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A comprehensive evaluation of the validity of Child-OIDP: further evidence from Peru

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Abstract – *Objective:* To comprehensively assess the psychometric properties of the child version of the Oral Impacts on Daily Performance (Child-OIDP), by reporting additional validation methodologies and highlighting underlying constructs. *Methods:* Four of seven public schools linked to the Mother-Child Health Centre from Puente Piedra (Lima, Peru) were randomly selected as clusters. All their 903 11- to 12-year-old children were invited to participate. The Child-OIDP was cross-culturally adapted to Spanish and its content, face, criterion and construct validity as well as internal and external reliability evaluated in successive pilot studies and a main study. *Results:* For criterion validity, Child-OIDP scores were associated to self-perceived oral health status, self-perceived dental treatment need and satisfaction with oral health status ($P < 0.001$ in all cases). In relation to construct validity, an exploratory factor analysis provided three factors with eigenvalues greater than 1, which represented the physical, psychological and social health components. Cronbach's alpha varied between 0.62 and 0.65, whereas test–retest reliability was 0.85 (intra-class correlation coefficient). *Conclusions:* The Spanish$_{(Peru)}$ Child-OIDP is a valid and reliable interviewer-administered instrument to measure the impact of the oral conditions on quality of life. This study provides new evidence in support of the psychometric properties of the Child-OIDP.

Key words: children; oral health; psychometrics; quality of life

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Child populations are the primary target group of oral health care services in many countries and are the major focus of dental public health research and practice (1). Children are prone to numerous oral conditions that may have negative effects on the quality of their lives (2). Therefore, there is a need to develop oral-health-related quality of life (OHRQoL) measures for them (2, 3).

At present, there are only three OHRQoL measures specifically designed to use with children, the Child Perception Questionnaire ($CPQ_{11–14}$) (3), the Michigan OHRQoL scale (4) and the child version of the Oral Impacts on Daily Performance (Child-OIDP) (5). The Child-OIDP allows for analysis of condition-specific impacts on daily performance, thus attributing impacts to specific oral conditions or diseases according to the respondent's perceptions. This special feature facilitates its use in needs assessment and for planning oral health care services (6–8).

The Child-OIDP assesses the serious oral impacts on children's daily life in relation to eight daily performances, namely, eating, speaking, cleaning mouth, sleeping, smiling, studying, emotion and social contact. If children report an impact on any performance, the frequency of the impact (scale from 1–3) and the severity of its effect on their daily life (scale from 1–3) are scored. If no impact is reported, then a zero score is assigned. The impact per daily performance is then estimated by multiplying the corresponding frequency and severity scores. The overall Child-OIDP score is the sum of the eight performance scores (ranging from 0–72) multiplied by 100 and divided by 72 (5).

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The Child-OIDP has been found to be a valid and reliable index among Thai (5), French (1) and British (9) children. Although it has been advocated that any OHRQoL measure must be tested before use in contexts different from where they were originally developed (10–12), merely repeating the same adaptation and validation processes in different populations and settings does not make a significant scientific contribution. Indeed, further evidence in support of any instrument needs to be gained through complementary methods of evaluation. The burden of evidence in testing psychometric properties arises not only from a single experiment but from a series of diverse experiments (13).

There is not only one way to assess content, face, criterion and construct validity or internal and external reliability (14, 15). Therefore, the objective of this study was to comprehensively evaluate the psychometric properties of the Child-OIDP, in Peruvian schoolchildren, by reporting additional validation methodologies and highlighting underlying constructs of the instrument.

Materials and methods

Study participants

The study was performed within the jurisdiction of the Mother-Child Health Centre of Zapallal, Puente Piedra (Lima, Peru). There are seven public schools in this area with 1519 children aged 11 to 12 years (born in 1995 and 1994, respectively) attending them during 2006. Four of these seven schools were randomly selected as clusters, and all their 903 children were invited to participate. About 805 of those 903 children participated in the interviews voluntarily (non-response rate of 10.9%); 51.2% were female and 48.8% male, with a mean age of 11.93 ± 0.63 years. As all four schools were located in similar underserved communities, the students had similar socioeconomic and demographic backgrounds.

Ethical approval was obtained from the International Review Board of Universidad Peruana Cayetano Heredia. Parents signed a consent letter accepting participation of their child and also gave written consent for interviews.

Translation and adaptation processes and psychometric evaluation

The study was performed in two stages: a series of pilot studies and a main study. The cross-cultural adaptation of the Child-OIDP and its psychometric evaluation were carried out in successive pilot studies. Thereafter, validity and reliability were re-evaluated in the main study using a larger sample.

The original Child-OIDP was obtained from the authors for its cross-cultural translation and adaptation into Spanish (16). For that, three Peruvian dentists fluent in English, and whose first language was Spanish, translated independently the exact content from English to Spanish. Then, a consensus version between them and the main researcher (Eduardo Bernabé) was agreed to in a group session. A first pilot study, with 30 schoolchildren, was performed to guarantee sensitivity to local culture and selection of the appropriate wording. The corrected version was then translated back into English by three individuals who had English as their first language and were fluent in Spanish. Again, each translator worked independently and a new consensus was subsequently obtained between translators and the main researcher. The cross-cultural translation and adaptation process ended after this version was sent to the team who designed the Child-OIDP (UCL, UK) for comparison and approval. That Spanish$_{(Peru)}$ Child-OIDP version was subjected to the evaluation process of its psychometric properties. The examined psychometric properties refer to validity in terms of content, face, criterion and construct validity, and reliability, in terms of consistency (internal reliability) and test–retest reproducibility (external reliability).

For evaluating content validity, copies of the Spanish$_{(Peru)}$ Child-OIDP were sent to eight Peruvian professors of dental public health, dental education and paediatric dentistry who had knowledge about oral problems in children and some experience of OHRQoL measures. Each expert selected everyday activities that could be affected by oral problems in 11- to 12-year-old children. Content validity was verified by calculating the Aiken's V coefficient as a measure of agreement between experts about performances to be included in Child-OIDP (17, 18). Face validity was first examined by repeat interviews with panels of children. Thereafter, a second pilot study was carried out with 60 schoolchildren divided into two classroom groups. The ease of understanding and response to the questions of the Spanish$_{(Peru)}$ Child-OIDP was assessed using a 4-point ordinal scale – very easy, somewhat easy, somewhat difficult and very difficult – in each group, and later compared statistically using the Mann–Whitney test (19, 20). It was hypothesised that

different groups of children from similar backgrounds would rate similarly the face validity of the instrument.

Because of the lack of a gold standard for measuring OHRQoL, criterion validity was evaluated by testing the instrument against some subjective proxy measures (13, 14). For that purpose, during a third pilot study with a new group of 60 schoolchildren, data were also collected on self-perceived oral health status (using a 5-point ordinal scale from very bad to very good), satisfaction with oral health status and self-perceived oral treatment need (using yes/no questions, respectively). The association between Spanish$_{(Peru)}$ Child-OIDP scores and each of the aforementioned proxy measures was tested using either the Spearman or point-biserial correlation coefficient (15). As Child-OIDP is a subjective measure, the rationale to omit clinical measures from the validation process is derived from the contemporary conceptual distinction between health and disease. While clinical indicators measure disease, a purely biological concept, subjective indicators concentrate on health, a concept inclined more towards sociology and psychology (21). Consequently, subjective measures are better placed than clinical measures to be used for the validation of OHRQoL indicators.

Information collected during the third pilot study was also used to evaluate internal reliability (15). Inter-item and item-total correlations, using the Pearson coefficient as well as alpha if item deleted, were calculated to find if there was any possible redundancy in evaluated performances (14, 15). Cronbach's alpha was also calculated at this stage. Test–retest reliability was evaluated by interviewing the same 60 schoolchildren 1 week later (fourth pilot study) and calculating the grade of agreement between responses through intraclass correlation coefficient (14).

The main study was performed on 805 children to re-evaluate all psychometric properties of the Spanish$_{(Peru)}$ Child-OIDP. With these data, the construct validity was also evaluated using exploratory factor analysis (15, 22, 23). For that, it was expected that the number of underlying factors to the responses given by children would coincide with the physical, psychological and social health components. An eigenvalue higher than 1 was used as criterion for factor inclusion (15, 23). As for the rotation, the oblimin method was chosen because it yields an oblique rotation, in which factors are not orthogonal, that is, factors have non-zero correlations among themselves, which is exactly what is presumed among the three oral health components. The percentage of variation in responses explained by the extracted factors was also calculated (22). Furthermore, about 10% of the children were randomly selected and re-interviewed after 2 weeks to re-evaluate test–retest reliability.

During all the aforementioned processes, two trained male interviewers carried out all individual face-to-face structured interviews in a noise-free room.

Results

Results of the pilot studies

As part of content validity evaluation, academics reviewed the Spanish$_{(Peru)}$ Child-OIDP for possible wording changes based on the expected understanding levels for the age group under study and then judged whether the instrument sampled all relevant daily life activities. According to the Aiken's V coefficient, the eight performances originally included in the instrument obtained values of agreement higher than the recommended standard of 0.80 (18). 'Eating' was the daily activity with the highest agreement among academics (1.00, $P < 0.001$), whereas 'speaking', 'sleeping', 'emotion' and 'studying' were those with the lowest agreement (0.81, $P = 0.04$, in all cases). Although experts suggested other daily activities such as 'doing light physical activity', none of them reached the recommended agreement level for its inclusion.

Face validity was initially evaluated during the first pilot study through identifying some problematic or unclear areas, in terms of the text used. The language was simplified and made less official to improve understanding and responsiveness to the questions. After that, the majority of participants did not have any difficulty in either understanding or responding to the questions (86.7% and 83.3%, respectively) during the second pilot study. Furthermore, when scores assigned by each group of 30 children were compared, there was no statistically significant difference in relation to understanding and responsiveness to questions ($P > 0.05$ in both cases).

Criterion validity was evaluated through the use of three self-perceived questions as proxy measures (Table 1). Spanish$_{(Peru)}$ Child-OIDP scores were inversely associated with self-perceived oral health status ($P = 0.002$) and directly associated with

Table 1. Evaluation of criterion validity in the pilot and the main studies

Proxy measures	*r*	*P*-value
Pilot study (*n* = 60)		
Self-perceived oral health status (very bad/…/very good)	−0.32[a]	0.002
Satisfaction with oral health status (no/yes)	−0.16	0.226
Self-perceived dental treatment need (no/yes)	0.36	0.004
Main study (*n* = 805)		
Self-perceived oral health status (very bad/…/very good)	−0.24[a]	<0.001
Satisfaction with oral health status (no/yes)	−0.22	<0.001
Self-perceived dental treatment need (no/yes)	0.21	<0.001

[a]Spearman rather than Point biserial correlation coefficient was used.

self-perceived dental treatment need ($P = 0.004$). However, Spanish $_{(Peru)}$ Child-OIDP scores were not associated with satisfaction with oral health status ($P = 0.226$).

The consistency of the items (performances) was evaluated through internal reliability analysis applied to the third pilot study data. Only five out of 28 inter-item correlations were negative (three in 'eating' and two in 'emotion'). However, none of these five coefficients was statistically different from zero ($P \geq 0.664$). The corrected item-total correlation varied between 0.16 for 'sleeping' and 0.57 for 'smiling'. Cronbach's alpha coefficient was 0.65, and it did not increase when any of the performances was deleted. These results showed the homogeneity of the performances included in the Spanish $_{(Peru)}$ Child-OIDP. Finally, in terms of test–retest reliability, the intraclass correlation coefficient was 0.79.

Results from the main study

Psychometric properties of the Spanish $_{(Peru)}$ Child-OIDP were re-evaluated on a large sample of 11- to 12-year-old children. Face validity was again evaluated through the two previously reported methods. According to the first method, most children did not have difficulties understanding and responding to the questions (86.7% and 82.8%, respectively). For the second method, each of the four selected schools was used as a different group of children from similar backgrounds (Table 2). No statistically significant difference was found when the assigned scores for understanding and responsiveness of questions were compared between schools ($P = 0.065$ and 0.070, respectively).

For criterion validity, there were statistically significant associations between Spanish $_{(Peru)}$ Child-OIDP scores and three proxy measures (Table 1). Spanish $_{(Peru)}$ Child-OIDP scores increased when the self-perceived oral health status decreased ($P < 0.001$). Similarly, Spanish $_{(Peru)}$ Child-OIDP scores increased when children reported self-perceived dental treatment need or were not satisfied with oral health status ($P < 0.001$ in both cases).

Construct validity was further evaluated through exploratory factor analysis with data from the main study. Assumptions in the correlation matrix among performances were corroborated prior to conducting this analysis. The Kayser–Meyer–Olkin measure of sampling adequacy

Table 2. Evaluation of face validity in the main study: understanding and responsiveness (*n* = 805)

Characteristic	School 1	School 2	School 3	School 4	*P*-value
Understanding of the questions (%)					
Very easy	61 (31.8)	65 (37.5)	117 (41.6)	63 (39.6)	0.065
Somewhat easy	99 (51.5)	82 (47.4)	138 (49.1)	73 (45.9)	
Somewhat difficult	28 (14.6)	24 (13.9)	21 (7.5)	21 (13.2)	
Very difficult	4 (2.1)	2 (1.2)	5 (1.8)	2 (1.3)	
Responsiveness of the questions (%)					
Very easy	62 (32.3)	65 (37.6)	112 (39.9)	55 (34.6)	0.070
Somewhat easy	86 (44.8)	79 (45.7)	134 (47.6)	73 (45.9)	
Somewhat difficult	41 (21.3)	25 (14.4)	30 (10.7)	29 (18.2)	
Very difficult	3 (1.6)	4 (2.3)	5 (1.8)	2 (1.3)	

Kruskal–Wallis test was used; values within parenthesis are percentages.

Table 3. Evaluation of construct validity in the main study: pattern matrix (n = 805)

Variables	Factor 1	Factor 2	Factor 3
Eating	−0.03	0.05	0.79
Speaking	0.51	−0.17	0.31
Cleaning mouth	0.03	0.06	0.73
Sleeping	0.20	0.68	−0.04
Emotion	0.60	0.09	0.05
Smiling	0.77	−0.08	−0.05
Studying	−0.10	0.81	0.15
Social contact	0.61	0.21	−0.09
Factor 1	1.00		
Factor 2	0.21	1.00	
Factor 3	0.26	0.10	1.00

Oblique factor solution is presented (oblimin method used).

(0.758) determined that partial correlations among items were small, and Bartlett's test of sphericity demonstrated that the correlation matrix was different from an identity matrix ($P < 0.001$). The factor analysis of the eight performances provided three factors with eigenvalues greater than 1 (2.22, 1.03 and 1.01, respectively) that explained 52.9% of the variance in the responses of children (27.8%, 12.6% and 12.5%, respectively). A rotated solution was then obtained to simplify their interpretation (Table 3), for which only those loading factors higher than 0.40 were considered significant based on the requirements of sample size (22). The correlation among the extracted factors is also shown in Table 3.

For internal reliability, all inter-item correlations were positive and statistically different from zero ($P \leq 0.007$). They varied between 0.10 and 0.26 (Table 4). The corrected item-total correlation varied from 0.27 for 'studying' to 0.36 for 'emotion', whereas the Cronbach's alpha coefficient was 0.62, and did not increase when any performance was deleted (Table 5). Finally, test–retest reliability was evaluated through intra-class correlation coefficient, whose value was 0.85.

Table 5. Evaluation of internal reliability in the main study: corrected item-total correlation and alpha if item deleted (n = 805)

Performance	Corrected item-total correlation	Alpha if item deleted
Eating	0.30	0.59
Speaking	0.33	0.59
Cleaning mouth	0.31	0.59
Sleeping	0.30	0.59
Emotion	0.36	0.57
Smiling	0.35	0.58
Studying	0.27	0.60
Social contact	0.35	0.58

Discussion

Whenever a scale or index is used in a new context or with a different population, its psychometric properties should be evaluated. At present, only two previous studies have reported the adaptation and validation process of the original Child-OIDP, both in European countries (1, 9). Therefore, this study was conducted to adapt and test the Child-OIDP in a sample of Peruvian 11- to 12-year-old children for its further use in epidemiological research. Moreover, the present study reports some additional methods to gain evidence in support of the validity of any instrument.

The evaluation of the psychometric properties of the Spanish$_{(Peru)}$ Child-OIDP, first in pilot studies, and later in the main study, showed similar results, demonstrating that the Spanish$_{(Peru)}$ Child-OIDP had appropriate validity and reliability. Initially, the process of translation and cross-cultural adaptation was done following guidelines proposed by Guillemin et al. (16). This procedure assured the

Table 4. Evaluation of internal reliability in the main study: matrix of inter-item correlations (n = 805)

Performance	Eating	Speaking	Cleaning mouth	Sleeping	Emotion	Smiling	Studying	Social contact
Eating	1.00							
Speaking	0.19	1.00						
Cleaning mouth	0.25	0.18	1.00					
Sleeping	0.15	0.14	0.10	1.00				
Emotion	0.17	0.18	0.17	0.21	1.00			
Smiling	0.14	0.24	0.15	0.16	0.27	1.00		
Studying	0.13	0.10	0.16	0.24	0.12	0.11	1.00	
Social contact	0.11	0.19	0.17	0.19	0.22	0.26	0.18	1.00

Pearson correlation coefficient was used.

conceptual and functional equivalence of the translated version in relation to the original Child-OIDP as well as guaranteeing sensitivity to local culture and language.

Although the Child-OIDP was developed on a sound theoretical framework (5, 10), its content validity was also evaluated during pilot studies. For that, a panel of academics verified the pool of everyday activities that could be affected by oral problems in children from this cultural setting. They agreed that the eight daily performances in the original Child-OIDP should be retained. Some experts also suggested inclusion of 'doing light physical activity' as an extra performance. That performance has previously shown to be very uncommon in a number of settings (5, 10, 21). Furthermore, it did not reach the minimum level of agreement required for inclusion in the index. In that sense, Aiken's V coefficient permitted assessing quantitatively the grade of agreement among experts (17, 18), a further methodological contribution in relation to previous reports.

Face validity of the Spanish$_{(Peru)}$ Child-OIDP was evaluated quantitatively in two complementary ways in the pilots and main study. First, a high proportion of children were positive about the ease of understanding and response to the questions. Although pictures were used in the Thai Child-OIDP to improve understanding, during the Peru pilot studies, pictures were not used because children understood the questions without pictures. Second, we tested the hypothesis that individuals from similar backgrounds rate face validity similarly, as suggested by Nevo (19, 20). The consistency in ratings was high between the two groups of children in the pilot study (classrooms) as well as among the four groups in the main study (schools). The relevance of the content of the Spanish$_{(Peru)}$ Child-OIDP for the children was also qualitatively assessed during the pilot studies. Further quantitative evidence in support of this property should be reported.

Criterion validity was evaluated using proxy measures in the pilots and main study. Spanish$_{(Peru)}$ Child-OIDP scores decreased progressively as children's self-perceived oral health status improved gradually from very bad to very good. Similarly, there were higher scores in children not satisfied with their mouth as well as in those with self-perceived dental treatment need. The Spanish$_{(Peru)}$ Child-OIDP was associated with different perceptions of oral health. This property facilitates its use in health surveys to identify children in need of targeted interventions (1).

Although factor analysis has been previously used to assess the construct validity of other general quality-of-life measures (24, 25), and in dentistry (26, 27), this is the first study of that approach in relation to the Child-OIDP. The exploratory factor analysis was carried out to identify the separable dimensions, representing theoretical constructs, within the OHRQoL domain. Despite our *a priori* hypothesis regarding number of underlying dimensions in the factor structure, we have no clear-cut *a priori* expectations, based on theory or prior research, about the composition of the subscales or about which items are grouped together as manifestations of underlying constructs.

An exploratory factor analysis is often considered more appropriate than a confirmatory factor analysis in early stages of scale development because the latter does not show how well the items load on the nonhypothesized factors (23, 28). Thus, an exploratory approach has been recommended as the first step to ensure factorial integrity for a further formal testing (29), whereas the use of both approaches on the same data set is still controversial (28, 30). For these reasons, we decided to perform an exploratory, rather than a confirmatory approach, in reporting initial results that permit developing a firm theory to be further tested with more complex analytic tools and in different settings (structural reliability) (22, 23, 29).

As hypothesised, the exploratory factor analysis showed that children's responses were organized around three different constructs, and also that these were moderately correlated to each other. However it should be kept in mind that an exploratory approach does not test the three-factor solution. Though, some interesting patterns could be obtained from this analysis. The first factor was characterized by high loadings on 'smiling', 'social contact', 'emotion' and 'speaking' performances. Difficulties smiling, laughing or showing teeth without embarrassment, for going out with a friend or going to friend's house, for maintaining a good emotional state without being irritable, and for speaking with peers loaded on this factor and could reflect the social component of oral health. The second factor included 'sleeping' and 'studying' performances. As the 'sleeping' item refers to difficulties not only for resting but also for relaxing (reading comic books or watching television) and the 'studying' item refers to difficulties to learn in

class and doing homework, both performances could be considered within the psychological component. The last factor was characterized by high loadings on 'eating' and 'cleaning' representing the physical component of oral health.

Although speaking and pronouncing clearly is considered a mainly physical activity, the fact that this item loaded above 0.30 as much for the physical factor as for the social factor, even after using pattern rather than structure matrix to simplify factors interpretation, may indicate that children were also affected in their ability to interact with peers through talking. This may indicate the necessity for item rewording in order to disentangle the seemingly dual role of the speaking performance. Unfortunately, there are no previous reports using this approach with which to compare our explanations. Further studies using confirmatory factor analysis may test the fit of the data to the three theoretical constructs representing the physical, psychological and social components of the child's oral health, as well as to confirm that Child-OIDP measures three rather than any other number of factors (15, 22, 23).

In terms of internal reliability analysis, all inter-item correlations were positive and no correlation was high enough for any performance to be redundant. In addition, all the corrected item-total correlations were above the recommended level of 0.20 for including an item in a scale (13). The small differences between the results in the pilots and main study might be attributed to the different sample sizes. The prevalence of the impacts on each performance could partly explain correlation values (1). Cronbach's alpha coefficient was 0.65 in the pilot and 0.62 in the main study, which were higher than those previously reported for the Child-OIDP (1, 5, 9). The reproducibility of the Spanish $_{(Peru)}$ Child-OIDP was evaluated through a test–retest procedure; the intraclass correlation coefficient of 0.85 indicated very good agreement.

Although both alpha coefficients were higher than the 0.5 threshold, they fell short of the 0.70 recommended threshold (13, 14, 31). Alpha is dependent not only on the magnitude of the correlation among the items, but also on the number of items in the scale (13, 31). Therefore, the alpha coefficient will be lower when there are few items in a scale (31, 32). As Cortina (32) has demonstrated, the alpha coefficient can be rather high and acceptable, greater than 0.70, by the standards of many authors, in spite of low mean inter-item correlation or multidimensionality, provided there are more than 14 items in the scale. In this sense, a higher alpha can be achieved only by increasing the number of items, even though the items are redundant (15, 33).

Even though scales with a larger number of items are expected to have higher alpha values, this also causes concern in relation to the practicality and costs of interviews. The Child-OIDP was designed to be a brief instrument that screens for ultimate impacts, thus focusing on only eight independent items (5). Consequently, the relatively low value of alpha may be a disadvantage, although, on the other hand, this may be to a certain extent an inherent attribute of an index designed to be brief and practical for assessing needs of a population (1). More importantly, from a methodological standpoint, the appropriateness of using the alpha coefficient on quality of life indices has been thoroughly questioned (33), thus casting serious doubts on the over reliance on alpha values for the assessment of reliability.

The cultural equivalence of any OHRQoL measure is an important aspect of instrument development, because of the increasingly international nature of research (34). Findings reported, here, support the validity and reliability of the Child-OIDP, even when using some additional validation methods.

The study has some limitations especially with regard to sample selection. It is expected that a random selection of schools provides a somewhat skewed sample of schoolchildren and wider confidence intervals compared with true randomisation of students. Consequently, and even though participants may represent, to a great extent, the child population living in Peruvian low-income urban communities, they are not strictly representative of the general population of children of similar ages attending basic education institutions in Peru. Therefore, the present findings are only valid for the group for which they were obtained. Further studies are needed to verify these results, especially in relation to the methodologies used here.

Conclusions

The Spanish $_{(Peru)}$ Child-OIDP is a valid and reliable interviewer-administered instrument to measure impacts of oral problems on the quality of life in Peruvian children aged 11–12 years. This

study also provides new evidence in support of the psychometric properties of the Child-OIDP.

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