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Assessment of Orthodontic Treatment Need in Mixed Dentition Period (11- 12 Years) Among School Children in Marathahalli, Bangalore

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Research Article

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ABSTRACT

Background: The demand for orthodontic treatment is increasing because of the high perception rates of malocclusions and greater attention to aesthetics. This stresses the need of epidemiological studies using malocclusion indices for objectively prioritizing orthodontic treatment need.

Aim: This study was undertaken to evaluate the orthodontic treatment need in mixed dentition (11-12 years) among school children of Marathahalli, located in Bangalore, India.

Material and methods: A representative sample of 447 school children aged 11-12 years was evaluated. The examination was carried out by a single trained calibrated examiner. The orthodontic treatment need was assessed using DHC of the IOTN and modified AC. Angles molar relationship for permanent molars was also assessed. The study followed WHO recommendations.

Results: The prevalence of children showing definitive orthodontic treatment need in the studied population according to DHC of IOTN and modified Aesthetic Component (AC) was 14.18% and 8.47% respectively with no gender predilection. Increased overjet was found to be the most prevalent occlusal trait (69.8%). Angle's Class I Molar Relation was found in 63.63% of the studied population.

Conclusion: The percentage of population with borderline treatment need according to modified aesthetic component was high (20.82%) indicating the increased sensitivity of the modified scale. The combined use of DHC of IOTN and modified AC can be effectively used for prioritizing orthodontic treatment needs in mixed dentition period for early institution of preventive and interceptive measures.

INTRODUCTION

Epidemiological studies of malocclusion and evaluation of orthodontic treatment need provides extensive data on the prevalence and severity of malocclusion in population groups [1-3]. In the past, considerable disagreements among investigators are reported especially regarding how much deviation from the ideal should be accepted within the bounds of normal [4]. For this reason, several quantitative systems of assessing malocclusion and evaluating treatment need have been recently developed especially in countries that have health services offering orthodontic treatment in order to rationalize their public expenditure [3]. The orthodontic treatment demand is reported to have notably increased because of the high perception rates of malocclusions and a greater attention to aesthetics [5].

The Orthodontic treatment need is reported to be assessed by considering the severity of malocclusion traits, age group and dentition period of the children to be treated so that interceptive treatment and timely referral can be carried out efficiently [6,7]. Interceptive orthodontic treatment regarding functional crossbite, maxillary canine eruption and excessive overjet and Class II malocclusion has been reported to reduce the phase two treatment [8].

This study was undertaken to determine the orthodontic treatment need in mixed dentition (11-12 years) among school

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children of Marathahalli, Bangalore, using the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN) and modified Aesthetic Component (AC). The results can be used to prioritize orthodontic treatment need among school children and provide baseline data for orthodontic treatment planning.

MATERIALS AND METHODS

A cross-sectional community based survey was carried out on a random sample of 447 school children in the age group of 11-12 years in the schools of Marathahalli, located in Bangalore, India. Six schools were randomly selected from the list of schools from different zones in Marathahalli region. An official permission for conducting the present study was obtained from the Head of the Schools. A written consent in this regard was obtained from parents/guardian of the children. Of the 447 children, ten students were excluded. Among the excluded students, two had developmental anomalies, five had fractured maxillary incisors, one was medically compromised and two had grossly decayed first permanent molars. A total of 437 students consisting of 231 males and 206 females who met the inclusion criteria were examined. The study followed WHO recommendations and employed Dental Health Component (DHC) of Index of Orthodontic Treatment Need (IOTN) and modified Aesthetic Component (AC). The clinical examination was performed by a single trained and calibrated examiner under natural day light at the respective schools with sufficient number of disposable mouth mirrors, probes and DHC ruler. Printed assessment forms were used with pictures of modified AC to match the aesthetic component and to record the data obtained from each child. No radiographs, study casts or previous written records of the children were used.

Molar relationship was documented according to the Angle's classification for permanent molars. This was recorded separately as this occlusal characteristic was not included in IOTN. The molar relationship was evaluated at a centric occlusal position which was achieved by asking the subject to swallow and then bite on his teeth together. The cheeks were fully retracted to obtain a direct lateral view of the dentition in occlusion on each side.

The Dental Health Component (DHC) of Index of Orthodontic Treatment Need (IOTN) given by Brook et al. was used to recognize the occlusal traits that can impair the function and affect the longetivity of the dentition **(Table 1)**. The dental health component (DHC) is based on five grades:

Grade 1 represents a negligible need for treatment

Grade 2 represents little need for treatment

Grade 3 represents borderline need for treatment

Grade 4 represents great need for treatment

Grade 5 represents very great need for treatment

The grading was assigned on the basis of the most severe trait which indicated the priority or need for treatment. The worst trait was recorded by using the hierarchical scale in descending order (Missing teeth, Overjet, Crossbite and Displacement of contact points and Overbite). The acronym "MOCDO" can be constructed from the first letter of each category.

Table 1. Dental health component (dhc) of index of orthodontic treatment need (iotn) [9,10].

Grade 1 (none)	Extremely minor malocclusions including displacements less than 1 mm.
Grade 2 (Little)	
2a	Increased overjet greater than 3.5 mm, but less than or equal to 6 mm with competent lips.
2b	Reverse overjet greater than 0 mm, but less than or equal to 1 mm.
2c	Anterior or posterior cross-bite with less than or equal to 1 mm discrepancy between retruded contact position and intercuspal position.
2d	Displacement of teeth greater than 1 mm, but less than or equal to 2 mm.
2e	Anterior or posterior open bite greater than 1 mm but less than or equal to 2 mm.
2f	Increased overbite greater than or equal to 3.5 mm without gingival contact.
2g	Prenormal or post-normal occlusions with no other anomalies. Included up to half a unit discrepancy.
Grade 3 (moderate)	
3a	Increased overjet greater than 3.5 mm, but less than or equal to 6 mm with incompetent lips.
3b	Reverse overjet greater than 1 mm, but less than or equal to 3.5 mm.
3c	Anterior or posterior cross-bites with greater than 1 mm, but less than or equal to 2 mm discrepancy between retruded contact position and intercuspal position.
3d	Displacement of teeth greater than 2 ram, but less than or equal to 4 mm.
3e	Lateral or anterior open bite greater than 2 mm, but less than or equal to 4 rnm.
3f	Increased and complete overbite without gingival or palatal trauma.
Grade 4 (great)	
4a	Increased overjet greater than 6 mm but less than or equal to 9 ram.

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4b	Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties.
4c	Anterior or posterior cross-bites with greater than 2 mm discrepancy between retruded contact position and intercuspal position.
4d	Severe displacements of teeth greater than 4 mm.
4e	Extreme lateral or anterior open bites greater than 4 mm.
4f	Increased and complete overbite with gingival or palatal trauma.
4h	Less extensive hypodontia requiring prerestorative orthodontics or orthodontic space closure to obviate the need for prosthesis.
41	Posterior lingual cross-bite with no functional occlusal contact in one or both buccal segments.
4m	Reverse overjet greater than 1 mm, but less than 3.5 mm with recorded masticatory and speech difficulties.
4t	Partially erupted teeth, tipped and impacted against adjacent teeth
Grade 5 (very great)	
5a	Increased overjet greater than 9 mm.
5h	Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring prerestorative orthodontics.
5i	Impeded eruption of teeth (with the exception of third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth and any pathological causes.
5m	Reverse overjet greater than 3.5 mm with reported maticatory and speech difficulties.
5p	Defects of cleft lip and palate.
5s	Submerged deciduous teeth.

Aesthetic Component (AC)

The Aesthetic Component (AC) was based on the modified aesthetic scale given by Khasim S et al. consisting of sixteen intraoral photographs illustrating varying degrees of dental attractiveness. A designated number (grade) was placed on lower left corner of each photograph, representing the level of orthodontic treatment need.

Grade 1 to 4 indicates no/slight need of treatment

Grade 5 to 7 indicates moderate need of treatment

Grade 8 to10 indicates the great need of treatment

The Aesthetic Component was rated in the normative manner by the examiner and was based on matching patient's dental appearance in front view with sixteen standardized photographs arranged from the most to least attractive dentition. The rating was allocated for overall dental appearance rather than specific morphological similarity to the photographs.

The obtained values were subjected to statistical analysis using Sysstat Software version 11. To test the relationship between DHC and AC Pearson chi-square test was performed. Gender wise difference in DHC and AC was analyzed using Mann-Whitney test. Correlation between DHC of IOTN and modified AC was analyzed using Spearman rank Correlation rank test. The level of significance was fixed at $p<0.05$.

RESULTS

The distribution of study population is given in **Table 2**. Angle's Class I molar relation was the most common molar relation and constituted 63.62% of the studied population. Angles Class II and Class III molar relation was found in 35.24% and 1.14% respectively **(Table 3)**. On the basis of DHC of IOTN, 27.69% of the studied population required no orthodontic treatment (DHC grade 1). Little treatment need was required in 33.18% students (DHC grade 2). Borderline treatment need was required in 24.97% students (DHC grade 3). Great need and very great need of orthodontic treatment was found in 11.21% and 2.97% respectively (DHC grade 4 and 5). The proportion of children who were professionally assessed as having an objective orthodontic treatment need obtained by combining DHC grades 3, 4, 5 was 39.1% **(Table 4)**.

Table 2. Descriptive statistics showing the age-wise and gender-wise distribution of study population.

Age Group (Years)	Gender				Combined	
	Female		Male			
	Count	%	Count	%	Count	%
11	102	47.4	113	52.6	215	49.2
12	104	46.8	118	53.2	222	50.8
Grand Total	206	47.14	231	52.86	437	

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Table 3. Descriptive statistics showing the prevalence of Angles Molar Relation in 11- 12 years old school children.

Angle's Molar Relation	Gender				Combined	
	Female		Male			
	Count	%	Count	%	Count	%
CLASS I	129	46.4	149	53.6	278	63.62
CLASS II	75	48.7	79	51.3	154	35.24
CLASS III	2	40	3	60	5	1.14
Grand Total	206	47.14	231	52.86	437	

Table 4. Descriptive statistics showing orthodontic treatment need according to the Dental Health Component (DHC) of Index of Orthodontic Treatment Need (IOTN).

Dental Health Component (DHC)	Female		Male		Total	
	N	%	N	%	N	%
No Treatment Need (Grade 1)	60	49.6	61	50.4	121	27.69
Slight Treatment Need (Grade – 2)	67	46.2	78	53.8	145	33.18
Borderline Treatment Need (Grade 3)	54	49.5	55	50.5	109	24.94
Great Treatment Need (Grade 4)	19	38.8	30	61.2	49	11.21
Very great Treatment Need (Grade 5)	6	46.2	7	53.8	13	2.97
Total	206	47.14	231	52.86	437	

The most prevalent occlusal trait is increased overjet which constitutes 69.9% of the studied population. This was followed by displaced contact points, crossbite and overbite and missing teeth in 15.10%, 6.86%, 2.75% and 0.46% respectively **(Table 5)**. According to the modified aesthetic component, 70.71% of the studied population required no orthodontic treatment need. Borderline orthodontic treatment need was required in 20.82% and 8.47% required definite orthodontic treatment need **(Table 6)**. The Spearman's rank correlation value between DHC and modified AC was 0.671 which suggests a positive correlation between the two components. Gender wise difference between DHC and modified AC analysed using Mann- Whitney test was not significant.

Table 5. Descriptive statistics showing the gender-wise prevalence of occlusal traits in the studied population.

Occlusal Traits	Gender			Combined	
	Female	Male			
	%	Count	%	Count	%
a (Overjet)	47.5	160	52.5	305	69.8
c (Crossbite)	30	21	70	30	6.9
d (Displaced Contact Points)	56.1	29	43.9	66	15.1
e (Open Bite)	50	3	50	6	1.4
f (Over bite)	33.3	8	66.7	12	2.7
h (Missing Teeth)	50	1	50	2	0.5
I (Impeded Erruption)	54.5	5	45.5	11	2.5
j (Posterior Lingual Crossbite)	50	1	50	2	0.5
x (Super numerary teeth)	0	3	100	3	0.7
Grand Total	47.1	231	52.9	437	

Table 6. Descriptive statistics showing the orthodontic treatment need according to the modified aesthetic component.

Modified Aesthetic Component	Gender				Combined	
	Female		Male			
	Count	%	Count	%	Count	%
No Treatment (Grade 1-4)	143	46.28	166	53.72	309	70.71
Borderline (5-7)	47	51.65	44	48.35	91	20.82
Definite Treatment (8-10)	16	43.24	21	56.76	37	8.47
Grand Total	206	47.14	231	52.86	437	

DISCUSSION

The present cross-sectional study has evaluated the need for orthodontic treatment in 11-12 year- old school children of

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Marathahalli, Bangalore using Dental Health Component (DHC) of Index of Orthodontic Treatment Need (IOTN) and modified Aesthetic Component (AC). Index of Orthodontic Treatment Need used for assessing the level of orthodontic treatment need consists of Dental Health Component (DHC) and Aesthetic Component (AC). Brook et al. [10-12]. Several studies report that as per the guidelines of Landis et al. the weighed kappa coefficient for DHC of IOTN is 0.79 indicating high intra examiner reliability [10]. DHC is reported to be a simple, quick and reproducible method of recording orthodontic treatment need [10,13]. It consists of a series of occlusal traits graded from 1 to 5 affecting the long-term dental health [3,10]. DHC can be applied directly to the subjects as well as to the dental casts. Its evaluation on dental casts is, however, reported to result in overestimation of the treatment need because certain malocclusion related complications such as incompetent lips, functional mandibular shifts, masticatory and speech difficulties are assumed to be present even though they may be clinically absent [14]. In the present investigation, instead of the conventional AC scale used by Brook et al. modified Aesthetic Component (AC) developed by Khasim et al. was used to assess the orthodontic treatment need on the aesthetic grounds. The modified Aesthetic Component consists of a series of sixteen photographs ranging from most to least attractive dentition and the patient's malocclusion is matched as closely as possible with one of the photographs [11]. The modified aesthetic scale in comparison to conventional AC scale was suggested to be a better epidemiological tool in assessing orthodontic treatment need because it includes malocclusions such as Class III with reverse overjet, anterior crossbite and anterior openbite [11].

The present study has revealed that matching the frontal dental profile of the children with the illustrated photographs of the modified aesthetic scale involves less effort. In contrast, several studies report that difficulties were encountered in matching due to the absence of similarity in the children's dental profile and the photograph of the conventional scale [9,11]. The aesthetic component in this study was assessed in a normative manner rather than self-evaluation by the children. Earlier studies reveal that children are less critical in their aesthetic judgments and their ratings are skewed towards the attractive end of the scale [15,16].

In studies on prevalence of malocclusion, a well-defined sample with no prior history of orthodontic treatment and objective data collection is reported to be essential [17]. The present study satisfies these requirements well. A total of 447 randomly selected students were examined, of which, ten students were excluded. The excluded students included six with fractured maxillary incisors, three with grossly decayed first permanent molars and one was medically compromised. The final sample comprised of 437 students (231 males and 206 females) in the age range of 11-12 years. The chronological age range of 11-12 years was also used to test the Index of Orthodontic Treatment Need (IOTN) by Brook et al. and aesthetic component scale was constructed using dental photographs of 12-year-old children by Evans et al. [11]. The self-correcting malocclusion gets resolved by this age and the overestimation of the orthodontic treatment need is avoided. DHC is known to be reliable between the age group of 11-19 years despite temporal changes in the separate occlusal traits that comprise the index [18]. The grading of DHC at the age of 11 years is likely to be similar when the patient reaches 19 years with the exception of posterior cross bites and displaced contact points that get worsened over time [18]. These reports validate the age range (11-12 years) of the sample selected for this study.

Malocclusion prevalence is reported to vary from 14.4% to 96.5% in Indian children [19,20] due to ethnic differences, limitations in sample selection, methodology and lack of uniform criteria in recording malocclusion and its traits [21]. The present study has revealed that Class I molar relation constituted 63.6% of the studied population which agrees with the findings of Mohandas U et al. [20]. (62%) but is lower than the findings of Siddegowda R et al. [21] (79.7%) which were conducted on a similar study population. The prevalence rates of Class II and Class III molar relation in this study were 35.2% and 1.14% respectively. A population of same origin can, however, show variability in distribution of different types of malocclusion [21].

In the present study, according to DHC, 60.87% of the studied population required no treatment (DHC grades 1-2), 24.94% had borderline treatment need (DHC grade 3) and 14.18% had definite treatment need (DHC grade 4 - 5). These results are similar to the findings of Al Jeshi A et al. [22] and Alkhatib et al. [23] who also report that 14.4% and 15% of the studied population require definite treatment. In contrast, Christophenson et al. [24], Hedayati Z et al. [25] and Mandall et al. [26] report that 17.2%, 18.3% and 18% of the children had definite treatment need whereas Otuyemi OD et al. [27] reported 12.6% of the studied population to be under definite treatment need category.

Brook et al. [10] found that DHC proportions in 333 school children of 11-12 years ago were 32.7% (great treatment need) and 35.1% (no/little treatment need). Burden and Holmes38 reported that 21-24% of the population were in the great need category when DHC was assessed for 1829 school children of 11-12 years age. Ucuncu [25] found that 38.8% among 500 Turkish students aged 11-14 years had great treatment need, 24.0% had moderate treatment need and 37.2% had no/slight treatment need. Birkland et al. [9] have reported that out of 359 students (11 year-old) examined, 53.2% had very great to moderate treatment need and 46.8% had little to no treatment need. Chaitra K et al. [14] have reported that based on DHC, 49.3% among 1000 school children aged 12-6 years in North Karnataka needed definite orthodontic treatment. In contrast to these reports, the present study shows that the proportion of children who were professionally assessed as having an objective orthodontic treatment need obtained by combining DHC grades 3, 4, 5 was 39.1%.

Modified AC scale in this study revealed that 70.7% of the population required no treatment (Grade 1-4), 20.82% was having moderate need (Grade 3) and 8.46% of the population had definite orthodontic treatment need (Grade 8-10). These results are similar to those obtained by Souames et al. [4] (7%), Nobile et al. [28] (8.6%), Otuyemi et al. [27] (7%), Mugonzibwa et al. [29] (11%)

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and Chaitra K et al. [10] (7.1%) and are less than those obtained by Fernandez NP et al. [30] (13.7%) and Abdullah et al. [31] (22.8%). The present study, however, showed that according to modified aesthetic component the percentage of population with borderline treatment need was 20.82% which is high than many of the published reports. This can be attributed to the fact that additional malocclusions included in the modified aesthetic scale increase the sensitivity of the scale [11]. The present study showed that the objective orthodontic treatment need on the basis of modified aesthetic component obtained by combining grade 3,4,5 was 29%.

Interrelation between DHC of IOTN and modified AC in the present study was calculated using Spearman's rank correlation test and the coefficient value was 0.671 which suggests a positive correlation between the two components. It has, however, been found that sometimes the children categorized as having treatment need according to DHC do not attract high aesthetic impairment score [25]. This includes children with occlusal traits such as ectopic teeth, deep traumatic overbite and cross bites. Similarly, children scored as needing treatment on aesthetic grounds e.g. generalized spacing may not have dental health implications [25]. The occlusal findings in this study indicated the highest prevalence for increased overjet (69.79%), followed by displaced contact points (15%) and dental crossbites (6.8%). These observations have public dental health implications because increased overjet, crowding and cross bite are the occlusal traits commonly associated with traumatic injuries, poor periodontal condition and gingival recession respectively [14]. A few studies show that increased overjet and inadequate lip coverage are important contributing factors for traumatic dental injuries and that reducing a large overjet is not only beneficial from an aesthetic stand point but it also minimizes the risk of trauma and long-term complications to the dentition [32-36]. In the present study, children identified as having overjet greater than 6 mm (DHC grade 4-5) were educated regarding the use of mouthgaurds especially while playing contact sports. No statistically significant differences in orthodontic treatment need between males and females were observed in this study which is in accordance with the earlier reports [37-41]. In contrast, increased orthodontic treatment need in the male gender has been reported by Al Jeshi A et al. [9] and Hedayati Z et al. [25].

CONCLUSION

The results of the present study reveal that 14.8% and 8.47% of population require definite orthodontic treatment need according to DHC of IOTN and modified AC with no gender predilection. The percentage of population with borderline treatment need according to modified aesthetic component was high (20.82%) indicating the increased sensitivity of the modified scale. The most prevalent occlusal trait was increased overjet (69.8%). Angle's Class I Molar Relation was the most common molar relation (63.63%). The combined use of DHC of IOTN and modified AC can be effectively used in epidemiological surveys for prioritizing orthodontic treatment needs in mixed dentition period.

REFERENCES

1. Hassan R and Rahiman AK. Occlusion, malocclusion and method of measurements – an overview. Archives of Orofac Sci. 2007;2:3-9.
2. Kharbanda OP. Orthodontics: Diagnosis and management of maloclussion and dentofacial deformities. Elsevier Publishers. 2010.
3. Bellot-Arcis C, et al. Orthodontic treatment need: An epidemiological approach. Orthodontics–Basic Aspects and Clinical considerations. 2012;1-28.
4. Souames M, et al. Orthodontic treatment need in French school children: An epidemiological study using the index of orthodontic treatment need. Eur J Orthod. 2006;28:605-609.
5. Perillo L, et al. Prevalence of orthodontic treatment need in Southern Italian school children. Eur J Orthod 2010;32:49-53.
6. Borzabadi-Farahani A. An insight into four orthodontic treatment need indices. Progress in Orthodontics. 2011;12:132-142.
7. Dias PF and Gleiser R. Orthodontic treatment need in a group of 9–12 year old Brazilian school children. Braz Oral Res. 2009;23:182-189.
8. Vakiparta MK, et al. Orthodontic treatment need from 8–12 years of age in an early treatment oriented public healthcare system: A prospective study. The Angle Orthodontist. 2005;73:344-349.
9. Birkland K, et al. Orthodontic concern among 11- year- old children and their parents compared with orthodontic treatment need assessed by Index of Orthodontic Treatment Need. Am J Orthod Dentofac Orthop.1996;110:197-205.
10. Brook PH and Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod. 1989;11:309-320.
11. Khasim S, et al. Assessment of orthodontic treatment needs using a modified aesthetic scale. Sains Malaysiana. 2013;42:759-764.
12. Jarvinen S. Indexes for orthodontic treatment need. Am J Orthod Dentofacial Orthop. 2001;120:237-239.
13. Chrystiane FC, et al. The dental aesthetic index and dental health component of the index of orthodontic treatment need as tools in epidemiological studies. Int J Environ Res Public Health. 2011;8:3277-3286.

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p-ISSN: 2322-0090

14. Chaitra K, et al. Orthodontic treatment: Need and demand in north Karnataka school children. J Clin Diagn Res. 2014;8:37-42.
15. Grzywacz I. The value of aesthetic component of the index of orthodontic treatment need in the assessment of the subjective orthodontic treatment need. Eur J Orthod. 2003;25:57-63.
16. Stenvik A, et al. Lay attitudes to dental appearance and need for orthodontic treatment. Eur J Orthod, 1997;19:271-277.
17. Tak M, et al. Prevalence of malocclusion and orthodontic treatment needs among 12–15 years old school children of Udaipur, India. Eur J Dent. 2013;7:S45-S53.
18. Cooper S, et al. The reliability of the index of orthodontic treatment need over time. J Orthod. 2000;27:47-53.
19. Kumar P, et al. Prevalence of malocclusion and orthodontic treatment need in schoolchildren – An epidemiological study. Medical J Armed Forces India. 2013;69:369-374.
20. Mohandas U, et al. Prevalence of malocclusion among school children in Bangalore, India. Int J Clin Pediatr Dent. 2008;1:10-12.
21. Siddegowda R and Rani MS. Assessment of malocclusion in school children of Karnataka state between the age groups of 10-12 years and 13-16 years. A Cross-sectional descriptive survey. J Dent Medical Sci. 2013;11:6-12.
22. Al Jeshi, et al. Orthodontic treatment need in Dubai school adolescents: A study of 20,000 school age adolescents in 66 public and private schools comparing orthodontic treatment need by Gender and Ethinicity. OHDM. 2014;13:857-865.
23. Alkhatib M, et al. Ethnic variations in orthodontic treatment need in London school children. BMC Oral Health. 2005;5:1-7.
24. Christopherson EA, et al. Objective, subjective, and self-assessment of preadolescent orthodontic treatment need – A function of age, gender, and ethnic/racial background? J Public Health Dent. 2009;69:9-17.
25. Hedayati Z, et al. The use of index of orthodontic treatment need in an Iranian population. J Indian Soc Pedod Prevent Dent. 2007;25:10-14.
26. Mandall, et al. Perceived aesthetic impact of malocclusion and oral self-perceptions in 14–15 year-old Asian and Caucasian children in greater Manchester. Eur J Orthod. 2000;22:175-83.
27. Otuyemi OD, et al. Unmet orthodontic treatment need in rural Nigerian adolescents. Community Dent Oral Epidemiol. 1997;25:363-366.
28. Nobile C, et al. Prevalence and factors related to malocclusion and orthodontic treatment need in children and adolescents in Italy. Eur J Public Health. 2007;17:637-641.
29. Mugonzibwa EA, et al. Need for orthodontic treatment among tanzanian school children. East Afr Med J. 2004;81:10-15.
30. Fernandez NP, et al. Orthodontic treatment need in a 12-year-old population in the Western Sahara. Eur J Orthod. 2011;33:377-380.
31. Abdulla MS and Rock WP. Assessment of orthodontic treatment need in 5112 Malaysian children using the IOTN and DAI indices. Community Dent Health. 2001;18:242-248.
32. Neeraja G, et al. Knowledge, attitude and practices regarding oro-facial injuries and orofacial protective devices among physical instructors in Bangalore. J Int Oral Health. 2014;6:1-6.
33. Harry RD. Orthodontics- Part 1: Who needs orthodontics? Br Dent J. 2003;195:433-437.
34. Sharma J and Sharma RD. IOTN- A tool to prioritize treatment need in children and plan dental health services. OHDM. 2014;13:65-70.
35. Diwan S, et al. Assessment of orthodontic treatment needs among school children in Doiwala region, Uttrakand, India. National J Community Medicine. 2013;4;208-211.
36. Kerosuo H, et al. Outcome and long term stability of an early orthodontic treatment strategy in public health care. Eur J Orthod. 2013;35:183-189.
37. Hamadan AM, et al. Perceptions of dental aesthetics of Class III and anterior open bite malocclusions- A comparison between 10 to 11 year old school children and orthodontists. Angle Orthodontist. 2012;82;202-208.
38. Manzanera D, et al. Orthodontic treatment need in Spanish school children: An epidemiological study using the Index of orthodontic treatment need. Eur J Orthod. 2009;31:180-183.
39. Ngom PL, et al. Orthodontic treatment need and demand in sengalese school children aged 12-13 years. Angle Orthodontist. 2007;77:323-330.
40. Burden DJ and Holmes A. The need for orthodontic treatment in the child population of the United Kingdom. Eur J Orthod. 1994;16:395-399.
41. World Health Organization. Oral Health Survey: Basic Methods. WHO. 2013.