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Parental-Caregivers Perceptions Questionnaire (P-CPQ) for Assessment of Child's Oral Health-Related Quality of Life in Croatia: Translation and Evaluation of Psychometric Properties

Upitnik roditeljske/starateljske percepcije (P-CPQ) za mjerenje kvalitete života povezane s oralnim zdravljem u djece u Hrvatskoj: prijevod i procjena psihometrijskih karakteristika

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Abstract. ***Aim:*** The aim was to perform the Croatian translation and psychometric validation of the Parental-Caregivers Perceptions Questionnaire (P-CPQ). ***Patients and methods*:** The study included 334 participants (children aged 11-14 years; 53% female) and their parents for validity and internal reliability testing. Reproducibility of the measure was tested on 26 participants and responsiveness on 46. The Child Perceptions Questionnaire (CPQ) and P-CPQ were self-administrated. The degree of malocclusion and caries severity were additionally assessed. ***Results:*** The results have shown that the four-factor structure was more appropriate in the Croatian cultural context than the two-factor structure. Confirmatory factor analysis confirmed the findings. The correlation between child and parental assessment was statistically significant but moderate to weak, being higher for emotional (EW) and social well-being (SW) (r=0.551 and 0.412; p<0.001). Higher scores were detected in all subscales in subjects with caries lesions, while only EW and SW scores differed between participants with low and high malocclusion severity. Internal consistency was the highest for EW and the lowest for oral symptoms (α=0.88 and 0.66; p<0.001). All subscales were stable over time, while the most significant changes in the quality of life before and after orthodontic treatment were present in the EW subscale. ***Conclusion:*** The original, four-dimensional P-CPQ can be used to provide aninsight into the parent's awareness of the negative impact of oral conditions on daily activities of their child in the Croatian population.

Keywords: oral health; quality of life; surveys and questionnaires; validation study

Sažetak. ***Cilj:*** Cilj je bio učiniti hrvatski prijevod i psihometrijsku validaciju Upitnika roditeljske/starateljske percepcije (P-CPQ). ***Ispitanici i metode:*** Istraživanje je uključilo 334 ispitanika (djeca 11 – 14 godina; 53 % ženskog spola) i njihove roditelje radi testiranja valjanosti i unutarnje konzistencije. Vremenska stabilnost testirana je na 26 sudionika, a prikladnost na 46. Upitnik percepcije djece (CPQ) i P-CPQ ispitanici su samostalno ispunili. Dodatno su procijenjeni stupanj zahvaćenosti denticije karijesom i težina malokluzije. ***Rezultati:*** Rezultati su pokazali da je četverofaktorska struktura primjerenija hrvatskom kulturnom kontekstu nego dvofaktorska. Konfirmatorna faktorska analiza potvrdila je nalaze. Korelacija između procjene djeteta i roditelja bila je statistički značajna, ali umjerena do slaba te veća za emocionalno (EW) i društveno blagostanje (SW) (r = 0,551 i 0,412; p < 0,001). Viši rezultati otkriveni su u svim dimenzijama kod ispitanika s karijesnim lezijama, dok su se samo rezultati dimenzija EW i SW razlikovali kod onih s blažim i težim stupnjem malokluzije. Unutarnja konzistencija bila je najveća za EW, a najmanja za oralne simptome (α = 0,88 i 0,66; p < 0,001). Sve su dimenzije bile vremenski stabilne, dok su najznačajnije

promjene u kvaliteti života prije i nakon ortodontskog liječenja bile prisutne u dimenziji EW. ***Zaključak:*** Izvorni, četverodimenzionalni P-CPQ može se koristiti za procjenu roditeljske percepcije negativnog utjecaja oralnih stanja na svakodnevne aktivnosti djeteta u hrvatskoj populaciji.

Ključne riječi: ankete i upitnici; kvaliteta života; oralno zdravlje; validacijsko istraživanje

INTRODUCTION

Various oral and craniofacial disorders that affect children and adolescents can have an impact on normal daily functioning of the child and the child's family. This has sparked an interest in developing and using oral health-related quality of life (OHRQoL) measures in the context of the entire family – including both the youngsters and their parents[1, 2].

The use of OHRQoL questionnaires in dentistry is of great importance, both in research and clinically. These measures help envision the patient's psychosocial background and daily functioning related to oral health. Simultaneously, they aid the assessment of treatment need, facilitate clinical procedures and the selection of the appropriate treatment modality[3]. The usefulness of such questionnaires has been recognized, which led to significant advancements in the construction and evaluation of the validity and reliability of psychometric instruments for parallel quality of life (QoL) assessment of children and their parents[4]. Access to data related to quality of life from two independent and reliable informants is essential to obtain a comprehensive view of psychosocial problems and disruptions in daily oral functioning[5, 6]. However, as childhood cognitive development is complex, developing children's versions of the questionnaire posed a significant methodological challenge. The problem has been overcome by a team of Canadian researchers, who constructed the Child Oral Health-Related Quality of Life (COHRQoL) instrument[7, 8]. The COHRQoL instrument is a psychometric measurement tool that consists of a series of questionnaires designed to assess the psychosocial well-being and the impact of oral health on the quality of life in children and their families from an early age to adolescence. The components of the COHRQoL are:

(1) Child Perceptions Questionnaire (CPQ), for assessing OHRQoL in children[9],
(2) Parental-Caregivers Perceptions Questionnaire (P-CPQ), for assessing the parental perception of a child's OHRQoL[10], and
(3) Family Impact Scale (FIS), for assessing the impact of a child's condition on the family[11].

To administer the original versions of the questionnaires in other countries with different cultural backgrounds and to analyse whether they correspond to the original structure, the questionnaires must pass through a process of translation, cross-cultural adaptation, and validation. To date, COHRQoL instruments, both children's and parental versions, have been translated into a large number of languages. They have shown good psychometric properties in different sociocultural environments and countries such as France[12], China[13], Brasil[14, 15], Peru[16], etc. The children's versions of the questionnaire – $CPQ_{11–14}$ – have been previously validated in the Croatian population with a positive outcome[17, 18]. However, to obtain a complete insight into the child's condition and family interactions, it is also necessary to perform a validation study of the parental version of the questionnaire.

This study aimed to carry out the process of translation, cross-cultural adaptation and validation of the P-CPQ with the aim of using it in the Croatian cultural context. Considering the validation studies previously conducted in other countries, we assumed that the Croatian version would show good psychometric properties with grouping of items into subscales similar to the original version. We expected that the questionnaire would be reliable and stable over time, that it would have the ability to distinguish between participants with high and low caries intensity

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and malocclusion severity, and that it would be able to detect QoL changes as a consequence of orthodontic treatment.

PATIENTS AND METHODS

Instrument

The P-CPQ consists of 31 items designed to determine a parent's or caregiver's awareness of the negative impact of oral health conditions on daily life and activities of their child in the past three months. Quality of life disruptions were assessed through four subscales: oral symptoms (OS) – 6 items, functional limitations (FL) – 8 items, emotional well-being (EW) – 7 items, and social well-being (SW) – 10 items. Assessment of quality of life impairment was conducted using a 5-point scale with answers ranging from 0-4: 0 = Never, 1 = Once or twice, 2 = Sometimes, 3 = Often, 4 = Every day or almost daily. "I don't know" responses were also considered and given a score of 0. The final score was calculated by summing the responses of each item. The OS subscale score ranged from 0-24, the FL subscale from 0-32, the EW subscale from 0-28, and the SW subscale from 0-40, while the overall score ranged from 0-124. A higher score indicated a greater negative impact of oral health on a child's quality of life, according to the parent or caregiver[10].

Translation and cross-cultural adaptation

The steps of translation and cross-cultural adaptation were performed following specific guidelines for HRQoL questionnaires, which include COSMIN checklist [19–21]. The instruments were translated into Croatian using the forward-backward double translation method. Two independent translators, a dentist and an English teacher, performed a forward translation of the P-CPQ from English into Croatian. The questionnaires were then independently translated back into English by two new translators – another doctor of dental medicine and an English professor. An expert committee consisting of three dentists and a developmental psychologist with perfect English knowledge then compared two forward translations into Croatian, two backward translations into the original language, and the equivalence of the original and translated versions before determining the first version of the joint translation. Content validity was established with a pre-test on a convenience sample of 20 participants who, after completing the questionnaire, provided their comments to linguistically and structurally improve the questionnaire. After the modifications were made, the committee agreed on the final version of the questionnaire.

Participants

The research protocol was approved by the Ethical Committee of the Clinical Hospital Center Rijeka (No. 2170-29-02/1-14-5 and No. 2170-29-02/1-14-5) and the Ethical Committee of the Faculty of Medicine, University of Rijeka (No. 2170-24-01-15-2). The research has been conducted in full accordance with the Declaration of Helsinki. The parent of each participant granted a written informed consent.

The study included 334 participants (children aged 11-14 years; 53% female) and their parents (84% mothers) recruited at the University Dental Clinics in Rijeka and Zagreb, Croatia, throughout 2015-2023. Inclusion criteria were native language Croatian, and exclusion criteria were children with special needs, chronic diseases, and conditions. Temporal stability was evaluated on a sample size of 26 participants, while the sample size for testing the questionnaire's responsiveness equalled 46 participants.

Data collection

Data were provided by participants who self-administered questionnaires related to socio-demographics, self-perceived oral health, and well-being of the child, which were evaluated on a Likert-type scale (0-4; excellent-bad), as well as satisfaction with appearance, self-assessed orthodontic treatment need and demand of the child (0-4; not at all-very much). Adolescents self-completed a questionnaire that was previously validated for the Croatian population – the regression-short form (RSF) of the CPQ_{11-14} [18, 19], while parents or caregivers completed the P-CPQ[10]. The self-administration of questionnaires was followed by an intraoral examination of the child performed by three calibrated examiners

(intra-rater reliability κ=0.892-0.923; inter-rater reliability κ=0.812-0.840 (95% CI 0.710-0.990; p<0.001)) who detected dental decay following the WHO criteria[22] and two orthodontists (intra-rater reliability κ=0.838-0.958; inter-rater reliability κ=0.671 (95% CI 0.469-0.873; p<0.001)) who classified the severity of the malocclusion with the Index of Orthodontic Treatment Need Dental Health Component (IOTN DHC)[23]. The evaluation of temporal stability was performed on 26 participants from a public school in Rijeka and their parents. The respondents completed the questionnaire twice in a two-week interval, without undergoing any intraoral intervention that could affect the final assessment. Responsiveness of the questionnaire was tested on 46 participants with a Class II division 1 malocclusion, who were treated with a removable functional appliance for one year.

Statistics

Data were processed and analyzed using the SPSS software (IBM SPSS, Version 22.0, IBM, Armonk, USA) and R 4.2.0. software (R Core Team, Vienna, Austria). The structural validity of the P-CPQ was tested with exploratory (EFA) and confirmatory factor analyses (CFA). Within EFA the loading of at least 0.3 was used as a cut-off for the item retention. A post-hoc power analysis was conducted to determine the statistical power of the CFA model, given the observed sample size and model specifications. Using the semPower package (semPower, Version 2.1.1, Moshagen & Bader, 2024, Germany) in R, the obtained post-hoc power estimation was larger than 0.999. Convergent validity was evaluated using the Pearson correlation coefficient. In contrast, discriminant validity was assessed with the independent t-test, where the items of the P-CPQ were compared with the presence of dental caries and malocclusion severity. The questionnaire's reliability was tested using two approaches: (1) internal consistency and (2) test-retest for assessment of temporal stability. Internal consistency was determined using the Chronbach's alpha coefficient and inter-item correlation, while test-retest reliability was investigated by paired t-test and correlations. The ability of the Croatian version of the P-CPQ to detect changes over time was evaluated using the Wilcoxon test and effect size. The effect size was determined with the formula r=Z/√N. Interpretation was based on the Cohen criteria: r=0.1–0.3 was a small effect size, 0.3–0.5 was medium, 0.5–0.7 was large while >0.7 was considered very large effect size. External responsiveness of the questionnaire was tested using the Pearson correlation coefficient, where the amount of overjet (OJ) reduction (in millimeters) was compared with the changes in the results of certain subscales after the completion of orthodontic treatment.

RESULTS

Structural validity

Exploratory factor analysis was performed using the principial component analysis extraction method based in eigenvalues greater than 1 and Varimax rotation with Kaiser normalization. The initial analysis revealed a four-factor structure of the Croatian version of the P-CPQ that explained 52.5% of variance, with mixing of some items of the original subscales. Factor loadings in the four-factor structure ranged from 0.836 to 0.251 (Table 1). After re-running the analysis with the specification to extract only two factors, the factor analysis indicated a grouping of OS and FL subscales as well as EW and SW subscales, explaining 41.2% of variance. The one-factor structure explained 32.9% of variability. Confirmatory factor analysis was performed using diagonally weighted least square estimation (DWLS) for ordinal data. After correlating errors between several items, the fit parameters were satisfactory, although $\chi 2$ statistic was statistically significant ($\chi 2$=762.84; df=425; p<0.001). Other parameters showed a reasonable fit with CFI=0.990, TLI=0.989 and RMSEA=0.049 (90%CI=0.043-0.054). SRMR parameter of 0.087 was slightly above the expected threshold of 0.08, but the overall fit supported model adequacy.

Convergent validity

The correlation between child and parental assessment was statistically significant but moderate to weak. The EW subscale correlated the

Table 1. Exploratory factor analysis: factor loadings, accounted variance and grouping of items (N=334), [a, b]

Item (original subscale)	F1 (EW)	F2 (FL)	F3 (SW)	F4 (OS)
Worried he/she is less attractive than others (EW‡)	0.836			
Shy/ embarrassed (EW)	0.759			
Avoided smiling when around other children (SW)	0.734			
Worried that is different from other people (EW)	0.682			
Upset (EW)	0.671			0.35
Irritable/frustrated (EW)	0.656			0.396
Anxious/fearful (EW)	0.613			0.355
Not wanted to talk to other children (SW)	0.61		0.377	
Teased/called names by other children (SW)	0.58		0.444	
Worried about having fewer friends (EW)	0.526		0.477	
Not wanted to speak/read aloud in class (SW)	0.521	0.299	0.466	
Asked by other children about the condition (SW)	0.489		0.282	
Had a hard time paying attention in school (SW)	0.469	0.418	0.447	
Difficulty chewing firm foods (FL)		0.719		
Difficulty eating foods would like to eat (FL)	0.259	0.712	0.31	
Restricted diet (FL)		0.696	0.251	
Trouble sleeping (FL)		0.67		
Slow eating (FL)	0.311	0.64		
Unclear speech (FL)	0.277	0.64		
Breathing through the mouth (FL)		0.526		
Difficulty drinking/eating hot/cold food (FL)		0.515		0.323
Pain in teeth/mouth (OS)		0.474		0.418
Food stuck to the roof of the mouth (OS)		0.458		0.346
Not wanted/unable to be with other children (SW)			0.795	
Not wanted/unable to take part in activities (SW)			0.695	
Left out by other children (SW)	0.359		0.657	
Missed school (SW)		0.361	0.41	
Bad breath (OS)				0.647
Food caught between teeth (OS)				0.608
Bleeding gums (OS)	0.274			0.596
Mouth sored (OS)				0.516
Total variance explained / %	19.1	14.9	10.5	7.7

[a]extraction method: principal component analysis; rotation method: Varimax with Kaiser normalization

[b]grouping of items in the original questionnaire

most with children's EW and EW+SW subscales. SW was mostly associated with impaired social relations of the child and with the EW+SW subscale. The OS subscale moderately correlated with the presence of oral symptoms and impaired function of the oral cavity of the child, while parental FL correlated more strongly with the OS, EW and EW+SW subscales than with the functional limitations of the child and OS+FL subscale, with which it did not significantly correlate. On the other hand, all subscales of the P-CPQ negatively correlated with satisfaction with appearance and smile aesthetics – dominantly the EW subscale. A positive but weak correlation was present between the P-CPQ and the self-assessed need for orthodontic treatment (Table 2). Multiple regression did not detect influence of age and sex on that relationship.

Table 2. Convergent validity (N=334)

Variable		EW	SW	OS	FL	EW+SW	OS+FL	P-CPQ sum
RSF-16 OS child	r	0.281	0.241	0.324	0.353	0.492	0.417	0.506
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RSF-16 FL child	r	0.311	0.313	0.421	0.319	0.279	0.365	0.354
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RSF-16 EW child	r	0.551	0.362	0.254	0.347	0.336	0.434	0.423
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RSF-16 SW child	r	0.441	0.411	0.244	0.263	0.490	0.291	0.439
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RSF-8 OS+FL child	r	0.323	0.305	0.441	0.227	0.494	0.270	0.431
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RSF-8 EW+SW child	r	0.516	0.395	0.243	0.368	0.333	0.441	0.425
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RSF-8 sum child	r	0.502	0.415	0.390	0.265	0.456	0.294	0.421
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Self-perceived oral health[a]	r	0.236	0.156	0.225	0.225	0.213	0.259	0.263
	p	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Self-perceived well-being[a]	r	0.189	0.183	0.069	0.092	0.199	0.096	0.167
	p	0.001	0.001	0.210	0.093	<0.001	0.079	0.002
Satisfaction with appearance[a]	r	-0.387	-0.240	-0.285	-0.283	-0.339	-0.323	-0.367
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Self-assessed orthodontic treatment need[a]	r	0.278	0.200	0.182	0.259	0.257	0.263	0.288
	p	<0.001	0.003	0.006	<0.001	<0.001	<0.001	<0.001
Self-assessed orthodontic treatment demand[a]	r	0.239	0.114	0.107	0.151	0.193	0.154	0.193
	p	0.001	0.090	0.110	0.024	0.004	0.022	0.004

[a]parental-caregiver perception of a child's perspective

Discriminant validity

Discriminant analysis of the P-CPQ proved that several subscales of the tested instrument were able to distinguish between subjects with present and absent caries (subscales FL, EW, OS+FL with a small effect size (r=0.152-0.167; p≤0.049) and between subjects with low and high malocclusion severity (subscales OS, FL, EW, EW+SW, OS+FL; IOTN DHC ≥ 3; with a small effect size (r=0.165-0.229; p≤0.022); Figure 1). The summary score also detected differences with a small effect size (r=0.188-0.207; p≤0.015).

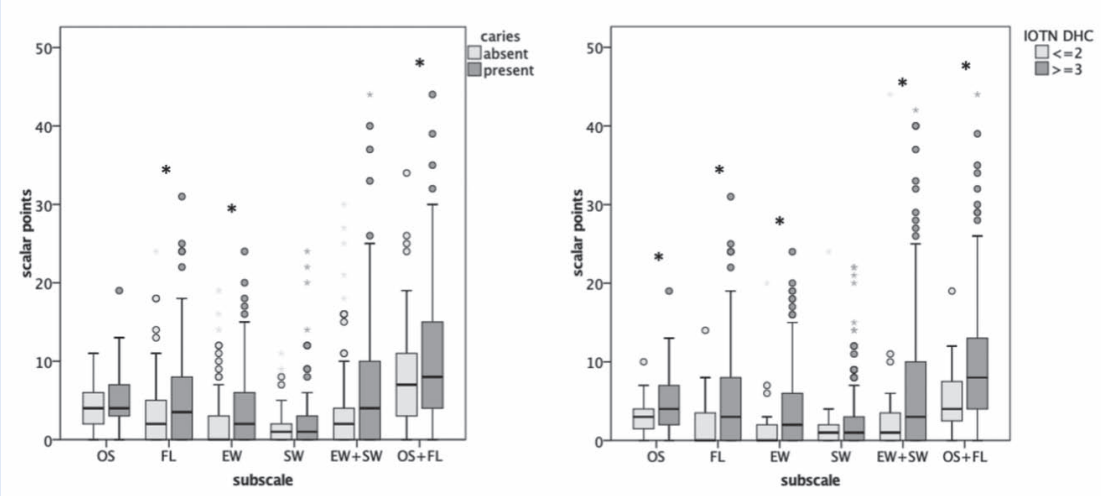

Figure 1. Discriminant ability of P-CPQ to discriminate between children with low and high malocclusion severity and with and without caries. The bars represent the interquartile range, the horizontal line the median, the whiskers the 5th and 95th quartiles, and the dots and small asterisks the outliers and extreme values. Large asterisks indicate significant differences (Mann-Whitney test; $p<0.05$)

Reliability

Internal consistency was the highest for EW and the lowest for OS. The Cronbach alpha values indicated excellent internal consistency for the total scale and EW+SW subscale. Deleting none of the items improved internal consistency. Inter-item correlations were weak to moderate – the strongest one being in the EW subscale (Table 3). Test-retest reliability for the Croatian version of the P-CPQ was excellent, while measurement error was low (Table 4). The difference between test and retest that were within the limit of agreement. SW demonstrated the highest test-retest reliability.

Responsiveness

Orthodontic treatment of Class II division 1 malocclusion with a functional appliance in early adolescence significantly reduced OJ values and was capable of inducing changes in the parental perception of their child's OHRQoL. The summary scale of the P-CPQ was able to detect a reduction of OJ following orthodontic treatment with a medium effect size ($p=0.021$; $r=0.340$). Among individual subscales, the most significant differences in observing changes in the quality of life before and after orthodontic treatment were present in the EW and EW+SW subscales (Table 5). Testing of external responsiveness has shown that the

Table 3. Internal consistency for the P-CPQ summary score and subscales (N=334)

Scale	Average±SD	Range	α	α if item deleted	Average inter-item correlation (range)
OS	4.7±3.2	0-19	0.66	0.59-0.64	0.25 (0.14-0.36)
FL	4.8±5.6	0-31	0.84	0.80-0.84	0.41 (0.17-0.64)
EW	3.3±4.7	0-24	0.88	0.85-0.88	0.24 (0.35-0.83)
SW	2.4±4.0	0-24	0.84	0.81-0.84	0.39 (0.15-0.71)
OS+FL	9.4±7.6	0-44	0.84	0.81-0.84	0.28 (0.004-0.64)
EW+SW	5.6±8.1	0-44	0.92	0.91-0.92	0.41 (0.14-0.83)
P-CPQ sum	15.1±14.0	0-77	0.92	0.91-0.92	0.29 (0.002-0.82)

Table 4. Test-retest reliability assessed by intraclass correlation coefficient and paired t-test (N=26)

Scale	ICC (95% CI)	ME[a]	SDC[b]	Paired differences mean (95% CI)	p	LOA[c]
OS1-OS2	0.943 (0.876-0.974)	0.5	2.0	0.2 (-0.1-0.5)	0.110	-1.2-1.5 (88%)
FL1-FL2	0.971 (0.937-0.987)	0.6	2.1	0.2 (-0.1-0.6)	0.161	-1.4-1.8 (92%)
EW1-EW2	0.971 (0.937-0.987)	0.4	1.7	0.2 (-0.1-0.4)	0.161	-0.9-1.3 (92%)
SW1-SW2	0.982 (0.960-0.992)	0.1	0.9	0.0 (0.0-0.1)	0.327	-0.4-0.4 (96%)
OS+FL1-OS+FL2	0.972 (0.934-0.988)	0.8	2.5	0.5 (0.0-0.9)	0.043	-1.7-2.6 (96%)
EW+SW1-EW+SW2	0.983 (0.961-0.992)	0.4	1.7	0.2 (0.0-0.4)	0.096	-0.9-1.3 (81%)
P-CPQ sum1- P-CPQ sum2	0.981 (0.951-0.992)	0.8	2.6	0.6 (0.1-1.1)	0.019	-1.4-2.6 (92%)

[a]Measurement error (ME) was calculated as square root of the residual variance; [b]Smallest detectable change (SDC) was calculated as 1.96*√2*ME; [c]Blant-Altman limits of agreement (LOA) were calculated as paired differences mean ± 1.96

Table 5. Internal responsiveness (N=46)

	Mean baseline score – mean follow up score	Paired differences mean (95% CI)	Summary score range at baseline	Glass' Δ effect size[a]	Standardized response mean[b]	p[c]	r[d]
OJ	8.1-3.6	4.5 (3.9-5.1)	5-13	2.356	2.178	<0.001	0.922
OS	5.5-4.4	1.1 (-0.2-2.5)	0-19	0.251	0.273	0.046	-0.294
FL	5.0-4.2	0.7 (-0.7-2.1)	0-22	0.108	0.152	0.411	-0.121
EW	4.4-2.2	2.2 (0.9-3.6)	0-26	0.373	0.508	0.001	-0.512
SW	3.6-2.3	1.3 (-0.5-3.1)	0-22	0.220	0.241	0.223	-0.176
OS+FL	10.5-8.7	1.9 (-0.5-4.2)	0-41	0.193	0.235	0.057	-0.281
EW+SW	8.1-4.5	3.6 (0.8-6.3)	0-42	0.331	0.381	0.035	-0.312
P-CPQ sum	18.6-13.2	5.4 (1.0-9.8)	0-76	0.297	0.368	0.021	-0.340

[a]Glass' Δ effect size = average difference between the two measurements divided by the standard deviation of the first measurement; [b]Standardized response mean = average difference between the two measurements divided by the standard deviation of the differences between the paired measurements; [c]Paired samples t-test; [d]Effect size (r) was calculated r=Z/√N

Table 6. External responsiveness (N=46)

	r[a]	p[a]
OS	-0.155	0.305
FL	-0.221	0.140
EW	0.126	0.404
SW	-0.005	0.972
OS+FL	0.147	0.330
EW+SW	0.062	0.683
P-CPQ sum	0.126	0.404

[a]Pearson correlation coefficient with corresponding p-values for correlation between OJ reduction in millimeters and changes in the P-CPQ scales

amount of OJ reduction did not significantly correlate with the changes in P-CPQ subscales (Table 6). Multiple regression did not detect influence of age and sex on that relationship.

DISCUSSION

This study was based on examining the psychometric properties of the P-CPQ in the Croatian cultural setting. The conducted research has shown good validity and reliability of the instrument, in particular the four-dimensional measure.

OHRQoL instruments are an essential element in dental public health research, but they must be

tailored to the population for which they are to be used. Suppose researchers do not have an adequate psychometric instrument at their disposal. In that case, two solutions are possible: (1) developing a new tool or (2) modifying an instrument that has already been constructed and validated. Developing a new instrument is a challenging and time-consuming task; hence we opted for a careful translation and cross-cultural adaptation of the original version of P-CPQ. In adapting the questionnaire to the Croatian population, the previously defined guidelines were thoroughly followed to achieve a high-quality translation and cultural adaptation, which is the basis for adequate implementation of the validation study[19–21]. Finally, the Croatian version of the questionnaire was very similar to the original structure, consisting of 31 items.

Exploratory factor analysis initially indicated a four-factor structure, while more factors were also reported in France[13]. The original four-factor structure analysis indicated a possible mixing of the subjective (EW and SW) and objective subscales (OS and FL), i.e., the existence of a two-factor structure. However, the two-factor structure of the questionnaire, where one subscale was OS+FL, which explained the alteration of oral health, and the other was SW+EW, which referred to psychosocial well-being, was not superior for use in the Croatian population. Due to the mentioned results, we could conclude that the cultural and linguistic differences between the original and Croatian version were not that significant, which is considered a positive feature. Likewise, the four-factor model enabled a more detailed analysis of the questionnaire's properties within each subscale compared to the two-factor model, which is another plus[24]. Compared to the French version[13], the items loaded a single factor to a very similar extent.

Confirmatory factor analysis confirmed the findings of the exploratory factor analysis. The χ^2 values associated with the examined instrument were statistically significant, which was interpreted as a poor model fit. However, it should be kept in mind that the χ^2 test is sensitive to the sample size of the model, which may lead to wrongful rejections of acceptable models. 334 participants were included in this validation study, which is why the significant χ^2 results were not surprising. However, other fit indices showed an adequate model fit for our measure. When comparing the results of the CFA of the Croatian version with the only study in which the factor structure of the P-CPQ was additionally confirmed, a much better fit of the Croatian model was observed compared to the French four-dimensional version[13]. The differences were again a possible consequence of the cultural and linguistic specificities of the two populations and the fact that the Croatian translation was potentially more comprehensible compared to the French version, which was also emphasized by the authors of the aforementioned study.

When comparing the results of the P-CPQ with a psychometric instrument that measures a similar construct – in this case, the RSF $CPQ_{11–14}$ with 16 items[19] – it was found that the correlation between these two psychometric instruments was weak to moderate but still significant. The subscales of parental reporting of impairment of the child's quality of life correlated the most with the same subscales of the children's version of the questionnaire, while differences existed for the FL subscale. On the one hand, it is possible that children do not report functional impairments of the oral cavity well, while on the other hand, maybe parents are not able to adequately assess the child's FL, or they directly associate the limitation of function with the existence of oral symptoms. When talking about a child-parent (dis)agreement related to OHRQoL, the child's cognitive development must be considered. Several studies have shown that a higher level of cognitive development in preadolescents and adolescents, compared to younger children, leads to a greater agreement between parents and children[25], which was also the case in this study. The negative correlation of the P-CPQ results with satisfaction with dentofacial aesthetics found was expected, because this instrument examines the way in which parents perceive the quality of life of the child, therefore, the worse the quality of life, the higher the expected P-CPQ score. On the other hand, the correlation between the questionnaire results and orthodontic treatment demand was not statistically significant, meaning that this questionnaire cannot

properly assess treatment demand expressed by parents. The questions in the P-CPQ are focused on problems that younger adolescents and their parents have due to oral health, which can be directly reflected in the need for treatment, while the existence of orthodontic treatment demand is then only an implication of a clearly defined need by the parents.

Testing the discriminant validity of the Croatian version of the P-CPQ has shown that parents recognize a greater deterioration in the quality of life of their children in those with a more severe form of malocclusion and in those with detected caries in the oral cavity. According to the results of this study, malocclusion significantly affected the parental perception of almost all aspects of the COHRQoL. On the other hand, parents whose children had experience with caries also believed that their child's quality of life was impaired, especially in subscales related to the intraoral state and function and the child's emotions. Such results were expected, as subjects with more caries experience are more likely to report a greater impairment in quality of life. In general, experience with caries strongly affects the oral symptoms and functional limitations subscales, whereas malocclusion more often affects the individual's psychosocial component[26]. Previous studies examining the discriminant validity of the P-CPQ have also confirmed this[10, 15, 16].

The reliability of the P-CPQ is satisfactory. Internal consistency is considered good when Cronbach's alpha values are 0.70 or higher[27], which is consistent with the values obtained in this study. Cronbach's alpha coefficient of the total scale and subscales was comparable to the values observed in the studies previously conducted in Canada, France, China, and Brazil[10, 13–16]. Alphas in the original Canadian instrument were OS=0.69, FL=0.79, EW=0.92, SW=0.82 and total P-CPQ=0.94[10]. However, the only subscale that presented questionable but still acceptable internal consistency was OS (0.66 in Croatia and 0.69 in the original Canadian version), which also corresponds to previous findings[10, 14, 16, 17]. This can be explained by the fact that the OS subscale consists of the smallest number of items explaining a relatively wide range of oral symptoms. Some of the options to overcome low internal consistency are revising the content to better align with the intended construct, increasing the number of items that assess a specific dimension, or aggregating with similar dimension, such as FL. The excellent test-retest reliability found among all subscales of the instrument means that the Croatian version of the P-CPQ has very good temporal stability and reproducibility, even better than most other versions intended for use in a different cultural setting[10, 13, 16]. Coefficients of reproducibility in the original Canadian instrument were OS=0.69, FL=0.79, EW=0.85, SW=0.79 and total P-CPQ=0.85[10]. Among individual subscales, the highest reproducibility was observed in the SW subscale and the lowest in the OS subscale, which is explained by the very construction of the P-CPQ. Namely, the SW subscale consists of the largest number of items and therefore has the largest scale range (40 scalar points), while for the oral symptoms the respondent can reach a maximum of 24 scalar points. The Croatian version of the questionnaire is responsive to changes in the OHRQoL as a result of functional treatment of Class II division 1 malocclusion. However, the reduction of OJ did not correlate significantly with changes in quality of life. This result does not correspond to that of Malden et al., who investigated the influence of caries treatment under general anesthesia on parents' assessment of a child's quality of life[28]. The observed difference can be explained by the fact that orthodontic treatment will have the greatest influence on the emotional well-being of the participants[26]. However, caries treatment may have a much greater impact on parental perceptions of quality of life compared with the treatment of malocclusion, due to the reduction of oral symptoms and consequent improvement of oral func-

The Croatian version of the P-CPQ consists of 31 items, which may be burdensome for respondents. This problem could be avoided by using short forms consisting of 16 and 8 items. However, for adequate use, it is necessary to conduct additional validation studies to assess the short versions' psychometric properties.

tion[28]. In another research, in which the impact of orthodontic treatment with a fixed appliance over a period of 12 months was studied, results similar to this study were found – the perception of emotional well-being changed significantly, as well as the way parents perceive their children's social relationships[29]. Improvements in psychosocial subscales are a possible consequence of new positive perceptions that are associated with the start of orthodontic treatment during adolescence[30]. The assumed outcome includes improvement of dental aesthetics[31], which provides benefits in the context of emotional experiences and social relationships for adolescents, but also for parents[30, 32]. On the other hand, external responsiveness has shown that the relationship between the improvement of the condition and the change in the parental perception of the COHRQoL was not linear. This could mean that even less successful treatments could positively influence the parental perception of the child's condition or that children involved in the orthodontic treatment started thinking that the therapy was useful, so they reduced the pressure on the family.

The positive aspects of this study are that all the necessary steps were taken into consideration to achieve a high-quality validation study. Overall, this study's main advantage is that it represents the foundation for subsequent studies related to COHRQoL in Croatia. Also, parallel versions of the questionnaires for children (CPQ – adapted to the age of the respondents) and parents or guardians (P-CPQ) were used, which allowed us to get a more comprehensive view of the presenting problems. Per contra, this study has some limitations that could stimulate further research. The length and completion time of the instrument may influence the use of such questionnaires in daily practice. The Croatian version of the P-CPQ consists of 31 items, which may be burdensome for respondents, reducing the convenience for routine use of the questionnaire for scientific and clinical purposes. This problem could be avoided by using short forms of the questionnaire consisting of 16 and 8 items[3]. However, for adequate use, it is necessary to conduct additional validation studies to assess the short versions' psychometric properties for the Croatian population. Furthermore, the sample size of this study may be debatable. Several guidelines are used for determining the sample size for health-related questionnaires – the ratio of respondents to items can range from 5:1[33] or more commonly 10:1[34]. According to those criteria the minimum sample size for 31 items is 155-310 participants. However, it should be noted that there are still no standardized guidelines for determining sample sizes in validation studies, but researchers should aim for the largest sample possible to confirm the results with greater reliability. It is also very likely that the obtained effect sizes and overall responsiveness of the questionnaire are partly a consequence of biased subject selection. Typically, Class II division 1 patients have a large OJ with protruding incisors that can seriously compromise dentofacial aesthetics. Therefore, it is not unreasonable to expect that treating this malocclusion can cause a significant change in P-CPQ results after orthodontic treatment. However, the OHRQoL instruments were designed for use in a general population rather than a specific one (such as patients with malocclusions), which is why further research should be conducted to more precisely assess the responsiveness of this instrument.

In conclusion, this research provided data that supports the initial hypothesis. P-CPQ has shown good psychometric properties and it is valid and reliable for use in the Croatian cultural context in a four-dimensional structure.

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REFERENCES

1. Kramer PF, Feldens CA, Ferreira SH, Bervian J, Rodrigues PH, Peres MA. Exploring the impact of oral diseases and disorders on quality of life of preschool children. Community Dent Oral Epidemiol. 2013;41:327–35.
2. Barbosa TS, Gavião MB. Oral health-related quality of life in children: part II. Effects of clinical oral health status. A systematic review. Int J Dent Hyg. 2008;6:100-7.
3. Thomson WM, Foster Page LA, Gaynor WN, Malden PE. Short-form versions of the Parental-Caregivers Percep-

tions Questionnaire and the Family Impact Scale. Community Dent Oral Epidemiol. 2013;41:441–50.

4. Cohen LK. Measuring Oral Health and Quality of Life. Chapel Hill: University of North Carolina, Department of Dental Ecology; 1997.
5. Eiser C, Morse R. Can parents rate their child's health-related quality of life? Results of a systematic review. Qual Life Res. 2001;10:347–57.
6. Van Roy B, Groholt, B, Heyerdahl S, Clench-Aas, J. Understanding discrepancies in parent-child reporting of emotional and behavioural problems: effects of relational and socio-demographic factors. BMC Psychiatry. 2010;10:56.
7. Barbosa TS, Gavião MB. Oral health-related quality of life in children: part I. How well do children know themselves? A systematic review. Int J Dent Hyg. 2008;6:93-9.
8. McGrath C, Broder H, Wilson-Genderson M. Assessing the impact of oral health on the life quality of children: implications for research and practice. Community Dent Oral Epidemiol 2004;32:81–5.
9. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G. Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. J Dent Res. 2002;81:459–63.
10. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G. Measuring parental perceptions of child oral health-related quality of life. J Public Health Dent. 2003; 63:67-72.
11. Locker D, Jokovic A, Stephens M, Kenny D, Tompson B, Guyatt G. Family impact of child oral and orofacial conditions. Community Dent Oral Epidemiol. 2002;30:438–48.
12. Razanamihaja N, Boy-Lefèvre ML, Jordan L, Tapiro L, Berdal A, de la Dure-Molla M, Azogui-Levy S. Parental-Caregivers Perceptions Questionnaire (P-CPQ): translation and evaluation of psychometric properties of the French version of the questionnaire. BMC Oral Health. 2018; 18:211.
13. McGrath C, Pang HN, Lo ECM, King NM, Hägg U, Samman N. Translation and evaluation of a Chinese version of the child oral health-related quality of life measure. Int J Paediatr Dent. 2008;18:267-74.
14. Barbosa T de S, Gavião MB. Validation of the parental-caregiver perceptions questionnaire: agreement between parental and child reports. J Public Health Dent. 2015;75:255–64.
15. Goursand D, Paiva SM, Zarzar PM, et al. 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. 2009;20:169–74.
16. Albites U, Abanto J, Bönecker M, Paiva SM, Aguilar-Gálvez D, Castillo JL. Parental-caregiver perceptions of child oral health-related quality of life (P-CPQ): psychometric properties for the Peruvian Spanish language. Med Oral Patol Oral bucal. 2014;19:e220–4.
17. Pop Acev D, Brumini M, Šlaj M, Katić V, Špalj S. Child Perceptions Questionnaire in Croatia: two domains for measuring oral health. Acta Stomatol Croat. 2019;53: 47-54.
18. Brumini M, Slaj M, Katic V, Pavlic A, Trinajstic Zrinski M, Spalj S. Parental influence is the most important predictor of child's orthodontic treatment demand in a preadolescent age. Odontology. 2020;108:109-16.
19. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. 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. 2010;19(4):539-49.
20. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol. 1993; 46:1417–32.
21. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine. 2000;25:3186–91.
22. Petersen PE, Baez RJ, World Health Organization. Oral health surveys: basic methods, 5th ed. Geneve: World Health Organization; 2013.
23. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod. 1989;11: 309-20.
24. Juniper EF, Guyatt GH, Streiner DL, King DR. Clinical impact versus factor analysis for quality of life questionnaire construction. J Clin Epidemiol. 1997;50:233-8.
25. Granville-Garcia AF, Gomes MC, Dantas LR, Dantas LR, da Silva BR, Perazzo MF, Siqueira MB. Parental influence on children's answers to an oral-health-related quality of life questionnaire. Braz Oral Res. 2016;30:e14.
26. Dimberg L, Arnrup K, Bondemark L. The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. Eur J Orthod 2015;37:238-47.
27. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika. 1951;16:151-5.
28. Malden PE, Thomson WM, Jokovic A, Locker D. Changes in parent-assessed oral health-related quality of life among young children following dental treatment under general anaesthetic. Community Dent Oral Epidemiol. 2008;36(2):108-17.
29. Abreu LG, Melgaço CA, Abreu MHNG, Lages EMB, Paiva SM. Parent-assessed quality of life among adolescents undergoing orthodontic treatment: a 12-month follow-up. Dental Press J Orthod. 2015;20:94-100.
30. Abreu LG, Melgaço CA, Lages EM, Abreu MH, Paiva SM. Parents' and caregivers' perceptions of the quality of life of adolescents in the first 4 months of orthodontic treatment with a fixed appliance. J Orthod. 2014;41(3):181-7.
31. Lombardo L, Berveglieri C, Guarneri MP, Siciliani G. Anterior dental alignment and smile: perception and sensations in a sample of 8- to 10-year-old children and their parents. Orthodontics (Chic). 2011;12:366-77.
32. Henson ST, Lindauer SJ, Gardner WJ, Shroff B, Tufekci E, Best AM. Influence of dental esthetics on social perceptions of adolescents judged by peers. Am J Orthod Dentofacial Orthop. 2011;140:389-95.
33. Gorusch RL. Factor Analysis. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1983.
34. Nunnally J. Psychometric Theory. New York: McGraw-Hill; 1978.