oral Health Impact Profile (Child-OHIP), Child-Oral Impact on Daily Performance Index (Child-OIDP), Child Perceptions Questionnaire 8-10 (CPQ8-10), Child Perceptions Questionnaire 11-14 (CPQ11-14), Dental Freetime Trade-Off Scale (DFTO), Impact of Fixed Appliances Questionnaire (IFAQ), Malocclusion Impact Questionnaire (MIQ), and Oral Health-Related Quality of Life for patients with Hypodontia (OHRQoL Hypodontia).

Fig. 4. Overall EMPRO ranking and attribute-specific scores of instruments designed for children and adolescents (Age 0-18 years)

Figure legend: The grey line on 50 (half of the 100 maximum theoretical points) represents the reasonably acceptable cut-off defined for EMPRO scores.

Abbreviations: Family Impact Scale (FIS), Parental-Caregiver Perceptions Questionnaire (P-CPQ), Pediatric Oral Health-Related Quality of Life (POQL), and Pediatric Quality of Life Inventory™ Oral Health Scale™ (PedsQL-OH™).

3832 Citations identified from electronic database searches

- MEDLINE [n=2055]
- EMBASE [n=1451]
- LILACS [n=206]
- SCIELO [n=76]
- COCHRANE [n=44]

577 Excluded (duplicates)

3255 Potentially relevant articles identified for **title** review

2828 Articles excluded

- No OHRLQoL measure used [n=2533]
- Generic PRO measure used [n=241]
- Adult population [n=13]
- No original article format [n=21]

427 Potentially relevant articles identified for abstract review

281 Articles excluded

- Article without metric property information [n=203]
- Generic PRO measure used [n=19]
- Adult population [n=38]
- No original article format [n=18]
- Language not included [n=3]

146 Potentially relevant articles identified for data extraction

25 Articles excluded

- Adult population [n=21]
- Article without metric property information [n=4]

11 Articles included after identification by hand-search and online databases of PRO

132 Articles identified and used in the EMPRO evaluation (18 Instruments)

Preschoolers (Age 0-5)

- DDQ [n=7 (2)]
- ECOHIS [n=27 (22)]
- Michigan OH [n=1]
- OH-ECQOL [n=1]
- SOHO-5 [n=5 (4)]

Schoolchildren and Adolescents (Age 6-18)

- Child-DPQ [n=1]
- Child-OHIP [n=16 (6)]
- Child-OIDP [n=21 (14)]
- CPQ8-10 [n=17 (16)]
- CPQ11-14 [n=54 (46)]
- DFTO [n=1]
- IFAQ [n=1]
- MIQ [n=2]
- OHRQoL Hypodontia [n=2]

Children and Adolescents (Age 0-18)

- FIS [n=10 (7)]
- P-CPQ [n=22 (18)]
- PedsQI OH [n=4 (3)]
- POQL [n=3]

Overall Score

Conceptual and measurement model

Reliability

Validity

Responsiveness

Interpretability

Overall Score

Reliability

Responsiveness

Conceptual and measurement model

Validity

Interpretability

Overall Score

Conceptual and measurement model

Reliability

Validity

Responsiveness

Interpretability

Supplement 1: Search strategy on MEDLINE

((((((((((((((((((Validation Studies[pt]) OR Psychometrics[mh]) OR Questionnaires[mh]) OR feasibility[tiab]) OR instrument[tiab]) OR instruments[tiab]) OR item*[tiab]) OR index[ti]) OR measure[tiab]) OR measures[tiab]) OR questionnaire*[ti]) OR scale[ti]) OR scales[ti]) OR reliability[tiab]) OR validation[tiab]) OR validity[tiab]) OR "Cross-Cultural Comparison"[Mesh])) AND (((((((("Quality of Life"[MeSH]) OR Quality of life[tiab]) OR HRQoL[tiab]) OR QoL[tiab]) OR QALY[tiab]) OR utility[tiab]) OR disability[tiab]) OR "Disability Evaluation"[Mesh]) OR "Quality-Adjusted Life Years"[Mesh])) AND (((((((("Oral Health"[MeSH]) OR "Dental Caries"[MeSH]) OR oral[tiab]) OR caries[tiab]) OR orofacial[tiab]) OR dental[tiab]) OR periodontal[tiab]) OR gingivitis[tiab]) OR maxillofacial[tiab]) OR temporomandibular[tiab]) OR tooth[tiab]) OR teeth[tiab]) OR "Periodontal Diseases"[Mesh]) OR "Tooth"[Mesh]) OR "Maxillofacial Injuries"[Mesh])) AND (((((((("Child"[MeSH]) OR "Infant"[MeSH]) OR "Adolescent"[MeSH]) OR "Pediatrics"[MeSH]) OR "Pediatric Dentistry"[MeSH]) OR pediatric*[tiab]) OR paediatric*[tiab]) OR infant*[tiab]) OR child*[tiab]) OR teen*[tiab]) OR adolescent*[tiab])

Supplement 2: Bibliographic reference lists for each instrument included in the standardized evaluation using the EMPRO tool.

PRESCHOOLER (AGE 0-5)

Dental Discomfort Questionnaire (DDQ)

1. Daher A, Versloot J, Costa LR (2014) The cross-cultural process of adapting observational tools for pediatric pain assessment: the case of the Dental Discomfort Questionnaire. BMC Res Notes 7:897.
2. Daher A, Versloot J, Leles CR, Costa LR (2014). Screening preschool children with toothache: validation of the Brazilian version of the Dental Discomfort Questionnaire. Health Qual. Life Outcomes 12:30.
3. Versloot J, Hall-Scullin E, Veerkamp JSJ, Freeman R (2008) Dental discomfort questionnaire: its use with children with a learning disability. Spec Care Dent 28:140–144.
4. Versloot J, Veerkamp J, Hoogstraten J (2006) Dental Discomfort Questionnaire: assessment of dental discomfort and/or pain in very young children Community Dent Oral Epidemiol 34:47–52.
5. Versloot J, Veerkamp JS, Hoogstraten J (2004) Dental Discomfort Questionnaire: predicting toothache in preverbal children. Eur J Paediatr Dent 5:170–173.
6. Versloot J, Veerkamp JSJ, Hoogstraten J (2005) Dental discomfort questionnaire for young children before and after treatment. Acta Odontol Scand 63:367–70.
7. Versloot J, Veerkamp JSJ, Hoogstraten J (2006) Dental Discomfort Questionnaire for young children following full mouth rehabilitation under general anaesthesia: a follow-up report. Eur Arch Paediatr Dent. 7:126–9.

Early Childhood Oral Health Impact Scale (ECOHIS)

1. Abanto J, Paiva SM, Sheiham A, Tsakos G, Mendes FM, Cordeschi T, Vidigal EA, Bönecker M (2016) Changes in preschool children's OHRQoL after treatment of dental caries: responsiveness of the B-ECOHIS. Int J Paediatr Dent 26:259–265.
2. Arrow P (2016). Responsiveness and sensitivity of the Early Childhood Oral Health Impact Scale to primary dental care for early childhood caries. Community Dent Oral Epidemiol 44:1–10.
3. Arrow P, Klobas E (2015) Evaluation of the Early Childhood Oral Health Impact Scale in an Australian preschool child population. Aust Dent J 60:375–381.
4. Bhat SG, Sivaram R (2015) Psychometric properties of the Malayalam version of ECOHIS. J Indian Soc Pedod Prev Dent 33:234–238.
5. Bordoni N, Ciaravino O, Zambrano O, Villena R, Beltran-Aguilar E, Squassi A (2012) Early Childhood Oral Health Impact Scale (ECOHIS). Translation and validation in Spanish language. Acta Odontol Latinoam 25:270–278.
6. Du RY, McGrath C, Yiu CKY, King NM (2010) Health- and oral health-related quality of life among preschool children with cerebral palsy. Qual Life Res 19:1367–1371.
7. Fernandes I, Ramos-Jorge J, Ramos-Jorge M, Bönecker M, Abanto J, Marques L, Paiva S (2015) Correlation and comparative analysis of discriminative validity of the Scale of Oral Health Outcomes for Five-Year-Old Children (SOHO-5) and the Early Childhood Oral Health Impact Scale (ECOHIS) for dental caries. BMC Oral Health 15:29.
8. Hashim AN, Yusof ZYM, Esa R (2015) The Malay version of the Early Childhood Oral Health Impact Scale (Malay-ECOHIS) – assessing validity and reliability. Health Qual Life Outcomes 13:190.
9. Jabarifar S-E, Golkari A, Ijadi MH, Jafarzadeh M, Khadem P (2010) Validation of a Farsi version of the early childhood oral health impact scale (F-ECOHIS). BMC Oral Health 10:4–11.

10. Jankauskiene B, Narbutaite J, Kubilius R, Gleiznys A (2012) Adaptation and validation of the early childhood oral health impact scale in Lithuania. *Stomatol Balt Dent Maxillofac J* 14:108–113.
11. Lee GHM, McGrath C, Yiu CKY, King NM (2009) Translation and validation of a Chinese language version of the Early Childhood Oral Health Impact Scale (ECOHIS). *Int J Paediatr Dent* 19:399–405.
12. Lee GHM, McGrath C, Yiu CKY, King NM (2010) A comparison of a generic and oral health-specific measure in assessing the impact of early childhood caries on quality of life. *Community Dent Oral Epidemiol* 38:333–339.
13. Lee GHM, McGrath C, Yiu CKY, King NM (2011) Sensitivity and responsiveness of the Chinese ECOHIS to dental treatment under general anaesthesia. *Community Dent Oral Epidemiol* 39:372–377.
14. Li S, Malkinson S, Veronneau J, Allison PJ (2008) Testing responsiveness to change for the early childhood oral health impact scale (ECOHIS). *Community Dent Oral Epidemiol* 36:542–548.
15. Li S, Veronneau J, Allison PJ (2008) Validation of a French language version of the Early Childhood Oral Health Impact Scale (ECOHIS). *Health Qual Life Outcomes* 6:9–15.
16. López Ramos RP, García Rupaya CR, Villena-Sarmiento R, Bordoni NE (2013) Cross cultural adaptation and validation of the Early Childhood Health Impact Scale (ECOHIS) in Peruvian preschoolers. *Acta odontológica Latinoam*. 26:60–67.
17. Martins-Júnior PA, Ramos-Jorge J, Paiva SM, Marques LS, Ramos-Jorge ML (2012) Validations of the Brazilian version of the Early Childhood Oral Health Impact Scale (ECOHIS). *Cad Saude Publica* 28:367–374.
18. Masumo R, Bardsen A, Mashoto K, Astrom AN (2012) Child- and family impacts of infants' oral conditions in Tanzania and Uganda- a cross sectional study. *BMC Res Notes* 5:538–547.
19. Pahel B, Rozier RG, Slade G (2007) Parental perceptions of children's oral health: The Early Childhood Oral Health Impact Scale (ECOHIS). *Health Qual Life Outcomes* 5:6–15.
20. Pani SC, Badea L, Mirza S, Elbaage N (2012) Differences in perceptions of early childhood oral health-related quality of life between fathers and mothers in Saudi Arabia. *Int J Paediatr Dent* 22:244–249.
21. Peker K, Uysal Ö, Bermek G. (2011) Cross - cultural adaptation and preliminary validation of the Turkish version of the early childhood oral health impact scale among 5-6-year-old children. *Health Qual Life Outcomes* 9:118.
22. Scarpelli AC, Oliveira BH, Tesch FC, Leão AT, Pordeus I a, Paiva SM (2011) Psychometric properties of the Brazilian version of the Early Childhood Oral Health Impact Scale (B-ECOHIS). *BMC Oral Health* 11:19.
23. Tesch FC, de Oliveira BH, Leão A (2008) Equivalência semântica da versão em português do instrumento Early Childhood Oral Health Impact Scale Semantic equivalence of the Brazilian version of the Early Childhood Oral Health Impact Scale. *Cad Saude Publica* 24:1897–1909.
24. Thomson WM, Foster Page L a, Malden PE, Gaynor WN, Nordin N (2014) Comparison of the ECOHIS and short-form P-CPQ and FIS scales. *Health Qual Life Outcomes* 12:36.
25. Wong HM, McGrath CPJ, King NM (2011) Rasch validation of the early childhood oral health impact scale. *Community Dent Oral Epidemiol*. 39:449–457.
26. Worsley DJ, Marshman Z, Robinson PG, Jones K (2016) Evaluation of the telephone and clinical NHS urgent dental service in Sheffield. *Community Dent Health* 33:9–14.
27. Yawary R, Anthonappa RP, Ekambaram M, McGrath C, King NM (2016) Changes in the oral health-related quality of life in children following comprehensive oral rehabilitation under general anaesthesia. *Int J Paediatr Dent* 26:322–329.

Michigan Oral health related QoL scale (Michigan- OHRQoL)

1. Filstrup S, Dan B, Marcio da F, Leslie L, Angela W, Marita I (2003) Early Childhood Caries and Quality of Life: Child and Parent Perspectives. *Pediatr Dent* 25:431–40.

Oral Health - related Early Childhood Quality of Life (OH- ECQOL)

1. Mathur VP, Dhillon JK, Logani A, Agarwal R (2014) Development and validation of oral health-related early childhood quality of life tool for North Indian preschool children. *Indian J Dent Res* 25:559–566.

Scale of Oral Health Outcomes for 5-year-old children (SOHO-5)

1. Abanto J, Tsakos G, Ardenghi TM, Paiva SM, Raggio DP, Sheiham A, Bönecker M (2013) Responsiveness to change for the Brazilian Scale of Oral Health Outcomes for 5-year-old children (SOHO-5). *Health Qual Life Outcomes* 11:1–7.
2. Abanto J, Tsakos G, Paiva SM, Goursand D, Raggio DP, Bönecker M (2013) Cross-cultural adaptation and psychometric properties of the Brazilian version of the scale of oral health outcomes for 5-year-old children (SOHO-5). *Health Qual Life Outcomes* 11:11–16.
3. Alvarez JHA (2012) Adaptação transcultural, propriedades psicométricas e aplicação da versão brasileira do SOHO-5, instrumento de qualidade de vida relacionada à saúde bucal para crianças de 5 anos de idade. Dissertation, Universidade de Sao Paulo
4. Fernandes I, Ramos-Jorge J, Ramos-Jorge M, Bönecker M, Abanto J, Marques L, Paiva S (2015) Correlation and comparative analysis of discriminative validity of the Scale of Oral Health Outcomes for Five-Year-Old Children (SOHO-5) and the Early Childhood Oral Health Impact Scale (ECOHIS) for dental caries. *BMC Oral Health* 15:29.
5. Tsakos G, Blair YI, Yusuf H, Wright W, Watt RG, Macpherson LMD (2012) Developing a new self-reported scale of oral health outcomes for 5-year-old children (SOHO-5). *Health Qual. Life Outcomes* 10:62.

SCHOOLCHILDREN AND ADOLESCENTS (AGE 6-18)

Child dental pain questionnaire (Child-DPQ)

1. Barrêto ER, Paiva SM, Pordeus IA, Ferreira e Ferreira E (2011) Validation of a child dental pain questionnaire instrument for the self-reporting of toothache in Children. *Pediatr Dent* 33:228–32.

Child Oral Health Impact Profile (Child-OHIP)

1. Asgari I, Ahmady AE, Broder H, Eslamipour F, Wilson-Genderson M (2013) Assessing the oral health-related quality of life in Iranian adolescents: validity of the Persian version of the Child Oral Health Impact Profile (COHIP). *Oral Health Prev Dent*. 11:147–54.
2. Bos A, Hoogstraten J, Zentner A (2010) Perceptions of Dutch orthodontic patients and their parents on oral health-related quality of life. *Angle Orthod*. 80:367–372.
3. Broder H, Wilson-genderson M (2007) Reliability and convergent and discriminant validity of the Child Oral Health Impact Profile (COHIP Child 's version). *Community Dent Oral Epidemiol* 35:20–31.
4. Broder HL, McGrath C, Cisneros GJ (2007) Questionnaire development: Face validity and item impact testing of the child oral health impact profile. *Community Dent Oral Epidemiol* 35:8–19.
5. Broder HL, Norman RG, Sischo L, Wilson-Genderson M (2014) Evaluation of the similarities and differences in response patterns to the pediatric quality of life inventory and the child oral health impact scores among youth with cleft. *Qual Life Res*. 23:339–347.
6. Broder HL, Wilson-Genderson M, Sischo L (2012) Reliability and validity testing for the Child Oral Health Impact Profile-Reduced (COHIP-SF 19). *J Public Health Dent*. 72:302–312.
7. Cho Y Il, Lee S, Patton LL, Kim H-Y (2016) Confirmatory factor analysis of the Child Oral Health Impact Profile (Korean version). *Eur J Oral Sci* 124:172–178.
8. Dunlow N, Phillips C, Broder HL (2007) Concurrent validity of the COHIP. *Community Dent Oral Epidemiol* 35:41–49.
9. Geels LM, Hoogstraten J, Prahl-Andersen B (2008) Confirmative factor analysis of the dimensions of the Child Oral Health Impact Profile (Dutch version). *Eur J Oral Sci*. 116:148–152.
10. Kragt L, Tiemeier H, Wolvius EB, Ongkosuwito EM (2016) Measuring oral health-related quality of life in orthodontic patients with a short version of the Child Oral Health Impact Profile (COHIP). *J Public Health Dent*. 76:105–112.
11. Li C, Xia B, Wang Y, Guan X, Yuan J, Ge L (2014) Translation and psychometric properties of the Chinese (Mandarin) version of the Child Oral Health Impact Profile-Short Form 19 (COHIP-SF 19) for school-age children. *Health Qual Life Outcomes* 12:3.
12. El Osta N, Pichot H, Soulier-Peigue D, Hennequin M, Tubert-Jeannin S (2015) Validation of the child oral health impact profile (COHIP) french questionnaire among 12 years-old children in New Caledonia. *Health Qual Life Outcomes* 13:176.
13. Ruff RR, Sischo L, Broder HL (2016) Minimally important difference of the Child Oral Health Impact Profile for children with orofacial anomalies. *Health Qual Life Outcomes* 14:140.
14. Sierwald I, John MT, Sagheri D, Neuschulz J, Sch??ler E, Splieth C, Jost-Brinkmann PG, Reissmann DR (2016) The German 19-item version of the Child Oral Health Impact Profile: translation and psychometric properties. *Clin Oral Investig*. 20:301–313.
15. Wilson-Genderson M, Broder HL, Phillips C (2007) Concordance between caregiver and child reports of children's oral health-related quality of life. *Community Dent Oral Epidemiol*. 35:32–40.
16. Worsley DJ, Marshman Z, Robinson PG, Jones K (2016) Evaluation of the telephone and clinical NHS urgent dental service in Sheffield. *Community Dent Health* 33:9–14.

Child-Oral Impact on Daily Performance Index (Child-OIDP)

1. Basavaraj P, Sunil MK, Nagarajappa R, Ashish S, Ramesh G (2014) Correlation between oral health and Child-OIDP index in 12- and 15-year-old children from Modinagar, India. *Asia-Pacific J Public Health*. 26:390–400.
2. Bernabé E, Krisdapong S, Sheiham A, Tsakos G (2009) Comparison of the discriminative ability of the generic and condition-specific forms of the Child-OIDP index: A study on children with different types of normative dental treatment needs. *Community Dent Oral Epidemiol*. 37:155–162.
3. Bernabé E, Sheiham A, Tsakos G (2008) A comprehensive evaluation of the validity of Child-OIDP: Further evidence from Peru. *Community Dent Oral Epidemiol*. 36:317–325.
4. Castro R a L, Cortes MIS, Leão AT, Portela MC, Souza IPR, Tsakos G, Marcenes W, Sheiham A (2008) Child-OIDP index in Brazil: cross-cultural adaptation and validation. *Health Qual Life Outcomes* 6:68–75.
5. Cortés-Martínicorena FJ, Rosel-Gallardo E, Artázcoz-Osés J, Bravo M, Tsakos G (2010) Adaptation and validation for Spain of the child-oral impact on daily performance (C-OIDP) for use with adolescents. *Med Oral Patol Oral Cir Bucal* 15:e106-11.
6. Gherunpong S, Sheiham A, Tsakos G (2006) A sociodental approach to assessing children ' s oral health needs : integrating an oral health-related quality of life (OHRQoL) measure into oral health service planning. *Bull World Health Organ*. 84:36–42.
7. Gherunpong S, Tsakos G, Sheiham A (2006). A sociodental approach to assessing dental needs of children: concept and models. *Int J paediatric Dent* 16:81–88.
8. Gherunpong S, Tsakos G, Sheiham A. (2006). A socio-dental approach to assessing children's orthodontic needs. *Eur J Orthod*. 28:393–399.
9. Gherunpong S, Tsakos G, Sheiham A (2004) Developing and evaluating an oral health-related quality of life index for children; The CHILD-OIDP. *Community Dent Health*. 21:161–169.
10. Krisdapong S, Sheiham A (2014) Which aspects of an oral health-related quality of life measure are mainly associated with global ratings of oral health in children? *Community Dent Oral Epidemiol*. 42:129–138.
11. Mashoto KO, Astrøm AN, Skeie MS, Masalu JR (2010) Changes in the quality of life of Tanzanian school children after treatment interventions using the Child-OIDP. *Eur J Oral Sci*. 118:626–634.
12. Mtaya M, Astrøm AN, Tsakos G (2007) Applicability of an abbreviated version of the Child-OIDP inventory among primary schoolchildren in Tanzania. *Health Qual. Life Outcomes* 5:40–50.
13. Nurelhuda NM, Ahmed MF, Trovik TA, Åstrøm AN (2010) Evaluation of oral health-related quality of life among Sudanese schoolchildren using Child-OIDP inventory. *Health Qual Life Outcomes* 8:152–163.
14. Rosel E, Tsakos G, Bernabé E, Sheiham A, Bravo M (2010) Assessing the level of agreement between the self- and interview-administered Child-OIDP. *Community Dent Oral Epidemiol*. 38:340–347.
15. Tsakos G, Bernabé E, O'Brien K, Sheiham A, de Oliveira C (2008.) Comparison of the self-administered and interviewer-administered modes of the child-OIDP. *Health Qual Life Outcomes* 6:40.
16. Tsakos G, Gherunpong S, Sheiham A (2006) Can oral health-related quality of life measures substitute for normative needs assessments in 11 to 12-year-old children? *J. Public Health Dent* 66:263–268.
17. Tubert-Jeanin S, Pegon-Machet E, Gremeau-Richard C, M-M L, Tsakos G (2005) Validation of the French version of the Child-OIDP index. *Eur J Oral Sci* 113:355–362.
18. Vera C, Moreno X, Adaptation RD, Oral C (2013) Adaptation and validation of Child Oral Impact on Daily Performance index in 11- 14-year-old Chilean school children . ORIGINAL ARTICLE. *J Oral Res* 2:119–124.

19. Worsley DJ, Marshman Z, Robinson PG, Jones K (2016) Evaluation of the telephone and clinical NHS urgent dental service in Sheffield. *Community Dent Health* 33:9–14.
20. Yusof ZYM, Jaafar N (2012) A Malay version of the Child Oral Impacts on Daily Performances (Child-OIDP) index: assessing validity and reliability. *Health Qual Life Outcomes* 10:63.
21. Yusuf H, Gherunpong S, Sheiham A, Tsakos G (2006) Validation of an English version of the Child-OIDP index, an oral health-related quality of life measure for children. *Health Qual Life Outcomes* 4:38.

Child Perceptions Questionnaire 8-10 (CPQ8-10)

1. Aguilar-Díaz F del C, Irigoyen-Camacho ME (2011) Validation of the CPQ 8-10ESP in Mexican schoolchildren in urban areas. *Med Oral Patol Oral Cir. Bucal* 16:430–435.
2. Barbosa T de S, Gavião MBD (2011) Qualidade de vida e saúde bucal em crianças - parte II: versão brasileira do Child Perceptions Questionnaire Quality of life and oral health in children - Part II: Brazilian version of the Child Perceptions Questionnaire. *Ciênc saúde coletiva* 16:4077–4085.
3. Barbosa TDS, Gavião MBD (2015) Validation of the Parental-Caregiver Perceptions Questionnaire: Agreement between parental and child reports. *J Public Health Dent* 75:255–264.
4. Barbosa TS, Tureli MCM, Gavião MBD (2009) Validity and reliability of the Child Perceptions Questionnaires applied in Brazilian children. *BMC Oral Health* 9:13–22.
5. Do LG, Spencer AJ (2008) Evaluation of oral health-related quality of life questionnaires in a general child population. *Community Dent Health* 25:205–210.
6. Foster Page L a, Boyd D, Thomson WM (2013) Do we need more than one Child Perceptions Questionnaire for children and adolescents? *BMC Oral Health* 13:26.
7. Hadzipasic-Nazdragic A (2012) Validation of the Child Perceptions Questionnaire 8-10 in Bosnia and Herzegovina. *Mater Socio Medica* 24:157–161.
8. Humphris G, Freeman R, Gibson B, Simpson K, Whelton H (2005) Oral health-related quality of life for 8-10-year-old children: an assessment of a new measure. *Community Dent Oral Epidemiol* 33:326–332.
9. Jokovic A, Locker D, Tompson B, Guyatt G (2004) Questionnaire for Measuring Oral Health-related Quality of Life in Eight- to Ten-year-old Children. *Pediatr. Dent.* 26:512–518.
10. Martins MT, Ferreira FM, Oliveira AC, Paiva SM, Vale MP, Allison PJ, Pordeus IA (2009) Preliminary validation of the Brazilian version of the Child Perceptions Questionnaire 8-10. *Eur J Paediatr Dent* 10:135–140.
11. de Paula JS, Sarracini KLM, Meneghim MC, Pereira AC, Ortega EMM, Martins NS, Mialhe FL (2015) Longitudinal evaluation of the impact of dental caries treatment on oral health-related quality of life among schoolchildren. *Eur J Oral Sci* 123:173–178.
12. Ramos-Jorge ML, Vieira-Andrade RG, Martins-Júnior PA, Cordeiro MMR, Ramos-Jorge J, Paiva SM, Marques LS (2012) Level of agreement between self-administered and interviewer-administered CPQ 8-10 and CPQ 11-14. *Community Dent Oral Epidemiol* 40:201–209.
13. Shin HS, Han DH, Shin MS, Lee HJ, Kim MS, Kim HD (2015) Korean version of child perceptions questionnaire and dental caries among korean children. *PLoS One* 10:3–8.
14. Tellez M, Martignon S, Zuluaga J, Barreiro L, Builes L, Córdoba D, Gomez J (2010) Correlación de un Instrumento de Calidad de Vida relacionado con Salud Oral entre niños de 8 a 10 años y sus acudientes en Bogotá. *Rev CES Odontol* 23:9–15.
15. Turton BJ, Thomson WM, Foster Page L a, Saub RB, Razak IA (2013) Validation of an Oral Health-Related Quality of Life Measure for Cambodian Children. *Asia-Pacific J Public Health* 27:2339-49

16. Wogelius P, Gjørup H, Haubek D, Lopez R, Poulsen S (2009) Development of Danish version of child oral-health-related quality of life questionnaires (CPQ8-10 and CPQ11-14). *BMC Oral Health* 9:11.
17. Yamada H, Miura H, Usui Y, Sato T (2013) Development of the Japanese version of the Child Perceptions Questionnaire (CPQ8–10_JP). *Pediatr Dent J* 23:86–90.

Child Perceptions Questionnaire 11-14 (CPQ11-14)

1. Abanto J, Albites U, Bönecker M, Martins-Paiva S, Castillo JL, Aguilar-Gálvez D. (2013) Cross-cultural adaptation and psychometric properties of the child perceptions questionnaire 11-14 (CPQ11-14) for the peruvian spanish language. *Med Oral Patol Oral Cir Bucal* 18:1–7.
2. Agou S, Malhotra M, Tompson B, Prakash P, Locker D (2008) Is the child oral health quality of life questionnaire sensitive to change in the context of orthodontic treatment? A brief communication. *J Public Health Dent* 68:246–248
3. Barbosa T de S, Gavião MBD (2011) Qualidade de vida e saúde bucal em crianças - parte II: versão brasileira do Child Perceptions Questionnaire Quality of life and oral health in children - Part II: Brazilian version of the Child Perceptions Questionnaire. *Ciênc Saúde Coletiva* 16:4077–4085.
4. Barbosa TDS, Gavião MBD (2015) Validation of the Parental-Caregiver Perceptions Questionnaire: Agreement between parental and child reports. *J Public Health Dent* 75:255–264.
5. Barbosa TS, Tureli MCM, Gavião MBD (2009) Validity and reliability of the Child Perceptions Questionnaires applied in Brazilian children. *BMC Oral Health* 9:13–22.
6. Bekes K, John MT, Schaller H-GG, Hirsch C (2011) The German version of the child perceptions questionnaire on oral health-related quality of life (CPQ-G11-14): population-based norm values. *J Orofac Orthop* 72:223–33.
7. Bekes K, John MT, Zyriax R, Schaller HG, Hirsch C (2012) The German version of the Child Perceptions Questionnaire (CPQ-G11-14): Translation process, reliability, and validity in the general population. *Clin Oral Investig* 16:165–171.
8. Benson P, O'Brien C, Marshman Z (2010) Agreement between mothers and children with malocclusion in rating children's oral health-related quality of life. *Am J Orthod Dentofac Orthop* 137:631–8.
9. Bhayat A, Ali MAM (2014) Validity and reliability of the Arabic short version of the child oral health-related quality of life questionnaire (CPQ 11-14) in Medina, Saudi Arabia. *East Mediterr Health J* 20:477–482.
10. Brosens V, Ghijselings I, Lemièr J, Fieuws S, Clijmans M, Willems G (2014) Changes in oral health-related quality of life reports in children during orthodontic treatment and the possible role of self-esteem: A follow-up study. *Eur J Orthod* 36:186–191.
11. Brown A, Al-Khayal Z (2006) Validity and reliability of the Arabic translation of the child oral-health-related quality of life questionnaire (CPQ11-14) in Saudi Arabia *Int J Paediatr Dent* 16:405–411.
12. Del Carmen Aguilar-Díaz F, Foster Page LA, Thomson NM, Borges-Yáñez SA (2013) Differential item functioning of the Spanish version of the Child Perceptions Questionnaire. *J Investig Clin Dent* 4:34–38.
13. Ferreira MC, Goursand D, Bendo CB, Ramos-Jorge ML, Pordeus IA, Paiva SM (2012) Agreement between adolescents' and their mothers' reports of oral health-related quality of life. *Braz Oral Res* 26:112–8.
14. Foster Page L a, Boyd D, Thomson WM (2013) Do we need more than one Child Perceptions Questionnaire for children and adolescents? *BMC Oral Health* 13:26.
15. Foster Page L a, Thomson WM, Jokovic a, Locker D (2005) Validation of the Child Perceptions Questionnaire (CPQ 11-14). *J Dent Res* 84:649–652.
16. Foster Page LA, Thomson WM, Jokovic A, Locker D (2008) Epidemiological evaluation of short-form versions of the Child Perception Questionnaire. *Eur J Oral Sci* 116:538–544.

17. Franz LN, Clericus RR, Bravo-Cavicchioli D, Del Río PJ, Gonzalez CF, Delgado GM. 2015. Adaptacion y validacion al Español del cuestionario de percepcion infantil CPQ-11-14 en población comunitaria Chilena. *Rev Esp Salud Publica* 89:585–595.
18. Ghijselings I, Brosens V, Willems G, Fieuws S, Clijmans M, Lemiére J (2014) Normative and self-perceived orthodontic treatment need in 11- to 16-year-old children. *Eur J Orthod* 36:179–185.
19. Goursand D, Paiva SM, Zarzar PM, Ramos-Jorge ML, Cornacchia GM, Pordeus I, Allison PJ (2008) Cross-cultural adaptation of the Child Perceptions Questionnaire 11-14 (CPQ11-14) for the Brazilian Portuguese language. *Health Qual Life Outcomes* 6:2–8.
20. Gururatana O, Baker SR, Robinson PG (2014) Determinants of children's oral-health-related quality of life over time. *Community Dent Oral Epidemiol.* 42:206–215.
21. Jokovic A, Locker D, Guyatt G (2004) How well do parents know their children? implications for proxy reporting of child health-related quality of life. *Qual Life Res* 13:1297–1307.
22. Jokovic A, Locker D, Guyatt G (2005) What do children's global rating of oral health and well being measure? *Community Dent Oral Epidemiol* 33:205–211.
23. Jokovic A, Locker D, Guyatt G (2006) Short forms of the Child Perceptions Questionnaire for 11-14-year-old children (CPQ11-14): development and initial evaluation. *Heal Qual Life Outcomes* 4:4–12.
24. Jokovic A, Locker D, Stephens M, Guyatt G (2003) Agreement between mothers and children aged 11-14 years in rating child oral health-related quality of life. *Community Dent Oral Epidemiol* 31:335–343.
25. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G (2002) Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res* 81:459–463.
26. Kok Y V, Mageson P, Harradine NWT, Sprod AJ (2004) Comparing a quality of life measure and the Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN) in assessing orthodontic treatment need and concern. *J Orthod* 31:312–318.
27. Kumar S, Kroon J, Lalloo R, Johnson NW (2016) Psychometric properties of translation of the Child perception questionnaire (CPQ11-14) in Telugu speaking Indian children. *PLoS One* 11:1–10.
28. Lau AWH, Wong MCM, Lam KF, McGrath C (2009) Confirmatory factor analysis on the health domains of the child perceptions questionnaire. *Community Dent Oral Epidemiol.* 37:163–170.
29. Locker D (2008) Validity of single-item parental ratings of child oral health. *Int J Paediatr Dent* 18:407–414.
30. Locker D, Jokovic A, Tompson B, Prakash P (2007) Is the child perceptions questionnaire for 11-14 year olds sensitive to clinical and self-perceived variations in orthodontic status? *Community Dent Oral Epidemiol* 35:179–185.
31. Malter S, Hirsch C, Reissmann DR, Schierz O, Bekes K (2015) Effects of method of administration on oral health-related quality of life assessment using the Child Perceptions Questionnaire (CPQ-G11-14). *Clin Oral Investig* 19:1939–1945.
32. Marshman Z, Gibson BJ, Benson PE (2010) Is the short-form Child Perceptions Questionnaire meaningful and relevant to children with malocclusion in the UK? *J Orthod.* 37:29–36.
33. Marshman Z, Rodd H, Stern M, Mitchell C, Locker D, Jokovic A, Robinson PG (2005) An evaluation of the Child Perceptions Questionnaire in the UK. *Community Dent Health* 22:151–155.
34. McGrath C, Pang HN, Lo ECM, King NM, Hägg U, Samman N (2008) Translation and evaluation of a Chinese version of the child oral health-related quality of life measure. *Int J Paediatr Dent* 18:267–274.
35. O'Brien C, Benson PE, Marshman Z (2007) Evaluation of a quality of life measure for children with malocclusion. *J Orthod* 34:185–193.

36. O'Brien K, Wright JL, Conboy F, Macfarlane T, Mandall N (2006) The child perception questionnaire is valid for malocclusions in the United Kingdom. *Am J Orthod Dentofac Orthop* 129:536–540.
37. Olivieri A, Ferro R, Benacchio L, Besostri A, Stellini E (2013) Validity of Italian version of the Child Perceptions Questionnaire (CPQ11-14). *BMC Oral Health* 13:55
38. Page L a F, Thomson WM, Mohamed R, Traebert J (2011) Performance and cross-cultural comparison of the short-form version of the CPQ11-14 in New Zealand, Brunei and Brazil. *Health Qual Life Outcomes* 9:40–45.
39. Paula JS, Meneghim MC, Pereira AC, Mialhe FL (2015) Oral health, socioeconomic and home environmental factors associated with general and oral-health related quality of life and convergent validity of two instruments. *BMC Oral Health* 15:26.
40. Ramos-Jorge ML, Vieira-Andrade RG, Martins-Júnior PA, Cordeiro MMR, Ramos-Jorge J, Paiva SM, Marques LS (2012) Level of agreement between self-administered and interviewer-administered CPQ 8-10 and CPQ 11-14. *Community Dent Oral Epidemiol.* 40:201–209.
41. Salinas-Martínez AM, Hernández-Elizondo RT, Núñez-Rocha GM, Ramos Peña EG. 2014. Psychometric properties of the Spanish version of the short-form Child Perceptions Questionnaire for 11-14-year-olds for assessing oral health needs of children. *J Public Health Dent* 74:168–174.
42. Shin HS, Han DH, Shin MS, Lee HJ, Kim MS, Kim HD (2015) Korean version of child perceptions questionnaire and dental caries among korean children. *PLoS One* 10:3–8.
43. Thomson WM, Foster Page LA, Robinson PG, Do LG, Traebert J, Mohamed AR, Turton BJ, McGrath C, Bekes K, Hirsch C, et al. (2016) Psychometric assessment of the short-form Child Perceptions Questionnaire: an international collaborative study. *Community Dent Oral Epidemiol* 44:549–556.
44. Torres CS, Paiva SM, Vale MP, Pordeus IA, Ramos-Jorge ML, Oliveira AC, Allison PJ (2009) Psychometric properties of the Brazilian version of the Child Perceptions Questionnaire (CPQ11-14) - short forms. *Health Qual Life Outcomes* 7:43.
45. Traebert J, Foster Page L a, Thomson WM, Locker D (2010) Differential item functioning related to ethnicity in an oral health-related quality of life measure. *Int J Paediatr Dent* 20:435–441.
46. Traebert J, Lacerda JT De, Thomson WM, Page LF, Locker D (2010) Differential item functioning in a Brazilian-Portuguese version of the Child Perceptions Questionnaire (CPQ11-14). *Community Dent Oral Epidemiol* 38:129–135.
47. Turton BJ, Thomson WM, Foster Page L a, Saub RB, Razak IA (2013) Validation of an Oral Health-Related Quality of Life Measure for Cambodian Children. *Asia-Pacific J Public Health* 27:1–11.
48. Turton BJ, Thomson WM, Foster Page LA, Saub R, Ishak AR (2015) Responsiveness of the child perceptions questionnaire 11-14 for cambodian children undergoing basic dental care. *Int J Paediatr Dent* 25:2–8.
49. Wogelius P, Gjørup H, Haubek D, Lopez R, Poulsen S (2009) Development of Danish version of child oral-health-related quality of life questionnaires (CPQ8-10 and CPQ11-14). *BMC Oral Health* 9:11.
50. Wong MCM, Lau AWH, Lam KF, McGrath C, Lu HX (2011) Assessing consistency in oral health-related quality of life (OHRQoL) across gender and stability of OHRQoL over time for adolescents using Structural Equation Modeling. *Community Dent Oral Epidemiol.* 39:325–335.
51. Worsley DJ, Marshman Z, Robinson PG, Jones K (2016) Evaluation of the telephone and clinical NHS urgent dental service in Sheffield. *Community Dent Health* 33:9–14.
52. Yau DTW, Wong MCM, Lam KF, McGrath C (2015) Evaluation of psychometric properties and differential item functioning of 8-item Child Perceptions Questionnaires using item response theory. *BMC Public Health* 15:792.

53. Zhang M, McGrath C, Hägg U (2007) Who knows more about the impact of malocclusion on children's quality of life, mothers or fathers? *Eur J Orthod* 29:180–185.
54. Zhang M, McGrath C, Hägg U (2008) Changes in oral health-related quality of life during fixed orthodontic appliance therapy. *Am J Orthod Dentofac Orthop* 133:25–29.

Dental freetime trade scale (DFTO)

1. Fyffe HE, Deery C, Nugent Z, Nuttall NM, Pitts NB (1999) The reliability of two methods of utility assessment in dentistry. *Community Dent Health* 16:72–79.

Impact of Fixed Appliances Questionnaire (IFAQ)

1. Mandall NA, Vine S, Hulland R, Worthington H V (2006) The impact of fixed orthodontic appliances on daily life. *Community Dent Health* 23:69–74.

Malocclusion Impact Questionnaire (MIQ)

1. Patel N, Hodges SJ, Hall M, Benson PE, Marshman Z, Cunningham SJ (2016) Development of the Malocclusion Impact Questionnaire (MIQ) to measure the oral health-related quality of life of young people with malocclusion: part 1 – qualitative inquiry. *J Orthod* 43:7–13.
2. Benson PE, Cunningham. SJ, Shah N, Gilchrist F, Baker SR, Hodges SJ, Marshman Z (2016) Development of the Malocclusion Impact Questionnaire (MIQ) to measure the oral health-related quality of life of young people with malocclusion: part 2 – cross-sectional validation. *J Orthod* 43:14–23.

Oral Health Related Quality of Life for patients with Hypodontia (OHRQoL-Hypodontia)

1. Akram AJ, Ireland AJ, Postlethwaite KC, Sandy JR, Jerreat AS (2013) Assessment of a condition-specific quality-of-life measure for patients with developmentally absent teeth: Validity and reliability testing. *Orthod Craniofac Res* 16(4):193–201.
2. Akram AJ, Jerreat AS, Woodford J, Sandy JR, Ireland AJ (2011) Development of a condition-specific measure to assess quality of life in patients with hypodontia. *Orthod Craniofac Res* 14:160–7.

CHILDREN AND ADOLESCENTS (AGE 0-18)

Family Impact Scale (FIS)

1. Agou S, Malhotra M, Tompson B, Prakash P, Locker D (2008) Is the child oral health quality of life questionnaire sensitive to change in the context of orthodontic treatment? A brief communication. *J Public Health Dent* 68:246–248.
2. Baghdadi ZD (2014) Effects of dental rehabilitation under general anesthesia on children's oral health-related quality of life using proxy short versions of OHRQoL instruments. *Sci World J* 2014:308439
3. Barbosa T de S, Gavião MBD (2009) Evaluation of the Family Impact Scale for use in Brazil. *J Appl Oral Sci* 17:397–403.
4. Goursand D, Paiva SM, Zarzar PM, Pordeus IA, Allison PJ (2009) Family Impact Scale (FIS): psychometric properties of the Brazilian Portuguese language version. *Eur J Paediatr Dent* 10:141–146.
5. Kumar S, Kroon J, Laloo R, Johnson NW (2016) Validity and reliability of short forms of parental-caregiver perception and family impact scale in a Telugu speaking population of India. *Health Qual Life Outcomes* 14:34.
6. Locker D, Jokovic A, Stephens M, Kenny D, Tompson B, Guyatt G (2002) Family impact of child oral and oro-facial conditions. *Community Dent Oral Epidemiol* 30:438–448.
7. Malden PE, Thomson WM, Jokovic A, Locker D (2008) Changes in parent-assessed oral health-related quality of life among young children following dental treatment under general anaesthetic. *Community Dent Oral Epidemiol* 36:108–117.
8. McGrant C, Pang HN, Lo ECM, King NM, Hägg U, Samman N (2008) Translation and evaluation of a Chinese version of the child oral health-related quality of life measure. *Int J Paediatr Dent* 18:267–274
9. Thomson WM, Foster Page L a, Malden PE, Gaynor WN, Nordin N (2014) Comparison of the ECOHIS and short-form P-CPQ and FIS scales. *Health Qual Life Outcomes* 12:36
10. Thomson WM, Foster Page LA, Gaynor WN, Malden PE (2013) Short-form versions of the Parental-Caregivers Perceptions Questionnaire and the Family Impact Scale. *Community Dent Oral Epidemiol* 41(5):441–450

Parental-Caregiver Perceptions Questionnaire (P-CPQ)

1. Agou S, Malhotra M, Tompson B, Prakash P, Locker D (2008) Is the child oral health quality of life questionnaire sensitive to change in the context of orthodontic treatment? A brief communication. *J Public Health Dent* 68:246–248.
2. Albites U, Abanto J, Bonecker M, Paiva S-M, Aguilar-Galvez D, Castillo J-L (2014) Parental-caregiver perceptions of child oral health-related quality of life (P-CPQ): Psychometric properties for the Peruvian Spanish language. *Med Oral Patol Oral y Cir Bucal* 19:e220–e224.
3. Alves LA, Luiz RR, Thomé AT, Maia LC (2012) Initial assessment of responsiveness of the P-CPQ (Brazilian Version) to describe the changes in quality of life after treatment for traumatic dental injury. *Dent Traumatol* 28:256–62.
4. Baghdadi ZD (2014) Effects of dental rehabilitation under general anesthesia on children's oral health-related quality of life using proxy short versions of OHRQoL instruments. *Sci World J* 2014: 308439
5. Barbosa T de S, Steiner-Oliveira C, Gavião MBD (2010) Tradução e Adaptação Brasileira do Parental- Caregiver Perceptions Questionnaire (P-CPQ). *Saúde Soc São Paulo* 19:698–708.
6. Barbosa TDS, Gavião MBD. 2015. Validation of the Parental-Caregiver Perceptions Questionnaire: Agreement between parental and child reports. *J Public Health Dent* 75:255–264.
7. Benson P, O'Brien C, Marshman Z (2010) Agreement between mothers and children with malocclusion in rating children's oral health-related quality of life. *Am J Orthod Dentofac Orthop* 137:631–8.

8. Ferreira MC¹, Goursand D, Bendo CB, Ramos-Jorge ML, Pordeus IA, Paiva SM (2012) Agreement between adolescents' and their mothers' reports of oral health – related quality of life. *Braz Oral Res* 26:112–119.
9. Do LG, Spencer AJ (2008) Evaluation of oral health-related quality of life questionnaires in a general child population. *Community Dent Health* 25:205–210.
10. Goursand D, Ferreira MC, Pordeus I a, Mingoti S a, Veiga RT, Paiva SM (2013) Development of a short form of the Brazilian Parental-Caregiver Perceptions Questionnaire using exploratory and confirmatory factor analysis. *Qual Life Res* 22:393–402.
11. Goursand D, Paiva SM, Zarzar PM, Pordeus IA, Grochowki R, Allison PJ (2009) Measuring Parental-Caregiver Perceptions of Child Oral Health-Related Quality of Life : Psychometric Properties of the Brazilian Version of the P-CPQ. *Braz Dent J* 20:169–174.
12. Jokovic a., Locker D, Guyatt G (2004) How well do parents know their children? implications for proxy reporting of child health-related quality of life. *Qual Life Res* 13:1297–1307.
13. Jokovic A, Locker D, Stephens M, Guyatt G (2003) Agreement between mothers and children aged 11-14 years in rating child oral health-related quality of life. *Community Dent Oral Epidemiol* 31:335–343.
14. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G (2003) Measuring Parental Perceptions of Child Oral Health-related Quality of Life. *J Public Health Dent* 63:67–72.
15. Kumar S, Kroon J, Lalloo R, Johnson NW (2016) Validity and reliability of short forms of parental-caregiver perception and family impact scale in a Telugu speaking population of India. *Health Qual Life Outcomes* 14:34
16. Malden PE, Thomson WM, Jokovic A, Locker D (2008) Changes in parent-assessed oral health-related quality of life among young children following dental treatment under general anaesthetic. *Community Dent Oral Epidemiol* 36:108–117.
17. Marshman Z, Rodd H, Stern M, Mitchell C, Robinson PG (2007) Evaluation of the Parental Perceptions Questionnaire , a component of the COHQoL, for use in the UK . *Community Dent Health* 24:198–204.
18. McGrath C, Pang HN, Lo ECM, King NM, Hägg U, Samman N (2008) Translation and evaluation of a Chinese version of the child oral health-related quality of life measure. *Int J Paediatr Dent* 18:267–274.
19. Tellez M, Martignon S, Zuluaga J, Barreiro L, Builes L, Córdoba D, Gomez J (2010) Correlación de un Instrumento de Calidad de Vida relacionado con Salud Oral entre niños de 8 a 10 años y sus acudientes en Bogotá. *Rev CES Odontol* 23:9–15.
20. Thomson WM, Foster Page L a, Gaynor WN, Malden PE (2013) Short-form versions of the Parental-Caregivers Perceptions Questionnaire and the Family Impact Scale. *Community Dent Oral Epidemiol* 41:441–50.
21. Thomson WM, Foster Page L a, Malden PE, Gaynor WN, Nordin N (2014) Comparison of the ECOHIS and short-form P-CPQ and FIS scales. *Health Qual Life Outcomes* 12:36.
22. Zhang M, McGrath C, Hägg U (2007) Who knows more about the impact of malocclusion on children's quality of life, mothers or fathers? *Eur J Orthod* 29:180–185.

Pediatric Quality of Life Inventory™ Oral Health Scale™ (PedsQL-OH)

1. Bendo CB, Paiva SM, Viegas CM, Vale MP, Varni JW (2012) The PedsQL™ Oral Health Scale: feasibility, reliability and validity of the Brazilian Portuguese version. *Health Qual Life Outcomes* 10:42–53.
2. Lin C-Y, Kumar S, Pakpour AH (2016) Rasch analysis of the Persian version of PedsQL(TM) Oral Health Scale: further psychometric evaluation on item validity including differential item functioning. *Heal Promot Perspect* 6:145–151.

3. Pakpour AH, Yekaninejad MS, Zarei F, Hashemi F, Steele MM, Varni JW (2011) The PedsQLTM Oral Health Scale in Iranian children: Reliability and validity. *Int J. Paediatr Dent* 21:342–352.
4. Steele MM, Steele RG, Varni JW (2009) Reliability and Validity of the PedsQLTM Oral Health Scale: Measuring the Relationship Between Child Oral Health and Health-Related Quality of Life. *Child Health Care* 38:228–244.

Pediatric Oral Health-Related Quality of Life (POQL)

1. Braun PA, Lind KE, Henderson WG, Brega AG, Quissell DO, Albino J (2015) Validation of a pediatric oral health-related quality of life scale in Navajo children. *Qual Life Res* 24:231–239.
2. Huntington NL, Spetter D, Jones JA, Rich SE, Garcia RI, Spiro A (2011) Development and validation of a measure of pediatric oral health-related quality of life: The POQL. *J Public Health Dent*. 71:185–193.
3. Yazicioglu I, Jones JA, Cortés D, Rich S, Garcia R (2013) Hispanic parents' reading language preference and pediatric oral health-related quality of life. *J Public Health Dent* 73:329–338.

Supplement 3: Rating of each EMPRO items and attribute for OHRQoL Preschoolers (Age 0-5)

	ATTRIBUTES	ECOHIS	SOHO	OH-ECQOL	DDQ	Michigan-OH
	CONCEPT AND MEASUREMENT MODEL	100.0	52.4	76.2	76.2	38.1
1	concept of measurement stated	++++	++++	++++	++++	+++
2	obtaining and combining items described	++++	+++	++++	+++	++
3	rationality for dimensionality and scales	++++	++	-	++	++
4	involvement of target population	++++	++++	++++	++++	++
5	scale variability described and adequate	++++	+	+++	++	+
6	level of measurement described	++++	++	++++	++++	+++
7	procedures for deriving scores	++++	++	+++	++++	++
	RELIABILITY - total score	66.7	33.3	41.7	41.7	25.0
	<i>Reliability: internal consistency</i>	66.7	33.3	41.7	41.7	25.0
8	data collection methods described	+++	++	+++	+++	+++
9	Cronbach's alpha adequate	++++	+++	++	+++	++
10	IRT estimates provided	-	-	-	-	-
11	testing in different populations	++++	n.a.	+++	++	-
	<i>Reliability: reproducibility</i>	58.3	16.7	41.7		
12	data collection methods described	+++	++	++	-	-
13	test-retest and time interval adequate	++++	++	++	-	-
14	reproducibility coefficients adequate	+++	-	++++	-	-
15	IRT estimates provided	-	-	-	-	-
	VALIDITY	100.0	46.7	93.3	55.6	55.6
16	content validity adequate	++++	+++	++++	-	++
17	construct/criterion validity adequate	++++	+++	+++	-	++
18	sample composition described	++++	++	++++	+++	+++
19	prior hypothesis stated	++++	+++	++++	++++	+++
20	rational for criterion validity	n.a.	n.a.	n.a.	++++	++++
21	tested in different populations	++++	-	++++	+++	++
	RESPONSIVENESS	77.8	100.0			
22	Adequacy of methods	++++	++++	-	-	-
23	description of estimated magnitude of change	+++	++++	-	-	-
24	comparison of stable and unstable groups	+++	++++	-	-	-
	INTERPRETABILITY	66.7	33.3	0.0	11.1	33.3
25	rational of external criteria	+++	++	+	++	++
26	description of interpretation strategies	+++	+++	-	+	++
27	how data should be reported stated	+++	+	+	-	++
	OVERALL SCORE	82.2	53.1	42.2	36.9	30.4
	BURDEN					
	<i>Burden: respondent</i>	44.4	44.4	0.0	33.3	44.4
28	skills and time needed	-	+++	-	-	++
29	impact on respondents	+++	+++	+	++	++
30	not suitable circumstances	+++	+	+	+++	+++
	<i>Burden: administrative</i>	100.0	50.0	16.7	100.0	33.3
31	resources required	++++	++	-	++++	-
32	time required	n.a.	n.a.	n.a.	n.a.	n.a.
33	training and expertise needed	n.a.	n.a.	n.a.	n.a.	n.a.
34	burden of score calculation	++++	+++	++	++++	+++

Explanation: +++++ 4 (strongly agree); +++ 3; ++ 2; + 1 (strongly disagree); - no information; n.a. not applicable. The higher the agreement the better the rating.

Schoolchildren and Adolescents (Age 6-18)

[illegible]

Children and Adolescents (Age 0-18)

	ATTRIBUTES	FIS	POQL	P-CPQ	PedsQI-OH
	CONCEPT AND MEASUREMENT MODEL	85.7	95.2	66.7	90.5
1	concept of measurement stated	+++	++++	++++	++++
2	obtaining and combining items described	++++	++++	+++	++++
3	rationality for dimensionality and scales	++++	++++	+	++++
4	involvement of target population	++++	++++	+++	++++
5	scale variability described and adequate	++++	+++	++++	++++
6	level of measurement described	+++	++++	+++	++
7	procedures for deriving scores	+++	++++	+++	++++
	RELIABILITY - total score	55.6	50.0	66.7	58.3
	<i>Reliability: internal consistency</i>	55.6	50.0	58.3	41.7
8	data collection methods described	++++	+++	+++	++++
9	Cronbach's alpha adequate	+++	+++	++++	+++
10	IRT estimates provided	-	-	-	-
11	testing in different populations	n.a.	+++	+++	-
	<i>Reliability: reproducibility</i>	50.0	41.7	66.7	58.3
12	data collection methods described	++++	+++	+++	++++
13	test-retest and time interval adequate	++++	+++	++++	+++
14	reproducibility coefficients adequate	-	++	++++	+++
15	IRT estimates provided	-	-	-	-
	VALIDITY	93.3	66.7	86.7	80.0
16	content validity adequate	++++	+++	++++	++++
17	construct/criterion validity adequate	++++	+++	++++	++++
18	sample composition described	++++	+++	++++	++++
19	prior hypothesis stated	++++	+++	++++	++++
20	rational for criterion validity	n.a.	n.a.	n.a.	n.a.
21	tested in different populations	+++	+++	++	-
	RESPONSIVENESS	88.9	66.7	77.8	
22	Adequacy of methods	+++	+++	+++	-
23	description of estimated magnitude of change	++++	+++	++++	-
24	comparison of stable and unstable groups	++++	+++	+++	-
	INTERPRETABILITY	77.8	66.7		
25	rational of external criteria	+++	++++	++	-
26	description of interpretation strategies	+++	-	-	-
27	how data should be reported stated	++++	++++	-	-
	OVERALL SCORE	80.3	69.0	59.6	45.8
	BURDEN				
	<i>Burden: respondent</i>		44.4	22.2	55.6
28	skills and time needed	-	++	-	+++
29	impact on respondents	+++	++	++	+++
30	not suitable circumstances	-	+++	++	++
	<i>Burden: administrative</i>	100.0	100.0		100.0
31	resources required	++++	++++	-	++++
32	time required	n.a.	n.a.	n.a.	n.a.
33	training and expertise needed	n.a.	n.a.	n.a.	n.a.
34	burden of score calculation	++++	++++	-	++++
Explanation: ++++ 4 (strongly agree); +++ 3; ++ 2; + 1 (strongly disagree); - no information; n.a. not applicable. The higher the agreement the better the rating.					