

Assessing the responsiveness of the CPQ₁₁₋₁₄ in New Zealand adolescents

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Objective: To assess the responsiveness of the CPQ₁₁₋₁₄ in a population sample of adolescents and to determine its evaluative properties. **Design:** A population-based sample of adolescents in Taranaki, New Zealand was followed up at age 16 (N = 255; 63.6% of those in the baseline sample), three years after baseline assessment. Adolescents' perceptions of change in their oral health were assessed using two global measures. Longitudinal construct validity was evaluated by ANOVA to examine the association between changes in (a) CPQ₁₁₋₁₄ scores and (b) responses to the global measures. Second, paired t-tests were used to examine the statistical significance of the within-individual change of those who changed and those in whom stability was reported. Measures of responsiveness included the minimum important difference and Guyatt's responsiveness index. **Results:** Cross-sectional internal consistency was acceptable, as was the construct validity. Test-retest reliability data for the duplicate questionnaires was in the acceptable range, but the intraclass correlation coefficient (ICC) for the 165 individuals who showed no significant change in self-rated oral health was relatively low. Mean change scores for the CPQ₁₁₋₁₄ and its four subscales showed a clear gradient in the expected direction for the CPQ₁₁₋₁₄. The minimally important difference to reflect deterioration or improvement was determined to be 4. **Conclusions:** This longitudinal investigation of the properties of the CPQ₁₁₋₁₄ in a population of New Zealand adolescents has shown that the measure's responsiveness appears to be acceptable, and that a clinically meaningful change in score is 4 scale points.

Keywords: Oral health related quality of life, adolescents, responsiveness

INTRODUCTION

The development of measures for assessing Oral-Health-Related Quality of Life (OHRQoL) in children and adolescents has occurred only recently, and much of the focus of that work has been on their validation and discriminative properties. There have been numerous studies published utilising different OHRQoL measures, although a recent systematic review of child OHRQoL measures found three well-validated instruments, with the Child Perception Questionnaire (CPQ₁₁₋₁₄) being the most commonly used (Barbosa and Gaviao, 2008).

The Child Perception Questionnaire was developed for use with those aged 11-14 years. The instrument was intended for use as an outcome measure in clinical trials and evaluation studies, so it needed to have properties suitable for the assessment of change at the group level (Jokovic *et al.*, 2002; Locker and Allen, 2007). Its use as an outcome measure is important for health services research (Bader, 1991; Locker *et al.*, 2004), due to the increased accountability required of dental programmes and the need for defining health status, in terms of

not only the amount of disease in a population but the level of function, satisfaction and other psychosocial factors (Bader, 1991).

A key component of any OHRQoL measure is its 'evaluative' capacity; that is, its ability to detect change, whether that occurs naturally or as a result of a clinical intervention. Relationships between biological or clinical variables and OHRQoL outcomes are not direct, but mediated by a variety of personal, social and environmental characteristics (as well as child development). Longitudinal studies are necessary to determine any OHRQoL scale's evaluative properties, and, while cross-sectional validity and test-retest reliability are desirable, necessary properties are longitudinal validity, reproducibility, and ability to detect the minimally clinically important difference. This was termed by Guyatt *et al.* (1987) as a measure's responsiveness. Validation of measures such as the CPQ₁₁₋₁₄ at the population level is important, since clinical samples may give a misleading picture of their utility, because of the biased nature of those samples (Locker *et al.*, 2004).

The CPQ₁₁₋₁₄ has been utilised already as a descriptive and discriminative measure, and it has been validated epidemiologically in New Zealand (Foster Page *et al.*, 2005). The CPQ's use as an evaluative measure in a population sample and its potential to perform as an outcome measure have yet to be examined. There are a number of ways in which the use of CPQ₁₁₋₁₄ as an evaluative measure can be assessed. One is to compare the scores on a measure prior to and following an intervention that is known to be efficacious in improving patient well-being (Deyo *et al.*, 1991). Thus, that one clinical trial has shown preliminary evidence that the CPQ₁₁₋₁₄ is sensitive to change when used with children receiving orthodontic treatment (Agou *et al.*, 2008) may be taken as evidence of the instrument's responsiveness. A second approach is to relate changes in CPQ₁₁₋₁₄ over time to patients' global ratings of change in their health and well-being. This can assess within-individual change that occurs naturally as natural variations in individuals' health state; variability in responses to treatment mean that some patients are likely to improve, some remain the same, and some deteriorate. This method assesses the longitudinal construct validity of change scores derived from repeat administrations of the measure. Paired t-tests can be used to determine the magnitude and significance of the change that occurs.

The aims of this study were to assess the responsiveness of the CPQ₁₁₋₁₄ in a population sample of adolescents and to determine its evaluative properties.

METHOD

Ethical approval was granted by the Central Regional Ethics Committee for the follow-up of a random sample of 430 Taranaki children who were first examined in 2003, when they were 13 years old (Foster Page *et al.*, 2005). The adolescents and their parents/caregivers were recontacted in 2006 (when the adolescents were 16 years old) and asked whether they would take part in the follow-up study. Written consent to take part was obtained from both the adolescent and their parent/caregiver. Each adolescent was dentally examined and completed a questionnaire. This asked questions on how they felt about their teeth, their attendance for dental care over the previous three years, and their orthodontic treatment history. The final section of the questionnaire included a standardised set of questions (the CPQ₁₁₋₁₄) to assess the participant's oral-health-related quality of life (<http://www.cdhsru-uoft.ca/cohqol> (Jokovic *et al.*, 2002)).

Each adolescent's dental caries experience was recorded by a single calibrated examiner (LFP) following WHO guidelines (WHO, 1997). Clinical data were manually recorded on a custom-designed sheet and later entered into a Microsoft Excel spreadsheet by a research assistant. The questionnaire data were also entered after the questionnaires had been checked for completeness. The baseline and follow-up data sets were merged once clinical data collection was completed.

Measures

Oral health-related quality of life was measured using the CPQ₁₁₋₁₄ (Jokovic *et al.*, 2002). This consisted of 37 items which each sought information on the frequency of events during the previous three months. Response options and scores were: 'Never' (scoring 0); 'Once or twice' (1); 'Sometimes' (2); 'Often' (3); and 'Every day or almost every day' (4). An overall CPQ₁₁₋₁₄ score was computed by summing all of the item scores, and subscale scores (for four domains) were also computed. The four sub-scales were oral symptoms (6 items), functional symptoms (9 items), emotional wellbeing (9 items), and social well-being symptoms (13 items). The test-retest reliability of the CPQ₁₁₋₁₄ was also examined at age 16.

Adolescents' perceptions of change in their oral health were assessed by two global measures. First, at age 13 and 16, they were asked to rate the health of their teeth, lips, jaws and mouth (response options: 'Excellent', 'Very good', 'Good', 'Fair' or 'Poor'). The second measure was a global transition judgement assessed by a single item used at age 16, whereby the adolescent was asked to rate his/her oral health since age 13 (response options: 'Much improved', 'A little improved', 'About the same', 'A little worse' or 'Much worse'). Two measures of socio-economic status were recorded from the parent/caregiver questionnaire, comprising one area-based measure—the NZDep2001 Index of Deprivation (Salmond and Crampton, 2002)—and one household-based measure, the New Zealand Socio-Economic Index (Davis *et al.*, 1999).

Statistical analysis

Cross-sectional construct validity and internal consistency were both examined using baseline scores. Cross-sectional construct validity was assessed by means of the association between baseline mean CPQ₁₁₋₁₄ scores and responses to the global self-rated oral health question. The statistical significance of difference between means was determined using the Kruskal-Wallis or Mann-Whitney tests or one-way analysis of variance (ANOVA) as appropriate. Internal consistency was assessed using Cronbach's alpha. Test-retest reliability was determined by the analysis of fourteen questionnaires at follow-up, using Cronbach's alpha and by examining the intra-class correlation coefficient between the baseline and follow-up scores of those for whom the global measures of oral health showed no change. Longitudinal construct validity was evaluated in a number of ways. First, it was assessed by using one-way analysis of variance (ANOVA) to examine the association between CPQ₁₁₋₁₄ change scores and changes in response to the standard questions between baseline and follow-up (self-rated and global transition). As used by Locker *et al.* (2004), longitudinal construct validity is acceptable where: individuals reporting improvement have negative change scores; those reporting no change, or stability have change scores of approximately zero; and those reporting deterioration have positive change scores. Second, paired t-tests were used to examine the statistical significance of the within-individual change of those who changed and those in whom stability was reported. If the first was significant and the latter not, there would be support for the assertion

that the measure is responsive. These tests were performed for each category of change in self-rated oral health and in the global transition judgement (GTJ). The mean change score for those who reported improvement or deterioration was used to determine the minimum important difference for the CPQ₁₁₋₁₄. This value was used to calculate Guyatt's responsiveness statistic (Guyatt *et al.*, 1987), which comprises the minimum important difference divided by an estimate of the within-individual variability for those who are stable. The denominator is identical to the standard deviation of change scores for those who are stable.

RESULTS

Description of sample

Complete data were available for 255 (63.6%) of the original 401 adolescents contacted, and a comparison of the sociodemographic characteristics of those followed up with adolescents lost to follow-up is presented below in *Table 1*. Among those who were lost to follow-up, there were more Māori and males, and there was a clear socioeconomic gradient, whereby fewer adolescents from lower SES groups or higher-deprivation areas took part in the later assessment. Thirty of the adolescents had completed orthodontic treatment over the three-year period, while 28 were still being treated at the time of follow-up.

Cross-sectional internal consistency, construct

validity and test-retest reliability

Cronbach's alpha for the overall CPQ₁₁₋₁₄ scale was 0.91, and, for the four subscales, it was as follows: oral symptoms (OS) 0.63, functional limitations (FL) 0.65, emotional wellbeing (EW) 0.87, and social wellbeing (SW) 0.84.

The responses to the global measure were *Excellent* (21 or 8.2%), *Very good* (97 or 38.0%), *Good* (112 or 43.9%) and *Fair/Poor* (25 or 9.8%). The latter were combined for statistical reasons, due to only one response in the 'poor' category. Baseline CPQ₁₁₋₁₄ and domain scores by self-rated oral health are presented in *Table 2* below.

There was a significant gradient in mean CPQ₁₁₋₁₄ (and most domain) scores across the categories of self-rated oral health in the expected direction, whereby those who rated their oral health as 'fair/poor' had higher scores than those with excellent self-rated oral health.

The reliability scores for the duplicate questionnaires using Cronbach's alpha for the overall scale were 0.96 (CPQ₁₁₋₁₄), 0.87 (OS), 0.85 (FL), 0.96 (EW), and 0.78 (SW); these were in the acceptable range.

The intraclass correlation (ICC) for the 165 who showed no significant change in self-rated oral health was 0.47 for the overall scale and 0.41, 0.40, 0.54 and 0.45 for the respective subscales indicating a weak correlation.

Longitudinal construct validity and

Table 1. Attrition analysis: comparison of the socio-demographic characteristics of those followed and not followed up.

Characteristic	Baseline (age 13) Number (%)	Followed up (age 16) Number (%)	Not followed up Number (%)
Sex			
Male	229 (53.3)	127 (49.8)	102 (44.5)
Female	201 (46.7)	128 (50.2)	73 (36.3)
Ethnicity			
Non Māori	342 (79.5)	226 (88.6)	116 (36.3) ^e
Māori	88 (20.5)	29 (11.4)	59 (67.0)
Household SES			
High	37 (9.1) ^a	26 (10.5) ^c	11 (29.7) ^e
Medium	155 (38.1)	108 (43.7)	47 (30.3)
Low	215 (52.8)	113 (45.7)	102 (47.4)
NZDep01 deprivation category			
High	117 (28.1) ^b	56 (22.7) ^d	61 (9.1) ^e
Medium	179 (43.0)	108 (43.7)	71 (39.7)
Low	120 (28.8)	83 (33.6)	37 (30.8)
Total	430 (100)	255 (59.5)	175 (40.5)

^a Data missing for 23 respondents, whose parents could not be classified
^b Data missing for 14 respondents, for whom geocoding was not possible
^c Data missing for 8 respondents, whose parents could not be classified
^d Data missing for 8 respondents, for whom geocoding was not possible
^e P<0.05

Table 2. Baseline (age 13) CPQ₁₁₋₁₄ and domain scores for self-rated oral health (brackets contain standard deviation)

Global Questions	CPQ ₁₁₋₁₄	Oral symptoms	Functional limitations	Emotional wellbeing	Social wellbeing
Overall Score	18.1 (15.1)	5.0 (3.2)	5.5 (4.5)	3.7 (5.0)	4.0 (5.4)
Self-rated oral health					
Excellent ^b	11.8 (7.8) ^a	3.6 (2.3)	3.1 (2.6) ^a	2.2 (3.4)	3.0 (3.8) ^a
Very good ^c	14.3 (11.2)	4.2 (2.9)	4.9 (3.9)	2.3 (3.2)	2.9 (3.8)
Good ^d	19.1 (14.3)	5.1 (3.0)	5.7 (4.3)	4.0 (4.8)	4.3 (5.7)
Fair/Poor	30.8 (22.9)	7.6 (4.0)	8.1 (6.3)	7.7 (8.3)	7.3 (7.7)

^ap-value<0.05

^bThe ‘Excellent’ category differed significantly from the ‘Good’, ‘Fair/Poor’ categories for all except the emotional and social well-being domain scores.

^cThe ‘Very good’ category differed significantly from the ‘Good’, ‘Fair/Poor’ categories for all domain scores.

^dThe ‘Good’ and ‘Fair/Poor’ category differed significantly from all categories except for social wellbeing and functional limitations domain scores.

Table 3. Change in self-rated oral health and global transition from age 13 to 16 with change in CPQ

Global Questions	Number (%)	Change in CPQ ₁₁₋₁₄	Change in oral symptoms	Change in functional limitations	Change in emotional wellbeing	Change in social wellbeing
Change in self-rated oral health						
Improved	24 (17.5)	-2.2 (15.1) ^a	0.6 (3.3)	-0.4 (3.7)	-1.7 (4.3) ^a	-1.4 (7.8)
No change	165 (64.0)	-1.5 (15.1)	0.0 (3.3)	-0.2 (5.0)	-0.2 (5.3)	-1.2 (5.5) ^d
Worsened ^c	66 (25.8)	4.6 (15.3) ^d	1.3 (3.5) ^d	0.9 (5.3)	1.5 (4.4) ^d	0.9 (5.8)
Global transition 13 to 16						
Improved	102 (40.0)	-1.1 (5.0) ^a	0.4 (3.7) ^a	-0.0 (4.9)	-0.3 (4.1) ^a	-1.2 (6.3)
No change	136 (53.3)	-0.4 (14.5)	0.2 (3.1)	-0.1 (4.8)	-0.1 (4.6)	-0.7 (5.2)
Got worse ^b	17 (6.7)	10.4 (20.6)	2.4 (3.6) ^d	2.6 (6.7)	3.2 (5.9)	1.9 (7.8)

^ap-value<0.05; Kruskal-Wallis/Mann-Whitney

^bOne-way ANOVA: the “got worse” differs from each of the others for all categories.

^cOne-way ANOVA: the “worsened” differs from all categories except for emotional wellbeing, and the “no change” for all but functional limitations

^dp-value<0.05; Paired t-tests

Longitudinal construct validity and responsiveness.

Slightly more adolescents (64%) had no significant change in their self-rated oral health measure from age 13 to 16 than with the GTJ measure (53%). There were significant differences between both global questions for those who improved and worsened (Table 3). Mean change scores (computed by subtracting the baseline score from the follow-up score) for CPQ₁₁₋₁₄ and its four subscales for each category of change in self-rated oral health and global transition judgement are shown in Table 3. On average, change scores were negative among those who improved, close to zero for those with no change, and positive for those who worsened. The observed difference was statistically significant for the overall CPQ₁₁₋₁₄ but not for all the subscales. Regardless of the global measure, the subscale change in oral symptoms was the only one, which showed a reverse gradient (positive change indicating

deterioration, with improvement over time).

Where the GTJ is concerned, those who got worse differed significantly from those who improved or had no change. For the change in self-rated oral health from baseline to follow-up, those who worsened also differed significantly from the others (except for the functional limitations and emotional well-being subscales).

Examination (using paired t-tests) of within-individual change among those who changed and for those whom stability was observed showed that only those who worsened had significantly greater CPQ₁₁₋₁₄ scores at follow-up. The direction of change across both measures was in the expected direction for the CPQ₁₁₋₁₄ but not for all of its subscales. Among the 74 adolescents whose self-rated oral health deteriorated by only one category (for example, from ‘excellent’ to ‘very good’, or from ‘fair’ to ‘poor’), the mean change score was 3.6 (SD, 15.4). For the 38 adolescents who improved by

one category, the mean change score was 3.7 (SD, 14.4). This indicates that the minimally important difference to reflect a change is 4. Between baseline and follow-up the CPQ₁₁₋₁₄ scores of 105 adolescents (41.2%) improved by the minimally important difference, with their mean change score being 13.0 (SD, 9.6). The CPQ₁₁₋₁₄ scores of 148 (58.0%) showed deterioration by the minimally important difference, and their mean change score was -9.2 (SD, 11.5). Guyatt's responsiveness statistic for this sample is 0.27.

DISCUSSION

This study has examined aspects of the evaluative properties of the CPQ₁₁₋₁₄, an instrument designed to have discriminative and evaluative properties (Jokovic *et al.*, 2002) in investigating child and adolescent oral health. The validity and responsiveness of the CPQ₁₁₋₁₄ were found to be acceptable, and the minimal important difference was determined to be 4 scale points, suggesting that a change in score of that magnitude is clinically meaningful.

Although the CPQ₁₁₋₁₄ was designed as a measure which conformed to contemporary concepts of child health, it can not be assumed that since it has shown good discriminative properties in a representative sample population (Foster Page *et al.*, 2005), it will be suitable for use in studies to detect change (even though it was intended for this). The rationale behind this current study is similar to that proposed and used by Locker *et al.* (2004), in that the responsiveness of all OHRQoL instruments which are developed needs to be assessed prior to using them in clinical trials and evaluation studies.

Before discussion of the findings, it is appropriate to consider the representativeness and retention of the sample. A simple random sample of 600 13-year-olds was selected in 2003, with an effective participation rate of 74% (N=430) at baseline; this was shown to be representative (Foster Page *et al.*, 2005). These adolescents were followed-up in 2006 with an effective participation rate of 63% (N=255). Although this response rate may be deemed "suspect" by some observers (Locker, 2000) the response rate is not the sole criterion: non-response error is a function of the non-response rate and the magnitude of the differences between responders and non-responders (Locker, 2000). The non-responders did differ in their sociodemographic characteristics, with more Maori and low-SES adolescents not part of the follow-up sample. This suggests that the longitudinal sample may not be representative of the Taranaki population. However, it is possible to argue that a possible lack of generalisability is more than outweighed by the longitudinal data and the adequacy of the sample size (as reflected in Guyatt's responsiveness statistic).

It is also appropriate to discuss the use of the CPQ₁₁₋₁₄ at follow-up in an older age group (with it having been designed for 11- to 14-year-olds), since developmental changes unavoidably affect OHRQoL between childhood and adolescence. Maturity and an increase in age generate a more sophisticated understanding and perception about health

and illness, changing perceptions about health and quality of life in adolescents (Wallander *et al.*, 2001). This may have impacted on our findings. However, it would not have been possible to assess the evaluative properties of the CPQ₁₁₋₁₄ without using the same questionnaire at follow-up.

The baseline data indicate that the CPQ₁₁₋₁₄ had acceptable cross-sectional construct validity and internal consistency reliability, although there were some minor concerns with the subscales. The internal consistency reliability of the functional limitations and oral symptoms subscales was not as high as would be preferred. The relatively low Cronbach's alpha for the latter most likely reflects the fact that it is not really a scale that represents a single construct; rather, it is a check-list of what can be independent events such as 'pain' and 'bleeding gums' (Malden *et al.*, 2008). However, the findings confirm early work indicating that the measure has good discriminative properties (Foster Page *et al.*, 2005).

The CPQ₁₁₋₁₄ as a measure of OHRQoL was designed as an evaluative measure, although little formal assessment of its properties has been conducted in that respect (Locker, 2004). The repeat questionnaires to the 14 adolescents had excellent reliability, but the weak correlation for those adolescents who remained stable over time indicates a need for further investigation of the evaluative properties of the CPQ. A high correlation reflects high concordance, the extent to which the repetition of the test yields the same values under the same conditions in the same individuals. In these adolescents, the observed weak concordance may be due to the impact of other variables over the study time frame; even so, this measure of reliability is accepted as the preferable measure of quantifying reliability (Guyatt *et al.*, 1987). Reproducibility is an essential component of the responsiveness of a measure, but it alone does not guarantee that a measure is suitable for use in clinical trials or for evaluative studies. From a theoretical point, a measure may show good reproducibility but be poor at detecting changes. Guyatt stated that a measure is useful if it detects clinically meaningful change using feasible sample sizes (Guyatt *et al.*, 1987), as in the current study. This study's findings on the responsiveness of the CPQ₁₁₋₁₄ are acceptable, although somewhat equivocal and similar to earlier observations of the responsiveness of the OHIP (Locker *et al.*, 2004). There were gradients in the expected direction across the categories of both global measures, with the differences between the change groups being significant for the change in overall CPQ₁₁₋₁₄ and in the emotional well-being subscale, but not for the other subscales. Our sample size of 255 was acceptable for confirming the construct validity of the CPQ₁₁₋₁₄ as we required 214 paired observations in order to detect a significant difference in mean change scores between adolescents who remained stable and either improved or worsened. By following at least 214 students over the three years, we had a sample, which was large enough to permit examination of the measure's responsiveness (Guyatt *et al.*, 1987).

In summary, this longitudinal investigation of the properties of the CPQ₁₁₋₁₄ in a population of New Zealand adolescents has shown that the measure's responsiveness appears to be acceptable.

Moreover, a clinically meaningful change in score is 4 scale points.

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