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Malocclusion and orthodontic treatment need measured by the Dental Aesthetic Index and its association with dental caries in Indian schoolchildren

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Objective: To assess prevalence of malocclusion and orthodontic treatment needs among 12 year old Indians using the Dental Aesthetic Index, and to find its association with dental caries. ***Method:*** 927 schoolchildren were randomly selected and their DAI and dentition status scores were recorded as per 1997 World Health Organization criteria. Clinical exams were carried out by one trained and calibrated examiner. The Chi–square test, Z-test and Spearman's correlation test were carried out. ***Results:*** Mean DAI score was 19.2 (sd 6.8). Differences were found between male and female DAI scores ($Z \leq 0.05$). 82% of children had DAI scores <26 with no or minor malocclusion requiring no or little treatment, 3.2 % had DAI scores 31-35 with severe malocclusion requiring highly desirable treatment and 1.8% DAI scores >35 with handicapping malocclusion requiring mandatory treatment. A mean DMFT of 1.15 (sd1.62) was recorded. Severe and handicapping malocclusions were associated with dental caries. ***Conclusions:*** The distribution of DAI scores among Indian schoolchildren differs from that reported in other populations. Positive correlation was found between severe and handicapping malocclusion with dental caries.

Key words: *malocclusion, DAI, dental aesthetic index, treatment needs, school children, dental caries*

Introduction

In recent years, much attention has been focused on measuring the severity and prevalence of malocclusion and orthodontic treatment need worldwide. The demand for orthodontic treatment is increasing in most countries. To assess the resources required to meet this demand and rationally plan for their provision requires population-level data. Moreover, the expanded opportunities for orthodontic treatment demand more careful individual evaluation of treatment needs and standardised criteria for their assessment.

Gray and Demirjian (1977) claimed that the most reliable assessments of malocclusion are made in the permanent dentition so avoiding the problems of assessment associated with dental development. In practice many recommendations for treatment are made before completion of the mixed dentition phase. Some may be unjustified as studies suggest that, during adolescence, certain features of malocclusion, including overjet, can change sufficiently to reduce recommendations for treatment (Tarvit and Freer 1998).

A variety of occlusal indices have been developed to categorise the treatment of malocclusion in groups according to urgency and treatment need. Aesthetic and functional criteria are major indications orthodontic treatment need. Dental appearance that deviates from social norms may have a negative impact on the patient's social and psychological wellbeing. The Dental Aesthetic Index, DAI, (Cons *et al.,* (1986), links clinical and aesthetic components of occlusion, including patient perception, mathematically to produce a single score. DAI has demonstrated reliability and validity and compares favorably with other indices being more versatile, quicker and simpler to use (Poonacha *et al*., 2010). This index can be used for different communities and populations without modification. However, DAI does not measure some occlusal traits such as crossbite therefore is not a complete measure of malocclusion.

The prevalence of malocclusion varies by region, age and gender, e.g. between 20 and 43% in Indian populations (Sureshbabu *et al*., 2005; Shivakumar *et al*., 2009), and orthodontic treatment needs range from 15% in English 12-14 year-olds (Alkhatib *et al*., 2005) to 71% in Jordanian 15 year-old. (Nobile *et al*., 2007)

Few studies appraised the prevalence and assessment of malocclusion status in India and even fewer have associated these scores with dental caries. Therefore the aim of the present study was to assess the prevalence of malocclusion and orthodontic treatment need among Indian 12-year-olds using the Dental Aesthetic Index and also to find its association with dental caries.

Method

The study took place from March to November 2007. A cluster sample was selected from a list of schools and their enrolment strengths obtained from the Udupi district

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Board Development Office. All 945 12-year-olds at 14 randomly selected junior-high schools in Udupi district, South India, were approached.

A pilot study was conducted to assess the feasibility of the study and indicated a minimum sample size of 818 children was required. However, all the children aged 12 years in the selected 14 schools were invited to participate in the study. The malocclusion was recorded according to the components of DAI as described by the World Health Organization (WHO, 1997) by using Community Periodontal Index (CPI) probe, mouth mirror and ruler; no radiographs were taken. Dental caries was recorded using DMFT index. Each subject was examined by an experienced specialist in public health dentistry and scored for the 10 components of the DAI according to the standard conventions (Cons *et al*., 1986). Distance was measured in whole millimeters using WHO periodontal probes. The examiner used gloves and mask throughout the clinical examinations. Children requiring immediate care were referred to the Manipal College of Dental Sciences or to the nearest dental hospital. A schedule was prepared for data collection from 20–25 children examined per day at school during class hours in a predetermined order. Intra-examiner variability was checked through a duplicate examination of 10% of the sample (95 subjects). Intra-examiner reliability scored 0.82 using the kappa statistic.

Ethical clearance was obtained from the Kasturba Hospital Ethics Committee, Kasturba Hospital, Manipal. Before the start of the survey, written informed consent to examine school children was obtained from the Directorate of Education, Udupi district, South India; the heads of the concerned schools; and the children's parents.

Data were transferred from pre-coded form to a computer and the χ^2 test used to compare severity of malocclusion, the Z-test for comparing mean DAI scores between genders and Spearman's correlation test used to measure correlation. Statistical significance was set at 0.05 and analysed using SPSS v13.

Results

Of the 945 children approached, 927 were examined, 482 (52%) were males and 455 (48%) females. The mean DAI score was 19.2 (sd 6.8) though there were differences by gender ($Z \leq 0.05$; Table 1). The most prevalent occlusal status was Class I malocclusion. 18% schoolchildren were in need of orthodontic treatment for dental health reasons.

Some 82% children had DAI scores under 26 with no abnormality or minor malocclusion requiring no or little treatment, 13% had DAI scores 26-30 with definite malocclusion and elective treatment need, 3.2% had DAI scores 31-35 with severe malocclusion and highly desirable treatment need and 1.8% had DAI scores over 35 with very severe or handicapping malocclusion requiring mandatory treatment.

Table 2 shows the distribution of DAI components with the only significant difference being males having a greater DAI score than females with respect to midline diastema ($p=0.034$).

Some 467 children (50.4%) had one or more decayed teeth, 41.4% had a DMFT>3 with the overall mean DMFT being 1.15 (sd 1.62). Just 13 (1.4%) had missing teeth and the same number, filled teeth. Positive correlation (association) was found between dental caries and both severe and handicapping malocclusions ($r=0.614$, $p \leq 0.05$ and $r=0.889$, $p \leq 0.01$; Table 3). There were no gender differences noted with respect to caries or correlation between DAI scores and DMFT values.

Discussion

The results of this study are evaluated bearing in mind the limited access to appropriate treatment of malocclusions the Indian public health services provide for the low-income population. Currently only the universities possess the resources, albeit limited ones, to provide prevention and treatment of the problem. Thus the execution of epidemiologic studies and dissemination of data such in the present study, in addition to identifying the prevalence and seriousness of the problem in the population, seeks to encourage the inclusion of an orthodontic focus in the Indian public health services.

This study using DAI found an 18% prevalence of malocclusion in children in Udupi district, South India, with Class I malocclusion being the most prevalent. Other studies in India reveal a higher prevalence of malocclusion in children (Dental Council of India, 2002-2003; Sureshbabu *et al*., 2005). It is difficult to compare their findings, because of the varying methods and indices used to assess and record occlusal relationships and complications arising from other variables including age of the study populations, examiner subjectivity, specific objectives and differing sample sizes. Further, DAI's failure

Table 1. Gender distribution of Dental Aesthetic Index scores

	Children		*Dental Aesthetic Index (DAI) score bands*								*DAI*	
			<26		*26-30*		*31–35*		*>35*			
Gender	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*	*mean*	*sd*
Male	482	(52)	378	(78.4)	76	(15.8)	16	(3.3)	12	(2.5)	19.8	(7.2)
Female	445	(48)	382	(85.9)	43	(9.7)	14	(3.2)	5	(1.2)	18.6	(6.1)
All	927	(100)	760	(82.0)	120	(12.9)	30	(3.2)	17	(1.8)	19.2	(6.8)

p=0.48, Mean DAI, Z=0.04

Table 2. Distribution of Dental Aesthetic Index components

DAI components	*Males n (%)*	*Females n (%)*	*Total n (%)*	*p value*
Missing anterior teeth				
0	473 (98.1)	441 (99.1)	914 (98.6)	0.81
1-3	9 (1.9)	4 (0.9)	13 (1.4)	
Incisal segment crowding				
0	274 (56.8)	232 (52.1)	506 (54.6)	0.63
1-3	208 (43.2)	213 (47.9)	421 (45.4)	
Incisal segment spacing				
0	432 (89.6)	402 (90.3)	834 (90)	0.49
1-3	50 (10.4)	43 (9.7)	93 (10)	
Midline Diastema				
0	454 (94.1)	382 (85.8)	836 (90.2)	**0.03**
1-3	28 (5.9)	63 (14.2)	91 (9.8)	
Maxillary anterior irregularity				
0-1mm	347 (76.7)	359 (80.7)	706 (76.2)	0.53
>1mm	135 (23.3)	86 (19.3)	221 (23.8)	
Mandibular anterior irregularity				
0-1mm	412 (85.5)	396 (88.9)	808 (87.2)	0.47
>1mm	70 (14.5)	49 (11.1)	119 (12.8)	
Maxillary overjet				
0-2mm	403 (83.7)	416 (97.9)	819 (88.3)	0.51
>2mm	79 (16.3)	29 (2.1)	108 (11.7)	
Mandibular overjet				
0-2mm	471 (97.8)	436 (97.9)	907 (97.8)	0.74
>2mm	11 (2.2)	9 (2.1)	20 (2.1)	
Anterior openbite				
0mm	469 (97.3)	440 (98.9)	911 (98.2)	0.61
≥1mm	13 (2.7)	5 (1.1)	16 (1.8)	
Antero-posterior molar relation				
Normal	432 (89.6)	419 (94.1)	851 (91.8)	0.27
Half cusp deviation	31 (6.4)	18 (4.0)	49 (5.3)	
Full cusp deviation	19 (4.0)	8 (1.9)	27 (2.9)	

Table 3. Association between DAI scores and DMFT value

Variables	*Correlation coefficient*	*p value*
<26 DAI - DMFT	0.026	0.364
26-30 DAI - DMFT	0.012	0.485
31-35 - DMFT	0.614	**0.042**
>35 - DMFT	0.889	**<0.001**

to measure some occlusal traits, such as crossbite, makes it a partial measure of malocclusion and this has to be considered when measuring, recording, or quantifying orthodontic treatment need (Manzanera *et al*., 2010). Specifically for this study it could explain the lower prevalence of malocclusion. A low Kappa value of 0.82 for the intra-examiner reliability and examination by a dental public health rather than an orthodontic specialist are other potential limitations of the study.

Our study revealed differences between male and female DAI scores. The results are similar to those of Esa *et al*., 2001 who found in Malaysian aged 12-13 year-olds a positive association between the DAI scores and gender. However, these results are at variance with studies from other countries (Baca-Garcia et al., 2004; Frazão *et al.,* 2002; Otuyemi *et al.,* 1999; Pires *et al.,* 2001).

Gender differences were also noted with respect to diastema, being more common in females. Similar findings were reported by Shivakumar and colleagues (2009). Differences observed again could be attributed to genetic predisposition or variation in growth and facial skeleton development.

Indian Children in the present study had DAI scores lower than those reported in other populations. Most of the children analysed in this research (82%) had a dental appearance requiring no orthodontic treatment. Studies reporting no orthodontic treatment needs using DAI were reported from Spain, 58.6% (Baca-Garcia *et al.*, 2004), Malaysia, 62.4% (Esa *et al.*, 2001), Australia 63.4% (Estioko *et al.*, 1994), and Nigeria, 77.4% (Otuyemi *et al.*, 1999). Differences observed in DAI scores could again be attributed to genetic predisposition or variation in growth and facial skeleton development (Esa *et al.*, 2001; Katoh *et al.*, 1998).

A mean DMFT of 1.15 (sd 1.62) was recorded with a positive correlation between dental caries and both severe and handicapping malocclusions. Specifically, incisal segment crowding, maxillary overjet ≥4mm, and anterior open bite ≥1mm were correlated with dental caries. Similar findings were reported by Stahl and Grabowski (2004) though Helm. and Petersen (1989) found no relationship between malocclusion traits and caries prevalence among Danish adolescents.

The dearth of funds for public health services, particularly oral health, makes it necessary to restrict treatment to the most serious cases. Therefore priority should be offered to those with incapacitating malocclusions (5% of the schoolchildren analysed). However, India's current social, political and economic situation precludes optimism concerning the feasibility of a more comprehensive provision. Since there is no government hospital or clinic to provide such treatment, an orthodontic assessment centre is desirable.

Conclusion

Of Indian 12 year-olds, 18% were in need of orthodontic treatment for dental health reasons and their most prevalent occlusal status was Class I malocclusion. Males were more likely than females to have higher DAI scores. A mean DMFT of 1.15 (sd 1.62) was recorded with a positive association between dental caries and both severe and handicapping malocclusions.

This study also provides baseline data on the need for orthodontic treatment among Indian schoolchildren, which can inform the planning of public orthodontic and other dental services. In general, Indian schoolchildren were found to have better dental aesthetics than other populations. Certainly, emphasis should be laid on proper preventive and/or interceptive services to meet demands related to gross functional impairments.

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References

Alkhatib, M.N., Bedi, R., Foster, C. (2005): Ethnic variations in orthodontic treatment need in London schoolchildren. *BMC Oral Health* **5**, 8.

Baca-Garcia, A., Bravo, M., Baca, P., Baca, A. and Junco, P. (2004): Malocclusions and orthodontic treatment needs in a group of Spanish adolescents using the Dental Aesthetic Index. *International Dental Journal* **54**, 138-142.

Cons, N.C., Jenny, J. and Kohout, F.J. (1986). DAI: The Dental Aesthetic Index. Iowa City: College of Dentistry, University of Iowa.

Dental Council of India (2004): National oral health survey and fluoride mapping 2002-2003. India: Dental Council of India.

Esa, R., Razak, I.A. and Allister J.H. (2001): Epidemiology of malocclusion and orthodontic treatment need of 12-13-year-old Malaysian schoolchildren. *Community Dental Health* **18**, 31-36.

Estioko, L.J., Wright, F.A and Morgan M.V. (1994): Orthodontic treatment need of secondary schoolchildren in Heidelberg, Victoria: an epidemiologic study using the Dental Aesthetic Index. *Community Dental Health* **11**, 147-151.

Frazão, P., Narvai, P.C., Latorre, M.R. and Castellanos, R.A. (2002): [Malocclusion prevalence in the deciduous and permanent dentition of schoolchildren in the city of São Paulo, Brazil, 1996.] *Cadernos de Saúde Pública* **18**, 1197-1205.

Gray, A. and Demirjian, A. (1977): Indexing occlusions for public health programs. *American Journal of Orthodontics* **72**, 191-197.

Helm, S. and Petersen, P.E. (1989): Mandibular dysfunction in adulthood in relation to morphologic malocclusion at adolescence. *Acta Odontologica Scandinavica* **47**, 307-314.

Katoh, Y., Ansai, T., Takehara, T., Yamashita, Y., Miyazaki, H., Jenny, J. and Cons, N.C. (1998): A comparison of DAI scores and characteristics of occlusal traits in three ethnic groups of Asian origin. *International Dental Journal* 48, 405-411.

Manzanera, D., Montiel-Company, J.M., Almerich-Silla, J.M. and Gandía, J.L. (2010): Diagnostic agreement in the assessment of orthodontic treatment need using the Dental Aesthetic Index and the Index of Orthodontic Treatment Need. *European Journal of Orthodontics* **32**, 193-198.

Nobile, C.G., Pavia, M., Fortunato. L. and Angelillo I.F. (2007): Prevalence and factors related to malocclusion and orthodontic treatment need in children and adolescents in Italy. *European Journal of Public Health* **17**, 637-641.

Otuyemi, O.D., Ogunyinka, A., Dosumu, O., Cons, N.C. and Jenny, J. (1999): Malocclusion and orthodontic treatment need of secondary school students in Nigeria according to the Dental Aesthetic Index (DAI). *International Dental Journal* **49**, 203-210.

Pires, D.M., Rocha, M.C., and Cangussu, M.C. (2001): [Prevalence of malocclusion in mixed dentition in schoolchildren - Salvador-BA]. *Revista Brasileira de Odontologia* **58**, 414-417.

Poonacha, K.S., Deshpande, S.D., Shigli A.L. (2010): Dental aesthetic index: Applicability in Indian population: A retrospective study. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, **28**:13-17.

Shivakumar, K.M., Chandu, G.N. and Reddy, S. (2009): Prevalence of malocclusion and orthodontic treatment needs among middle and high school children of Davangere city, India by using Dental Aesthetic Index. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, **27**, 211-218.

Stahl, F. and Grabowski, R. (2004): Malocclusion and caries prevalence: is there a connection in the primary and mixed dentitions? *Clinical Oral Investigations* **8**, 86-90.

Sureshbabu, A.M., Chandu, G.N. and Shafiulla, M.D. (2005): Prevalence of malocclusion and orthodontic treatment needs among 13 -15 year old school going children of Davangere city, Karnataka, India. *Journal of Indian Association of Public Health Dentistry* **6,** 32-35.

Tarvit, D. and Freer, T. (1998) Assessing Malocclusion—the Time Factor. *British Journal of Orthodontics* **25**, 31-34.

World Health Organization (1997): *Oral health surveys – Basic methods, 4th ed*. Geneva: World Health Organization.