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Impact of self-esteem on the relationship between orthodontic treatment need and oral health-related quality of life in 11- to 16-year-old children

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SUMMARY The interest in the psychological aspects of orthodontic treatment increases, but a drawback of many studies is that the psychological characteristics of the children themselves are often ignored. One of these psychological attributes is self-esteem (SE), which is a relatively stable personal resource that might moderate the effects of conditions or events. The aim of this study was to investigate whether there is a relationship between orthodontic treatment need and oral health-related quality of life (OHRQoL) and whether this relationship is influenced by SE. This cross-sectional study comprised 223 children (113 boys and 110 girls) between 11 and 16 years of age (mean age 13.2 years), seeking orthodontic treatment. The OHRQoL was scored by the use of the Child Perception Questionnaire (CPQ^{11-14}). The Dutch adaptation of the Harter's Self-Perception Profile was used to assess SE, and the Index of Orthodontic Treatment Need defined the need for treatment. Spearman correlations, Mann–Whitney *U*-tests, and regression models were used to analyze the data. There was a significant relationship between orthodontic treatment need and OHRQoL, and between SE and OHRQoL. No evidence was found that SE moderates the relationship between OHRQoL and treatment need.

Introduction

There are children complaining about minor aesthetic orthodontic problems, while others with severe malocclusions are not even aware of it. Shaw (1981) reported that visible occlusal irregularity is the major determinant of desire for orthodontic treatment, but reality seems to be more complex.

Although a malocclusion is not a disease but rather a deviation from the aesthetic norm in a society, a demand for orthodontic care exists since many decades (Jenny, 1975; Shaw *et al.*, 1980; Mohlin *et al.*, 2002; Grzywacz, 2003; Tsakos, 2008). Self-perceived dental appearance has always been important in the decision to seek orthodontic treatment (Espeland *et al.*, 1993). In order to objectify treatment need, some indices have been developed. Among these, the Index of Orthodontic Treatment Need (IOTN), proposed by Brook and Shaw (1989), is nowadays widely used because of its practical and efficient application. The IOTN determines the treatment need by taking into consideration the dental health condition as well as the aesthetic appearance of the dentition.

The disadvantage of traditional indices is that they do not give any information about the impact of a malocclusion on the patient's quality of life in terms of limited function and psychosocial well-being (Kok *et al.*, 2004). Since the last decade, the interest in these aspects increased considerably in the field of (medicine and) dentistry. For example, the Child Perception Questionnaire (CPQ), which measures the oral health-related quality of life (OHRQoL) in children, became a popular tool in orthodontic outcome research because of its adequate validity and reliability (Jokovic *et al.*, 2002; O'Brien *et al.*, 2006). The term 'health-related quality of life' (HRQoL) has been used to describe an individual's assessment of how the following factors affect his or her well-being: experience of pain/discomfort, physical function, psychology, and social function (World Health Organization, 1993). Becker *et al.* (1993) define quality of life as 'a person's sense of well-being that stems from satisfaction or dissatisfaction with the areas of life that are important to him or her'.

Several studies have investigated the impact of orthodontic treatment on psychological aspects, such as self-esteem (SE). SE can be defined as the perception of one's own ability to master or deal effectively with the environment and is affected by the reactions of others towards an individual (Tung and Kiyak, 1998). Until now, there exists no clear-cut evidence that an orthodontic treatment improves one's SE (Birkeland *et al.*, 2000; DiBiase and Sandler, 2001; Shaw *et al.*, 2007; Bernabé *et al.*, 2008; Kiyak, 2008).

However, this finding may not be surprising since it has been demonstrated that SE is a relatively stable construct (Huang, 2010). Additionally, there is evidence that SE might influence the effects of conditions or events (Crocker *et al.*, 1987; Curbow *et al.*, 1990; Flammer, 1995; Haine *et al.*, 2003).

The Wilson–Clearly model provides a useful framework to investigate the relation between orthodontic treatment need and OHRQoL and the potential moderating role of SE (Wilson and Cleary, 1995). This model states that HRQoL is influenced by several factors: biological variables, symptom status, health functioning, general health perceptions, environmental, and individual (e.g. SE) factors. Recently, this model has been used to study OHRQoL (Baker *et al.*, 2010). According to this model, SE is a potential moderator between orthodontic treatment and OHRQoL.

The aim of this study was to investigate whether there is a relationship between orthodontic treatment need and OHRQoL in children and whether this relationship is influenced by SE. The first objective was to investigate whether there is a relationship between orthodontic treatment need and OHRQoL. A second objective was to study whether SE alters the strength of relationship between OHRQoL and treatment need. The hypothesis is that children with high SE will have better OHRQoL compared to children with low SE, especially when orthodontic treatment is needed.

Subjects and methods

Every 11- to 16-year-old healthy child registered for a first consultation at the Orthodontic Department of the University Hospitals of Leuven (Belgium) was kindly requested to complete a questionnaire. Children that had previous orthodontic treatment and that did not have thorough knowledge of the Dutch language to fully understand the questions were excluded.

The study protocol was approved by the Committee of Medical Ethics of the University Hospitals of Leuven (Belgian Number B32220096365, May 8 2009). Informed consent was obtained for all subjects and one of their parents.

Two hundred and twenty-three children (113 boys and 110 girls) completed the questionnaires. Their mean age was 13.22 years (SD 1.35).

The OHRQoL of the child was scored by the use of the Dutch translation of the CPQ^{11-14}, which already proved its reliability and validity (Jokovic *et al.*, 2002; O'Brien *et al.*, 2006). The CPQ^{11-14} contains 37 questions about the frequency of events in four domains: oral symptoms (OS), functional limitations (FL), emotional well-being (EW), and social well-being (SW). Each question has five answering possibilities: 'never' (scoring 0), 'once or twice' (1), 'sometimes' (2), 'often' (3), and 'everyday or almost everyday' (4). Besides a total CPQ score, each domain can be rated separately. Note that higher CPQ scores refer to worse OHRQoL.

The Dutch adaptation of the Harter's Self-Perception Profile (SPPA) was used to assess SE (Harter, 1988; Treffers *et al.*, 2002). The SPPA consists of 35 questions designed to discover adolescent's perception of themselves in different domains: social skills, social acceptance, sports skills, physical appearance, behavioural manner, close friendship, and sense of dignity (SD). This study focused on SD as a measure of global SE (Hagborg, 1993). The raw scores were converted into percentile scores by using the age norms of the Dutch adaptation of the SPPA (Treffers *et al.*, 2002).

Clinical examination by calibrated orthodontists in training, supervised by one professor (certified in the UK in 1993), was undertaken to assess the IOTN. Both Dental Health Component (DHC) and Aesthetic Component (AC) were recorded. An IOTN DHC score of 3 or greater and an IOTN AC score of at least 5 were considered as clinical need for treatment (Kuijpers and Kiekens, 2005).

Statistical analysis

All analyses were performed using the SAS software, Windows version 9.2 (SAS Institute Inc., Cary, North Carolina, USA).

Spearman correlations are used to evaluate the relation between continuous/ordinal variables and Mann–Whitney *U*-tests for comparisons between two groups (gender dichotomized treatment need).

A linear regression model is used with the CPQ score as dependent variable and SE and treatment need (dichotomized) as independent variables. Furthermore, age and gender are included in the model as control variables. The model is fitted separately for each and the total of the CPQ domains and for both components of IOTN, which resulted in 10 regression models. A logarithmic transformation (after adding a constant, since zero values can occur) is used whenever appropriate to obtain a more symmetric distribution of the model residuals. No corrections for multiple testing are used. As a result, a single *P*-value needs to be interpreted with care.

The sample size was determined on practical considerations. Note however that with 223 included subjects, the current study had 80 per cent power to detect an interaction, which explains 18.8 per cent (semi-partial R^2) of the variability in a model with five predictors (age, gender, treatment need, SE, and the interaction between treatment need and SE).

Results

Table 1 shows the summary statistics for the OHRQoL, self-perception, and orthodontic treatment need.

Table 1 Descriptive statistics for oral health-related quality of life (OHRQoL; domain scores and total score of the Child Perception Questionnaire [CPQ$^{11-14}$]), self-perception [domain (percentile) scores of adaptation of the Harter's Self-Perception Profile (SPPA), focus on 'Sense of dignity' as a measure of global self-esteem (SE)], and orthodontic treatment need (Dental Health and Aesthetic Component of Index of Orthodontic Treatment Need [IOTN]). SD, standard deviation; Min, lowest value; Max, highest value; $n = 223$.

Variable	Mean	SD	Median	Min	Max
OHRQoL (CPQ$^{11-14}$)					
Oral symptoms	6.26	2.92	6.00	0	15.00
Functional limitations	4.00	3.30	4.00	0	16.00
Emotional well-being	4.16	5.18	2.00	0	30.00
Social well-being	2.67	3.31	2.00	0	21.00
Total	17.09	10.80	15.00	1.00	66.00
Self-perception (SPPA)					
Social skills	60.9	27.5	62.0	1.0	100.0
Social acceptance	63.3	26.4	68.0	1.0	98.0
Sports skills	61.1	29.1	67.0	0.0	99.0
Physical appearance	65.4	24.5	67.0	4.0	99.0
Behavioral manner	60.5	27.7	66.0	1.0	99.0
Close friendship	56.1	25.9	52.0	2.0	88.0
Sense of dignity (SE)	67.7	23.3	64.0	1.0	99.0
Treatment need (IOTN)					
Dental Health Component	4.2	2.1	4.0	1.0	10.0
Aesthetic Component	3.4	1.0	4.0	1.0	5.0

Table 2 OHRQoL as function of treatment need. CPQ, Child Perception Questionnaire; OHRQoL, oral health-related quality of life; IOTN, Index of Orthodontic Treatment Need.

Spearman correlation coefficients		
	Treatment need (IOTN)	
OHRQoL (CPQ)	Dental Health Component	Aesthetic component
Oral symptoms domain	−0.00817 $P = 0.9034$	0.04452 $P = 0.5084$
Functional limitations domain	0.02541 $P = 0.7059$	0.07700 $P = 0.2522$
Emotional well-being domain	0.14921 $P = 0.0259$*	0.23481 $P = 0.0004$*
Social well-being domain	0.14742 $P = 0.0277$*	0.12323 $P = 0.0662$
Total	0.10520 $P = 0.1172$	0.16665 $P = 0.0127$*

*Correlation significant ($P < 0.05$).

Relation between OHRQoL and treatment need

In the univariable analyses, there are significant relations between treatment need and the EW domain, SW domain, and the total CPQ score: the higher the need for treatment, the higher the CPQ scores, thus the worse the OHRQoL (Table 2). Note however that although being significant, the correlations are relatively small in size. Dichotomizing the need for treatment [DHC < 3 ($n = 43$) versus DHC ≥ 3 ($n = 180$); AC < 5 ($n = 136$) versus AC ≥ 5 ($n = 87$)] resulted in less evidence.

In the multiple regression models (where treatment need is dichotomized), there only remains evidence for a relation between treatment need based on AC and OHRQoL for the EW domain ($P = 0.006$) and the total CPQ score ($P = 0.034$).

Table 3 OHRQoL as function of self-esteem (SE). CPQ, Child Perception Questionnaire; OHRQoL, oral health-related quality of life.

Spearman correlation coefficients	
OHRQoL (CPQ)	SE
Oral symptoms domain	−0.19178 $P = 0.0040$*
Functional limitations domain	−0.16099 $P = 0.0161$*
Emotional well-being domain	−0.30737 $P < 0.0001$*
Social well-being domain	−0.18947 $P = 0.0045$*
Total	−0.30875 $P < .0001$*

*Correlation significant ($P < 0.05$).

Relation between OHRQoL and SE

Univariable analysis indicated significant relations with SE for all the four CPQ domains and the total CPQ score: the higher the SE, the lower the CPQ score, thus the better the OHRQoL (Table 3). The same conclusions are obtained in the multiple regression models.

Does SE moderate the relation between treatment need and OHRQoL?

Using the DHC of the IOTN to construct two groups of treatment need, there is a significant interaction between SE and treatment need for the OS domain ($P = 0.002$; Figure 1) and the total CPQ score ($P = 0.047$; Figure 2). Note however that the direction of the interaction is unexpected. The results do not support the expectation that children with high SE would have better OHRQoL than children with low SE, especially when orthodontic treatment is needed.

However, any evidence for the interaction disappears in a sensitivity analysis for the total CPQ score. Removing the observation with the highest influence on the result (the subject with the highest total score in the group without treatment need) yields a non-significant interaction ($P = 0.34$). For the OS domain, the evidence for the interaction completely depends on three observations with the highest CPQ scores in the group without treatment need (one

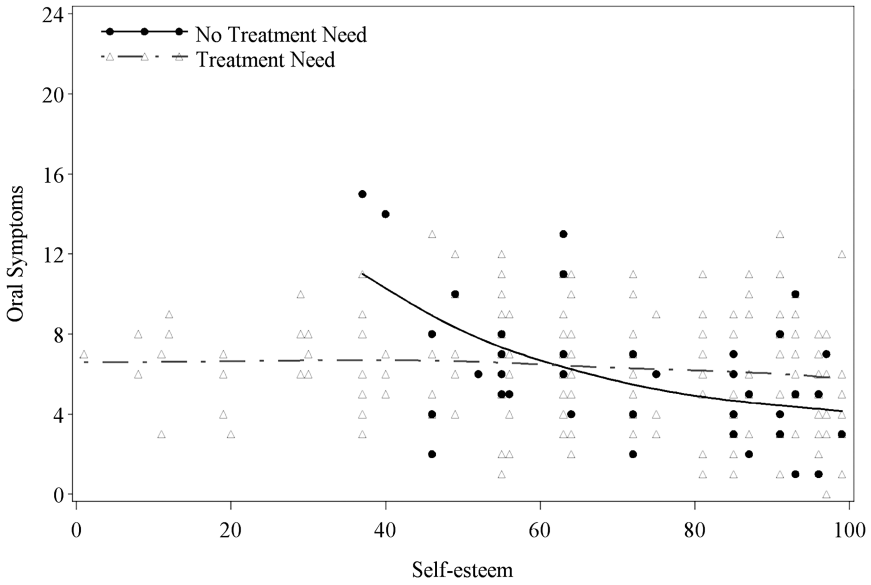

Figure 1 Interaction between self-esteem (percentile score) and treatment need (based on Dental Health Component) for the oral symptoms domain of the Child Perception Questionnaire. The lines represent smoothed trends in the observed data.

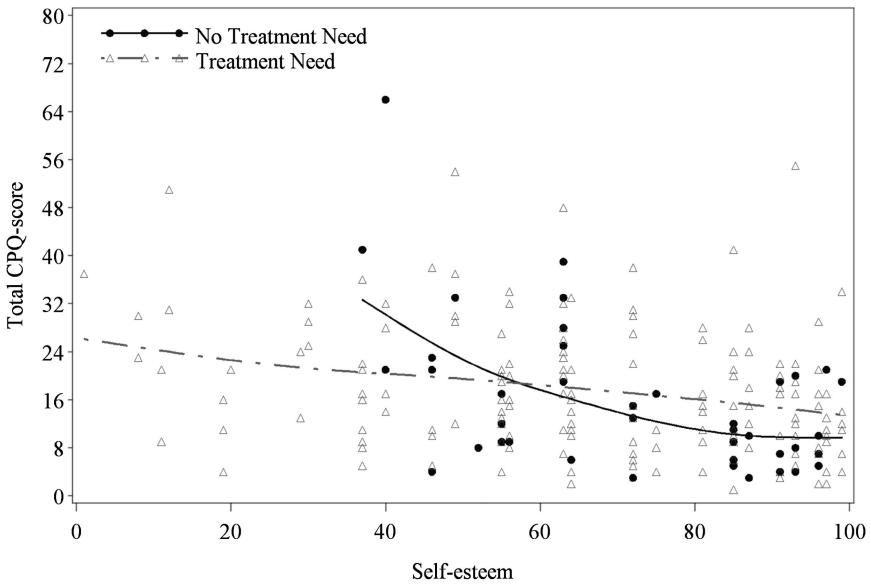

Figure 2 Interaction between self-esteem (percentile score) and treatment need (based on Dental Health Component) for the total Child Perception Questionnaire-score. The lines represent smoothed trends in the observed data.

subject with score 15, two subjects with score 14). In a sensitivity analysis on the dataset without these three subjects, the interaction is not significant ($P = 0.23$). Table 4 contains detailed results from the multiple regression model including the interaction between SE and treatment need.

Using the AC of the IOTN, there is no evidence that the differences in OHRQoL between children with and without treatment need depend on SE: the interaction between treatment need and SE is not significant for the four domain scores and the total CPQ score. Figure 3 shows the results for the total CPQ score.

Discussion

Although it is generally accepted that the impact of a malocclusion on a child's self-perception may be considerable, physical as well as psychological, and may have a negative influence on an individual's OHRQoL, there still exists

conflicting evidence about the extent of these effects (O'Brien *et al.*, 2006, 2007; Hassan and Amin, 2010). This could be due to the lack of standardized approaches for assessment (Hassan and Amin, 2010) or by not taking into account potential important moderators or baseline psychological attributes (Shaw *et al.*, 2007; Agou *et al.*, 2008).

The results of our study demonstrated that there is a modest relationship between orthodontic treatment need and some aspects of OHRQoL. A systematic review of Liu *et al.* (2009) confirms this finding. When we consider the domains of the CPQ$^{11-14}$, the current results reveal a significant relationship between orthodontic treatment need and the domain of emotional and SW. No relationship could be found with the domain of OS and FL. The results of this study are partly confirming the findings of Spalj *et al.* (2010) who claim that a malocclusion has more impact on EW than on function or social contacts.

The major objective of the present study was to resolve the question whether SE plays a role as moderator on the relationship between treatment need and OHRQoL. This could not be proven in this study. Agou *et al.* (2008) on the other hand demonstrated that the child's psychological profile can influence the social and emotional impacts of malocclusion.

The literature of SE in orthodontic treatment is confusing because some studies define SE as an endpoint and other studies investigate whether SE influences OHRQoL. As already mentioned, SE has proven to be a relatively stable psychological construct (Huang, 2010) and therefore, we can expect little or no effect of orthodontic treatment on the patient's SE. Birkeland *et al.* (2000) reported that patients present higher SE after orthodontic treatment in comparison with an untreated group but mentioned that a similar tendency already existed at the start of the study. DiBiase and Sandler (2001) assert that there is little evidence of a marked increase in SE following orthodontic treatment in children. According to Kiyak (2008), treatment indeed improves some aspects of OHRQoL, but SE does not appear to be significantly affected over the long term. A 20 year cohort study of Shaw *et al.* (2007) confirms this finding.

Many psychological studies support the belief that SE is a personal resource that facilitates coping with less

Table 4 The results of interaction model for the oral symptoms domain of Child Perception Questionnaire, with treatment need based on Dental Health Component (DHC; $R^2 = 0.115$).

Effect	Estimate (SE)	*P*-value
Age (years)	−0.37 (0.14)	0.01
Gender (female versus male)	0.45 (0.38)	0.24
Interaction treatment need and SE*		0.002
Treatment need (yes versus no) at low SE	−1.21 (0.62)	0.051
Treatment need (yes versus no) at median SE	−0.53 (0.51)	0.30
Treatment need (yes versus no) at high SE	1.24 (0.61)	0.043
SE in group without treatment need	−0.094 (0.023)	<0.0001
SE in group with treatment need	−0.017 (0.009)	0.053
SE for the total group	−0.056 (0.012)	<0.0001

*Since the interaction between treatment need (based on DHC) and self-esteem (SE) is significant, the effect of treatment need is reported at various levels of SE, e.g. at a 'low' score (percentile 25), at a median score, and at a 'high' score (percentile 75). Likewise, for the relation between SE and oral health-related quality of life, the slope is given for the total group, as well as separately for both groups (with and without treatment need).

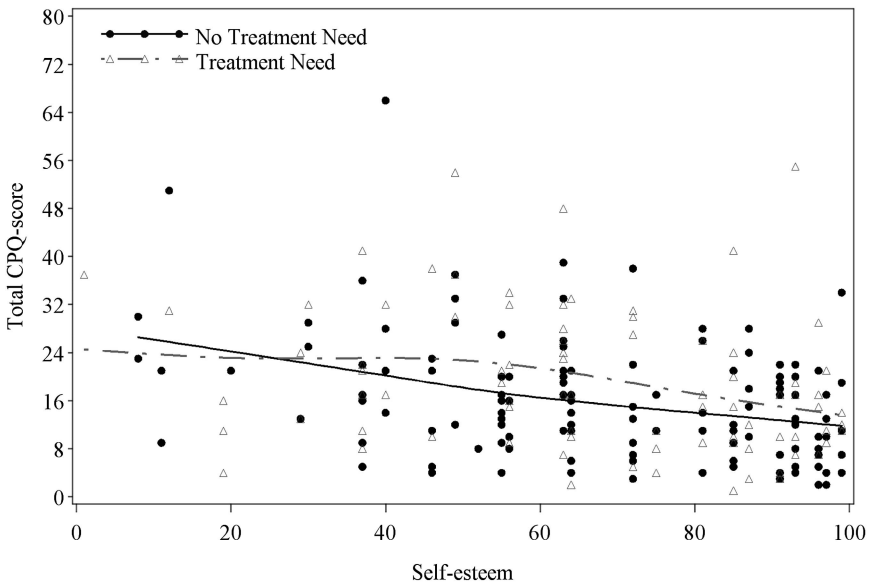

Figure 3 Interaction between self-esteem (percentile score) and treatment need (based on Aesthetic Component) for the total Child Perception Questionnaire score. The lines represent smoothed trends in the observed data.

favourable conditions such as poor dental aesthetics (Harter, 1992; Agou *et al.*, 2008). According to the Wilson–Clearly model, SE is considered as a focal aspect of psychological health and higher levels of SE would be related to greater life satisfaction (Rosenberg, 1965; Lachman and Weaver, 1998). Furthermore, several studies found a relationship between SE and the way people are satisfied with their faces (Berscheid *et al.*, 1973; McDonald and Eilenfield, 1980; Albino *et al.*, 1990).

Some limitations of the present study need to be considered. Our results demonstrated a correlation between orthodontic treatment need and OHRQoL and between SE and OHRQoL in a clinical population. The question remains whether these correlations are still present in the general population.

The IOTN was used to determine the need for orthodontic treatment. One major disadvantage of this instrument is the risk of insensitivity for and misjudgement of the needs of the individual patient. It is hard to map the minor irregularities about which a patient is deeply concerned (Shaw *et al.*, 1995). Another possible problem is that when orthodontic treatment need is based on the IOTN only, some patients who do not actually have psychosocial need for treatment would be treated (Kok *et al.*, 2004).

The OHRQoL measure used in this study is the CPQ^{11-14}. Because of its demonstrable psychometric properties, the CPQ^{11-14} is a useful measure for orthodontic trials and became a popular tool in orthodontic outcome research (Foster Page *et al.*, 2005; Locker *et al.*, 2005; O'Brien *et al.*, 2006). The use of this instrument is validated for the age group 11–14 years but in our study, we also included 15- to 16-year-old subjects (n = 19). Furthermore, some authors question whether the CPQ is a good measure of OHRQoL in children with malocclusion (Locker *et al.*, 2005; Marshman *et al.*, 2010).

Our study focused on a very clear hypothesis about the moderating role of SE on the relationship between orthodontic treatment need and OHRQoL. The results suggest that orthodontic treatment need and SE have an influence on OHRQoL, but we did not find that SE moderates the relationship between orthodontic treatment need and OHRQoL. Consequently, orthodontic treatment need and SE seem to be independently related with OHRQoL. However, according to the model of Wilson–Clearly, also biological variables, health perception and other (psychosocial) factors need to be taken into consideration (Wilson and Cleary, 1995). Recently, Baker et al. (2010) demonstrated that sense of coherence was the most important psychosocial predictor for OHRQoL.

The present study is cross-sectional and investigated orthodontic treatment need. According to the literature, we expect that the OHRQoL will improve because of orthodontic treatment. To further unravel this issue, longitudinal research is needed.

Conclusions

In this study, the aim was to investigate whether there is a relationship between treatment need and OHRQoL in children seeking orthodontic treatment and whether this relationship is influenced by SE.

The findings can be summarized as follows:

1. The higher the SE, the better the OHRQoL.
2. The OHRQoL (for some domains and for the total CPQ score) is better if treatment need is lower.
3. There is no evidence that SE moderates the relationship between OHRQoL and treatment need.

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