Original Article

Correlation coefficients of three self-perceived orthodontic treatment need indices

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ABSTRACT

Background: To determine patient orthodontic treatment need, appropriate self-perceived indices are required. The aim of this study was to assess the sensitivity and specificity of esthetic component (AC) of the index of orthodontic treatment need (IOTN), oral esthetic subjective index scale (OASIS), and visual analog scale (VAS) through dental health component (DHC) IOTN as a normative index to determine the more appropriate self-perceived index among young adults.
Materials and Methods: In this cross-sectional study, a sample of 993 was randomly selected from freshman students of Isfahan University. Those with a history of orthodontic treatment or current treatment were excluded. DHC was evaluated by two inter- and intra-calibrated examiners. Data for AC, OASIS, and VAS were collected through a questionnaire completed by students. Descriptive statistics, Mann–Whitney U-test, and Spearman correlation test, were used for data analyses. Sensitivity, specificity, positive and negative predictive values of self-perceived indices were calculated through DHC.
Results: Sensitivity of AC, OASIS, and VAS for evaluating definite orthodontic treatment need was calculated at 15.4%, 22.3%, and 44.6%, respectively. Specificity of these indices for evaluating definite orthodontic treatment need was calculated at 92.7%, 90.5%, and 76.2% percent, respectively. All self-perceived indices had a significant correlation with together and with DHC ($P < 0.01$). Among demographic factors, there was weak but significant correlation only between mother's educational level and VAS ($P < 0.01$).
Conclusion: Due to the sensitivity and specificity of the three self-perceived indices, these indices are not recommended for population screening and should be used as adjuncts to a normative index for decision-making in orthodontic treatment planning.

Key Words: Dental Health Surveys, index of orthodontic treatment need, Self-Assessment, sensitivity, specificity

INTRODUCTION

Orthodontic treatments have become very popular due to the ever-increasing attention of individuals to the esthetic appearance of their teeth.[1,2] In this context, in contemporary orthodontics, determination of the need for treatment does not solely depend on clinical symptoms and signs, but also, attention should be paid to the esthetic appearance and functional efficacy of the dentition.[3] Since the esthetic factors cannot

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be evaluated only based on the dentist's opinion, the patient's personal perception of the esthetic appearance of his/her dentition should be taken into account for a more accurate evaluation of these factors.[4-6]

Some orthodontic indices have been used to determine the need for treatment. Indices should be able to evaluate the patient's opinion in regard with the need for treatment, in addition to dentist's discretion. To this end, different indices have been designed based on the favorable esthetic appearance of dentition in the community.[7]

In general, the indices used to evaluate the need for orthodontic treatment can be classified into two groups:
- Indices that have been designed based on the individual's opinions (self-perceived and subjective indices) about the esthetic appearance of their dentition and teeth, such as esthetic component (AC) of the index of orthodontic treatment need (IOTN), oral esthetic subjective index scale (OASIS), and visual analog scale (VAS), which are all considered valid indices[8-17]
- Indices that depend on the judgment of a professional such as a dentist and are considered as normative or objective indices, for example, dental health component (DHC) of IOTN, Dental esthetic Index (DAI), and Peer Assessment Index (PAI).[8,12,18,19]

Since the evidence-based dentistry has become very popular; based on modern science, the patient has the right to be engaged in the treatment planning processes and to receive the most comprehensive treatment.[20,21] To this end, proper self-perceived indices can be used in association with normative indices. In general, both self-perceived and normative indices can be used to evaluate the need for orthodontic treatment; however, since the perceptions of the lay people in relation to the need for treatment sometimes are different from professional aspects, it is necessary to evaluate the reciprocal relationship between these indices to determine the need for orthodontic treatment more accurately.[1,22]

Since an individual's self-perception is under the influence of living conditions and the culture of their community,[23] the relationship between self-perceived and normative indices should be evaluated in each community.[24]

It is inevitable to select an appropriate target group to evaluate and compare the reciprocal relationship between self-perceived and normative indices. It appears the most appropriate age group for this purpose is the young adult group because attention to appearance and self-perception increase from childhood to adulthood and after adulthood the individual achieves a rather stable self-perception.[1,25,26] Therefore, in the present study, young adults were used as the target group.

In two studies by Flores-Mir *et al*. and Mir.[11,27] in Peru on freshmen with an average age of 18.02 years, a significant relationship was reported between self-perceived AC, OASIS, and VAS indices. In a study by Hedayati *et al*. on 11–14 age groups in Shiraz, a poor correlation was reported between the DHC and AC indices.[23]

Borzabadi-Farahani and Eslamipour in a study on adolescence showed a high positive correlation between AC of IOTN and DAI as a normative index (ρ =0.79).[28] Asgari *et al*. reported the specificity of AC to detect the healthy persons (based on DHC of IOTN) was excellent, but its sensitivity was low (0.08).[29] To determine the most reliable self-perceived indices, the present study designed to assess sensitivity and specificity of self-perceived indices (AC, OASIS, and VAS) in comparison to DHC as a normative index in young adults.

MATERIALS AND METHODS

In the present descriptive cross-sectional study, 993 students were randomly selected from 1670 freshmen students of Isfahan University. Health sciences or artistic career students were excluded because of their possible sensitivities in cosmetic subjects which have been known as confounding factors.[11] Random sampling procedure was carried out to select subjects in the present study. The student lists of different fields in Isfahan University were used to select subjects on an every-other basis. Then the subjects were briefed on the study procedures. Subjects not willing to participate and who had a history of orthodontic treatment or the current orthodontic treatment were excluded from this study.

Data were collected using a questionnaire. The questionnaire consisted of three sections: the demographic data (age, sex, family economic welfare, and parent's education level), the index of OASIS, VAS, and IOTN (DHC, AC).

The subjects underwent an examination to evaluate the DHC index of IOTN, and the data were recorded in the examination form. The examinations were carried out under natural light using a dental mirror and a periodontal probe to measure overbite and overjet.

The contents of the questionnaire

Oral esthetic subjective index scale

This section of the questionnaire consisted of 5 questions with 7-point Likert scale about their self-perception of oral esthetics from never = 0 to always = 7. The questions evaluated each patient's satisfaction with their appearance and its effect on self-confidence and the individual's social relationships. The possible range of this score was 7–35.[9,27]

Since the OASIS questionnaire has not been translated into Farsi, the questionnaire was translated and evaluated for validation by five orthodontists. In addition, to evaluate the face validity and the reliability of the translated questionnaire, a pilot study was carried out with a sample size of fifty individuals. The reliability of the questionnaire was confirmed (Cronbach's alpha = 0.87).

Visual analog scale

The VAS on the questionnaire consisted of a horizontal 100-mm line, with 0 indicating the least dental attractiveness and 100 indicating the most attractive dental appearance. The subjects were asked to mark a point on the line to determine their self-perceived dental attractiveness.[13,16] The following criteria were used in the present study to determine the need for orthodontic treatment:

- 0–49: Definite need for treatment
- 50–75: Moderate need for treatment
- 76–100: No need for treatment.

Index of orthodontic treatment need

The IOTN has two separate components, a clinical component called the DHC and an AC.

DHC incorporates the various occlusal traits considered to increase the morbidity of dentition. There are five grades within the DHC: Grade 1 and 2 represent no need for treatment, Grade 3 represents borderline need, and Grade 4 and 5 represent a need for orthodontic treatment. DHC was determined by occlusal examination of two calibrated examiners.

The AC consists of 10 color photographs showing dentitions that differ in attractiveness: Grade 1

represents the most attractiveness and Grade 10 the least attractiveness, the photographs were shown to the participants, and then asked them to match his or her dental appearance with one of the series of photographs. The 4 first photographs represented no orthodontic need, 5–7 represented borderline need, and 8–10 considered as definite orthodontic need.[8,18]

Calibration

The examinations were carried out by two examiners. A pilot study was carried out with fifty subjects to calibrate the two examiners with each other and with the orthodontist as the gold standard. Intraclass coefficient was used to evaluate the correlation between the examiners and the gold standard and with each other (intraclass correlation coefficient = 0.92 for both examiners).

To carry out test/retest, two subjects were randomly selected for each fifty subjects and underwent reexamination by the same examiners using the recorded codes. Then the correlation of the results of the second and first examination was analyzed. The intraclass coefficient for each examiner was over 0.9.

Statistical analysis

Cronbach's alpha was used to evaluate the reliability of the Persian version of OASIS. Intraclass coefficient was used to evaluate the correlation of data collected for calibration and test/retest. Descriptive statistics were used for the analysis of descriptive data, and Spearman's correlation coefficient was used to evaluate the correlation of indices. Mann–Whitney U-test was used to analyze the relationship between demographic data and the indices.

Sensitivity, specificity, and the positive and negative pedicure values were calculated, for self-perceived indices. Sensitivity, test the possibility of identifying those with the disease correctly in a method (true positive rate), while specificity test the ability of correctly identifying those without the disease in a method (true negative rate). These values of the three self-perceived indices were calculated in terms of DHC as for definitive treatment need.

RESULTS

A total of 993 subjects were examined in the present study; 30 subjects (3%) were excluded from the study due to a history of orthodontic treatment or receiving orthodontic treatment at the time of examination (response rate = 96.9). Of 963 subjects,

262 (27.6%) were male and 701 (72.8%) were female, with a mean age of 21.46 years (range of 17–28 years). Based on the results of Kolmogorov–Smirnov test, the data of OASIS, VAS, DHC, and AC did not exhibit normal distribution ($P < 0.001$).

The percentages of definitive need for orthodontic treatment based on DHC, AC, OASIS, and VAS indices in the participants were 34.5%, 10.1%, 13.9%, and 30.9%, respectively [Table 1]. Based on Spearman's correlation analysis, all the three self-perceived indices had a weak but significant correlation with the DHC index ($P < 0.01$), with the VAS index exhibiting the highest correlation with DHC ($\rho = 0.241$) [Table 2].

Comparison of the mean AC, OASIS, and VAS scores according to DHC category showed a trend of higher AC and OASIS scores and lower VAS scores for the subjects with more treatment need [Table 3]. Sensitivity, specificity, and negative and positive predictive values of the three self-perceived indices in terms of DHC for definitive treatment need were calculated. In this context, of all the indices, VAS had the highest sensitivity (44.6%) and negative predictive value (72.3%), AC had the highest specificity (92.7%), and OASIS had the highest positive predictive value (55.2%) to determine the definitive need for orthodontic treatment [Table 3].

Based on the results, only the mother's educational level had a weak but significant correlation with VAS ($\rho = 0.150$, $P < 0.001$). Father's educational level, age, and the family's economic status had no significant correlation with the indices evaluated.

Based on the results of Mann–Whitney U-test, there was no significant relationship between gender and any of the indices evaluated.

DISCUSSION

The need for orthodontic treatment cannot be determined solely based on dental and occlusal characteristics evaluated by the dentist; rather, such a need might be under the influence of the cultural, social and economic circumstances and an individual's perception of his/her facial esthetics. Therefore, during evaluations for such a need indices that have incorporated the patient's appraisal of the problem can also be used.[1,3,18,19]

The present study showed that OASIS, AC, and VAS indices are rather favorable for use in association with normative indices.

Table 1: The percentages of the need for orthodontic treatment based on the indices evaluated

Index	Need		
	No need for treatment	Moderate need for treatment	Definitive need for treatment
DHC	36.7	28.9	34.5
AC	60.1	29.8	10.1
OASIS	50.5	35.6	13.9
VAS	22.4	46.6	30.9

VAS: Visual analog scale; OASIS: Oral esthetic subjective index scale; AC: Esthetic component; DHC: Dental health component

Table 2: The correlation of different indices based on Spearmen's analysis (ρ) (P<0.01)

	DHC	AC	OASIS	VAS
DHC	1	0.207	0.186	0.241
AC	-	1	0.194	0.288
OASIS	-	-	1	0.326
VAS	-	-	-	1

VAS: Visual analog scale; DHC: Dental health component; AC: Esthetic component; OASIS: Oral esthetic subjective index scale

Table 3: Sensitivity, specificity, and the negative and positive predictive value percentages of the three self-perceived indices based on dental health component for determination of the definitive need for orthodontic treatment

Index	Need		
	AC	OASIS	VAS
Sensitivity	15.4	22.3	44.6
Specificity	92.7	90.5	76.2
Positive predictive value	52.6	55.2	49.7
Negative predictive value	67.6	68.9	72.3

AC: Esthetic component; OASIS: Oral esthetic subjective index scale; VAS: Visual analog scale

In studies by Flores-Mir *et al.*[11] and Mir[27] a significant correlation was shown between AC, OASIS, and VAS self-perceived indices. In addition, in studies by Mandall *et al.*[12] and Petersen and Dahlström[15] significant correlation was shown between AC and DHC indices, consistent with the results of the present study.

Despite the correlation between these three self-perceived indices, the percentages of treatment needs calculated in a community using these three indices are different.[11,23,27,30] Such differences might be attributed to differences in individuals' self-perceptions about their esthetic appearance by these indices.

The difference in the results of the AC and DHC index is due to the confinement of AC to 10 intraoral photos which are intended to evaluate the patient's opinion

about the esthetic appearance of their anterior teeth; however, the DHC evaluated the various occlusal traits in both anterior and posterior teeth.

Differences in the OASIS index and DHC might be attributed to the fact that this index makes an attempt to evaluate the perceptions of others and themselves, as well as, questions about their previous behavior related to the appearance of their teeth by asking 5 relevant questions.[9,11,12] Therefore, it appears the age, social, and cultural factors might affect the selection of the appropriate response, so the differences may be expected.

Compared to the two former indices, VAS is an easy and understandable index for all the age groups and social levels, and it appears the ease of using this index increases the screening rate.

Since sensitivity and specificity of self-perceived indices have not been calculated in previous studies, and also due to determining the need for orthodontic treatment based on self-perception, it is necessary to determine sensitivity and specificity of these indices separately for each community.

Based on the results of this study, VAS exhibited a mildly higher sensitivity. Since VAS is a general and completely nonspecific index and is easy for all the community members at all ages with different educational levels to understand, such a finding can be justified. In a study by Borzabadi-Farahani and Eslamipour[28] in 2009 in Isfahan on adolescents aged 11–14, the need for orthodontic treatment based on DHC and AC of IOTN was reported to be 36.1% and 10.1%, respectively, consistent with the present study (DHC = 34.5% and AC = 17.9%). The difference between these two studies might be attributed to differences in the age groups evaluated in these two studies. In studies by Flore-Mir *et al.*[11,27] in 2007 on freshmen in Peru, gender, age, and the family's economic status had no effect on the self-perceived and normative evaluation of orthodontic treatment need, consistent with the results of the present study and some other studies.[11,27,29,30] In addition, Mir[27] reported a prevalence rate of 13.01% for subjects receiving orthodontic treatment at the time of examination, different from that in the present study (3%), which might be attributed to cultural and economic differences and insurance coverage in these communities.

The results of the present study showed a mild relationship between the mother's educational level and VAS index, which might be justified by the fact that parents' education affects understanding and the expectations of the individual and the acquaintances.

Finally, since the sensitivity and specificity of none of self-perceived indices in this study cannot be accepted for screening purposes, these indices are not recommended as appropriate self-perceived criteria for screening in the community; however, they are suggested to be used in association with the professional evaluations by orthodontists for making decisions about planning orthodontic treatment for their patients based on the patient's age and the feasibility of the plan and and preferences of the dentist.

It is suggested that further studies be carried out to compare the self-perceived indices between groups with malocclusion and those without malocclusion so that the accuracy and efficacy of these indices can further be elucidated.

CONCLUSION

- The three indices of AC, OASIS, and VAS exhibited a poor but significant correlation with the DHC index
- Due to low sensitivity, the AC, OASIS, and VAS indices cannot be applied as proper self-perceived criteria for screening purposes in community
- Age and gender of the patient, and also the economic status of the family had no significant correlation with the these indices.

Conflicts of interest
The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

REFERENCES

1. Espeland LV, Stenvik A. Perception of personal dental appearance in young adults: Relationship between occlusion, awareness, and satisfaction. Am J Orthod Dentofacial Orthop 1991;100:234-41.
2. Järvinen S. Indexes for orthodontic treatment need. Am J Orthod Dentofacial Orthop 2001;120:237-9.
3. Gosney MB. An investigation into some of the factors influencing the desire for orthodontic treatment. Br J Orthod 1986;13:87-94.
4. Kiekens RM, Maltha JC, van't Hof MA, Kuijpers-Jagtman AM. Objective measures as indicators for facial esthetics in white adolescents. Angle Orthod 2006;76:551-6.

5. Searcy VL, Chisick MC. Perceived, desired, and normatively determined orthodontic treatment needs in male US Army recruits. Community Dent Oral Epidemiol 1994;22:437-40.

6. Sheats RD, McGorray SP, Keeling SD, Wheeler TT, King GJ. Occlusal traits and perception of orthodontic need in eighth grade students. Angle Orthod 1998;68:107-14.

7. Jenny J, Cons NC, Kohout FJ, Jakobsen J. Differences in need for orthodontic treatment between Native Americans and the general population based on DAI scores. J Public Health Dent 1991;51:234-8.

8. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989;11:309-20.

9. 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;13:326-34.

10. Dixon JS, Bird HA. Reproducibility along a 10 cm vertical visual analogue scale. Ann Rheum Dis 1981;40:87-9.

11. Flores-Mir C, Major PW, Salazar FR. Self-perceived orthodontic treatment need evaluated through 3 scales in a university population. J Orthod 2004;31:329-34.

12. Mandall NA, McCord JF, Blinkhorn AS, Worthington HV, O'Brien KD. 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.

13. Maxwell C. Sensitivity and accuracy of the visual analogue scale: A psycho-physical classroom experiment. Br J Clin Pharmacol 1978;6:15-24.

14. Ohnhaus EE, Adler R. Methodological problems in the measurement of pain: A comparison between the verbal rating scale and the visual analogue scale. Pain 1975;1:379-84.

15. Petersen B, Dahlström L. Perception of treatment need among orthodontic patients compared with professionals. Acta Odontol Scand 1998;56:299-302.

16. Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain 1983;17:45-56.

17. Schiff A. Psychophysics and patient self-ratings. Br J Clin Pharmacol 1979;7:124-9.

18. Ngom PI, Brown R, Diagne F, Normand F, Richmond S. A cultural comparison of treatment need. Eur J Orthod 2005;27:597-600.

19. Stenvik A, Espeland L, Linge BO, Linge L. Lay attitudes to dental appearance and need for orthodontic treatment. Eur J Orthod 1997;19:271-7.

20. Ackerman M. Evidence-based orthodontics for the 21st century. J Am Dent Assoc 2004;135:162-7.

21. Ismail AI, Bader JD; ADA Council on Scientific Affairs and Division of Science; Journal of the American Dental Association. Evidence-based dentistry in clinical practice. J Am Dent Assoc 2004;135:78-83.

22. Phillips C, Tulloch C, Dann C. Rating of facial attractiveness. Community Dent Oral Epidemiol 1992;20:214-20.

23. Hedayati Z, Fattahi HR, Jahromi SB. The use of index of orthodontic treatment need in an Iranian population. J Indian Soc Pedod Prev Dent 2007;25:10-4.

24. de Oliveira CM, Sheiham A. The relationship between normative orthodontic treatment need and oral health-related quality of life. Community Dent Oral Epidemiol 2003;31:426-36.

25. Burden DJ, Pine CM, Burnside G. Modified IOTN: An orthodontic treatment need index for use in oral health surveys. Community Dent Oral Epidemiol 2001;29:220-5.

26. Soh J, Sandham A. Orthodontic treatment need in Asian adult males. Angle Orthod 2004;74:769-73.

27. Mir CF. Correlation of four different scales for orthodontic treatment need assesment in a Peruvian university population. J Orthod 2002;28:284-9.

28. Borzabadi-Farahani A, Eslamipour F. Orthodontic treatment needs in an urban Iranian population, an epidemiological study of 11-14 year old children. Eur J Paediatr Dent 2009;10:69-75.

29. Asgari I, Ahmady AE, Yadegarfar G, Eslamipour F. Evaluation of orthodontic treatment need by patient-based methods compared with normative method. Dent Res J (Isfahan) 2013;10:636-42.

30. Hamdan AM. The relationship between patient, parent and clinician perceived need and normative orthodontic treatment need. Eur J Orthod 2004;26:265-71.