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Factors determining perceived orthodontic treatment need in adolescents of Swedish and immigrant background

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SUMMARY The aim of this study was to evaluate the association between self-perceived orthodontic treatment need and malocclusion in 12 to 13-year-old-adolescents of Swedish and immigrant background. The sample consisted of 379 students, stratified according to geographic background: both parents born in A/Sweden (n = 269), B/Eastern Europe (n = 56), and C/the Middle East (n = 54). Registrations were based on a questionnaire, a clinical examination, radiographs, and patient records. Treatment need was classified according to the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN). Logistic regression analysis was used for comparison of the results.

There was a strong association between subjects who thought that they needed an orthodontic appliance and IOTN-DHC grades 4 and 5, an anterior crossbite, those who avoided smiling because of their teeth, and those who considered their teeth to be somewhat worse or much worse than those of their peers. The self-perceived need for orthodontic treatment was significantly ($P < 0.05$) higher in the Swedish than in the eastern European group.

Introduction

The major factors determining a patient's perceived need for orthodontic treatment may be broadly described as aesthetic, functional, financial, or social (Tickle *et al.*, 1999; Josefsson *et al.*, 2005). While the orthodontist is obliged to prioritize function and occlusion in objective assessment of treatment need (Thilander and Myrberg, 1973; Svedström-Oristo *et al.*, 2000; Thilander *et al.*, 2001; Egermark *et al.*, 2005; Mandall *et al.*, 2005; Souames *et al.*, 2006), the patient might perceive other factors to be just as important.

A questionnaire study by Fox *et al.* (1999) found that aesthetics were of greater concern to children seeking orthodontic treatment than to other children. Birkeland *et al.* (2000), in a questionnaire study, found that both parents and children rated aesthetics as an important factor for psychosocial well-being. In young adults, even a minor deviation can be of perceived importance (Klages *et al.*, 2004) and the impact of malocclusion on a child's quality of life might be profound (O'Brien *et al.*, 2006).

In countries where orthodontic treatment is subsidized to some extent by public funding, different indices are used to determine eligibility for such treatment (Järvinen, 2001; Mandall *et al.*, 2005; Theis *et al.*, 2005). Whether these indices select the same patients or not, is an important question. A comparison of three indices when a group of orthodontists set the gold standard resulted in good agreement after adjusting the cut-off points for the different indices (Beglin *et al.*, 2001). The cut-off point for eligibility for subsidized treatment is a political rather than a clinical issue.

Cultural or geographic origin can also influence demand for treatment (Mandall *et al.*, 2000; Linder-Aronson *et al.*, 2002; Ngom *et al.*, 2005; Josefsson *et al.*, 2007). One Swedish study found a greater treatment demand among Swedish girls than among those of an immigrant background (Josefsson *et al.*, 2005).

Children seeking orthodontic treatment have been found to have poorer aesthetics than their peers, but whether poor aesthetics alone generates greater treatment demand has not been determined (Mandall *et al.*, 2000). Hamdan (2004) has shown poor correlation between normative need and patients' perceptions of orthodontic treatment need.

In this context, an interesting question arises: do children with a normative treatment need also seek treatment?

Earlier studies have shown that self-perceived orthodontic treatment need and also the frequency of malocclusions varies among children of different geographic origin (Kerosuo *et al.*, 1991; Ahmed *et al.*, 2001; Thilander *et al.*, 2001; Josefsson *et al.*, 2005, 2007).

The aim of the present study was to investigate the association between self-perceived orthodontic treatment need and malocclusion in 12 to 13-year olds of Swedish and immigrant background.

Subjects and methods

This study was approved by the Research Ethics Committee, Faculty of Health Sciences, Linköping University, Sweden, and conducted in two southern Swedish towns, Jönköping and Motala. Both cities have areas of mixed socio-economic structure. In the specific uptake areas for the study, the immigrant frequency (40 per cent) was higher than the national average (24 per cent in 2000; Statistics Sweden, 2001). The sample consisted

of 553 subjects, all 12- and 13-year olds (born between 1988 and 1989) from six schools. Information about the study was sent home to the parents and pupils. On the examination days, 37 were absent from school due to illness, 23 declined to participate in the clinical examination, and eight did not answer the questionnaire. From the sample, three groups were selected according to family origin (Table 1).

Subjects with both parents born in:

A—Sweden
B—Eastern Europe (Former Yugoslavia)
C—Middle East (Lebanon, Iraq, and Syria).

This sample was part of an investigation undertaken in 2001.

The study included a questionnaire and patient-related registrations. The questionnaires were answered at the schools by students in attendance on that day. A participating orthodontist or a dental assistant was available to clarify any questions (Table 2).

A clinical examination was conducted in the school nurse's room by an orthodontist (EJ) and comprised extraoral assessment of soft tissues and intraoral inspection of teeth and occlusion. A mouth mirror, sliding calliper, and ruler were used.

For subjects with ongoing orthodontic treatment with fixed (n = 18) or functional (n = 9) appliances, registrations were made on the pre-treatment study models. These records were analysed and assessed at the general dental or orthodontic clinics by the same examiner who undertook the clinical examinations. The soft tissue registrations were excluded in those with ongoing treatment. In subjects who had earlier undergone treatment with functional appliances (n = 14), the assessments were made after completion of treatment. With respect to other appliance therapy, 38 had previously undergone treatment and 16 were currently undergoing treatment, mainly with space maintainers, lingual arch appliances, and expansion plates. Existing conditions were registered in these subjects.

The following clinical variables were recorded to determine the presence of any malocclusion with a detrimental aesthetic effect:

Anterior crossbite: of one to four teeth. When the incisal edge of the maxillary incisors occluded lingually to the incisal edge of the corresponding mandibular tooth.
Overjet: the distance from the most labial point of the incisal edge of the maxillary incisors to the most labial surface of the corresponding mandibular incisor. Measured to the nearest half millimetre, parallel to the occlusal plane.
Overbite: measured vertically from the incisal edge of the most inferior maxillary incisor to the incisal edge of the corresponding mandibular incisor. Measured to the nearest half millimetre.
Contact point displacement: measured between the normal contact points in a bucco-lingual direction to the nearest millimetre. The highest value for each jaw was registered.
Lip closure: normal or strained.

Available radiographs (panoramic and intraoral) and patient records were examined.

The subjects were also classified according to the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN; Brook and Shaw, 1989).

From the questionnaire, the answer to the question 'Do you think that you need a brace today?' was selected as representing individual, self-perceived orthodontic treatment need. The characteristics of the group of subjects with a positive response to this question were compared with those with a negative response and then tested in relation to the clinical variables, the demographic data, and to the other items in the questionnaire (Table 2).

The subjects with ongoing orthodontic treatment with functional or fixed appliances (n = 27) were statistically tested in relation to self-perceived treatment need and their opinion of their own teeth in relation to the peers, compared with the other subjects (questions 3 and 5, Table 2).

Reliability

Reliability tests were performed on 25 randomly selected children from each age group. After an interval of 4 weeks, these subjects were presented with the same questionnaire

Table 1 Distribution of the 12- and 13-year-old boys and girls related to country of origin.

Group	n	Female (n)	Male (n)
A. Sweden	269	139	130
B. Eastern Europe (former Yugoslavia)	56	25	31
C. Middle East (Lebanon, Iraq, and Syria)	54	24	30
Total	379	188	191

Table 2 Questionnaire.

1.	You are Girl/Boy
2.	Your parents were born in (mother's country) (father's country)
3.	Do you think your teeth look better or worse than your peers'? Much better, Better, equal, Somewhat worse, Much worse
4.	Do you avoid smiling because of your teeth? Not at all—whole time, (1–5), ordinal scale
5.	Do you think that you need a brace today? Yes, Uncertain, No
6.	How is your general appearance compared with your peers? Much better, Better, Same, Worse, Much worse

and were also re-examined under the same conditions. Reliability was analysed by weighted kappa statistics. Inclusion in the study was restricted to questions and variables with good and very good reliability (0.6–1.0), with the exception of one variable with moderate reliability (the question 'Do you avoid smiling because of your teeth?' with a kappa value of 0.53). The initial answers and registrations were used in the study.

Statistical analysis

Differences between groups were tested for significance using the non-parametric methods chi-square and logistic regression. When more than one dependent variable was tested, multiple regression analyses were used.

Results

The question 'Do you think that you need a brace today' was answered by 373 subjects, of whom 22.3 per cent (26.5 per cent females and 18.1 per cent males) answered 'Yes' and 55.5 per cent (48.6 per cent females and 62.2 per cent males) answered 'No'. Twenty-two per cent were uncertain.

Fifty-eight per cent of subjects who considered the appearance of their teeth to be somewhat worse or much worse than that of their peers thought that they needed orthodontic treatment.

Of the subjects with an overjet greater than 6 mm (greater than 6 to less than or equal to 9 and greater than 9 mm), an anterior crossbite or a maxillary contact point displacement greater than 4 mm, self-perceived treatment need was 49.1, 59.5, and 55.8 per cent, respectively. The distribution of answers to the question 'Do you think that you need a brace today?' according to different variables is shown in Table 3.

Table 4 shows the analysis of the 83 subjects who thought they needed appliances. Significantly more girls than boys, 26 and 18 per cent ($P = 0.02$), and more Swedish students than Eastern European students, 24 and 14 per cent, respectively [($P = 0.04$, odds ratio (OR) = 2.3)] considered they had a treatment need.

There was a significant association between the response to the above question and the presence of overjet, with positive responses from 49 per cent of subjects with an overjet greater than 6 mm and 16 per cent with an overjet of 1–6 mm.

Subjects with an anterior crossbite of one or more teeth answered 'yes' significantly more often to the question (60 per cent), compared with those without an anterior crossbite (17 per cent; $P = 0.000$, OR = 7.0).

Maxillary contact point displacement greater than 4 mm and strained lip closure were strongly associated with a self-perceived need for orthodontic treatment ($P = 0.000$ and $P = 0.005$, respectively).

Subjects with IOTN-DHC grades 4 and 5 differed significantly from those with grades 1 and 2: 44 and 7 per cent, respectively ($P = 0.000$, OR = 13.0; Tables 3 and 4).

A positive response to the question 'Do you think that you need a brace today?' in relation to geographic origin and clinical and subjective variables were also examined. Among subjects of Middle Eastern origin, none of the occlusal anomalies influenced the perceived 'need for braces'. In the Eastern European subjects, a positive response to the specific question was significantly connected with an overjet greater than 6 mm, maxillary contact point displacement greater than 2–4 mm, and IOTN-DHC grades 4 and 5. In the Swedish group (group A), a significantly higher proportion of positive responses to the specific question was recorded for girls than for boys ($P = 0.002$), in students with an overbite less than 5 mm ($P = 0.010$), anterior crossbite ($P = 0.000$), maxillary contact point displacement greater than 4 mm ($P = 0.000$) and greater than 2 mm in the mandible ($P = 0.015$), strained lip closure ($P = 0.012$), and IOTN-DHC grades 4 and 5 ($P = 0.000$).

Subjects in groups A and C who thought that they needed an orthodontic appliance also considered that their teeth looked somewhat worse or much worse than those of their peers ($P = 0.000$ and $P = 0.005$, respectively) compared with those who thought that their teeth looked 'better or much better'. There was also a positive connection between Swedes who thought they needed an appliance and avoided smiling because of their teeth ($P = 0.000$). No association was found in any of the groups between general appearance and the need for orthodontic appliances.

The most important factors explaining a positive response to the question 'Do you think that you need a braces today?' were the morphological variables IOTN-DHC grades 4 and 5 and anterior crossbite ($P = 0.000$ and $P = 0.021$; OR = 7.7 and OR = 3.5; Table 5). The subjective variable 'My teeth look somewhat worse or much worse than those of my peers', $P = 0.000$ (OR = 26.8), was most closely associated with a perceived need for an orthodontic appliance (Table 5).

A positive response to the question Do you avoid smiling because of your teeth? was recorded in 34 per cent in group A, 9 per cent in group B, and 31 per cent in group C. The most important factors explaining a positive response to this question are shown in Table 6. For the morphological variables, the strongest association was found for contact point displacement 2–4 mm in both the maxilla ($P = 0.013$, OR = 2.3) and the mandible, ($P = 0.027$, OR = 2.1) and for the subjective variable 'My teeth look worse or much worse than those of my peers' ($P = 0.000$, OR = 8.8).

Of all students with IOTN-DHC grades 4 and 5, 74.5 per cent ($n = 104$) were allocated to these grades on the basis of the occlusal variables overjet greater than 6 mm ($n = 55$), maxillary contact point displacement greater than 4 mm ($n = 43$), or anterior crossbite ($n = 34$).

A larger proportion of the subjects with ongoing orthodontic treatment with functional or fixed appliances showed a higher self-perceived treatment need (70 per cent) and also thought that their teeth were worse or much worse in relation to their

Table 3 Distribution of responses to the question 'Do you think that you need a brace today?' in relation to gender, origin, clinical variables, and responses to questionnaire (percentage, in brackets).

Variable, *n*	Yes, % (*n*)	Uncertain, % (*n*)	No, % (*n*)
Gender			
Female (185)	26.5 (49)	24.9 (46)	48.6 (90)
Male (188)	18.1 (34)	19.7 (37)	62.2 (117)
Origin			
Sweden (A) (264)	24 (63)	25 (67)	51 (134)
Eastern Europe (B) (55)	14.5 (8)	14.5 (8)	70.9 (39)
Middle East (C) (54)	22.2 (12)	14.8 (8)	63.0 (34)
Overjet			
≤0 (7)	28.6 (2)	28.6 (2)	42.9 (3)
>0 to ≤6 (303)	16.2 (49)	21.8 (66)	62.0 (188)
>6 to ≤9 (46)	45.7 (21)	23.9 (11)	30.4 (14)
>9 (11)	63.6 (7)	18.2 (2)	18.2 (2)
Overbite			
≤0 (16)	37.5 (6)	12.5 (2)	50.0 (8)
>0 to <5 (209)	22.5 (47)	22.5 (47)	55.0 (115)
≥5 (142)	18.3 (26)	22.5 (32)	59.2 (84)
Anterior crossbite			
Yes (42)	59.5 (25)	11.9 (5)	28.6 (12)
No (325)	16.6 (54)	23.4 (76)	60.0 (195)
Contact point displacement maxilla			
≤1 (161)	13.7 (22)	19.9 (32)	66.5 (107)
>1 to ≤2 (73)	16.4 (12)	20.5 (15)	63.0 (46)
>2 to ≤4 (90)	23.3 (21)	28.9 (26)	47.8 (43)
>4 (43)	55.8 (24)	18.6 (8)	25.6 (11)
Contact point displacement mandible			
≤1 (158)	17.7 (28)	20.9 (33)	61.4 (97)
>1 to ≤2 (111)	21.6 (24)	21.6 (24)	56.8 (63)
>2 to ≤4 (84)	27.4 (23)	22.6 (19)	50.0 (42)
>4 (14)	28.6 (4)	35.7 (5)	35.7 (5)
Lip closure			
Normal (298)	17.4 (52)	21.5 (64)	61.1 (182)
Strained (54)	31.5 (17)	27.8 (15)	40.7 (22)
IOTN-DHC			
1 + 2 (123)	7.3 (9)	17.9 (22)	74.8 (92)
3 (90)	10.0 (9)	27.8 (25)	62.2 (56)
4 + 5 (139)	43.9 (61)	22.3 (31)	33.8 (47)
Do you think your teeth look better or worse than your peers?			
'Much better' + 'Better' (65)	13.8 (9)	12.3 (8)	73.8 (48)
'Equal' (231)	13.0 (30)	22.9 (53)	64.1 (148)
'Somewhat worse' + 'Much worse' (74)	58.1 (43)	28.4 (21)	13.5 (10)
Do you avoid smiling because of the appearance of your teeth?			
'Never' (261)	17.6 (46)	19.2 (50)	63.2 (165)
'Sometimes'—'Often' (111)	33.3 (37)	29.7 (33)	39.6 (44)
How is your general appearance compared with your peers?			
'Much better' + 'Better' (75)	21.3 (16)	18.7 (14)	60.0 (45)
'Same' (264)	22.0 (58)	22.3 (59)	55.7 (147)
'Worse' + 'Much worse' (26)	23.0 (6)	30.8 (8)	46.2 (12)

peers (30 per cent) compared with the other subjects (18 and 19 per cent, respectively; questions 3 and 5, Table 2).

Discussion

The present study investigated the association between self-perceived orthodontic treatment need in children of different geographic origins, with the prevalence of primarily aesthetic malocclusions. The main focus was the connection between normative and self-perceived need at an individual level.

The subjects within each of the three origin groups were similar with respect to parental geographic background. They were extracted from the sample in a previous study (Josefsson *et al.*, 2007), but the group 'other countries' was excluded because of its diversity. In this study, groups B and C were more homogeneous because only students with both parents from the same geographic origin were included. Compared with the previous study, the subjects were recruited from more limited geographic areas in both Eastern Europe and Asia. Consequently, these groups comprised fewer subjects. To bring the results of different

Table 4 Logistic regression analyses [odds ratio (OR)] of gender, origin, and clinical variables when the dependent variable was a positive response to the question 'Do you think that you need a brace today'. The basic alternative for each variable is shown in bold type.

Variable	*n*	*P*	OR
Gender	83		
Male versus female		*	1.9
Origin	83		
Eastern Europe (B) versus Sweden (A)		*	2.3
Middle East (C) versus Sweden (A)		n.s	
Middle East (C) versus eastern Europe (B)		n.s	
Overjet	77		
>0 to ≤6 versus >6		**	1.3
Overbite	79		
>0 to <5 versus ≤0		n.s	
>0 to <5 versus ≥5		n.s	
Anterior crossbite	79		
No versus yes		***	7.0
Contact point displacement upper jaw	79		
≤1 versus >1 to ≤2		n.s	
≤1 versus >2 to ≤4		*	2.4
≤1 versus >4		***	11.0
Contact point displacement lower jaw	79		
≤1 versus >1 to ≤2		n.s	
≤1 versus >2 to ≤4		n.s	
≤1 versus >4		n.s	
Lip closure	69		
Normal versus strained		**	2.7
IOTN-DHC	79		
1 + 2 versus 3		n.s	
1 + 2 versus 4 + 5		***	13.0

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; n.s., not significant.

Table 5 The four variables with the highest explanatory factors for a positive response to the question 'Do you think that you need a brace today?' Twelve variables were analysed by multiple regression analysis [odds ratio (OR)].

Variable	*P*	OR
Morphological variable		
Dental health component of the index of orthodontic treatment need, 4 + 5	***	7.7
Anterior cross bite 1–4 teeth	*	3.5
Subjective variable		
Do you avoid smiling because of the appearance of your teeth?: Sometimes—often	***	3.3
Do you think your teeth are better or worse than your peers?: Somewhat worse + much worse	***	26.8

*$P < 0.05$; ***$P < 0.001$; n.s., not significant.

origin groups to a critical stage, it was important to have more homogeneous groups even if this resulted in a smaller number of subjects.

Table 6 The three variables with the highest explanatory factors for a positive response to the question 'Do you avoid smiling because of your teeth?' Twelve variables were analysed by multiple regression.

Variable	*P*	OR
Morphological variable		
Contact point displacement		
Upper jaw, >2 to ≤4 mm	**	2.3
Lower jaw, >2 to ≤4 mm	*	2.1
Anterior crossbite 1–4 teeth	*	2.1
Subjective variable		
Do you think your teeth are better or worse than your peers?: Somewhat worse + much worse	***	8.8

OR, odds ratio.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Subjects with a reversed overjet or edge-to-edge incisal relationships were excluded from the analyses because of the limited numbers.

A few of the subjects had started fixed appliance therapy prior to the study and some were midtreatment with functional appliances. This could have influenced their perception that their teeth looked better than the normative need registered on the pre-treatment study models and therefore influenced the results. However, statistical analysis of interaction did not demonstrate any such influence.

The topics included in the questionnaire (Table 2) were selected to explore the student's self-perceived treatment need and satisfaction with their own teeth (multiple choice, five-point ordinal scale) and with their general appearance (five-point ordinal scale), in accordance with Shaw (1981) and Mandall *et al.* (2000). A positive response to the question 'Do you think that you need a braces today' represents a perceived need (or demand) for orthodontic treatment.

The results showed a strong association between subjects who perceived that they needed an orthodontic appliance and IOTN-DHC grades 4 and 5, an anterior crossbite, avoiding smiling because of the appearance of their teeth and the perception that their teeth look somewhat worse or much worse than those of their peers. The association between malocclusion and the perception that they needed braces was stronger in group A than in groups B and C. When all subjects were tested together (A–C), the variables overbite and mandibular contact point displacement did not seem to influence the perceived need for treatment.

The self-perceived need for an orthodontic appliance was 22 per cent while a similar percentage was uncertain about their need. These frequencies are lower than those reported by Kok *et al.* (2004), who found, in a study of 10- to 12-year old children, that 35 per cent wanted orthodontic treatment and 17 per cent were not sure.

Several occlusal variables in this study showed a connection with self-perceived orthodontic treatment need. This is in agreement with the study of Helm *et al.* (1986) which showed a close relationship between 'concern-for-dental-appearance' and the most conspicuous traits in the anterior region of the dentition. The same results were found by Espeland and Stenvik (1991) that 'dissatisfaction was based on realistically perceived anomalies'.

In the present study, 44 per cent of the subjects with IOTN-DHC grades 4 and 5 thought that they needed an orthodontic appliance, compared with 7 per cent in subjects with grades 1 and 2. Thus in these age groups, few children with a perceived treatment need would probably not qualify for treatment according to a treatment priority index. Consequently, 12 to 13-year-old adolescents who think that they need treatment also have a need according to the IOTN-DHC. On the other hand, 34 per cent with a great normative treatment need (IOTN-DHC 4 and 5) did not perceive a need for treatment. There was also a large group who were uncertain about their need for treatment (22 per cent), whereas orthodontic assessment showed a need for treatment. Thus, the group with IOTN-DHC grades 4 and 5 includes those subjects who will not request treatment of their own accord, probably because of a malocclusion that is less obvious, or because they belong to the group of subjects who are uncertain about their need for treatment. This group is even larger if one considers that in selecting patients for referral, general dental practitioners tend to include cases with IOTN grade 3 as in need of treatment (Bearn *et al.*, 1996).

The occlusal variables with an obvious discrimination in the students who thought that they needed an orthodontic appliance were: overjet greater than 6 mm, anterior crossbite, and maxillary contact point displacement greater than 2 mm. These occlusal features represented a majority of the subjects with IOTN-DHC grades 4 and 5. This may be a good validation for the normative part of this index and also a good predictor of self-perceived orthodontic treatment need. This is in concordance with the results of Hamdan (2001) who found, in a study of orthodontic treatment need according to IOTN-DHC, that 'severe tooth displacements of more than 4 mm' and 'increased overjet greater than 6 mm but less than or equal to 9 mm' were two of the three main occlusal features determining allocation to 'definite need'.

Mandall *et al.* (2005) studied the prediction of the IOTN on orthodontic treatment uptake and found that sociodental measures do not predict future utilization of orthodontic services. Factors such as clinical IOTN will adequately predict this and assessment of future manpower requirements will probably require IOTN-DHC data to fully assess dental health risks. In contrast, Mohlin and Kurol (2003) found that IOTN-DHC could not serve the basic purpose of creating relevant cut-off points for treatment need.

Birkeland *et al.* (1996), in a study of 11-year-old Norwegian children and their parents, found an association between orthodontic concern and IOTN: about 70 per cent of subjects with IOTN-DHC grades 4 and 5 'agreed very much' or 'agreed a little' with a desire to have their teeth straightened. It is known that in a clinical situation, where the parent's opinion is an important factor, self-perceived treatment need is higher. In the present study, 22 per cent of subjects with IOTN-DHC grades 4 and 5 had uncertain responses to the question about the need for an orthodontic appliance. The percentage of uncertain and positive responses to this question (66 per cent) is in good agreement with the results of Birkeland *et al.* (1996).

Hamdan (2004) found no correlation between normative need and patients' perceptions of orthodontic treatment need in a study of patients seeking treatment: 71 per cent had IOTN-DHC scores of grade 4 and 5, and the perceived need for orthodontic treatment was measured using a visual analogue scale ('No need for treatment' to 'Very great need for treatment') and the aesthetic component of the IOTN. The subjects comprised new patients attending an orthodontic clinic and thus the highly selected study sample precludes comparison of the results with those of the present research. The result showed that IOTN-DHC was not a good predictor of perceived need.

Other factors may contribute to treatment demand, such as social class, financial limitations, individual perceptions of psychosocial benefits, and attitude to appliances (Birkeland *et al.*, 1996).

When the subjects were tested according to geographic origin, a significantly higher self-perceived need for orthodontic appliance was found in Swedish students than in those from Eastern Europe. In contrast to the Swedish group (A), in the Eastern European and Middle Eastern groups (B and C), only a few morphological variables associated well with the perceived need for orthodontic treatment. A possible explanation is the small number of subjects in groups B and C. In the Swedish group (A), there were strong associations between the perceived need for appliances and the variables anterior crossbite and maxillary contact point displacement greater than 4 mm. The same trend emerged in group B. This seems to be logical, as these variables represent malocclusions which are aesthetically disturbing. The only variable that correlated well with the perceived need for an orthodontic appliance in group C was the opinion that 'my teeth look somewhat worse or much worse than those of my peers'.

Both in the Swedish and Eastern European groups, the variable IOTN-DHC grades 4 and 5 associated well with the perceived need for an appliance, but no such association was found in the Middle Eastern group. Thus in this group, other factors determine the perceived need for braces. Questionnaires with a different focus or in-depth interviews might be necessary to determine why these patients think they need an appliance. It may be helpful in distinguishing between various

patient and provider perspectives and values and serve as means of documenting the benefits of orthodontic treatment in health policy discussions (Klages *et al.*, 2006).

Mandall *et al.* (2000) failed to find a correlation between ethnic origin and orthodontic treatment need. A previous study by Josefsson *et al.* (2005) found that eastern European students were more apprehensive than Swedish students about treatment-related pain. This may be one explanation for the lower treatment demand in the Eastern European group (B). Another reason may be a higher frequency of aesthetically objectionable malocclusions in Swedish students than among those of Eastern European origin (Josefsson *et al.*, 2007). Sayers and Newton (2007) found that compared with Caucasians, non-Caucasians anticipated more treatment-related pain and expressed more negative expectations of orthodontic treatment.

In the group A, there was a connection between demand for treatment and an overbite less than 5 mm and mandibular contact point displacement greater than 2 and less than or equal to 4 mm. General appearance did not seem to influence self-perceived orthodontic treatment need in any of the groups.

An intriguing finding is that while Swedish students and those of Middle Eastern origin have a similar perceived need for treatment, no association with malocclusion was observed in the latter group. To increase our understanding of the underlying issues, other methods of investigation will be required.

Conclusions

1. There were strong associations between subjects perceiving a need for orthodontic appliance and IOTN-DHC grades 4 and 5, an anterior crossbite, avoiding smiling because they were self-conscious about their teeth and the perception that their teeth look somewhat worse or much worse than those of their peers.
2. The self-perceived need for orthodontic appliance was significantly higher among Swedish students than those of eastern European origin.

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