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ORIGINAL ARTICLE

Oral health-related quality-of-life among children in Swedish dental care: The impact from malocclusions or orthodontic treatment need

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Abstract

Objectives. To describe oral health-related quality-of-life (OHRQoL) and the impact of malocclusions or orthodontic treatment need in a cohort of children in Swedish dental care, using the Swedish version of the Child Perceptions Questionnaire–Impact Short Form ($CPQ_{11–14}$–ISF:16). ***Subjects and methods.*** Two hundred and fifty-seven children (mean age = 11.5 years, SD = 0.8, range = 9.8–13.5 years) completed the $CPQ_{11–14}$–ISF:16 in conjunction with a clinical examination. In addition to malocclusions and orthodontic treatment need (based on the Index of Orthodontic Treatment Need–Dental Health Component), possible confounders (caries, enamel defects, dental trauma, headache and socio-economic markers) were recorded. Children also rated their own dental fear on the Children's Fear Survey Schedule–Dental Sub-scale (CFSS-DS). ***Results.*** The mean total $CPQ_{11–14}$–ISF:16 score was 9.31. The logistic regression analyses revealed an impact of orthodontic treatment need on OHRQoL (CPQ), but no clear association between higher severity and higher impact on OHRQoL was seen. Dental fear and headache appeared to discriminate for poorer OHRQoL. No impact from caries, enamel defects, dental trauma, or socio-economic markers was revealed. ***Conclusions.*** This cohort of children reported good self-perceived OHRQoL. Effects on OHRQoL from malocclusions or orthodontic treatment need were limited and inconsistent. Dental fear and headache were found to be more distinct impact factors on OHRQoL than were malocclusions or orthodontic treatment need.

Key Words: *Child, cross-sectional study, orthodontics*

Introduction

One of the most prevalent oral conditions is malocclusion. Prevalence ranges between 39–93% depending on ethnic group, age group and method of registration. In early childhood, the most prevalent malocclusions are anterior open bite and posterior cross-bite, while, in school-age children, crowding and displacement of teeth are more common [1–4]. Earlier studies have revealed that visible malocclusions (anterior malocclusions) have been associated with bullying and lower self-esteem among teenage children [5,6].

Orthodontic treatment need is usually assessed by grading malocclusion severity. However, a person's self-perception of the malocclusion may not always be related to malocclusion severity. Therefore, when evaluating the individual need for treatment it may be equally important to consider what impact the malocclusion can have on the self-perceived oral health-related quality-of-life (OHRQoL).

To evaluate OHRQoL, questionnaires of quantitative design have frequently been used. A common instrument used in child populations is the Child Perceptions Questionnaire 11–14 ($CPQ_{11–14}$) containing 36 items, which was developed specifically to assess the perception of children on how oral health conditions impact them physically and psychologically [7].

Two systematic reviews reported that there is scientific evidence that anterior malocclusions had

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negative effects on OHRQoL. However, most studies included in the reviews and concerning children are made on non-European populations [8,9]. Because of cultural differences and different dental care systems between countries, results from different parts of the world are not easily comparable. Also, in the most recent review the importance of taking possible confounders into consideration was pointed out, such as oral health status, socio-demographics and individual characteristics [9]. To our knowledge, there are only a few studies assessing the OHRQoL related to malocclusion among children and adolescents in Scandinavia [10,11]. The study by Tagavi Bayat et al. [10] presented an interview study that involved 12 teenagers aged between 13–14 years and the main finding of the study was that dissatisfaction with dental aesthetics influenced the teenager's self-esteem negatively and they applied strategies in order to avoid thinking of their malocclusions. The other study by Silvola et al. [11] was conducted on a Finnish adult population with severe malocclusions. Their findings showed that, when severe malocclusions were treated, the OHRQoL improved, especially the patient's well-being. Thus, the patient perspective in child populations and the influence from malocclusions on OHRQoL need to be further investigated to gain valuable knowledge into the decision process for the clinician when deciding if and when orthodontic treatment will be offered to a child. Therefore, the aims of this study were:

- To describe OHRQoL in a cohort of child patients in Swedish dental care; and
- To evaluate the impact of malocclusions or orthodontic treatment need on OHRQoL, with age, gender, socio-economic markers, dental fear and aspects of oral health taken into consideration.

Materials and methods

Subjects

The sample ($n = 277$; 46% boys and 54% girls; mean age = 11.5 years, SD = 0.8, range = 9.8–13.5 years), with no difference between genders, was sourced from three Swedish Public Dental Service Clinics, each located in a small rural community of ~ 22 000 inhabitants. The material in this cross-sectional study was derived from a longitudinal study aiming to determine prevalence and change of malocclusion [3,12]. Children at the three clinics had been consecutively included at age 3 years and followed from primary to early permanent dentition (present data collection). To be included children had to be born in Scandinavia and with at least one Scandinavian parent. Children with functional disabilities or syndromes, for example cleft lip and palate, were excluded at the original sampling. Data collection for the present study took place from October 2012 to September 2013. Children and their parents were re-invited to attend and were asked to give their informed consent before entering the study. The study protocol and informed consent form were approved by the Regional Ethical Review Board in Uppsala, Sweden (Dno: 2012/273).

Questionnaire measures

To assess the OHRQoL, the children were asked to fill in the Swedish version [13] of the $CPQ_{11–14}$–ISF:16 [14]. This short form containing 16 items was used in connection with a clinical examination. The items of the $CPQ_{11–14}$–ISF:16 are grouped into four sub-scales (four items each): oral symptoms, functional limitations, emotional wellbeing, and social wellbeing, and also summed into a total scale score. Each item is related to symptoms from the teeth, lips, jaws, and mouth during the last 3 months. Response alternatives on a 5-point frequency scale range from 0 ('never') to 4 ('every day'), with a total score range of 0–64 (sub-scale scores range from 0–16) and with higher scores corresponding to poorer status. The questionnaire also contains two global self-ratings of oral health (using a 5-point scale ranging from 'excellent' to 'poor') and overall wellbeing (using a 5-point scale ranging from 'not affected at all' to 'very much affected'). The global self-rating questions are the same as in the original version $CPQ_{11–14}$ [7]. The internal consistency was sufficient for the 16-item total scale, with Cronbach's alpha being 0.81, but low (< 0.70) for three out of the four sub-scales; oral symptoms (OS) = 0.53, functional limitation (FL) = 0.57, emotional wellbeing (EW) = 0.77 and social wellbeing (SW) = 0.57. In some of the analyses, $CPQ_{11–14}$–ISF:16 scale scores were dichotomized using the respective medians as cut-off values.

At the same visit, the children rated their dental fear on the Children's Fear Survey Schedule–Dental Subscale (CFSS–DS) [15]. The CFSS–DS is a commonly used questionnaire that consists of 15 items with responses ranging from 1 ('not afraid at all') to 5 ('very afraid'), giving a possible score range of 15–75. The CFSS–DS has been validated in several countries, among them Sweden [16]. The internal consistency in this sample was sufficient, with Cronbach's alpha being 0.83 for CFSS-DS.

The children had the opportunity to ask questions about the questionnaires and, if needed, to get support with reading the questions from two of the authors, B.L. and L.D. The children answered the questions without help from their parents. Both parents and children did all understand Swedish. A separate room at the clinic was provided for the children to answer the questionnaires. If there were more than one item missing in any sub-scale in

$CPQ_{11–14}$–ISF:16 (> 25%), the questionnaire was excluded from the analyses.

Clinical measures

The clinical examinations followed a specific protocol and were used to collect data about malocclusions, caries and enamel defects. Mouth mirror and probe were used and the methods of Björk et al. [17] served as guidelines for registration of malocclusion in centric occlusion. Malocclusions were recorded in sagittal, transversal and vertical relations; and contact point displacements and spacing were also noted according to the method described by Björk et al. [17]. Each malocclusion was then dichotomized as present or not. Data were then categorized into any malocclusion (yes/no), at least two malocclusion types (yes/no) and anterior malocclusion (yes/no). The examinations were performed by two experienced orthodontists (B.L., L.D.) who were calibrated before the examinations started and an inter-examiner test was performed by kappa statistics and ranged from 0.84–1.0.

The severity of malocclusion and treatment need was evaluated using the Index of Orthodontic Treatment Need–Dental Health Component (IOTN–DHC) [18]. This index divides the treatment need into five different levels: (1) no need; (2) mild/little need; (3) moderate/borderline need; (4) severe need; and (5) extreme treatment need [18].

Manifest caries was recorded as decayed, missing, filled surfaces (DMFS) for permanent teeth. A manifest caries lesion was defined as caries detected by probing or visible into dentine on bite-wing radiographs from the last regular recall visit to the ordinary public dental clinic. An approximal manifest caries lesion was defined as a carious lesion that clearly extended into the dentine. Enamel defects were recorded for permanent teeth and in the analysis dichotomized into present, quantitative loss of enamel (hypoplasia) or qualitative change in the translucence (opacity) of the enamel, and no enamel defect.

Interview measures

In connection with the clinical examination, a semi-structured interview was performed with both parent and child together in order to collect information about experiences of dental trauma or headache as well as socio-economic markers. Reported experience of dental trauma was confirmed by checking the dental records and in the analysis dichotomized into trauma experience or not. Children were asked about their experience of headache and rated the headache on a 5-point frequency scale from 0 ('never') to 4 ('every day'); in the analysis, this parameter was dichotomized into 'no' ('never'/'a few times a year') or 'yes' ('every month'/'week'/'day') [19].

As socio-economic markers, we used parents' educational levels and present occupation. Where at least one parent was unemployed and/or none of the parents had higher education than primary (9 years in school) this was recorded as low socio-economic level. We also recorded cohabitation status (child living with both parents or not).

Statistics

All data were analysed using IBM SPSS Statistics version 22.0 (SPSS, Chicago, IL). Descriptive statistics included frequencies, means, SD and medians. Means between groups were compared using Student's *t*-test (two groups) or one-way analysis of variance (ANOVA). Chi-square test was used for analysis of binary variables. Logistic regression analyses were performed using a total CPQ score above cut-off (i.e. with values above median value 8 constituting the higher group and median value 8 and lower values included in the lower group) as the dependent variable and a significant malocclusion/treatment need variable as the independent discriminant, with possible confounders systematically entered. For evaluation of internal consistency, we used Cronbach's alpha and alpha values of ≥ 0.70 were considered sufficient [20].

Results

Sample characteristics

Of the 277 children participating, 13 were excluded due to ongoing orthodontic treatment with fixed appliance and seven were excluded due to missing data on the $CPQ_{11–14}$–ISF:16, giving a final sample of 257 children, 121 (47%) boys and 136 (53%) girls. The mean age was 11.5 years (SD = 0.8, range = 9.8–13.5 years) and age was equal between genders. Seventy per cent of the children had at least one malocclusion type and 65% had malocclusion in the anterior region (Table I). The orthodontic treatment need was assessed as extreme in 4%, severe in 18%, moderate/borderline in 21% and mild in 33%; 24% had no treatment need (Table I).

Oral health-related quality-of-life

The mean total score on the $CPQ_{11–14}$–ISF:16 was 9.31 (SD = 6.24; range = 0–33), with no difference between genders. Sub-scale mean scores were for oral symptoms (OS) 3.89, functional limitation (FL) 2.22, emotional wellbeing (EW) 1.94, social wellbeing (SW) 1.26 and ranged from 0–10 (FL and SW) or 0–11 (OS and EW). The mean scores by gender are presented in Table I.

The mean CPQ scores and proportions above cut-off (using the median for each scale as respective

Table I. CPQ scores by gender, malocclusion and treatment need levels (decided by the clinician).

			CPQ total			OS			FL			EW			SW		
Variables	*n*	%	Mean	SD	%> cut-off	Mean	SD	%> cut-off	Mean	SD	%> cut-off	Mean	SD	%> cut-off	Mean	SD	%> cut-off
Gender																	
Boys	121	47	9.35	6.01	46.3	4.11	2.12	38.8	2.12	2.07	32.2	1.87	2.21	45.5	1.26	1.74	30.6
Girls	136	53	9.26	6.46	47.8	3.69	2.07	33.8	2.31	2.24	38.2	2.01	2.42	44.1	1.25	1.71	31.6
Malocclusion																	
Yes	181	70	9.26	6.37	45.9	3.78	2.09	34.3	2.26	2.19	36.5	1.93	2.31	45.9	1.29	1.78	32.6
No	76	30	9.40	5.97	50.0	4.14	2.10	40.8	2.14	2.12	32.9	1.96	2.36	42.1	1.17	1.57	27.6
Malocclusion (at least 2)																	
Yes	94	37	9.46	5.95	46.6	3.80	2.04	36.2	2.21	2.08	34.0	2.03	2.21	46.8	1.41	1.81	37.2
No	163	63	9.21	6.42	47.9	3.94	2.14	36.2	2.23	2.21	36.2	1.89	2.39	43.6	1.15	1.67	27.6
Anterior malocclusion																	
Yes	167	65	9.22	6.48	44.3	3.72	2.08	32.9	2.24	2.20	34.6	1.93	2.33	45.5	1.32	1.82	32.3
No	90	35	9.47	5.79	52.2	4.20	2.10	42.2	2.20	2.11	36.7	1.96	2.32	43.3	1.13	1.52	28.9
Treatment need (IOTN)																	
No	61	24	9.32	7.17	44.3*	3.89	2.31	39.3	2.27	2.24	36.1	2.07	2.56	41.0	1.10	1.61	26.2
Mild/Little	86	33	9.22	5.45	52.3*	3.98	1.92	37.2	2.23	2.23	36.0	1.81	2.19	45.3	1.21	1.64	31.4
Borderline	55	21	7.95	5.90	32.7*	3.47	2.23	29.1	1.87	1.81	27.3	1.56	2.08	38.2	1.04	1.60	25.5
Severe	46	18	10.63	5.80	60.9*	4.09	1.81	37.0	2.56	2.29	41.3	2.30	2.22	54.3	1.67	1.99	41.3
Extreme	9	4	11.48	9.66	33.3*	4.44	2.83	44.4	2.33	2.55	44.4	2.78	3.53	55.6	1.89	2.31	44.4

*$p = 0.042$, Chi-square analysis.
OS, Oral symptoms; FL, Functional limitations; EW, Emotional well-being; SW, ocial-well-being; CPQ, Child Perceptions Questionnaire.

cut-off value) for children with or without malocclusion, with or without at least two malocclusion types and with or without anterior malocclusion varied only slightly and no significant differences were found (Table I). Considering the five levels of treatment need, we found that CPQ total and sub-scale mean scores were highest (although non-significant) for severe and extreme treatment need levels (Table I). The proportions above cut-off (CPQ total score) differed significantly between treatment need levels ($p = 0.042$), with the highest proportions above cut-off found for children with mild/little or severe treatment need. Differences in proportions above cut-off for the CPQ sub-scales were all non-significant (Table I).

Descriptive data on caries, enamel defects, dental fear, experiences of dental trauma or headache and socio-economic markers (possible confounders) are presented in Table II.

The logistic regression analyses revealed some, although non-linear in pattern, impact of treatment need (IOTN level) on OHRQoL ($CPQ_{11–14}$–ISF:16, total score > 8; Table III). The highest ORs were revealed for severe and mild treatment needs vs no treatment need, while ORs for borderline and extreme treatment needs vs no treatment need were

Table II. Possible confounders by gender and in total ($N = 257$).

		Dental fear (CFSS-DS)		Caries (DMFS)		Enamel defects		Dental trauma		Headache		Co-habitation		Low socio-economic level	
	N	Mean	SD	Mean	SD	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Boys	121	23.4	6.1	0.6	1.4	25	20.7*	47	38.8**	47	38.8	90	74.4	26	21.5
Girls	136	24.4	6.5	0.6	1.3	48	35.3*	35	25.7**	63	46.3	110	80.9	27	19.8
Total	257	23.9	6.4	0.6	1.4	73	28.4	82	31.9	110	42.8	200	77.8	53	20.6

* $p = 0.009$ Chi-square analysis.
** $p = 0.024$ Chi-square analysis.
CFSS-DS, Children's Fear Survey Schedule–Dental Subscale; DMFS, Decayed Missing Filled Surfaces.

Table III. The impact from treatment need levels on the dependent variable OHRQoL assessed by CPQ11–14-ISF:16 above cut-off (≥ 8). Three multiple logistic regression models illustrating the impact without (model 1) and with (models 2 and 3) confounders were taken into account.

	Model 1 (unadjusted)			Model 2			Model 3[a]		
Variables	OR	95% CI	*p*-value	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Treatment need (IOTN)			0.047[d]			0.052[d]			0.023[d]
Mild vs No	1.38	0.71–2.67	0.336	1.40	0.72–2.72	0.320	1.47	0.73–2.94	0.280
Borderline vs No	0.61	0.29–1.31	0.204	0.61	0.28–1.32	0.211	0.57	0.25–1.27	0.167
Severe vs No	1.96	0.90–4.27	0.090	1.92	0.88–4.21	0.102	2.25	0.99–5.15	0.054
Extreme vs No	0.63	0.14–2.75	0.539	0.63	0.14–2.79	0.544	0.79	0.17–3.62	0.758
Age				1.01	0.72–1.42	0.939	1.06	0.74–1.51	0.762
Gender (Boys vs Girls)				0.89	0.53–1.48	0.649	1.04	0.61–1.78	0.879
No co-habitation (Yes vs No)				1.16	0.63–2.14	0.643	1.08	0.57–2.04	0.818
Low socioeconomic level (Yes vs No)				0.98	0.52–1.85	0.961	0.95	0.49–1.85	0.880
Dental fear (Sumscore)							1.07[b]	1.03–1.13	0.001
Headache (Yes vs No)							1.75[c]	1.08–3.18	0.025
R^2		0.051		0.052			0.053		

[a]Variables that did not enter the model (stepwise conditional was applied for the last set of confounders): caries, enamel defects, dental trauma.
[b]Step 1.
[c]Step 2.
[d]*p*-value related to the overall treatment need.
IOTN, Index of Orthodontic Treatment Need; CI, confidence interval; OR, odds ratio.

lower, although differences were not significant (Table III). There were no significant effects from age, gender or socioeconomic markers. The impact pattern of treatment need on OHRQoL remained stable when possible confounders including oral health aspects were taken into account. Dental fear appeared to discriminate for poorer OHRQoL (Table III). In addition, frequent headache had an impact on OHRQoL, while no impact from caries, enamel defects or dental trauma was revealed (Table III).

Discussion

This study of a cohort of children in ordinary dental care in a Swedish County focused on OHRQoL and evaluated the impact of malocclusion or orthodontic treatment need on OHRQoL, as assessed by the $CPQ_{11–14}$–ISF:16. Our findings could not reveal any impact from malocclusions *per se* and only partly paralleled findings from earlier studies from other cultures [21,22] reporting that perceived OHRQoL in children may have been affected by orthodontic treatment need. Furthermore, taking into account potential confounders including dental fear and headache points towards a complex pattern of impact of oral health and oral health-related aspects on quality-of-life. The clear effect of dental fear on OHRQoL is an important finding for the clinician.

The CPQ total and sub-scale mean scores were generally low, indicating that our cohort had good self-perceived OHRQoL. Normative values for OHRQoL as assessed by the $CPQ_{11–14}$–ISF:16 in Sweden are lacking, but the comparable short form version, applied in development and evaluation processes in clinical groups in Toronto, Canada [14], and among school children in New Zealand [23] has given clearly higher total mean scores for the clinical groups, while yielding a total mean score similar to our cohort among school children.

We intended to primarily investigate the impact of malocclusions *per se* and tested associations for each malocclusion type as well as for the pooled and dichotomized variable malocclusion or not, at least two malocclusion types or not, and anterior malocclusion or not. We found no impact of either malocclusions *per se* or malocclusion in the anterior region (aesthetic zone). Considering treatment need as indicated by the IOTN–DHC, there were significant differences in OHRQoL between the treatment need levels, although no consistent gradient was apparent. These findings are in agreement with an earlier study from Brazil (2003) [5], which found a significant impact from malocclusions on OHRQoL in children with no treatment need, as well as children with severe treatment need, while children with a moderate need did not show any impact on OHRQoL. However, more recent reports from Brazil [24] and New Zealand [25] showed the impact on

OHRQoL followed a more consistent pattern of an increasing impact with more severe malocclusion and/or higher treatment need levels.

The low impact on OHRQoL found in our study may in part be explained by the young age of our cohort (11.5 years of age). These children are at the beginning of their adolescent period and the awareness of malocclusion and its impact on facial appearance normally rises with increasing age. Consequently, one cannot expect any great subjective orthodontic treatment need among these young children. A recent systematic review, where most of the included studies were performed on older children between 12–15 years of age [21,22,24–26], supports an association between more severe malocclusion and increasing impact [9].

In the logistic regression analyses, the impact of treatment need showed the same inconsistent picture as was seen in the bivariate analyses. Beside the IOTN treatment need level, dental fear and headache were the only oral health-related aspects that showed impact on OHRQoL. The impact of dental fear on OHRQoL, especially on social and emotional well-being, has been reported previously and preferably among girls [27,28]. Headache is one of the most common complaints of children. A recently published systematic review concludes that there is a general increase of headache in children, with a higher prevalence in girls [29]. This supports our findings, even though the difference between gender was not significant. Since headache is common and may influence the OHRQoL in children, it is a confounder to further investigate in future studies.

The inconsistent findings regarding the impact of malocclusions or treatment needs on OHRQoL imply a complex pattern. The individual patient-perceived treatment need including aspects of OHRQoL may, therefore, not be sufficiently predicted by normative measures such as the IOTN–DHC. Different children with different experiences and from different contexts might diverge in their perceptions of more, or less, severe malocclusions. Therefore, it is important, in research as well as in clinical practice, to ask for and consider other personal, environmental and situational aspects in evaluation of OHRQoL and treatment need.

The internal consistency, for the Swedish version of the $CPQ_{11–14}$–ISF:16, total scale was considered sufficient while only one sub-scale, the emotional wellbeing scale, reached this level. Therefore, our analyses were focused on the total score, while sub-scale scores ought to be interpreted with caution.

One strength of this study was the sample size and homogeneity. The high response rate, the controlled responding procedure and the confounders taken into consideration in the regression models further strengthen the study. However, since the sample was conducted from a small rural community and all children were of Scandinavian origin, the potential for generalization may be limited. Another strength was that the children answered the questionnaire in a separate room at the clinic without help from their parents.

In future studies, evaluations of the impact of malocclusions on quality-of-life in older children or adolescents can be recommended, but also studies with a design combining quantitative questionnaire instruments with qualitative interviews would perhaps be helpful in gaining a deeper understanding of the possible association between malocclusions or orthodontic treatment need and OHRQoL among children. Also studies from different countries are needed to further add knowledge regarding the importance of OHRQoL and its associations with different aspects of oral health, treatment need and dental fear.

Conclusions

- This cohort of children showed good oral health-related quality-of-life (OHRQoL).
- The effect of orthodontic treatment need on OHRQoL was limited and inconsistent.
- Dental fear and headache were found to be more distinct impact factors on OHRQoL than malocclusions or orthodontic treatment need.

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