



Using OI and DAI Index to Compare the Need and Demand of Orthodontic Treatment

Farzaneh Golfeshan¹, Parisa Salehi^{1,*} and Kimiya Beygi²

¹Orthodontic Research Center, Shiraz University of Medical Science, Shiraz, Fars, Iran

²Student Research Committee, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran

*Corresponding author: Orthodontic Research Center, Shiraz University of Medical Science, Shiraz, Fars, Iran. Email: salehipa@yahoo.com

Received 2021 June 02; Revised 2021 August 13; Accepted 2021 August 14.

Abstract

Objectives: The objective of this research was to compare the orthodontic treatment need and demand using Dental Aesthetic Index (DAI) and Occlusal Index (OI) among dentistry students of Shiraz University of Medical Sciences.

Methods: This descriptive cross-sectional study was performed on 113 dental students in Shiraz University of Medical Sciences. The demand for orthodontic treatment was assessed using a standardized questionnaire and 10 photographs of aesthetic component (AC) of IOTN for the self-assessment of subjects about their dental attractiveness. Occlusal Index (OI) and Dental Aesthetic Index (DAI), which were calculated by clinical examination and dental model analysis, were used to assess the orthodontic treatment need. Students with a history of orthodontic treatment were excluded.

Results: Final analysis was done on 113 cases (48 men and 65 women). The study showed that there was a significant relationship between the demand for orthodontic treatment and the self-assessment of subjects about their dental attractiveness (according to the photograph they had chosen) ($P = 0.015$). There is also a significant relationship between the self-assessment of subjects about their dental attractiveness (according to the photographs) and the orthodontic treatment need based on DAI ($P = 0.008$). Furthermore, a significant connection was found between the self-assessment of subjects about their dental attractiveness (according to the photographs) and the orthodontic treatment need based on OI ($P < 0.001$).

Conclusions: The results of our study revealed that both indices show that the need for orthodontic treatment is in line with the demand, which could be used for planning public orthodontic and dental services.

1. Background

Malocclusion is a deviation from an ideal occlusion (1). Many of these deviations are normal biologic variations, but some deviations may have a negative effect on the physical and psychological health of patients (2). Some physical problems that may be caused by malocclusion include tooth and periodontal injuries, dentofacial development anomalies and orofacial functional problems (2).

Orthodontic treatment demand suggests that one should receive orthodontic care, which can be measured qualitatively by giving a standard questionnaire to patients (3).

There is an element of IOTN (Index of orthodontic treatment need) that has been used for evaluating aesthetic treatment need. This component is called the aesthetic component (AC), which includes 10 standard photographs categorized into 4 grades (4).

There are orthodontic treatment indices that are used worldwide. In this study, we used Dental Aesthetic Index (DAI) and Occlusal Index (OI) in order to measure the or-

thodontic treatment need in the dental students of Shiraz University of medical sciences.

Dental Aesthetic Index was introduced by Cons et al. in 1986. This index uses clinical, objective and subjective aesthetic factors to measure orthodontic treatment need and the severity of the problem (5). This index is considered to be reliable. There are 10 occlusal traits in this index that measure the need for orthodontic treatment and the final results are categorized into 4 levels of malocclusion (6).

The occlusal index includes 9 measurements (7): (1) dental age, (2) molar relationship, (3) overbite, (4) over jet, (5) posterior cross bite, (6) posterior open bite, (7) tooth displacement or rotation, (8) midline relations, and (9) missing maxillary permanent incisors. The score then will be categorized into 5 levels.

2. Objectives

The aim of the present study was to clarify the relationship between the orthodontic treatment need and demand in the dentistry students of Shiraz University of Med-

ical Sciences and to design a plan for predicting orthodontic treatment need in the society.

3. Methods

This cross-sectional study evaluated the orthodontic treatment need and demand in the dentistry students of Shiraz University of Medical Sciences. First to third year student were asked to enter to study. All students received written information about the study. The study was approved by the Research and Ethics Committee, faculty of Dentistry, Shiraz University of Medical Sciences, Iran. The ethics code for this study was Ir.sums.rec.1397.820.

A total of 113 students were selected randomly, with an average age of 20 years. Sample size was determined assuming a true correlation of 0.20 to be detected (average effect size in social psychological research), with a statistical power of 0.80 and a probability of type I error (α) of 0.05, a sample size of 94 individuals was required (2). Considering the probability that 20% of the selected individuals will be excluded from the study, 113 were selected as the sample.

3.1. Questionnaire Design

The participants were asked to complete a standard questionnaire modified from a French article, (1) which was composed of 3 sections (Appendix 3): (1) the first section included basic demographic information including age and gender; (2) the second section included yes or no questions evaluating patient's information about orthodontic treatment and asking them if they think they needed to receive orthodontic treatment; (3) in the third section, dental aesthetics were assessed using the IOTN AC (4). The subjects were presented with 10 photographs of anterior teeth displaying varying degrees of malocclusion, and were asked to indicate which photograph is most similar to their own dentition (Figure 1).

Two occlusal indices were used to assess the need for orthodontic treatment of the target population. These included the Dental Aesthetic Index⁶ and Occlusal Index (7).

DAI was introduced by Cons et al. in 1986, it links objective, clinical, and subjective aesthetic factors to produce a single score that reflects the severity and the treatment needs of the malocclusion. It evaluates 10 occlusal characteristics: missing incisors, canine or premolar teeth (upper and lower), crowding in the anterior segment, spacing in the incisal segment, midline diastema in mm, the largest anterior irregularity in maxilla (mm), the largest anterior irregularity in mandible (mm), anterior maxillary over jet (mm), anterior mandibular over jet (mm), anterior open bite (mm) and antero-posterior molar relation (6). All of these characteristics were measured by clinical exams and using dental models.

The final DAI scores were categorized in 4 levels of malocclusion severity: (1) a score lower than or equal to 25 (no or slight treatment need); (2) a score between 26 and 30 (elective treatment); (3) a score between 31 and 35 (treatment highly desirable) and a score greater than 36 (treatment mandatory) (6) (Appendix 1).

OI index evaluated 9 dental characteristics: (1) dental age, (2) molar relationship, (3) overbite, (4) over jet, (5) posterior cross bite, (6) posterior open bite, (7) tooth displacement or rotation, (8) midline relations, and (9) missing maxillary permanent incisors. These characteristics were measured by clinical exams and dental cast analysis (7) (Appendix 2).

3.2. Statistical Analysis

In this research, for the analysis of the collected data, descriptive statistics were first described and dictated by the data. Descriptive data was presented briefly and categorized. Then, considering that the variables of the research were of a qualitative type, in order to investigate the relationship between the need and demand for treatment based on the DAI and OI indices, consensus tables and chi-square test were used. All calculations were performed using SPSS 23 software, and the level of significance was set at 0.05.

4. Results

In this study, 113 students of Shiraz University of Medical Sciences with the age range of 18 to 22 were examined. 48 of the subjects (42.5%) were male and 65 of (57.5%) were female.

The need for orthodontic treatment according to the DAI index is shown in Table 1. 18.6% of the subjects did not require any orthodontic treatment, 23.9% needed elective treatment, for 51.3% of the subjects, treatment was highly desirable and for 6.2% of the subjects, treatment was mandatory.

The need for orthodontic treatment according to the OI index is shown in Table 2. 10.6% of subjects didn't need orthodontic treatment. 19.5% needed minor treatment, 61.1% of subjects needed definite treatment and 8.8% had the worst occlusion.

Table 1. Orthodontic Treatment Need Based on DAI Index

DAI	Frequency	Percentage
No treatment need	21	18.6
Elective treatment	27	23.9
Desirable treatment	58	51.3
Mandatory treatment	7	6.2
Total	113	100.0

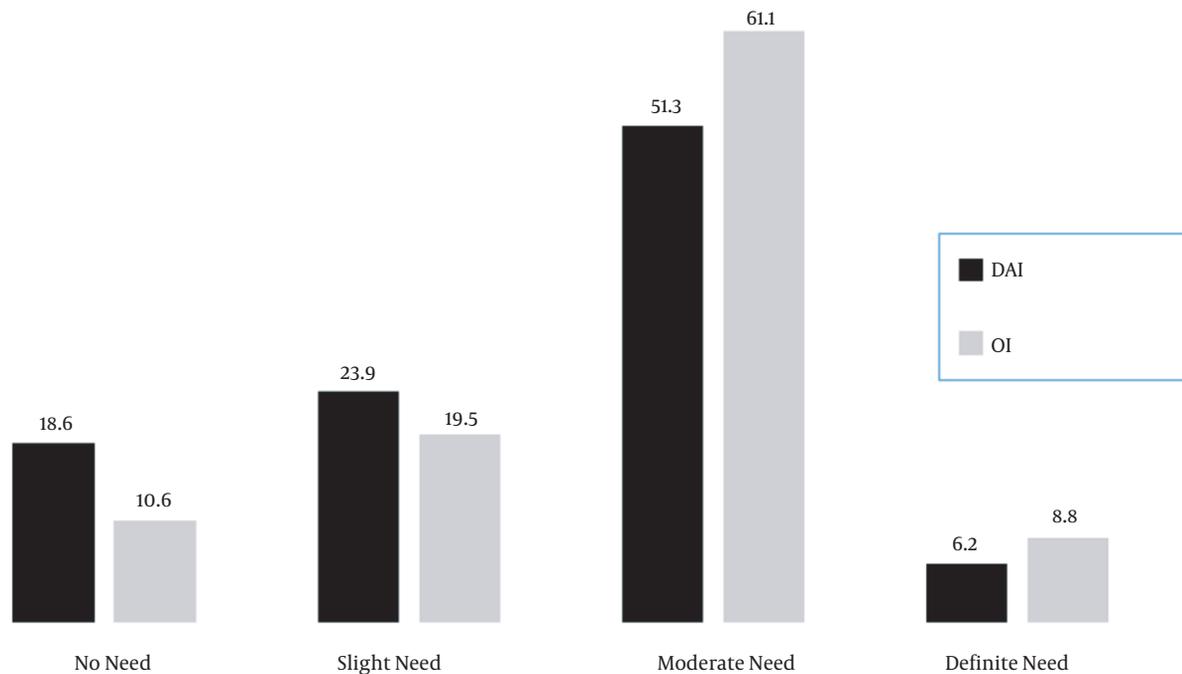


Figure 1. The aesthetic component (AC) of IOTN (Brook and Shaw)

Table 2. Orthodontic Treatment Need Base on OI Index

OI	Frequency	Percentage
No treatment need	12	10.6
Elective treatment	22	19.5
Desirable treatment	69	61.1
Mandatory treatment	10	8.8
Total	113	100.0

The demand for treatment according to the questionnaire's results is shown in Table 3. 40.7% of the subjects demanded orthodontic treatment.

Table 3. Orthodontic Treatment Demand Based on Questionnaire

Orthodontic Treatment Demand	Frequency	Percentage
Yes	46	40.7
No	62	54.9
I don't know	5	4.4
Total	113	100.0

Table 4 depicts the self-assessment of dental attractive-

ness according to the chosen photographs of the aesthetic component of IOTN. 31% of the subjects did not need any orthodontic treatment. 39.8% had a slight need, 19.5% had a moderate need and 9.7% definitely needed treatment. According to Table 3, most of the subjects who did not demand any treatment based on the photographs they had chosen (45.2%), did not need treatment. However, 45.7% had a slight need and 26.1% had a moderate need for treatment ($\chi^2 = 15.768, P = 0.015$).

Table 4. Self-Assessment of Dental Attractiveness Based on Photography

Photography	Frequency	Percentage
No need	35	31.0
Slight need	45	39.8
Moderate need	22	19.5
Definite need	11	9.7
Total	113	100.0

The relationship between the need for orthodontic treatment according to the DAI index and the demand are shown in Table 4. For most of the subjects who had chosen photographs with a moderate need (22 of them) and

definite need (11 of them), treatment was desirable according to the DAI index and few of them (13.6%) needed definite treatment. Additionally, subjects who had chosen no need for treatment according to their chosen photographs (37.1%) did not need treatment based on the DAI index. Subjects who had chosen photographs with a slight need (51.9%), required desirable treatment according to the DAI index ($\chi^2 = 22.171, P = 0.008$).

The relationship between the need for orthodontic treatment according to the OI index and the demand are shown in Table 5. Subjects who had chosen photographs needing no treatment, as well as 68.9% of those who had chosen slight need photographs, needed definite treatment according to the OI index. Also, 77.3% of subjects who had chosen moderate need photographs needed definite treatment according to the OI index. 45.5% of subjects who had chosen definite need photographs had the worst occlusion ($\chi^2 = 33.099, P < 0.001$).

In order to compare the two OI and DAI indices, the Mann-Whitney test was used to determine the quality of the data. The results of the test depicted that at the 95% confidence level, the need for treatment based on these two indices did not have a significant difference ($P = 0.12$) (Table 6). Figure 2 shows the need for treatment comparing these two indices (Table 7).

5. Discussion

In the epidemiological studies of malocclusion, giving accurate and reliable information about the need for orthodontic treatment is crucial. The resulting data can be used to affect the policies in health care systems and influence resource planning, as well as to evaluate the effectiveness of orthodontic care services. Orthodontic treatment indices provide descriptive information on the distribution of population needs (epidemiological use) and the priority for treatment (use in health care management) (8, 9).

In this study, DAI and OI indices were used to evaluate orthodontic needs in the population and to understand the need for treatment in a group of dentistry students in Shiraz University of Medical Sciences. Since learning specialized dental courses might have affected the demand for orthodontic treatment in dental students, students of first to third year were included in this study since the specialized dentistry courses have not yet begun during this period.

Although the OI index has been shown to have advantages such as low error, relevance to clinical findings, and reliability and validity of outcomes over time, this index also has shortcomings (10).

The OI index does not prioritize cases with molar relationships which are a complete class I, although this may be fully consistent with static and functional obstructions.

This index does not favor missing teeth, except for the upstream teeth in which closure of the preoperative orthodontic spaces may be required that in turn results in underestimating the need for treatment. The guide is also long and complex and may be hard to compute in field studies (11).

Dental Aesthetic Index (DAI) assesses the relative social acceptance of a dental appearance based on a general understanding of the aesthetics of the teeth. This index is used in epidemiological studies in order to identify the need for orthodontic treatment, and as a screening tool for determining the priority of treatment. Like the OI, DAI has also been used to evaluate health standards. Although the DAI has several limitations (it does not include cases with cross-bite, posterior open bite, midline discrepancies and deep overbite), simplicity, reliability, and reuse and the easy re-production of data have promoted its use as an agreed orthodontic indicator (12).

Al-Zubair et al. (2015) conducted a study on students' self-assessment of dental attractiveness based on 10 photographs and the demand for orthodontic treatment. The results of the study showed that 65.5% of the subjects were satisfied with the appearance of their teeth, while 96.4% of the subjects did not require orthodontic treatment according to the questionnaire (13).

Overall orthodontic treatment need based on the DAI index is 81.4%, based on the OI index, it is 89.4% in the current study, and the demand for orthodontic treatment is 69%.

There was a significant relationship between self-assessment based on photographs and need for treatment based on the DAI index. There was also a significant relationship between self-assessment based on photographs and need for treatment based on the OI index.

Generally, self-assessment of people of the appearance of their teeth is different from the professional assessment. This is due to the fact that professional practitioners examine all aspects of the dentition, including missing teeth, interdental spacing, cross-bite, over jet and open bite. Meanwhile, self-assessment measures only the attractiveness of the appearance of the anterior teeth in the smile. On the other hand, the patient may have a better understanding of the demand for orthodontic treatment after seeing photographs in the photographic index. This could indicate a greater association between the photographic index and the orthodontic index in our study (13).

In the 2007 study, Danaei et al. examined the orthodontic need of adolescents from state-run high schools in Shiraz. A random sample of 900 students (450 boys and 450 girls) age between 12 and 15 who had received no orthodontic treatment before or during the study were randomly selected in 2 months in 2004. Most of the students (70.1%) had normal or partial malocclusion, indicating no need



Figure 2. Comparison of DAI and OI index

Table 5. Comparison of the Demand Based on Subject's Opinion and Photography^a

Subject's	Photography				Total
	No Need	Slight Need	Moderate Need	Definite Need	
Demand for treatment					
Yes	6 (13.0)	21 (45.7)	12 (26.1)	7 (15.2)	46 (100.0)
No	28 (45.2)	22 (35.5)	8 (12.9)	4 (6.5)	62 (100.0)
I don't know	1 (20.0)	2 (40.0)	2 (40.0)	0 (0.0)	5 (100.0)
Total	35 (31.0)	45 (39.8)	22 (19.5)	11 (9.7)	113 (100.0)

^a Values are expressed as No. (%).**Table 6.** Comparison of Self-Assessment (Photography) and Orthodontic Treatment Need (DAI)^a

Variables	Treatment Need Based on DAI				Total
	No Need	Elective Treatment	Desirable Treatment	Mandatory Treatment	
Photography					
No need	13 (37.1)	12 (34.3)	10 (28.6)	0 (0.0)	35 (100.0)
Slight need	5 (11.1)	13 (28.9)	23 (51.1)	4 (8.9)	45 (100.0)
Moderate need	3 (13.6)	1 (4.6)	15 (68.2)	3 (13.6)	22 (100.0)
Definite need	0 (0.0)	1 (9.0)	10 (91.0)	0 (0.0)	11 (100.0)
Total	21 (18.6)	27 (23.9)	58 (51.3)	7 (6.2)	113 (100.0)

^a Values are expressed as No. (%).**Table 7.** Comparison of Self-Assessment (Photography) and Orthodontic Treatment Need (OI)^a

Variables	Treatment Need Based on OI				Total
	No Need	Elective Treatment	Desirable Treatment	Mandatory Treatment	
Photography					
No need	4 (11.4)	13 (37.1)	18 (51.4)	0 (0.0)	35 (100.0)
Slight need	5 (11.1)	6 (13.3)	31 (68.9)	3 (6.7)	45 (100.0)
Moderate need	2 (9.1)	1 (4.5)	17 (77.3)	2 (9.1)	22 (100.0)
Definite need	1 (9.1)	2 (18.2)	3 (27.3)	5 (45.5)	11 (100.0)
Total	12 (10.6)	22 (19.5)	69 (61.1)	10 (8.8)	113 (100.0)

^a Values are expressed as No. (%).

for orthodontic treatment. Only 4.2% had severe malocclusion, requiring treatment. Excessive and severe malocclusion scores were higher in boys than in girls. Also, comparison with other populations showed that the population studied in Shiraz had a better appearance of the teeth and less need for orthodontic treatment than other populations (14).

In a 2010 study by Eslamipour et al. (15), using stratified sampling method in public and private schools in Isfahan, 748 subjects were studied and divided into three age groups of 11 - 14 years old, 14 to 17 years old And 17 to 20 years old (355 women and 393 men, 15.11 ± 2.23 years). Of these, 20 had a history of orthodontic treatment. DAI

scores were recorded in subjects without a history of orthodontic treatment (728, 340 women, and 388 men). The average DAI score was 26.14 points. In general, 54.5% did not require treatment. In 23.6%, treatment was considered to be selective. However, in 11.0%, treatment was very desirable and 10.9% had severe malocclusion and treatment was essential. Considering the needs for treatment, there was a significant difference between the sexes but there was no significant difference between the different age groups according to the DAI treatment groups. According to the findings of this study, 21.8% of evaluated Iranian students had a score of DAI higher than or equal to 31 points, indicating that the need for orthodontic treatment is highly desir-

able or compulsory.

Some studies, like our study, showed that there is a meaningful relationship between the DAI Index and the individual's satisfaction with the appearance of the teeth.

According to a systematic review by Eslamipour et al. (16), The need for orthodontic treatment in Iran based on DAI has a prevalence of about 16%. Asian studies according to DAI, reported 12.8% and 24.1% in orthodontic treatment in India and Malaysia, which is relatively close to the results in Iran. In a survey of a population of 165 students in Yemen, using the AC of the IOTN index, which evaluated personal evaluation of tooth appearance, orthodontic treatment and functional disorders, 3.6% of the people had average or high demand for orthodontic treatment. Of all the individuals, 96.4% mentioned that they did not need orthodontic treatment. Also, 65.5% of respondents were satisfied with the appearance of their teeth. In African countries, the prevalence is 44.7%. In the Studies show that the prevalence in Brazil is 32.8%, which is higher than in Iran (17-19).

The conclusion of previous studies in Iran has shown that the majority of the Iranian population are classified in the group without the need for orthodontic treatment. According to DHC, about a quarter of the population has criteria for orthodontic treatment, but using DAI, less than one quarter (16%) of the subjects need orthodontic treatment. If AC score is used as an indicator of their understanding, the need for treatment among people will be reduced to 5%. It has also been shown in general that the Iranian population needs more orthodontic treatment than they may think, but most are pleased with the appearance of their teeth and consider themselves attractive based on their dental appearance (20).

In this study, the data were analysed in both groups of males and females. However, since there was no significant difference between these two groups and due to the high volume of data, the results of these analyses are not given in the article.

It is suggested that a larger-scale study be conducted in the future, as well as the same study in the students studying from the third year onwards, to determine the impact of dental training on the demand for orthodontic treatment.

5.1. Conclusion

Both DAI and OI have reported the need for orthodontic treatment in the studied population almost identically.

The need for treatment was estimated 81.4 - 89.4% in the population, while the demand was 69%, which indicates that the subjects were more tolerant about their teeth unattractiveness and they had less need for orthodontic treatment.

The degree of correlation between the demand and need according to the DAI index was higher in subjects

without the need for treatment and need for desirable treatment. The degree of correlation between the demand and need according to the OI index was higher in subjects with desirable treatment need and definite treatment need.

Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Acknowledgments

The authors thank the Vice-Chancellor of research in Shiraz University of Medical Sciences for supporting this research (Grant#1396-01-03-15452). This article is based on the thesis by Dr Kimia Beigi. The authors also wish to thank Adele Osareh of the Dental Research Development Center, of the School of Dentistry for the statistical analysis.

Footnotes

Authors' Contribution: Study concept and design, Parisa Salehi; Acquisition of data, Kimiya Beygi; Analysis and interpretation of data Kimiya Beygi; Drafting of the manuscript, Kimiya Beygi, Farzaneh Golfeshan; Critical revision of the manuscript for important intellectual content, Farzaneh Golfeshan; Statistical analysis, Kimiya Beygi; Administrative, technical, and material support, Parisa Salehi, Study supervision, Farzaneh Golfeshan.

Conflict of Interests: There is no conflict of interests.

Ethical Approval: The study was approved by the Research and Ethics Committee, faculty of Dentistry, Shiraz University of Medical Sciences, Iran. The ethics code for this study was Ir.sums.rec.1397.820.

Funding/Support: There is no funding/support.

References

1. Ngom PI, Diagne F, Dieye F, Diop-Ba K, Thiam F. Orthodontic treatment need and demand in Senegalese school children aged 12-13 years. An appraisal using IOTN and ICON. *Angle Orthod.* 2007;77(2):323-30. doi: [10.2319/0003-3219\(2007\)077\[0323:OTNADI\]2.0.CO;2](#). [PubMed: [17319769](#)].
2. Taghavi Bayat J, Huggare J, Mohlin B, Akrami N. Determinants of orthodontic treatment need and demand: A cross-sectional path model study. *Eur J Orthod.* 2017;39(1):85-91. doi: [10.1093/ejo/cjw020](#). [PubMed: [26980843](#)].
3. Zreayat M, Hassan R, Ismail AR, Ismail NM, Aziz FA. Orthodontic treatment need and demand among 12- and 16 year-old school children in Malaysia. *Oral Health Dent Manag.* 2013;12(4):217-21. [PubMed: [24390019](#)].

4. Eslamipour F, Riahi FT, Etemadi M, Riahi A. Correlation coefficients of three self-perceived orthodontic treatment need indices. *Dent Res J (Isfahan)*. 2017;**14**(1):37-42. doi: [10.4103/1735-3327.201131](https://doi.org/10.4103/1735-3327.201131). [PubMed: [28348616](https://pubmed.ncbi.nlm.nih.gov/28348616/)]. [PubMed Central: [PMC5356387](https://pubmed.ncbi.nlm.nih.gov/PMC5356387/)].
5. Goyal S, Goyal S, Muhigana A. Assessment of malocclusion severity levels and orthodontic treatment needs using the dental aesthetic index (DAI): A retrospective study. *Rwanda Medical J*. 2013;**70**(3):20-7.
6. Summers CJ. The occlusal index: A system for identifying and scoring occlusal disorders. *Am J Orthod*. 1971;**59**(6):552-67. doi: [10.1016/0002-9416\(71\)90002-9](https://doi.org/10.1016/0002-9416(71)90002-9). [PubMed: [5280423](https://pubmed.ncbi.nlm.nih.gov/5280423/)].
7. Borzabadi-Farahani A. An insight into four orthodontic treatment need indices. *Prog Orthod*. 2011;**12**(2):132-42. doi: [10.1016/j.pio.2011.06.001](https://doi.org/10.1016/j.pio.2011.06.001). [PubMed: [22074838](https://pubmed.ncbi.nlm.nih.gov/22074838/)].
8. Borzabadi-Farahani A. A review of the oral health-related evidence that supports the orthodontic treatment need indices. *Prog Orthod*. 2012;**13**(3):314-25. doi: [10.1016/j.pio.2012.03.002](https://doi.org/10.1016/j.pio.2012.03.002). [PubMed: [23260543](https://pubmed.ncbi.nlm.nih.gov/23260543/)].
9. So LL, Tang EL. A comparative study using the Occlusal Index and the Index of Orthodontic treatment need. *Angle Orthod*. 1993;**63**(1):57-64. discussion 65-6. doi: [10.1043/0003-3219\(1993\)063<0057:ACSUTO>2.0.CO;2](https://doi.org/10.1043/0003-3219(1993)063<0057:ACSUTO>2.0.CO;2). [PubMed: [8507032](https://pubmed.ncbi.nlm.nih.gov/8507032/)].
10. Otuyemi OD, Noar JH. Variability in recording and grading the need for orthodontic treatment using the handicapping malocclusion assessment record, occlusal index and dental aesthetic index. *Community Dent Oral Epidemiol*. 1996;**24**(3):222-4. doi: [10.1111/j.1600-0528.1996.tb00846.x](https://doi.org/10.1111/j.1600-0528.1996.tb00846.x). [PubMed: [8871024](https://pubmed.ncbi.nlm.nih.gov/8871024/)].
11. Nayak UA, Winnier J, S R. The relationship of dental aesthetic index with dental appearance, smile and desire for orthodontic correction. *Int J Clin Pediatr Dent*. 2009;**2**(2):6-12. doi: [10.5005/jp-journals-10005-1023](https://doi.org/10.5005/jp-journals-10005-1023). [PubMed: [25206105](https://pubmed.ncbi.nlm.nih.gov/25206105/)]. [PubMed Central: [PMC4086561](https://pubmed.ncbi.nlm.nih.gov/PMC4086561/)].
12. Cifter M. A qualitative analysis of dental photography in orthodontics: The patient's perspective. *Biomed Res Int*. 2018;**2018**:5418592. doi: [10.1155/2018/5418592](https://doi.org/10.1155/2018/5418592). [PubMed: [30151384](https://pubmed.ncbi.nlm.nih.gov/30151384/)]. [PubMed Central: [PMC6091326](https://pubmed.ncbi.nlm.nih.gov/PMC6091326/)].
13. Danaei SM, Amirrad F, Salehi P. Orthodontic treatment needs of 12-15-year-old students in Shiraz, Islamic Republic of Iran. *East Mediterr Health J*. 2007;**13**(2):326-34. [PubMed: [17684855](https://pubmed.ncbi.nlm.nih.gov/17684855/)].
14. Eslamipour F, Borzabadi-Farahani A, Asgari I. Assessment of orthodontic treatment need in 11- to 20-year-old urban Iranian children using the Dental Aesthetic Index (DAI). *World J Orthod*. 2010;**11**(4):e125-32. [PubMed: [21490981](https://pubmed.ncbi.nlm.nih.gov/21490981/)].
15. Jha K, Saha S, Gv J, Narang R, Biswas G, Sood P, et al. Prevalence of malocclusion and its psycho-social impact among 12 to 15-year-old school children in Lucknow city. *J Clin Diagn Res*. 2014;**8**(10):ZC36-9. doi: [10.7860/JCDR/2014/9814.5000](https://doi.org/10.7860/JCDR/2014/9814.5000). [PubMed: [25478444](https://pubmed.ncbi.nlm.nih.gov/25478444/)]. [PubMed Central: [PMC4253262](https://pubmed.ncbi.nlm.nih.gov/PMC4253262/)].
16. Eslamipour F, Afshari Z, Najimi A. Prevalence of orthodontic treatment need in permanent dentition of Iranian population: A systematic review and meta-analysis of observational studies. *Dent Res J (Isfahan)*. 2018;**15**(1):1-10. doi: [10.4103/1735-3327.223616](https://doi.org/10.4103/1735-3327.223616). [PubMed: [29497441](https://pubmed.ncbi.nlm.nih.gov/29497441/)]. [PubMed Central: [PMC5806424](https://pubmed.ncbi.nlm.nih.gov/PMC5806424/)].
17. Abdullah MS, Rock WP. Assessment of orthodontic treatment need in 5,112 Malaysian children using the IOTN and DAI indices. *Community Dent Health*. 2001;**18**(4):242-8. [PubMed: [11789703](https://pubmed.ncbi.nlm.nih.gov/11789703/)].
18. Utomi I, Onyeano C. Malocclusion and orthodontic treatment need of patients attending the Lagos University Teaching Hospital, Lagos, Nigeria. *Odontostomatol Trop*. 2015;**38**(150):23-30. [PubMed: [26934769](https://pubmed.ncbi.nlm.nih.gov/26934769/)].
19. de Almeida AB, Leite IC. Orthodontic treatment need for Brazilian schoolchildren: A study using the Dental Aesthetic Index. *Dental Press J Orthod*. 2013;**18**(1):103-9. doi: [10.1590/s2176-94512013000100021](https://doi.org/10.1590/s2176-94512013000100021). [PubMed: [23876957](https://pubmed.ncbi.nlm.nih.gov/23876957/)].
20. Al-Zubair NM, Idris FA, Al-Selwi FM. The subjective orthodontic treatment need assessed with the aesthetic component of the Index of Orthodontic Treatment Need. *Saudi J Dent Res*. 2015;**6**(1):9-14. doi: [10.1016/j.sjdr.2014.02.003](https://doi.org/10.1016/j.sjdr.2014.02.003).