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Perceived aesthetic impact of malocclusion and oral self-perceptions in 14–15-year-old Asian and Caucasian children in Greater Manchester

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SUMMARY The aims of this study were to evaluate (i) the effect of ethnicity, social deprivation, and normative orthodontic treatment need on orthodontic aesthetic self-perception, self-perceived need for orthodontic treatment, and oral aesthetic impact of malocclusion; (ii) the effect of ethnicity, social deprivation, and gender on perceived orthodontic treatment need and use of orthodontic services; (iii) the influence of perceived oral aesthetic impact of malocclusion on perceived need and wish for orthodontic treatment; and (iv) whether orthodontic treatment experience influences perceived oral aesthetic impact of malocclusion.

A stratified, random sample of 434 14–15-year-old children from schools in Manchester, UK, was obtained. Information was collected on orthodontic aesthetic self-perception and orthodontic treatment experience using a questionnaire. The former data were combined to form an Oral Aesthetic Subjective Impact Scale (OASIS). Normative orthodontic treatment need was measured with the Index of Orthodontic Treatment Need (IOTN).

Children with higher clinical need for orthodontic treatment perceived themselves as worse off than their peers with lower need. More socially deprived children or those with high IOTN aesthetic component (AC) scores had a higher (i.e. more negative) aesthetic impact (OASIS) score. Asians and females had higher IOTN dental health component (DHC) scores, but a better aesthetic appearance than Caucasians and males. More deprived children were less likely to have received orthodontic treatment. Despite this, OASIS scores were similar between treated and untreated children. Untreated children who wished for orthodontic treatment had higher IOTN AC and OASIS scores.

Introduction

This study was concerned with measurement of orthodontic aesthetic self-perception, and the perceived aesthetic impact of malocclusion and social variables that may influence this. Therefore, the literature will be reviewed in two main parts: (i) orthodontic perceptions and (ii) the measurement of oral aesthetic impact in dentistry.

Orthodontic oral self-perceptions

A number of authors (Shaw *et al*., 1975, 1980; Lindsay and Hodgkins, 1983; Tulloch *et al*., 1984; Roberts *et al*., 1989) have suggested that teenage children have developed an oral perceptual awareness. For example, Shaw (1981) found that children with less perceptual awareness tended to be dissatisfied with their dental appearance and perceived a greater need for orthodontic treatment. In contrast to this, in a study comparing schoolchildren in Wales, UK, and Kentucky, USA, Tulloch *et al*. (1984) showed that perceptions of dental attractiveness and treatment need were similar. However, subtle differences were found, with the American children having a more realistic perception of treatment time, probably attributable to their greater exposure to peers undergoing orthodontic treatment.

Other work has measured orofacial perceptions in older teenagers or adults (Bell *et al*., 1985; Kerr and O'Donnell, 1990; Espeland and Stenvik, 1991; Phillips *et al*., 1992). In summary, whilst people seem mostly aware of their malocclusion traits, they do not perceive a need for treatment to the same extent as a dentist or orthodontist. Thus, a professional person was seen to have a more critical view of malocclusions and consider that treatment was needed, whereas the lay person would be more likely to say that the same malocclusion did not need treatment.

The influence of ethnicity on orthodontic perceptions has not been extensively investigated. Cross and Cross (Cross and Cross, 1971) found that white subjects gave a set of pictures lower facial beauty ratings than black subjects, whilst Kiyak (Kiyak, 1981) showed that Pacific Asians were more tolerant of skeletal facial disproportion and tooth spacing than Caucasians.

This leads us to consider if these differences between ethnic groups are reflected in variations in the demand for orthodontic treatment. However, this question is not easily evaluated because ethnic minority groups tend to be socially disadvantaged (United Kingdom Census, 1991) and also under-utilize dental services in comparison with Caucasian populations (Beautrais *et al*., 1982; Hayward *et al*., 1989; Aday and Forthofer, 1992). Therefore, it is necessary to account for the potential confounding effect of social deprivation in such studies.

The measurement of oral aesthetic impact

Brook and Shaw (1989) evaluated clinical orthodontic treatment need using normative measures such as IOTN. However, there is a strong case to suggest the need for an additional social viewpoint (Sheiham *et al*., 1982). Generally, such information confers advantages in terms of understanding oral health-related behaviour and widening dental evaluation outside the limits of epidemiological indices (Slade and Spencer, 1994).

Locker (1988) proposed a model that described a number of oral psychosocial outcomes of impairment, functional limitation, discomfort, disability, and handicap. Other examples of oral health impact scales are the Oral Health Impact Profile (Slade and Spencer, 1994), Social Impacts of Dental Disease (Leao and Sheiham, 1996), the Dental Impact Profile (Strauss, 1997), and Oral Health Quality of Life Inventory (Cornell *et al*., 1997). Unfortunately, as the population demanding orthodontic treatment is mostly young adolescents, these measures are not relevant because their development was based on adult populations, who are more likely to suffer impairment because of caries, periodontal disease, and its consequences.

Aims of the study

To evaluate:

(1) the effect of ethnicity, social deprivation, and normative orthodontic treatment need on adolescent orthodontic aesthetic self-perception, self-perceived need for orthodontic treatment, and oral aesthetic impact of malocclusion;
(2) the effect of ethnicity, social deprivation, and gender on orthodontic treatment need and use of orthodontic services;
(3) the influence of perceived oral aesthetic impact of malocclusion on perceived need and wish for orthodontic treatment;
(4) whether orthodontic treatment experience influences perceived oral aesthetic impact of malocclusion.

Subjects

Sample size calculation

The sample size was calculated using previous data (Shaw, 1981). In that study, nearly one-third of the sample of 9–12-year-old children failed to recognize a picture of their own teeth. This implies that the remaining two-thirds (0.66) had an accurate perception of their own teeth. It was thought unlikely that the proportion of children who were accurate in the present study would be higher than previously reported. If there was a difference between ethnic groups that this would be in a negative direction and that hopefully at least two-fifths (0.40) of the sample would have an accurate orthodontic aesthetic self-perception.

The magnitude of the expected differences between groups was taken as 0.25 (the difference between 0.66 and 0.40), so in order to have a study with an alpha of 0.05 and beta 0.2, it was calculated that a sample of 280 subjects was required.

Population

All 14–15-year-old Asian and Caucasian children from schools in Manchester were eligible for inclusion in the study.

Ethnicity

Each Asian child had been prospectively identified using a previously validated name bank (Nicoll *et al*., 1986). This method had been shown to have very high sensitivity and specificity for identifying Asian subjects. Therefore, the definition of Asian used was '… a person who, irrespective of birthplace, would identify him/herself as racially and ethnically originating from peoples indigenous to India, Pakistan, Bangladesh and Sri Lanka. This includes Asians born in East Africa, the UK and Mauritius, but excludes whites born in India.'

Sampling

Random stratification by school was carried out and 434 children were then randomly selected from class lists. As part of the sampling process, each child was matched for age, sex, and broad social class [determined by school (independent or state funded)] and ethnicity (Caucasian or Asian). The sampling procedure resulted in a group of children from a range of socio-economic backgrounds.

Methods

Development of a measure of oral aesthetic impact of malocclusion

A series of questions was formulated to assess the degree of concern or disadvantage the children perceived because of the arrangement of their teeth. The questions were piloted for understanding on 14 children and the definitive questions are shown in Figure 1. The children recorded a response on a seven point Likert scale. They were then asked to identify which photograph of the Index of Orthodontic Treatment Need Aesthetic Component scale, (IOTN AC), most closely matched their orthodontic aesthetic self-perception of the appearance of their anterior teeth. This was carried out from memory and no self-examination or conferring was allowed.

The scores for all questions and the child's perceived AC score were totalled to give an overall perceived oral aesthetic impact score for each child. This was called the OASIS score (Orthodontic Aesthetic Subjective Impact Score).

Each child was then asked whether they had received orthodontic treatment and whether they thought they needed orthodontic treatment. The accuracy of the latter response was determined by comparison with clinical treatment need, and coded as agree, disagree, or don't know. Clinical need was defined as an IOTN dental health component score (IOTN DHC) of 3 or greater.

The examination

A clinical examination was undertaken by a trained and calibrated examiner to collect data on normative orthodontic treatment need in the teenage sample using both IOTN AC and DHC.

Reliability

Ten per cent of the sample was chosen at random and re-examined at the end of each session.

Confirmation of level of social deprivation

Initially, the children were broadly matched for social deprivation using the type of school they attended. Following this, their postcode was linked to small area statistics at the ward level, available from the United Kingdom Census (United Kingdom Census, 1991). The level of social deprivation was then calculated using Townsend's Index of Social Deprivation (Townsend, 1987).

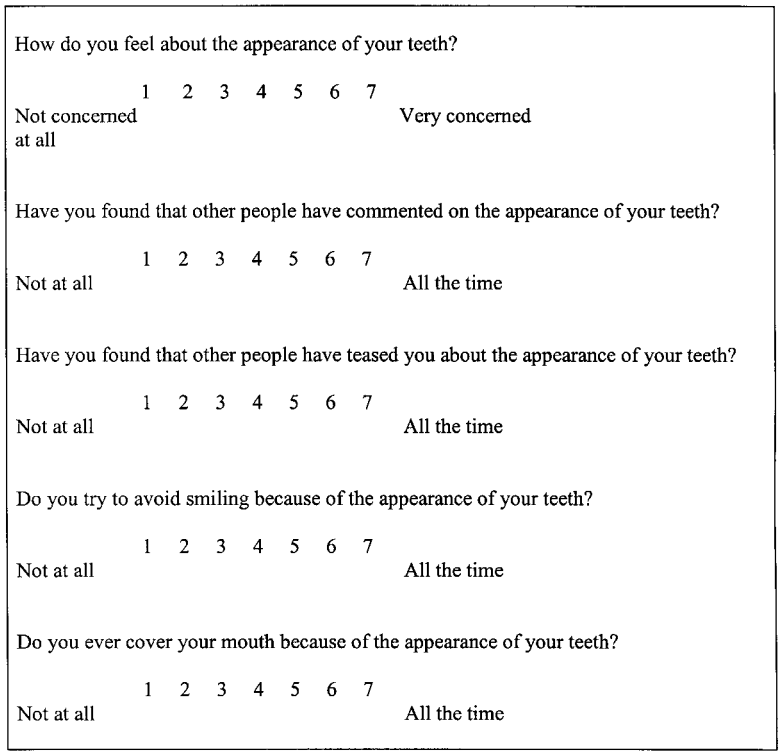

Figure 1 The questions used to contribute to the oral aesthetic subjective impact scale (OASIS).

Statistical analysis

Standard descriptives were generated and the data checked for normality. The following inferential statistical analyses were carried out and, where relevant, the children who had already received orthodontic treatment were removed from the analysis:

(1) *t*-tests were used for group comparisons of oral aesthetic impact of malocclusion.
(2) Chi-square statistics to assess any group differences for self-perceived need for treatment.
(3) The relative influence of the independent variables on the dependent variables was assessed with stepwise multiple regression analysis. The probability value for independent variables entering the equation was 0.05 and for removal, 0.1.
(4) Analysis of variance was used to compare OASIS scores between treated and untreated children. A Bonferroni correction was applied to establish which groups (if any) were statistically significantly different from one another.
(5) Internal consistency of OASIS, an aspect of reliability, was assessed by computing Cronbach's alpha.
(6) Inter- and intra- examiner reliability were computed using weighted kappa for the clinician.

Results

Of the 434 children sampled, a 77 per cent response ($n = 334$) was obtained. A considerable number of children (94 per cent) perceived their anterior tooth arrangement to be acceptable (IOTN AC score 1–4). Table 1 shows the distribution of IOTN scores as perceived by the examiner. A comparison of child and examiner IOTN AC scores showed that only 54 per cent agreed with the examiner regarding need for treatment.

Table 1 The distribution of examiner IOTN AC and DHC scores of the 334, 14–15-year-old subjects.

	IOTN score		
	No need	Moderate need	Need
Aesthetic component	241 (72%)	64 (19%)	29 (9%)
Dental health component	161 (48%)	113 (34%)	60 (18%)

Mean aesthetic component score = 3.8 (SD = 2.2).
Mean dental health component score = 2.7 (SD = 0.8).

Table 2 Mean OASIS scores for treatment experience and IOTN dental health component score.

	Mean OASIS score (SD)
Had treatment	13.5 (5.8)
No treatment & IOTN DHC score 1, 2 or 3	11.9 (5.0)
No treatment & IOTN DHC score 4 or 5	14.2 (5.2)

Table 2 details the mean OASIS scores for children according to their treatment experience. When treatment experience was evaluated separately, 21 per cent had already received treatment, 14 per cent were under treatment, and 65 per cent were not treated. When the latter group were asked if they wanted orthodontic treatment, 16 per cent were positive, 57 per cent negative, and 27 per cent did not know.

Multiple stepwise regression analysis

This revealed that ethnicity, social deprivation, and gender did not influence a child's orthodontic aesthetic self-perceived AC scores (Table 3) or self-perceived need for orthodontic treatment (Table 4). However, children with a poorer aesthetic anterior tooth arrangement, as recorded by the examiner, generally perceived themselves as worse off ($P < 0.001$). Table 3 also shows that there was a higher orthodontic treatment need on dental health grounds as measured by the examiner in Asians ($P = 0.017$) or females ($P = 0.014$). Paradoxically, AC scores were worse in Caucasian ($P = 0.03$) or male groups ($P = 0.004$). There were no statistically significant differences between Asians and Caucasians for

Table 3 Stepwise multiple linear regression models fitted to aesthetic self-perception and orthodontic treatment need*.

Dependent variable	Statistically significant independent variables	B	SE B	*P*-value	R^2	Non-significant independent variables
Child orthodontic aesthetic self-perception	IOTN AC (examiner)	0.23	0.053	<0.001	0.09	Ethnicity Townsend IOTN DHC (examiner) Gender
IOTN AC (examiner score)	IOTN DHC (examiner)	1.53	0.15	<0.001	0.35	Townsend social deprivation score
	Gender	–0.7	0.25	0.004		
	Ethnicity	0.55	0.25	0.03		
IOTN DHC (examiner score)	IOTN AC (examiner)	0.22	0.02	<0.001	0.35	Townsend social deprivation score
	Gender	0.24	0.10	0.014		
	Ethnicity	–0.23	0.10	0.017		

*Children who had received treatment were removed from the analysis.
B (beta) is the standardized regression coefficient or the slope of the least squares line. A positive value indicates that as the dependent variable value increases so does the independent variable value. A negative value indicates as the dependent variable value increases, the independent variable value decreases. SE B is the standard error of beta.

Table 4 Stepwise multiple logistic regression analysis to investigate the influence of the independent variables on self-perceived need for treatment and wish for orthodontic treatment in untreated cases.

Dependent variable	Statistically significant independent variables	B	SE B	*P*-value	Odds ratio	Non-significant dependent variables
Orthodontic treatment uptake	Townsend social deprivation score	0.09	0.025	<0.001	1.09	Ethnicity Gender
Self-perception of need for orthodontic treatment*	IOTN DHC	1.14	0.28	<0.001	3.13	Townsend IOTN AC (examiner) OASIS (child score) Ethnicity Gender
Wish for orthodontic treatment in untreated cases	IOTN AC (examiner)	–0.27	0.10	0.006	0.76	Townsend social deprivation score
	OASIS (child score)	–0.11	0.043	0.009	0.89	IOTN DHC (examiner)

*Children who had received treatment were removed from the analysis.

Table 5 Stepwise multiple linear regression analysis to show the effect of the independent variables on oral aesthetic impact of malocclusion (OASIS).

Dependent variable	Statistically significant independent variables	B	SE B	*P*-value	R^2	Non-significant independent variables
OASIS score	IOTN AC (examiner)	0.78	0.16	<0.001	0.19	IOTN DHC (examiner)
	Townsend social deprivation score	0.28	0.065	<0.001		Received orthodontic treatment

use of orthodontic services. However, socially deprived children did not use services as much as their more affluent peers (Table 4).

Finally, the analysis investigated the effects on and influences of perceived oral aesthetic impact of malocclusion (OASIS). Perceived oral aesthetic impact did not influence a child's perceived need for orthodontic treatment (Table 4). However, increased scores (higher concern) were registered in untreated children who wanted appliances compared with those who did not (Table 4). Table 2 compares OASIS scores of children who had undergone treatment and those who had not been treated according to different levels of normative need. No two groups were significantly different from each other when a Bonferroni correction was applied. In support of this, Table 5 shows that receiving orthodontic treatment did not appear to significantly change the child's perceived aesthetic impact of malocclusion. However, children with poorer IOTN AC scores or from more deprived backgrounds had a more negative perception of their teeth (higher OASIS score) compared with children with more aesthetic malocclusions or more affluent backgrounds.

Weighted kappa for inter-examiner IOTN AC was 0.88 (95 per cent confidence intervals (CI) 0.77–0.99) and IOTN DHC 0.92 (95 per cent CI 0.84–1.00). Values for intra-examiner reliability were 0.95 (AC, 95 per cent CI 0.91–0.99) and 0.91 (DHC, 95 per cent CI 0.88–1.00). The

internal consistency of OASIS was good with a Cronbach's alpha of 0.76.

Discussion

The results of the study have revealed whether ethnicity and social deprivation influenced orthodontic aesthetic self-perceptions and perceived aesthetic impact of malocclusion.

The lack of effect of ethnicity on orthodontic aesthetic self-perception

The finding that ethnicity did not influence orthodontic aesthetic self-perception is supported by Cons *et al*. (Cons *et al*., 1983), who found cross-cultural perceptions of dental aesthetics to be the same. However, they are not in agreement with Cross and Cross (Cross and Cross, 1971) and Kiyak (Kiyak, 1981), who suggested ethnicity influenced perceptions of facial appearance. However, it may not be surprising that ethnicity did not influence perceptions since over 95 per cent of 14–15-year-old Asian children were born in this country (United Kingdom Census, 1991). Asian children will thus have received similar social and cultural messages to Caucasians outside the home.

The effect of orthodontic treatment need and social deprivation on perceived aesthetic impact of malocclusion

The data revealed that children with higher normative aesthetic need had higher aesthetic impact scores. The former finding would seem to uphold the popular belief that children with less attractive dentitions may be psychosocially disadvantaged to have aesthetic concerns.

The finding that more socially deprived children also had higher OASIS scores is difficult to explain since further analysis of the data did not suggest any influence of social deprivation on IOTN scores. Therefore, it cannot be suggested that a more negative psychosocial response might be a result of poorer aesthetic tooth appearance in more deprived children. Despite increased teasing reported in more socially deprived children, it is not known whether general teasing is related to social deprivation or if teasing about teeth is dependent on severity of dental aesthetics. However, Shaw *et al*. (1980) reported that about 60 per cent of children teased about their teeth disliked it.

The influence of ethnicity on orthodontic treatment need

Although ethnicity had a statistically significant effect on IOTN scores, it had a different effect on each component of IOTN. The reason for this is unclear. However, it can be suggested that:

1. Caucasians are more willing to accept a slightly worse aesthetic tooth appearance.
2. Asians may not be as aware of a higher dental health need since their aesthetic appearance is better than the other groups and some form of compromised appearance may be a cue for seeking orthodontic treatment.

This effect of ethnicity on normative orthodontic treatment need has not previously been shown. Unfortunately, all previous studies in this area have not used an index of malocclusion, but have simply measured occlusal factors such as molar and incisor relationships (Kapila, 1983; Corrucini, 1984; Garner and Butt, 1985; Woon, 1988; Woon *et al*., 1989; Kerusuo *et al*., 1990). Such studies give no information on treatment need since they are confined to differences in the relationships of the teeth and, as a result, their findings lack validity.

The lack of influence of ethnicity on uptake of orthodontic services

The finding that ethnicity did not influence uptake of orthodontic services was surprising, since previous work has mostly supported the view that ethnic minorities under-utilize dental services compared with Caucasians (Beautrais *et al*., 1982; Medina *et al*., 1982; Hayward *et al*., 1989), and this should influence orthodontic referral and treatment uptake. It is difficult to suggest a reason, although this finding may have its origins in the statistical approach in accounting for social deprivation as a confounder used in this investigation.

The influence of social deprivation on uptake of orthodontic services

It was also found that social deprivation had a negative influence on orthodontic treatment uptake. Previous investigators have shown that social deprivation influences uptake of general dental services, unless the dentist to patient ratio is favourable (O'Mullane and Robinson, 1977). In the light of current unfavourable orthodontist to patient ratios, especially in areas of high levels of social deprivation (O'Brien, 1991), this was not unexpected.

The results also support the findings of Kenealy *et al*. (1989), who reported that there was a greater chance of a child receiving treatment for a moderate/mild malocclusion if they were 'middle class' than if they were 'working class'. However, they found no association between social class and uptake of treatment in children thought to have the greatest need.

The influence of perceived oral aesthetic impact of malocclusion (OASIS) on the desire for orthodontic treatment

OASIS scores were higher in untreated children who said they wanted orthodontic treatment compared with those who did not. The children who wanted treatment also had poorer aesthetic appearances. Therefore, oral aesthetic impact seems important in motivating children to want treatment. However, it is not known if this is translated into an increased demand for treatment and further investigation is needed.

These results highlight the importance of introducing a perceptual measure of the aesthetic impact of malocclusion, in addition to measuring normative orthodontic treatment need. It is evident that children do not always respond perceptually in the way that an epidemiological index might suggest they should.

Conclusions

The conclusions from this research are:

1. Ethnicity and social deprivation were not important variables with respect to orthodontic aesthetic self-perception.
2. Socially deprived children or those with high aesthetic need had a more negative perceived aesthetic impact of their malocclusion, but this did not influence their accuracy of perceived treatment need.
3. Asians and females had higher orthodontic treatment need on dental health grounds than Caucasians and males, despite having a lower aesthetic need for treatment.
4. Asians do not seem disadvantaged compared with Caucasians with respect to the use of orthodontic services. However, more socially deprived children seem to suffer such disadvantage in contrast to less deprived children.
5. Perceived aesthetic impact of malocclusion is unlikely to be reliably influenced by receipt of orthodontic treatment. However, such perceived aesthetic impact seems important with respect to a wish for treatment and, therefore, potential use of orthodontic services.

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References

Aday L A, Forthofer R N 1992 A profile of black and Hispanic subgroups access to dental care: findings from the national health interview survey. Journal of Public Health Dentistry 52: 210–215

Beautrais A L, Fergusson D M, Shannon F T 1982 Use of pre-school dental services in a New Zealand birth cohort. Community Dentistry and Oral Epidemiology 10: 249–252

Bell R, Kiyak H A, Joondeph O R, McNeill R W, Wallen T R 1985 Perceptions of facial profile and their influence on the decision to undergo orthognathic surgery. American Journal of Orthodontics 88: 323–332

Brook P H, Shaw W C 1989 The development of an index of orthodontic treatment priority. European Journal of Orthodontics 11: 309–320

Cons N C, Jenny J, Kohout F J, Freer T J, Eisman D 1983 Perceptions of occlusal conditions in Australia and the German Democratic Republic and the United States of America. International Dental Journal 33: 200–206

Cornell J E, Saunders M J, Paunovich E D, Frisch M B 1997 In: Slade G D (ed.) Measuring oral health quality of life.

Department of Dental Ecology, School of Dentistry, University of North Carolina, pp. 135–149

Corrucini R S 1984 An epidemiologic transition in dental occlusion in world populations. American Journal of Orthodontics 86: 419–426

Cross J F, Cross J 1971 Age, sex and race and the perception of facial beauty. Developmental Psychology 5: 433–439

Espeland L V, Stenvik A 1991 Perception of personal dental appearance in young adults: relationship between occlusion, awareness and satisfaction. American Journal of Orthodontics and Dentofacial Orthopedics 100: 234–241

Garner L D, Butt M H 1985 Malocclusion in black Americans and Nyeri Kenyans. An epidemiologic study. Angle Orthodontist 55: 139–146

Hayward R A, Meetz H K, Shapiro M F, Freeman H E 1989 Utilization of dental services: 1986 patterns and trends. Journal of Public Health Dentistry 49: 147–152

Kapila S 1983 Distribution of malocclusions in African and Asian children in some Nairobi schools. Odontostomatologie Tropicale 6: 131–136

Kenealy P, Frude N, Shaw W C 1989 The effects of social class on the uptake of orthodontic treatment. British Journal of Orthodontics 16: 107–111

Kerr M E, O'Donnell J 1990 Panel perception of facial attractiveness. British Journal of Orthodontics 17: 299–304

Kerusuo H, Laine T, Nyyssonen V, Honkala E 1990 Occlusal characteristics in groups of Tanzanian and Finnish urban school children. Angle Orthodontist 61: 49–56

Kiyak H A 1981 Comparison of aesthetic values among Caucasians and Pacific Asians. Community Dentistry and Oral Epidemiology 9: 219–223

Leao A, Sheiham A 1996 The development of a socio-dental measure of dental impacts on daily living. Community Dental Health 13: 22–26

Lindsay S J E, Hodgkins J F W 1983 Children's perceptions of their own malocclusions. British Journal of Orthodontics 10: 13–20

Locker D 1988 Measuring oral health: a conceptual framework. Community Dental Health 5: 3–18

Medina A S, Wallace H M, Ralph N, Goldstein H 1982 Adolescent health in Alameda County. Journal of Adolescent Healthcare 2: 175–182

Nicoll A, Basset K, Ulijaszek S J 1986 What's in a name? Accuracy of using surnames and forenames in ascribing Asian ethnic identity in English populations. Journal of Epidemiology and Community Dental Health 40: 364–368

O'Brien K D, 1991 Orthodontic interactions: the relationships between the orthodontic services of England and Wales. British Journal of Orthodontics 18: 91–98

O'Mullane D M, Robinson M E 1977 The distribution of dentists and uptake of dental treatment by schoolchildren in England. Community Dental and Oral Epidemiology 5: 156–159

Phillips C, Tulloch C, Dann T V 1992 Rating of facial attractiveness. Community Dentistry and Oral Epidemiology 20: 214–220

Roberts E E, Beales J G, Dixon L, Willcocks A J, Willmot D 1989 Variations in the perceived need for orthodontic treatment in a sample of 14-year-old children in North Derbyshire. Community Dental Health 6: 349–356

Shaw W C 1981 Factors influencing the desire for orthodontic treatment. European Journal of Orthodontics 3: 151–162

Shaw W C, Lewis H G, Robertson N R E 1975 Perception of malocclusion. British Dental Journal 138: 211–216

Shaw W C, Meek S C, Jones D S 1980 Nicknames, teasing, harassment and the salience of dental features among school children. British Journal of Orthodontics 7: 75–80

Sheiham A, Maizels J E, Cushing A M 1982 The concept of need in dental care. International Dental Journal 32: 265–269

Slade G D, Spencer A J 1994 Development and evaluation of the oral health impact profile. Community Dental Health 11: 3–11

Strauss R P 1997 The dental impact profile. In: Slade G D (ed.) Measuring oral health quality of life. Department of Dental Ecology, School of Dentistry, University of North Carolina, pp. 81–91

Townsend P 1987 Deprivation. Journal of Social Policy 16: 125–146

Tulloch J F C, Shaw W C, Smith A, Jones G, Jones M 1984 A comparison of attitudes towards orthodontic treatment in British and American communities. American Journal of Orthodontics 85: 253–259

United Kingdom Census 1991 Ethnic group and country of birth. Office of Population Census & Surveys. HMSO, London, UK

Woon K C 1988 Mixed dentition occlusion in 3 ethnic groups. International Journal of Orthodontics 26: 16–19

Woon K C, Thong Y L, Abdul Kadir R 1989 Permanent dentition occlusion in Chinese, Indian and Malay groups in Malaysia. Australian Orthodontic Journal 11: 45–48