A socio-dental approach to assessing children's orthodontic needs

Sudaduang Gherunpong*, Georgios Tsakos** and Aubrey Sheiham**

*Department of Community Dentistry, Chulalongkorn University, Thailand and **Department of Epidemiology and Public Health, University College London, UK

SUMMARY Traditional methods of assessing orthodontic treatment need using mainly clinical measures are inadequate and would be improved by integrating normative, oral health-related quality of life (OHRQoL), and behavioural propensity measures. This study aimed to develop and test a socio-dental system of orthodontic needs assessment, and to compare normative and socio-dental estimates of orthodontic need. The socio-dental system integrates three types of need: normative need (NN), impact-related need (IRN) and propensity-related need (PRN).

A cross-sectional survey of all 1126 children aged 11–12 years in Suphanburi, Thailand, was carried out to test the new system. The dental health component of the Index of Orthodontic Treatment Need was used to assess NN, and the simplified oral hygiene index for oral hygiene status. Oral impacts were assessed using the child-Oral Impacts on Daily Performances (child-OIDP) index. A self-administered questionnaire recorded information on demographic and oral health-related behaviour. Treatment needs were assessed according to the developed socio-dental system.

The socio-dental approach to assess orthodontic needs was easy to use and readily accepted by the children. The estimates of orthodontic need assessed normatively and socio-dentally differed markedly. The prevalence of NN and IRN was 35.0 and 10.5 per cent, respectively, thus representing a reduction of approximately 70 per cent in the volume of treatment need according to the new method. Children with IRN had different levels of propensity for orthodontic treatment, and therefore required appropriate treatment plans according to their PRN. Of the 10.5 per cent with IRN, 6.9 per cent had high or medium–high PRN, while 3.6 per cent were at medium–low and low levels of propensity.

Introduction

Malocclusions and oral deformities mainly affect aesthetics and function. There is little evidence that untreated malocclusions increase the risk of dental caries and gingivitis (Shaw *et al.*, 1991). Therefore, the main benefits of orthodontic treatment relate to improvements of oral function and appearance that will lead to improved psychological and social well being (Shaw *et al.*, 1991; Sandy and Roberts-Harry, 2003). Children's feelings concerning their dental appearance or function should be central to assessing need and outcome of orthodontic treatment. However, traditional methods of estimating orthodontic need or evaluating treatment outcome are mainly based on normative need (NN) assessed by professionals, using occlusal or cephalometric measurements to define the need for or success/failure of treatment. This shortcoming is serious because there are considerable differences between professional and patients' perceptions of dental appearance and need for orthodontic treatment (Bell *et al.*, 1985; Espeland *et al.*, 1992; Phillips *et al.*, 1995; Hancock and Blinkhorn, 1996; Kokich *et al.*, 1999; Koochek *et al.*, 2001). Moreover, normative orthodontic need estimated by converting clinical data into the amount of need is usually high and unlikely to be met due to the high cost of treatment (British Society of Paediatric Dentistry, 1997; Murray, 1998; Ugur *et al.*, 1998; Pleuttiworanan, 2001).

Some authors have stressed the importance of patients' opinions above those of professionals, particularly when considering conditions where there is no disease, such as malocclusion. Bowling (1997) argued that patients' feelings were more important than how doctors thought they ought to feel, while O'Brien *et al.* (1998) went as far as to say that orthodontic treatment outcome should perhaps only be evaluated by subjective quality of life measures. These views challenge and highlight the inadequacies of the traditional methods of using only professional-based indicators to assess orthodontic need.

Another group of factors that affects the assessment of orthodontic need is the child's oral health-related behaviour that relates to treatment outcome. Poor oral hygiene and non-compliance commonly affect the outcome of orthodontic treatment (Shaw *et al.*, 1991; Patel, 1992; Sandy and Roberts-Harry, 2003).

It is evident that a method of assessing orthodontic need requires the integration of a normative clinical measure with a patient-based indicator of the child's feelings and/or impacts relating to oral functioning and appearance, as well as with measures of the child's oral health-related behaviour. In this way, orthodontic need can be more appropriately used in dental service planning by providing better manpower estimations and resource allocation, based on

oral health gain. Such a method, named the socio-dental approach of needs assessment, has been used on adult and elderly populations (Adulyanon, 1996; Srisilapanan and Sheiham, 2001; Srisilapanan *et al.*, 2003; Sheiham and Tsakos, 2006). However, the socio-dental system has not been adapted for assessing the orthodontic needs of schoolchildren. The objectives of this study were to develop and test a socio-dental system of orthodontic need assessment in primary schoolchildren. Furthermore, the normative and socio-dental estimates of orthodontic treatment need were compared.

Methods

Developing a socio-dental system for assessing orthodontic needs

The study developed a theoretical framework and model of socio-dental orthodontic treatment needs assessment. Socio-dental orthodontic needs are assessed at three levels (Table 1, Figure 1):

1. Normative need (NN) assessed by clinical examination. Malocclusions or oral deformities that normally require orthodontic treatment are detected at this level by professionals.
2. Impact-related need (IRN) assessed by integrating NN with oral health-related quality of life (OHRQoL). This level aims to identify and prioritize children for treatment according to the level of socio-dental impact and normative orthodontic need. Children who have both NN and OHRQoL affected by malocclusions/oral deformities are considered as having an IRN for orthodontic treatment. They can be prioritized for treatment according to their level of socio-dental impact. Children with a malocclusion who do not have any oral impacts and therefore no IRN are first allocated to a dental health education (DHE) and oral health promotion (OHP) group because they may develop negative dental consequences from more plaque accumulation due to their malocclusion.
3. Propensity-related need (PRN) is assessed by integrating NN with OHRQoL, behavioural propensity and evidence-based treatment guidelines. This PRN level of socio-dental needs takes into account the effectiveness and appropriateness of treatment in the decision-making process. This is important in particular for expensive, time-consuming, or specialist treatments. Methods of assessing PRN should be adjusted according to local circumstances. However, decisions should be made on the basis of the best available scientific evidence. There are two steps in the PRN assessment.

First, children are assessed for their oral hygiene and dental attendance pattern which are the two significant propensity factors for orthodontic treatment. Poor oral

Table 1 Levels of socio-dental needs and factors under consideration for orthodontic treatment.

| Dental need level	Factors under consideration
Normative need	Malocclusion or oral deformity
Impact-related need	Malocclusion or oral deformity Condition-specific impacts (CS-impacts) relating to malocclusion or oral deformity
Propensity-related need	Malocclusion or oral deformity CS-impacts relating to malocclusion or oral deformity Behavioural propensity for orthodontic treatment: oral hygiene and dental attendance pattern

DHE/OHP = dental health education/oral health promotion
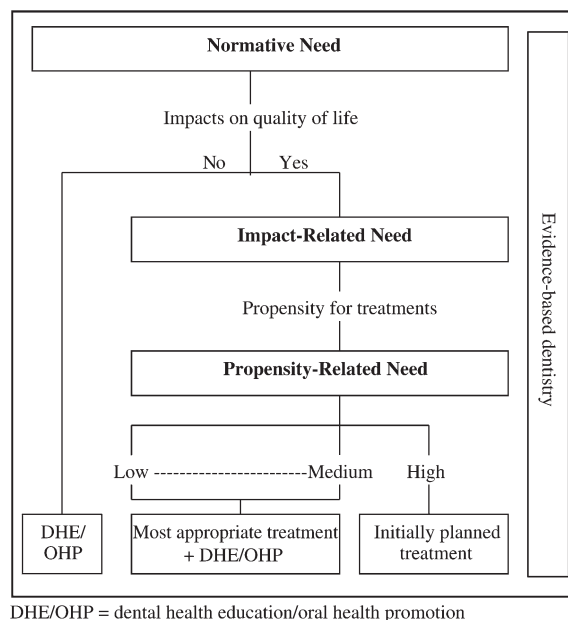
Figure 1 Model of socio-dental needs for orthodontic treatment. DHE/OHP = dental health education/oral health promotion.

hygiene significantly increases the risk of caries and gingival diseases while a child is having orthodontic treatment (Petti *et al.*, 1997; Sanders, 1999; Gabris *et al.*, 2002). Similarly, the patient's co-operation needs to be taken into consideration because failure of treatment is commonly associated with poor co-operation, non-compliance, or discontinuation of treatment (Shaw *et al.*, 1991). Thus, it is not recommended to provide orthodontic treatment to children with unacceptable levels of oral hygiene or poor dental attendance. Each of the two factors is assessed and categorized into three levels: poor, moderate, and good (Table 2).

Second, children are categorized into four levels of PRN—(1) the high-PRN group: children whose both oral hygiene and dental attendance patterns are good, (2) the medium- to high-PRN group: children in whom neither factor is poor, (3) the medium- to low-PRN group: children in whom one factor is poor, and (4) the low-PRN group:

Table 2 Suggested categorization of levels of propensity-related need (PRN) for orthodontic treatments.

Propensity factor			Low	Medium–low	Medium–high	High
Oral hygiene	P	3.1–6.0	P	One poor factor (G and P, M and P)	No poor factor (G and M, M and M)	G
	M	0.3–3.0				
	G	0.0–1.2				
Visit dentists after having appointments	P	Rarely	P			G
	M	Sometimes				
	G	Always				

G, good; M, moderate; P, poor. Combinations are not in priority order.

those with both factors classified as poor (Table 2). Children in the high-PRN group will benefit most from orthodontic treatment and therefore should be considered to need treatment as normatively planned. Those at lower levels of PRN will have a high risk of treatment failure or developing other negative oral consequences, if the normatively planned treatment is carried out. Therefore, treatment for them may be delayed or modified until their propensity improves, e.g. until they can maintain adequate oral hygiene. In addition, children who do not have high propensity should be offered dental health education/oral health promotion (DHE/OHP) to improve their propensity.

It should be apparent that the assessment of PRN is comparable with any thorough treatment plan for individual patients carried out by orthodontists. In subjects where the adoption of a particular behaviour, such as adequate oral hygiene, is a prerequisite for orthodontic treatment and has not yet been achieved by patients, dentists will provide another initial intervention and/or a DHE programme. Treatment then will be reconsidered later in the light of the patient's response to DHE. Decisions to provide any alternative treatment should be made by taking into consideration the child's condition and the availability of dental resources, as well as the type of tooth movement required. For example, a removable appliance can be used for simple tooth movements, such as tipping anterior teeth or correcting posterior crossbites (Sandy and Roberts-Harry, 2003).

In dental public health planning, the amount of initially planned treatment can be approximately estimated, but as the changes in propensity and individual details cannot be assessed, only an estimate of the DHE/OHP needs can be made, with guidelines to reassess for treatment thereafter.

Testing the socio-dental need system

The process of the conceptual system began with testing measures for three groups of data, namely, clinical status, OHRQoL, and behavioural propensity. A back-translation method was used to check the validity of language translation from English to Thai. A number of pilot studies were carried

out to validate all questionnaires and improve the practicality of their application in fieldwork.

The dental health component of the index of orthodontic treatment need (IOTN; Brook and Shaw, 1989), the most commonly used orthodontic measure in the UK (de Oliveira, 2003), was selected for use in this study. Children with NN were those with IOTN grade 4 or 5.

The child-oral impacts on daily performances (child-OIDP) index (Gherunpong *et al.*, 2004a) was chosen for assessing the OHRQoL of children because it is the only OHRQoL index developed specifically to assist in dental need assessment in this age group. It allows for the calculation of condition-specific impacts (CS-impacts) that attribute impacts to specific oral conditions such as malocclusion, oral deformity, traumatic dental injury, and enamel defects. The child-OIDP was administered through individual interviews, except for the first question that was self-administered in a classroom setting to save time. A method of self-administration for the whole process was also tested as it would reduce the cost of fieldwork. The method did not work satisfactorily, and was consequently abandoned, because the assessment of oral influences inevitably involved questions whose meanings were difficult for children under 12 years of age to comprehend unassisted (Gherunpong *et al.*, 2004a). Thus, individual interviews were considered appropriate for this age group. To further facilitate the children's understanding, reduce the time for interviews, and make the interview more practical for children, 16 pictures referring to the eight daily performances covered by the child-OIDP (one positive and one negative picture for each performance) were developed and used as interview aids (Jenney and Campbell, 1997; Gherunpong *et al.*, 2004a); the pictures did not contribute to the child-OIDP score. The method of using a parent's perception as a proxy is considered inappropriate as it is not practical to arrange interviews with parents in a school setting. In addition, their perceptions are frequently different from those of their children (Jenney and Campbell, 1997; Jokovic *et al.*, 2003).

The simplified oral hygiene index (Greene and Vermillion, 1964) was used to categorize children into three levels of

oral hygiene (poor, moderate, and good). Dental attendance pattern refers to school dental services in the area; they consist of oral examinations and further provide dental appointments to children who need treatment. The children were classified into three groups according to their attendance for dental appointments: those who always visited dentists when they had appointments, those who did so sometimes, and, finally, those that rarely attended for their appointments (Table 2).

Main survey

A cross-sectional survey was conducted on all 1126 final-year primary Thai schoolchildren, aged 11–12 years, in a municipal area of Suphanburi province. Data were collected through clinical examination and questionnaires. The clinical examinations were carried out by four calibrated dentists; kappa scores for the IOTN calibration were 0.92 and 0.82 for intra- and interexaminer variability, respectively. The child-OIDP index was interviewer administered. Finally, all children completed a self-administered questionnaire on demographic and oral behaviour information with the assistance of a schoolteacher. Ten per cent random duplication was conducted for reliability testing. Weighted kappa score for the child-OIDP was 0.91, and kappa scores for the self-administered questionnaires 0.87, while those for intra- and interexaminer variability (the IOTN) were 0.89 and 0.70, respectively, indicating good to excellent agreement.

Data were analysed using the orthodontic socio-dental needs model. The prevalence of NN, IRN, and high PRN for orthodontic treatment was calculated. Estimates of NN referred to clinical examination results, while IRN covered NN cases where CS-impacts relating to malocclusions or oral deformities were present. Finally, high PRN referred to children with IRN where the two behavioural propensity factors were good. The McNemar statistical test was used for comparing estimates of NN with IRN and with high PRN.

The Ethics Committee of the Ministry of Public Health of Thailand approved the protocol of the study. Primary education, local health authorities, and all primary schools in study areas gave permission. Positive consent forms and information letters were sent to parents.

Results

A total of 1101 (52.4 per cent male and 47.6 per cent female) of the 1126 children returned positive consent forms and 1034 (91.8 per cent) completed all stages of the survey. The mean age was 11.3 years. In addition to the conventional full oral examination, the child-OIDP interview, aided by images of daily performances, took 10 minutes per child. The behavioural questionnaire was found to be very simple to answer and could be completed easily in a classroom

setting. At least one oral impact was reported by 89.8 per cent of children in their daily performance and 20.3 per cent attributed an impact to malocclusions or conditions related to orthodontics. The percentages of children having good, moderate, and poor propensity factors were 5.4, 69.1, and 25.5 per cent for oral hygiene and 72.8, 19.1, and 8.1 per cent for dental attendance pattern, respectively.

The prevalence of NN for orthodontic treatment was 35.0 per cent, while, based on the child-OIDP, there was an IRN in 10.5 per cent of the children; the difference between assessments was highly significant ($P < 0.001$). The 24.5 per cent of children with an NN who did not have CS-impacts relating to malocclusion were considered to need DHE/OHP instead of clinical interventions as their quality of life was not affected by their malocclusions. The third component of the socio-dental system of assessing needs was to determine whether a child's behaviour was compatible with successful orthodontic treatment. For that estimate, the PRN was assessed. Of the 10.5 per cent with IRN, 0.3 per cent had a high propensity, and should be treated as initially planned based on the first two steps in the assessment; 6.6 per cent had a medium–high propensity and might also be clinically treated and given courses of DHE/OHP to improve their behaviour. The other 3.1 and 0.5 per cent were at medium–low and low levels of propensity, respectively, and therefore needed extensive DHE/OHP prior to clinical interventions; while alternative less demanding orthodontic treatments should also be considered for them because of their inadequate dental health-related behavioural patterns.

For every 100 children with an NN for orthodontic treatment, 30.2 children had an IRN (Table 3). Classified by the intensity of CS-impacts (Gherunpong *et al.*, 2004b), 6.4 per 100 children with an NN had very little, 7.2 had little, 8.0 had moderate, 8.6 had severe, and none had very severe CS-impacts. In terms of PRN, only 0.9 children (for every 100 children with NN) were categorized in the high-propensity group, 18.9 children were in the medium- to high-propensity group, 8.9 children were in the medium–low group, and 1.5 children in the low-propensity group for orthodontic treatment. In addition to the orthodontic treatment requirements, those children who did not have high behavioural propensity for orthodontic treatment (29.3 children per 100 with NN) should also receive DHE or OHP programme, in order to improve their propensity levels and, thus, have a higher success probability for the normatively planned orthodontic treatment.

Discussion

This study developed and tested a socio-dental system for orthodontic needs assessment on primary schoolchildren. Apart from the oral examination, which is comparable with the traditional normative approach, procedures for collecting data used in the socio-dental system were acceptable in

Table 3 Socio-dental needs for orthodontic treatment, per 100 children with normative needs.

Normative need		Per 100 children CS-OIDP*			
Impact-related need		30.2			
Level of CS-impacts	Very severe	0.0			
	Severe	8.6			
	Moderate	8.0			
	Little	7.2			
	Very little	6.4			

Propensity for complex treatments

Propensity-related need		Low	Medium–low	Medium–high	High
		1.5	8.9	18.9	0.9
Level of CS-impacts	Very severe	0.0	0.0	0.0	0.0
	Severe	0.6	3.3	4.7	0.0
	Moderate	0.3	2.5	5.2	0.0
	Little	0.0	1.4	5.5	0.3
	Very little	0.6	1.7	3.5	0.6

Treatment options + DHE/OHP**	29.3

*CS-OIDP, condition-specific child-oral impacts on daily performances; **DHE/OHP, dental health education and/or oral health promotion.

terms of children's response, time consumed, and personnel burden.

When the socio-dental approach was used to assess orthodontic needs, the estimates of treatment need decreased markedly. Per 100 children with NN, 30.2 had an IRN and 0.9 had high and 18.9 medium–high PRNs. This indicated that less than one-third of those with NN would actually demand some kind of orthodontic care. Furthermore, most of these children did not have a high propensity and, therefore, would require a broader approach to orthodontic care, involving possible alternative interventions and health education programmes. Eventually, if orthodontic treatment were to be provided to those at medium–high or high propensity, the numbers with a treatment need would be less than one-fifth of that assessed normatively.

In this population, impacts from malocclusions or oral deformities affected children's quality of life to various degrees. Of the 30 children with IRN per 100 children with NN, eight had severe, eight had moderate, while 14 had little or very little impacts. This categorization of CS-impacts can be further used for priority setting where resources are scarce; those with more severe impacts would have a higher priority for health care (Drotar *et al.*, 1998). However, care needs to be taken that this prioritization does not lead to social bias favouring the higher income groups, who may report higher levels of impacts.

This study's findings confirm that the normative approach to estimating orthodontic needs gives relatively high estimates of need. More than one-third of Thai primary school children had IOTN grades 4 and 5 that would conventionally qualify them for costly orthodontic treatment. These findings are similar to another study in Thailand (Pleuttiworanan, 2001). Similarly, unrealistically high amounts of normative orthodontic needs were reported in many other countries. For example, in the United Kingdom, 57 per cent of 9-year-old children and 30 per cent of 12-year olds were in either great or very great need of orthodontic treatments (Murray, 1998). Over 30 per cent of children approaching school-leaving age had untreated malocclusions (British Society of Paediatric Dentistry, 1997). In Turkish primary schoolchildren, 38 per cent were classified as having a definite to severe orthodontic need (Ugur *et al.*, 1998).

There is no systematic study on orthodontic socio-dental needs with which to compare the findings of the present investigation. The marked reduction in the amount of need found was consistent with findings of previous investigations using the socio-dental method to assess other types of dental treatment needs in adults. Adulyanon (1996) found that

need for scaling reduced from 98.4 per cent for NN to 22.0 per cent for IRN. Srisilapanan and Sheiham (2001) reported that half of those with NN for dentures had IRN and two-thirds of the latter had high PRN. Similarly, IRN was 60 per cent of NN in an edentulous population (Srisilapanan *et al.*, 2003).

Studies on orthodontic need have also found that children and adolescents are less concerned than professionals about their malocclusions. In an experimental setting it has been shown that patients had a significantly lower threshold of detecting malocclusion traits than professionals (Espeland *et al.*, 1992; Kokich *et al.*, 1999). Koochek *et al.* (2001) found that only 50–65 per cent of those normatively assessed as in need of orthodontic treatment actually perceived such a need. Even among patients considered to have an NN for orthognathic surgery, only 50–60 per cent reported that they perceived a need for such treatment (Bell *et al.*, 1985; Phillips *et al.*, 1995). However, the issue of a changing concern with appearance over time should also be considered. While there may not be a great volume of oral quality of life impacts among children, by early adulthood (when issues such as securing employment or meeting a boyfriend/girlfriend become more relevant) young people may think very differently about the impact of their dental appearance. This issue needs to be explored further through appropriate longitudinal studies.

Although there are a number of OHRQoL indicators, there are relatively few studies that integrate them into current systems of dental health services. This is possibly because outcomes of most OHRQoL measures represent overall oral impacts caused by various perceived problems, such as pain or functional limitation, and therefore are not useful for planning or evaluating services. The relationship between the overall OHRQoL score and a specific oral condition, such as malocclusion, is likely to be questionable as the impact score cannot be directly attributed to the specific condition. This is particularly so in a high dental disease population, where various problems contribute to overall impacts. Therefore, planning treatment or evaluating outcomes requires measures that can detect oral impacts caused by specific oral conditions. For example, the need for orthodontic services should be associated with a measure that detects impacts caused only by malocclusions or oral deformities (O'Brien *et al.*, 1998). This study used the child-OIDP index which was designed primarily for needs assessment and planning services. It measures overall impacts, and can be used to calculate CS-impacts, thereby associating each impact with a specific dental condition. Then, CS-impacts relating to orthodontic treatment (including those of malocclusion and oral deformity) are integrated with normative orthodontic need.

The integration of NNs and CS-impacts as well as behavioural-related propensity into the system of socio-dental needs assessment was performed at an individual level before summing up the needs into population estimates. Thus, a more coherent picture of health and dental needs of a population is obtained. Although some countries include an assessment of oral behaviour and even OHRQoL in their national oral health surveys (Steele *et al.*, 2004), such data are not integrated at an individual level and are not linked with clinical status to determine needs assessment. The present study was undertaken for public health planning purposes. More accurate results can be obtained by assessing individual needs in clinical practice where a more detailed investigation of a child's CS-impacts and propensity can be carried out and evaluated over time by recalling the child for reassessment.

The significant reduction of the estimate of needs using the socio-dental approach has implications for dental service planning. The socio-dental approach selects children who are more likely to benefit from orthodontic treatment through a systematic process of identifying children with oral impacts due to malocclusion or oral deformity and children who will effectively and appropriately receive orthodontic treatment. The socio-dental system would lead to a more rational method of estimating treatment need and resources required to meet the need, more rational allocation and utilization of dental services and resources, as well as efficient and effective dental care expenditure.

Conclusions

A socio-dental system for assessing orthodontic needs was developed and tested on Thai primary schoolchildren. Estimates of orthodontic need assessed normatively and socio-dentally were markedly different. Compared with NN, the level of need decreased by 70 per cent when using IRN. PRN assessment indicated which children with IRN had different levels of propensity for successful orthodontic treatment. Those with a low propensity would require a broader behavioural approach of dental care than would be detected using a normative approach. By considering that orthodontic treatment should only be provided for children with high or medium–high levels of propensity, the estimate of need decreased by 80 per cent compared with that of NN.

Address for correspondence

Dr Georgios Tsakos
Department of Epidemiology and Public Health
University College London
1-19 Torrington Place
London WC1E 6BT
UK
E-mail: g.tsakos@ucl.ac.uk

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