

To assess the prevalence of severity of malocclusion and orthodontic treatment needs using Dental aesthetic index (DAI) in 7-9 years old school children in Lucknow city

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Abstract.

Background: Malocclusion is not an acute condition, and therefore, treatment of malocclusion has been associated with a great degree of subjectivity and distorted perceptions of treatment need. Malocclusion may lead to such deviations and if left untreated may lead to various health problems like difficulty in speech, difficulty in eating and swallowing, hampered esthetics and psychological distress

Materials and Methods: The total sample comprised of 1598 subjects (47.1% males and 52.9% females), aged from 7-9 years. Clinical examination was made according to the Dental Aesthetic Index (DAI). Chi-square test was used find the relationship between malocclusion with different independent variables

Results: According to DAI, 84.7% of children had ≤ 25 DAI scores which required slight or no orthodontic treatment. 10.5% had a DAI score of 26-30 indicating definite malocclusion and elective treatment need. 3.2% had the DAI score of 31-35, indicating severe malocclusion and need for highly desirable treatment. 1.7% had DAI score ≥ 35 representing very severe/handicapping malocclusion requiring mandatory orthodontic treatment. The prevalence was greater among females than males

Conclusion: DAI is considered the most appropriate orthodontic treatment need index for conducting epidemiological studies in developing countries. It is useful in both epidemiological surveys to identify unmet need

for orthodontic treatment and as a screening device to determine priority for subsidized orthodontic treatment.

Key Word: Dental Aesthetic Index, Malocclusion,

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I. Introduction

Malocclusions and dental deformities mainly affect aesthetics and function. Dental aesthetics is an important element of facial appearance, poor dental appearance such as severe crowding in anterior teeth or a midline diastema, might negatively influence the general dentofacial appearance.¹

According to **Shenoy et al, (2014)** malocclusion affects oral health by leading to an increased prevalence of dental caries and can cause gingival inflammation and temporomandibular joint disorders.² Moreover, the self-perceived level of the attractiveness or “positive” feelings toward the dentofacial region is a more important factor contributing to self-concept in preadolescents and adolescents than the self-perceived severity of the malocclusion alone.¹

Malocclusion has not been so rigorously scrutinize because pain and miseries are seldom acute. It has a large impact on individual and society in terms of discomfort, quality of life, social and functional limitations.³ Malocclusions are third in the ranking of priorities among the problems of dental public health worldwide, surpassed only by dental cavity and periodontal diseases.⁴

Several indices have been developed to allow categorization of malocclusion according to the level of treatment need by different researchers.⁵ Number of recognized indices, validated by various international associations are available to determine treatment need objectively.⁶ These include Grainger’s Treatment Priority Index (TPI), Salmaz’s Handicapping Malocclusion Assessment, the Dental Aesthetic Index (DAI), Summer’s the Occlusal Index (OI), The Index of Complexity, Outcome and Need (ICON), Index of Orthodontic Treatment Need (IOTN) and The Peer Assessment Rating (PAR).⁵ Till date, various indexes are used to identify the need for orthodontic treatment each having advantages as well as disadvantages. To overcome the disadvantages of continual indices used, Dental Aesthetic Index (DAI) has been introduced by World Health Organization in (1977) for determining the need for orthodontic treatments.⁵⁴

DAI is a simple, globally accepted index which is used in epidemiological studies to determine the individual's need for treatment.⁷ This index is more versatile, time saving and simple to use. It links clinical and aesthetic components mathematically and it identifies deviant occlusal traits and mathematically derives a single score.^{5,8} It has four stages of malocclusion severity: a score lower than or equal to 25 (no or slight treatment need), a score between 26-30 (elective treatment), a score between 31 and 35 (treatment highly desirable) and a score greater than 36 (treatment mandatory).^{9,1} Few studies have been conducted to know the prevalence of severity of malocclusion and orthodontic treatment needs using Dental Aesthetic Index in Lucknow population.

Hence, the present study have been taken up to assess the prevalence of malocclusion and orthodontic treatment needs using Dental Aesthetic Index (DAI) among school children in Lucknow city.

II. Material And Methods

A cross-sectional study was conducted in 1598 school children aged 7-9 years of both sexes in Department of Pedodontics and Preventive Dentistry, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow in collaboration with schools of Lucknow city.

Study Design: Prospective study

Study Location: The study was conducted in Department of Pedodontics and Preventive Dentistry, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow in collaboration with schools of Lucknow city.

Study Duration: 1 year.

Sample size: 1598 patients.

Subjects & selection method: The city was divided into four zones (North, South, East and West) and from each zone two schools were selected. 400 students from each zone were selected for the study. The study design, objectives, potential benefits and methodology was explained to the selected children.

Inclusion criteria:

1. Children who were willing to participate in the study.
2. All healthy ambulant children (boys and girls) residing in Lucknow, available during the day of the examination.
3. Children under the category of American Society of Anesthesiologists (ASA I) and American Society of Anesthesiologists (ASA II).

Exclusion criteria:

1. Children not willing to take part in the study.
2. Children with any handicapped conditions.
3. Children with any systemic disease.
4. Children who had orthodontic treatment, including those on interceptive orthodontics.

Procedure methodology

Before the commencement of survey, informed consent was taken from the concerned school authorities and parents were informed by the school authority. The study was reviewed by the Institutional Ethical Committee and clearance was obtained.

The examination for malocclusion was made according to the Dental Aesthetic Index (DAI) as described by WHO, Oral Health Survey, Basic Methods 1997 by using CPI probe and plane mouth mirror. To determine the overjet and overbite, William's probe was used. Each study subject was examined and scored for ten components as

illustrated in the DAI Index. The ten DAI components were: missing visible mandibular and maxillary incisor, canine and molar teeth (number of teeth); crowding in the incisal segment (number of crowded segments 0, 1 or 2); spacing in the incisal segment (number of spaced segments 0, 1 or 2); maxillary diastema (mm); largest maxillary anterior irregularity (mm); largest mandibular anterior irregularity (mm); anterior maxillary overjet (mm); anterior mandibular overjet (mm); vertical anterior open bite (mm); and antero-posterior molar relation (0 = normal, 1 = half cusp, 2 = full cusp). (Annexure 3) The rounded weights of each component was then multiplied by its corresponding regression coefficient to reach the DAI score. The product was then added and summed with the regression constant to give the final DAI score. The results were classified on the four grade scale proposed by Jenny and Cons (1996).

Statistical analysis

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. The values were represented in Number (%) and Mean \pm SD. Data comparison was done by chi square test.

III. Result

Table no 1: shows distribution of cases according to gender. A total of 1598 children, 752 (47.1%) were males and remaining 846 (52.9%) were females. Male to female ratio was 0.89:1.

Table no 1: Distribution of cases according to gender

SN	Gender	No. of children	%
1.	Male	752	47.1
2.	Female	846	52.9
	Total	1598	100

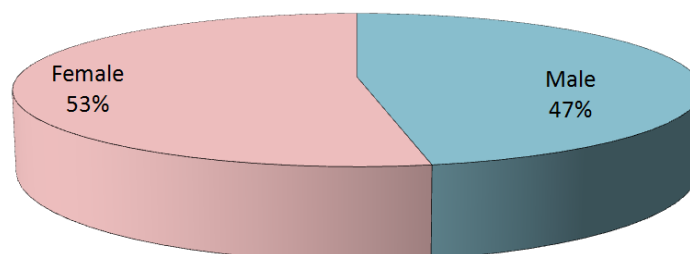


Table no 2: shows distribution of DAI components. Maxillary overjet was the most common finding in both the genders while missing anterior teeth >1, mandibular overjet >1 and anterior vertical openbite >1 was the least common finding. A statistically significant difference between two genders was observed for incisal segment spacing, midline diastema, largest anterior maxillary irregularity, largest anterior mandibular irregularity and mandibular overjet respectively.

Table no 2: Distribution of DAI Components

DAI Component	Males		Females		Total		Statistical significance	
	No.	%	No.	%	No.	%	χ^2	'p'
Missing anterior teeth								
0	741	98.5	841	99.4	1582	99.0	3.05	0.081
>1	11	1.5	5	0.6	16	1.0		
Incisal segment crowding								
0	637	84.7	737	87.1	1374	86.0	1.92	0.166
1-2	115	15.3	109	12.9	224	14.0		
Incisal segment spacing								
0	731	97.2	836	98.8	1567	98.1	5.43	0.020
1-2	21	2.8	10	1.2	31	1.9		
Midline diastema								
0	723	96.1	834	98.6	1557	97.4	9.47	0.002
1 to ≥ 3	29	3.9	12	1.4	41	2.6		
Largest anterior maxillary irregularity				0.0				
0	673	89.5	724	85.6	1397	87.4	5.55	0.018
>1	79	10.5	122	14.4	201	12.6		
Largest anterior mandibular irregularity				0.0				
0	592	78.7	760	90.9	1352	84.6	37.7	<0.001
>1	160	21.3	86	9.1	246	15.4		
Maxillary overjet								

0-2	380	50.5	666	78.7	1046	65.5	140.0	<0.001
>2	372	49.5	180	21.3	552	34.5		
Mandibular overjet								
0	741	98.5	826	97.6	1567	98.1	1.70	0.192
≥1	11	1.5	20	2.4	31	1.9		
Anterior vertical open bite								
0	741	98.5	839	99.2	1580	98.9	1.44	0.230
≥1	11	1.5	7	0.8	18	1.1		
Anterior-posterior molar relation								
Normal	686	91.2	789	93.3	1375	86.0	3.05	0.217
Half cusp deviation	49	6.5	46	5.4	95	5.9		
Full cusp deviation	17	2.3	11	1.3	28	1.8		

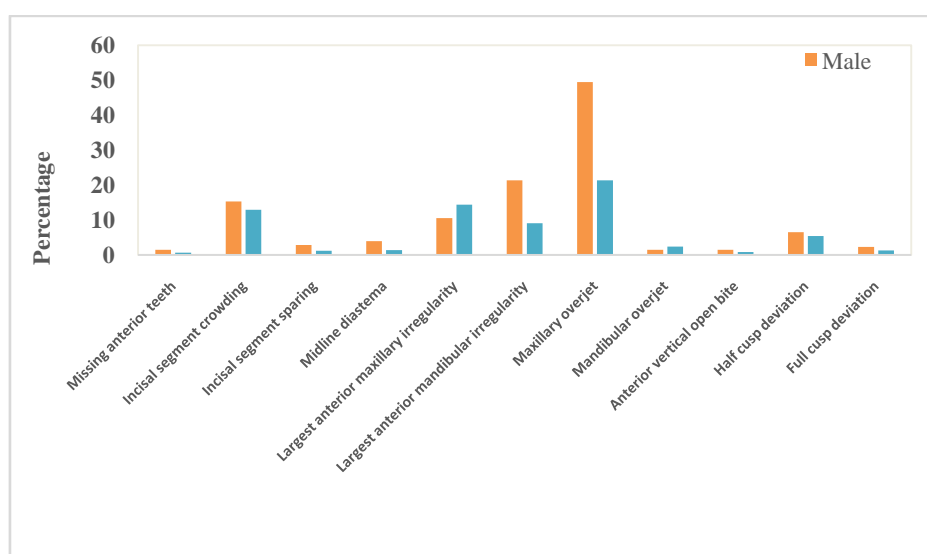


Table no 3: shows prevalence of malocclusion and orthodontic treatment needs. Majority (84.7%) had DAI score ≤ 25 thus indicating no abnormality or minor malocclusion. A total of 167 (10.5%) had DAI score in range 26-30, thus indicating definite malocclusion and correspondingly an elective treatment need. There were 51 (3.2%) who had DAI score 32-35 and indicated a condition of severe malocclusion requiring highly desirable treatment. Remaining 27 (1.7%) had DAI score ≥ 35 indicating very severe or handicapping occlusal status thus indicating mandatory treatment needs.

Table no 3: Prevalence of malocclusion and orthodontic treatment needs

No. of affected children (%)	DAI Score	Severity of malocclusion	Treatment needs
1353 (84.7%)	≤ 25	No abnormality or minor malocclusion	No treatment need
167 (10.5%)	26-30	Definite malocclusion	Elective
51 (3.2%)	32-35	Severe malocclusion	Highly desirable
27 (1.7%)	≥ 35	Very severe or handicapping	Mandatory

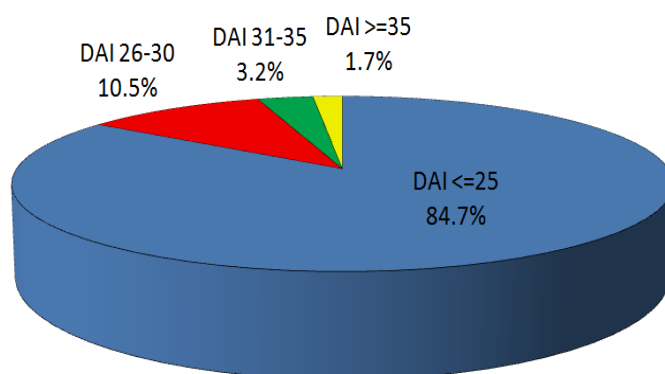
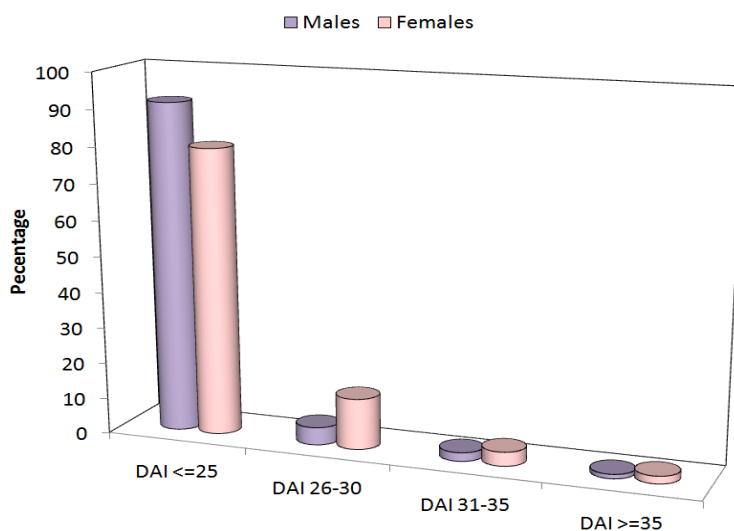


Table no4 shows gender wise distribution of DAI scores orthodontic treatment. In males, proportion of those with DAI scores ≤ 25 , 26-30, 31-35 and ≥ 36 was 91.5%, 4.9%, 2.4% and 1.2% whereas in females this proportion was 79.8%, 14.2%, 3.9% and 2.1% respectively. Statistically, this difference was significant ($p < 0.001$).

Table no4: Gender wise distribution of DAI scores orthodontic treatment

Gender	No. of children No. (%)	DAI Scores				Mean \pm SD
		≤ 25 No. (%)	26-30 No. (%)	31-35 No. (%)	≥ 36 No. (%)	
Male	752 (47.1%)	688 (91.5%)	37 (4.9%)	18 (2.4%)	9 (1.2%)	15.88 \pm 6.14
Female	846 (52.9%)	675 (79.8%)	120 (14.2%)	33 (3.9%)	18 (2.1%)	15.98 \pm 5.96
Total	1598 (100%)	1353 (84.7%)	167 (10.5%)	51 (3.2%)	27 (1.7%)	15.93 \pm 6.04

$\chi^2=46.0$ (df=3); $p < 0.001$



IV. Discussion

The Dental Aesthetic Index (DAI) has been frequently used for epidemiological data collection and assessment of orthodontic treatment need and it was integrated into the items of the International Collaboration Study of Oral Health Outcomes by the World Health Organization in 1989.¹⁰ However, the DAI criteria have never been used in Lucknow city before, although they have extensively been used in other parts of India. Therefore, the present study was designed to determine the prevalence of severity of malocclusion and orthodontic treatment needs among 7-9 years old school going children using DAI in Lucknow city.

According to the present study, the prevalence of malocclusion was 15.4%. The findings was in accordance to a study conducted by **Shivakumar et al. (2009)**, in which they reported the prevalence of

malocclusion to be 19.99%. The studies conducted by **Reddy et al. (2010)** and **Sharma et al. (2015)** found prevalence of malocclusion to be 43.7%, 33.1% respectively which was in contrast to our study.^{11,12,13}

Missing anterior teeth

In the present study 1.0% of the study population had one or more missing anterior teeth either in the maxilla or mandible. The results of the present study are in accordance with the study done by **Kumar et al. (2012)** and in contrast with study conducted by **Sanadhya et al. (2014)**.^{11,14}

Incisal segment crowding

The results of the present study for Incisal segment crowding was 14.0%. This was in accordance to **Kumar et al. (2012)** where 12.1% of children had incisal segment crowding. According to the study done by **Almeida et al. (2013)** prevalence rate of crowding was 69.8% which was very high and in contrast to the present study. The nature of the diet in human plays a vital role in the evolution of the form and function of the dentition and the whole masticatory mechanism. The consumption of soft and refined diet fails to produce the stimulus required for growth of both arches. This results in the lack of mesial migration of the teeth and ultimately a lack of space for accommodating all the teeth in the jaws which may predispose to crowding in the dental arches. In this study males had more crowding (15.3%) than females (12.9%) which agree with findings of the studies done by **Takahashi et al. (1995)**; **Johnson et al. (2000)** on Japanese and New Zealand population and **Kumar et al. (2010)** on Indian population.^{3,15,16,17,18}

Incisal segment spacing

Results of the present study inferred that incisal segment spacing either in one or both the arches was 1.9%. The prevalence observed by **Otuyemi et al. (1993)** and **Kumar et al. (2010)** was higher. This difference may be attributed due to parafunctional habits such as thumb sucking, mouth breathing, tongue thrusting, dento-alveolar discrepancies and jaw size discrepancies. In this study, spacing was more among males 2.8%, than females 1.2% which was in accordance with the study conducted by **Kumar et al. (2010)**.^{19,29}

Midline diastema

In the present study, 2.6% had midline diastema. Almost similar results was observed by **Chauhan et al. (2013)** in his study.²⁰

Largest anterior maxillary irregularity

Considering maxillary anterior irregularity ≥ 1 mm, results of the present study showed a prevalence of 12.6% which was similar to the studies done by **Kumar et al. (2012)** and **Rajmani et al. (2014)**. In contrast higher prevalence of 67.2% was observed by **Gupta et al. (2015)**.^{1,4,21}

Largest anterior mandibular irregularity

15.4% had ≥ 1 mm anterior mandibular irregularity. In the study done by **Sushanth et al. (2015)**, 18.1% of the study population had ≥ 1 mm anterior mandibular irregularity which was in favor to our study. According to the studies done by **Kumar et al. (2012)** and **Sanadhaya et al. (2014)**, prevalence was found to be 6.8% and 3.3%, respectively which was in contrast to our study. The difference could be due to the racial and genetic composition of the study groups.^{22,3,14}

Anterior maxillary overjet

The result of the study indicated that 34.5% population had ≥ 2 mm maxillary overjet which was in accordance to **Garbin et al. (2010)** who found 37.8% with ≥ 2 mm maxillary overjet. This result was in contrast to the study done by **Rwakatema et al. (2007)** where, 12% of the children had increased maxillary overjet.^{23,24}

Anterior mandibular overjet

The results of the present study showed a prevalence of 1.7% when considering mandibular overjet ≥ 1 mm. This observation was in agreement to the studies by **Kumar et al. (2012)** and **Chauhan et al. (2015)**. A study conducted by **Vellappally et al. (2014)**, 16.7% had anterior mandibular overjet ≥ 1 mm which was in contrast to our study. This could be attributed to genetic predisposition, variation in growth and disproportion in the dento-alveolar width of both arches.^{3,20,25}

Anterior vertical openbite

An anterior vertical openbite of ≥ 1 mm was seen in 1.1% of children. Similar results were observed by **Bernabe et al. (2006)**; **Rajmani et al. (2014)** and **Chauhan et al. (2015)**. The study by **Sanadhaya et al. (2014)** showed higher prevalence. This difference could be attributed to variation in development and maturation of the arches and children may had different deleterious oral habits such as mouth breathing, tongue thrusting and dento-alveolar discrepancies of the jaws.^{26,4,20,14}

Antero-posterior molar relationship

In the present study, 92.3% had normal antero-posterior molar relationship and 7.7% presented with antero-posterior molar discrepancies. A study conducted by **Kumar et al. (2012)** found 95.6% of the children with normal antero-posterior molar relationship and 4.4% with antero-posterior molar discrepancies which was almost similar to our study. On the contrary, according to **Tak et al. (2013)**, 86.1% of children had normal antero-posterior relationship of dental arches and 13.9% with antero-posterior molar discrepancies. The ancestral background of the various populations may have an effect on the prevalence of deviated anteroposterior molar relation. It may also be due to a premature loss or massive caries of deciduous teeth.^{3,27}

Results of the present study inferred a higher mean DAI score among females than in males. This finding was in accordance with studies by **Helms et al. (1970)** and **Jalili et al. (1993)** and was in contrast by **Khanehmasjedi et al. (2013)**, where significantly lower DAI in girls was found. The differences in the nutritional status, amount of food, and consistency of food consumed between males and females may again be the possible explanation for the higher prevalence of malocclusion among females. Traditionally, Indian females have poor nutritional status, less choice for selecting their food than males and also, they prefer food items which are softer and more refined than that consumed by males [**Barker et al. (2006)**]. It may also be attributed to the differences in the adverse habits such as mouth breathing, nail biting, tongue thrusting and thumb sucking etc.^{28,29,30,31}

The results of the present study inferred that 84.6% of the study population had the mean DAI score of ≤ 25 which required slight or no orthodontic treatment. This was in favour with studies by **Kumar et al. (2010)** and **Chauhan et al. (2015)** and was quite high as compared to other studies by **Esa et al. (2001)** and **Otuyemi et al. (1999)**. 10.5% of the study population had a DAI score of 26-30 indicating definite malocclusion and elective treatment need which was similar to **Sushanth et al. (2015)** and contrary to **Almeida et al. (2013)**. 3.2% had DAI score of 31-35, indicating severe malocclusion and treatment highly desirable need for treatment which was in accordance to **Kumar et al. (2010)**. A similar study done by **Onyeso et al. (2006)** found higher prevalence.^{29,23} 1.7% of study population had DAI score ≥ 35 representing very severe/handicapping malocclusion requiring mandatory orthodontic treatment. Similar results were found by **Sushanth et al. (2015)**. In contrast to this study a much higher occurrence was observed by **Otuyemi et al. (1996)**, **Johnson et al. (2000)** and **Chi et al. (2000)** respectively in their study. Large difference in the mean DAI scores of the above mentioned studies as compared to the present study may be due to racial variation, different sample size, genetic predisposition, differences in lifestyle and variations in growth and facial skeleton.^{18,20,32,19,22,15,33,34}

V. Conclusion

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. It had been developed as a screening tool for permanent dentitions, it might be unsuitable during the mixed dentition stage accompanied with changes in future dental appearance. However, it could be easily adapted for use in mixed dentition stage

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