A study of malocclusion and orthodontic treatment needs according to dental aesthetic index among school children of a hilly state of India

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Abstract

Background: The documentation of magnitude of malocclusion in terms of prevalence and severity has not been done till date in Himachal Pradesh, India. **Aims:** To assess the prevalence of malocclusion and orthodontic treatment needs (OTNs) among 9-and 12-year-old school children by using the Dental Aesthetic Index (DAI) in the state. **Materials and Methods:** A cross-sectional study was conducted among 1188 children from randomly selected schools. The survey was done according to the Oral Health Assessment Form (modified). DAI was used to assess the severity of malocclusion, along with collection of demographic data. **Results:** The overall prevalence of malocclusion was 12.5% and required orthodontic treatment, whereas 87.5% did not require treatment. A severe malocclusion for which treatment was highly desirable was recorded in 3.1%; 8% had a definite malocclusion for which treatment was elective. Only about 1.3% had a handicapping malocclusion that needed mandatory treatment. Almost equal proportions of males and females were affected with malocclusion with the means 20 ± 4.6 and 19.9 ± 4.9, respectively ($P < 0.641$). The prevalence and severity of malocclusion was more in 12-year age group than in 9-year age group ($P = 0.002$**). There was an increase in the proportion of malocclusion among older children: In 12-year age group, 15.7% with mean 20.5 ± 5.1 and in 9-year-old children, 8.9% with the mean 19.3 ± 4.1 were in the need of orthodontic treatment. **Conclusion:** Severity and treatment needs, both are important factors in public health planning.

Key words: *Dental Aesthetic Index, malocclusion, orthodontic treatment needs, World Health Organization*

INTRODUCTION

There has been an increased concern about dental appearance during childhood and adolescence to an early adulthood. The public equates good dental appearance with success in many pursuits. In general, societal forces define the norms for acceptable, normal, and attractive physical appearance.[1] Fundamentally, the difficulties seen are due to the fact that malocclusion is not a disease but a morphological variation which may or may not be associated with pathological conditions.[2] Malocclusion can be defined as an occlusion in which there is a malrelationship between the arches in any of the planes or in which there are anomalies in tooth position, number, form, and developmental position of teeth beyond normal limits.[3] Genetic, environmental, or a combination of both factors, along with various local factors such as adverse or deleterious oral habits can cause malocclusion.[4]

Individuals with malocclusion might develop a feeling of shame about their dental appearance and may feel shy in social situations or lose career

opportunities.[5] Malocclusion also has a large impact on both individuals and society in terms of discomfort, quality of life, and social and functional limitations.[6,7] The prevalence of malocclusion varies from country to country and between different age and sex groups.[8] It has been shown to affect periodontal health, increase the prevalence of dental caries, and cause temporo-mandibular joint problems.[3]

The decision to pursue orthodontic treatment is influenced by the desire to look attractive, self-perception of dental appearance, self-esteem, gender, age, and peer-group norms.[9-11] The major benefits of orthodontic treatment include improvement of physical function, prevention of tissue damage, and correction of aesthetic components.[12] Considering these factors, the Dental Aesthetic Index (DAI), which is recommended by the World Health Organization (WHO) as a rapid and relatively simple method of assessing dento-facial anomalies, was developed.[13] The DAI is an orthodontic index that links clinical and aesthetic components mathematically to produce a single score. It also aims to predict the clinical judgments of orthodontists by separating handicapping and non-handicapping malocclusions.[14]

The DAI has been studied worldwide in several different populations over recent years, but it has been sparingly used to estimate the prevalence of malocclusion in India, especially in the state of Himachal Pradesh. The present study was therefore conducted to assess the severity of malocclusion and orthodontic treatment needs in 9- and 12-year-old school children of Himachal Pradesh, India.

MATERIALS AND METHODS

The present study was carried out in six districts out of a total 12 districts of Himachal Pradesh. The districts selected were: Chamba (North), Sirmour (South), Lahaul-Spiti (East), Una (West), Mandi (Central), and Shimla – the capital of Himachal Pradesh. This cross-sectional study was conducted amongst 9- and 12-year-old school children studying in various primary and middle schools of Himachal Pradesh. An approval from the concerned school authorities and informed consent from the parents or guardians of school children were obtained prior to the study. Students who had received or were undergoing orthodontic treatment, medically compromised children, handicapped children, and subjects not willing to participate were excluded from the study. Out of total 1188 school children, 650 (54.7%) were boys and 538 (45.3%) were

girls. Amongst 650 boys, 304 (25.6%) were in 9-year age group and 346 (29.8%) were in 12-year age group. Similarly amongst girls, out of 538, 260 (21.9%) were in 9-year age group and 278 (23.4%) in 12-year age group [Table 1].

All the study subjects were examined by a single examiner by using a mouth mirror and Community Periodontal Index probe. The clinical examination was done according to the DAI, which is rank-ordered on a continuous scale to assess severity levels in order to prioritize treatment need.[8] Each subject was examined and scored for the 10 components of the DAI and was multiplied by its corresponding regression coefficient using the rounded weights [Table 2]. The products were added, and summed with the regression constant to give the total DAI score. Each subject's DAI score was then placed along the dental aesthetic continuum to determine their percentile score [Table 3].

Data consisting of DAI components were recorded according to the WHO proforma a of Oral Health Survey; Basic Methods: 4th edition, 1997. Before starting the study, an ethical clearance was obtained from the ethical clearance committee of Himachal dental college, Sundernagar. The inter-examiner reliability was assessed and kappa statistics was applied ($\kappa = 0.71$). Statistical analysis was done by using Chi-square test (χ^2) to compare malocclusion prevalence between different groups. The "Z" test was used to compare the mean DAI scores between sex groups. A probability value of 0.05 or less was set as the significance level. The data were analyzed using the Statistical Package for Social Sciences (SPSS).

RESULTS

Table 4 shows the distribution of DAI components. Out of 1188 children examined, 1180 (99.3%) had no missing anterior teeth while 8 (0.7%) had one or more missing anterior teeth. Among 650 boys examined, 644 (99.07%) had no missing anterior teeth and 6 (0.9%) had one or more missing anterior teeth. Out of 538 girls examined, 536 (99.6%) had no missing anterior teeth and 2 (0.4%) had only one or more missing

Table 1: Demographic characteristics of the study population			
Age and sex wise distribution of study population			
Age in years	Male *n* (%)	Female *n* (%)	Total *n* (%)
9	304 (25.6)	260 (21.9)	564 (47.5)
12	346 (29.1)	278 (23.4)	624 (52.5)
Total	650 (54.7)	538 (45.3)	1188 (100)

Table 2: The components of the standard DAI regression equation and their actual and rounded regression coefficients (weights)		
DAI component	**Regression coefficient**	
Weight	**Actual weight**	**Rounded**
Number of missing visible teeth (incisors, canines and premolars in the maxillary and mandibular arches)	5.76	6
Crowding in the incisal segments: 0=no segment crowded; 1=1 segment crowded, 2=2 segment crowded	1.15	1
Spacing in incisal segments: 0=no spaced, 1=1 segment spaced, 2=2 segment spaced	1.31	1
Midline diastema in mm	3.13	3
Largest anterior irregularity on the maxilla in mm	1.34	1
Largest anterior irregularity on the mandible in mm	0.75	1
Anterior maxillary overjet in mm	1.62	2
Anterior mandibular overjet in mm	3.68	4
Vertical anterior open bite in mm	3.69	4
Antero-posterior molar relation: Largest deviation from normal either left or right: 0=normal, 1=half cusp either mesial or distal, 2=one full cusp or more, either mesial or distal	2.69	3
Constant	13.36	13
Total	DAI score	

DAI = Dental aesthetic index

Table 3: Malocclusion severity levels	
DAI score	**Severity levels**
≤25	Minor or no anomaly: No treatment need
26-30	Definite malocclusion: Elective treatment
31-35	Severe malocclusion: Highly desirable treatment
36-70	Handicapping malocclusion: Mandatory treatment

DAI = Dental aesthetic index

anterior teeth. This difference between boys and girls was not found to be statistically significant ($P = 0.247$). A total of 977 (82.2%) school children had no incisal segment crowding and 211 (17.8%) had one or two segment crowding. No statistically significant differences in anterior segment crowding were observed in the study group ($P = 0.406$).

A total of 1170 (98.5%) school children had no incisal segment spacing and 18 (1.5%) had one or two segment spacing. No statistically significant differences were observed when incisor segment spacing was compared between the males and females ($P = 0.307$). Similarly no statistically significant differences were observed in the occurrence of midline diastema, maxillary and mandibular anterior irregularity when the prevalence was compared between males and females [Table 4].

When the prevalence of an anterior maxillary and mandibular overjet was compared between the males and females, no statistically significant differences were observed ($P < 0.094$). Out of 1188 children examined, 757 (63.7%) had an anterior maxillary overjet of 0-2 mm and 431 (36.3%) had an overjet of >2 mm. In boys, 401 (61.7%) had an anterior

maxillary overjet of 0-2 mm and 249 (38.3%) had an overjet of >2 mm; in girls, 356 (66.2%) had an anterior maxillary overjet of 0-2 mm and 182 (33.8%) had an overjet of >2 mm. Also, 1173 (98.7%) had no mandibular overjet and 15 (1.3%) had a mandibular overjet of 1-2 mm.

Out of 1188 examined school children, 1178 (99.2%) had no anterior open bite and 10 (0.8%) had an anterior open bite of ≥1 mm. Of total 650 examined boys, 643 (98.9%) had no anterior open bite and 7 (1.1%) had an anterior open bite of 1-3 mm ($P < 0.329$, NS). Also, 1080 (90.9%) had normal molar relationship, 89 (7.5%) had half-cusp deviation, and 19 (1.6%) had full-cusp deviation ($P < 0.455$).

Table 5 depicts the prevalence of malocclusion and orthodontic treatment needs for all the age groups and both sexes combined. Out of 1188 school children, 1040 (87.5%) children had DAI scores ≤25 (no abnormality or little malocclusion requiring no or slight orthodontic treatment), 95 (8.0%) had DAI scores of 26-30 (definite malocclusion requiring elective orthodontic treatment), 37 (3.1%) had DAI scores of 31-35 (severe malocclusion requiring highly desirable orthodontic treatment), and 16 (1.3%) had DAI scores ≥36 (very severe or handicapping malocclusion requiring mandatory orthodontic treatment).

As depicted in Table 6, the distribution of DAI scores and orthodontic treatment needs according to age showed that there was an increase in the proportion of malocclusion in older children; 15.7% in the age group of 12 years with the mean 20.5 ± 5.1 and 8.9% in the age group of 9 years with the mean 19.3 ± 4.1 were in

Table 4: Distribution of DAI components

DAI component	Males n (%)	Females n (%)	Total n (%)	P value
Missing anterior teeth				
0	644 (99.07)	536 (99.6)	1180 (99.3)	P=0.247
>1	6 (0.9)	2 (0.4)	8 (0.7)	
Incisal segment crowding				
0	540 (83.1)	437 (81.2)	977 (82.2)	P=0.406
1-2	110 (16.9)	101 (18.8)	211 (17.8)	
Incisal segment spacing				
0	638 (98.1)	532 (98.9)	1170 (98.5)	P=0.307
1-2	12 (1.9)	6 (1.1)	18 (1.5)	
Midline diastema				
0	635 (97.7)	528 (98.1)	1163 (97.9)	P=0.595
1 to ≥3	15 (2.3)	10 (1.9)	25 (2.1)	
Max. ant. irregularity				
0	577 (88.8)	450 (83.6)	1027 (86.4)	P=0.010
>1	73 (11.2)	88 (16.4)	161 (13.6)	
Mandi. ant. irregularity				
0	561 (86.3)	459 (85.3)	1020 (85.9)	P=0.625
>1	89 (13.7)	79 (14.7)	168 (14.1)	
Max. overjet				
0-2	401 (61.7)	356 (66.2)	757 (63.7)	P=0.110
>2	249 (38.3)	182 (33.8)	431 (36.3)	
Mandi. overjet				
0	645 (99.2)	528 (98.1)	1173 (98.7)	P=0.094
≥1	5 (0.8)	10 (1.9)	15 (1.3)	
Ant. open bite				
0	643 (98.9)	535 (99.4)	1178 (99.2)	P=0.329
≥1	7 (1.1)	3 (0.6)	10 (0.8)	
Ant. post-molar relation				
Normal	590 (90.8)	490 (91.1)	1080 (90.9)	P=0.455
Half cusp deviation	47 (7.2)	42 (7.8)	89 (7.5)	
Full cusp deviation	13 (2.0)	6 (1.1)	19 (1.6)	

P<0.05 significant (S), P>0.05 not significant (NS), DAI = Dental aesthetic index

the need of orthodontic treatment. The difference was statistically significant ($P < 0.002$).

The prevalence and severity did not vary with gender much. The proportion of children suffering from malocclusion among males and their female counterparts were almost equal. These were 20 ± 4.6 and 19.9 ± 4.9 in males and female children, respectively, and the results were not statistically significant ($P < 0.64$) [Table 7].

DISCUSSION

Present study was first to be conducted on a large sample population of both rural and urban school children of Himachal Pradesh with aim of to evaluate the prevalence of severity malocclusion and compare the findings with other national and international studies to establish a baseline for comparison with future studies. The results of this study indicate that 87.5% of the school children were found with little or no malocclusion requiring no orthodontic treatment. This is quite high as compared to other studies conducted among 12-13-year-old Malaysian school children (62.6%)[15] and 12-18-year-old Nigerian secondary school children (77.4%).[16]

The results were compared with the study conducted at Chennai where 37.5% of the study population was with definite to severe malocclusion, which is quite high as compared to the present study where the prevalence of definite to severe malocclusion was found to be only 11.1% (definite + severe) requiring treatment elective to highly desirable to be based on the decision points along the DAI scale. Similarly, 1.3% of the children were found with handicapping malocclusion which is also quite low as compared to 6.2% of children with handicapping malocclusion (Joseph John *et al.*).[14]

Prevalence of crowding, spacing, and diastema was found to be 17.8%, 1.5%, and 2.1%, respectively. The findings were very low when compared to previous studies where the prevalence of crowding, spacing, and diastema was found to be 76.2%, 26.6%, and 14.2%, respectively.[12,14] When comparing the mean DAI score with other populations from different countries, it was found that Spanish,[17] Native Americans,[18] Australians,[19] and Japanese[20] showed higher mean scores.

Large differences between the mean DAI scores of Himachal Pradesh school children and populations in other studies may be due to racial and genetic variation [Table 8]. Also, the differences may be due to different sample sizes and/or ages ranges. Nevertheless, the DAI is not exempt from drawbacks: It fails to detect certain occlusal disorders that may have major aesthetic impact, such as deep bites or posterior cross-bites, and it takes no account of the shape, size, or color of teeth and gums.

CONCLUSION

This study demonstrated that 1040 (87.5%) out of 1188 school children had little or no malocclusion requiring no or little orthodontic treatment. A total of 95 (8.0%) school children had definite malocclusion requiring definite orthodontic treatment. The need to implement preventive and interceptive orthodontic care is of utmost importance, thereby improving the aesthetic perception and social function.

Table 5: Prevalence of malocclusion and orthodontic treatment needs

No. of children affected *n* (%)	DAI score	Severity of malocclusion	Treatment needs
1040 (87.5)	≤25	No abnormality or minor malocclusion	No or slight need
95 (8.0)	26–30	Definite malocclusion	Elective
37 (3.1)	31–35	Severe malocclusion	Highly desirable
16 (1.3)	≥36	Very severe of handicapping	Mandatory

DAI = Dental aesthetic index

Table 6: Distribution of DAI scores and orthodontic treatment needs according to age

Age in years	No. of children No (%)	DAI scores				
		≤25 *n* (%)	26–30 *n* (%)	31–35 *n* (%)	≥36 *n* (%)	Mean±SD
9	564 (47.5)	514 (91.1)	35 (6.2)	12 (2.1)	03 (0.5)	19.3±4.1
12	624 (52.5)	526 (84.3)	60 (9.6)	25 (4.0)	13 (2.1)	20.5±5.1
Total	1188 (100)	1040 (87.5)	95 (8.0)	37 (3.1)	16 (1.3)	19.9±4.7

P = 0.002 (significant), DAI = Dental aesthetic index

Table 7: Gender wise distribution of DAI scores orthodontic treatment

Sex	No. of children No %	DAI scores				
		≤25 *n* (%)	26–30 *n* (%)	31–35 *n* (%)	≥36 *n* (%)	Mean±SD
Male	650 (54.7)	573 (48.2)	46 (3.9)	23 (1.9)	8 (0.7)	20±4.6
Female	538 (45.3)	467 (39.3)	49 (4.1)	14 (1.2)	8 (0.8)	19.9±4.9
Total	1188 100)	1040 (87.5)	95 (8.0)	37 (3.1)	16 (1.3)	19.9±4.7

P<0.641 (non-significant), DAI = Dental Aesthetic Index

Table 8: Mean dental aesthetic index score for other populations and Himachal Pradesh school children

Population (reference)	Sample size	Age range	Mean DAI score
Caucasian Americans[18]	1337	7–12	26.5
Native Americans[18]	485	7–12	31.8
Caucasian (S. Australia)[19]	5000	13	28.8
Australian[20]	309	10	26.6
Caucasian Australians[19]	268	12–16	24.1
Poles (lodz)[21]	1000	12–13	24.5
Malaysian[15]	1512	12–13	24.6
S. Africa[22]	5744	12	16.8
New Zealand[17]	150	13	26.7
Iranians[23]	900	12–15	23.5
Nigerian[16]	703	12–18	22.3
Indian (Chennai)[14]	613	12	25.56
Indians (Himachal; hill population) present study	1188	9 and 12	19.9

DAI = Dental aesthetic index

Malocclusion is not a single entity but rather a collection of situations, each in itself constituting a problem, and any of these situations can be complicated by a multitude of genetic and environmental causes.

The DAI is a relatively simple, reproducible, and valid index that can be used as a practical tool by epidemiologists and other dental personnel for screening children for orthodontic treatment need and also to assess the prevalence of malocclusion categories.

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