Original Article

Agreement and association between normative and subjective orthodontic treatment need using the Index of Orthodontic Treatment Need

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Abstract:

AIMS: To determine the association and level of agreement between young adults' perception of orthodontic treatment need (subjective need) and the orthodontists' assessment of treatment need (normative objective need).

METHODOLOGY: For this study, 670 students [280 males and 390 females; mean age (standard deviation) of 15.32 (1.81) years] were selected from public and private schools from different demographic areas of Jeddah city, Saudi Arabia, and divided into two age groups (12–15 years) and (16–19 years). All the participants were examined, and the Index of Orthodontic Treatment Need (IOTN) components [dental health component (DHC) and aesthetic component (AC)] were recorded.

RESULTS: Kappa statistics showed a statistically significant but fair agreement between clinician AC (CAC) and student AC (SAC) assessments in both age groups ($k = 0.343$ and 0.334, respectively; $P < 0.001$), whereas Spearman's correlation coefficient showed a statistically significant but moderate association ($r = 0.487$ and 0.517, respectively; $P < 0.001$). The degrees of agreement were 76.4% and 76.7% at the no-need and mild-need levels of treatment, respectively. There was a statistically significant but weak association between the subjective and normative needs (SAC and IOTN-DHC) in both age groups ($r = 0.336$ and 0.360, respectively; $P < 0.001$). However, the degrees of agreement were 58.9% and 61.5% at the no-need and mild-need levels of treatment, respectively.

CONCLUSION: Significant but weak positive association was found between the normative and subjective orthodontic treatment needs, indicating a lack of understanding of the nature of malocclusion and its consequences. Thus, promoting further knowledge and awareness of malocclusion are indicated.

Keywords:

Index of Orthodontic Treatment Need, normative need, patient education, subjective orthodontic need

Introduction

In modern society, malocclusion, which affects oral health, is becoming increasingly prevalent. Considering its consequences that affect several aspects of quality of life, such as appearance, function, personal and social relationships, and psychological aspects,[1] several authors believe that the main motivation of patients for seeking orthodontic treatment is aesthetics to improve their attractiveness and, thus, their social life.[2-4]

Patient selection for orthodontic treatment involves assessing both the objective need, which is based on the specialist's clinical diagnosis, and the subjective need, which involves the patient's self-perception and aesthetic factors. Professional specialist assessment of malocclusion is important, but at the same time, aesthetic perception of

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the patient cannot be underestimated.[3] Thus, patients' assessments of their aesthetic needs must be included in the evaluation of orthodontic treatment needs.[5-7]

To determine the need for orthodontic services in any population, treatment requirements must be estimated,[8] and to perform such estimation, many occlusal indexes have been established to categorize treatment need severity, such as the occlusal index, treatment priority index, and dental aesthetic index. These indexes measure the deviation from normal. On the other hand, the Index of Orthodontic Treatment Need (IOTN) and the Grade Index Scale for Assessment Treatment Need measure malocclusion grades based on the severity and type of malocclusion.[7]

The IOTN was designed by Brook and Shaw[9] and is one of the most widely used diagnostic tools in orthodontics; it assesses malocclusion on the basis of both normative and subjective treatment needs.[10] The IOTN fulfills the World Health Organization's requirements.[11] Several studies have shown the validity of the IOTN; it is accurate, reproducible, and easy to use and takes only 1-3 minutes to perform. Therefore, many studies consider it as a powerful tool to assess treatment needs.[7,9,12-14] Hassan also concluded that IOTN is a valuable tool for screening and is applicable to the population in the western region of the Kingdom of Saudi Arabia.[15]

IOTN has two components. One is the dental health component (DHC), which represents the normative component of the index and is composed of five grades ranging from "no treatment need" at grade 1 to "extreme need" at grade 5. It documents severity using specific malocclusion characteristics such as overjet, crossbite, displacement, overbite, and missing teeth.[7,13,14] The second is the aesthetic component (AC), which represents the subjective component of the index. It is composed of 10 photographs of the anterior teeth, ranging from grade 1 as "the most attractive" to grade 10 as the "least attractive" dental appearance. It provides a visual assessment of patients' perception of their aesthetic treatment needs.[3,13,14] However, the greatest limitations of the AC index are that it does not measure occlusal traits and that it is subjective.[8]

Literatures have shown a range of agreement between normative and self-perceived treatment needs from absent to moderate associations.[14,16,17] Esthetic treatment requires that the patient and the clinician have mutual agreement on the severity of the presenting malocclusion. Such agreement of perception affects treatment demands, improves patient understanding, and assists in better communication between clinicians and patients.[14] Hence, this study is important because it evaluated the degree of agreement between the patient's and the clinician's perceptions of the severity of malocclusion, that is, knowing the degree of agreement between the normative and subjective needs of the patient on the basis of the severity of malocclusion. This will help evaluate patients' understanding and findings may improve their collaboration.

The aim of this study was to calculate the level of agreement and association between students' assessments of their orthodontic treatment needs (subjective need) and orthodontists' assessment of treatment need (normative need) using the IOTN components (AC and DHC).

Methodology

Ethical approval for this cross-sectional, descriptive, and analytical study was obtained from the research ethics committee of King Abdulaziz University in Jeddah city Kingdom of Saudi Arabis (RCE 040-13). This study was designed according to the principles of Declaration of Helsinki.

Study sample

This study was conducted in Jeddah Saudi Arabia. The study sample was composed of 670 students who met the inclusion criteria; 280 (41.8%) were male and 390 (58.2%) were female. The students' ages ranged from 12 to 19 years, with a mean age (standard deviation) of 15.32 (1.81) years. The study sample was divided into two age groups as follows: age group 1 included students whose ages ranged from 12 to 15 years, whereas age group 2 included students whose ages ranged from 16 to 19 years. The sample was selected from public and private schools from different demographic areas of Jeddah city.

Inclusion criteria

Students who did not receive or undergo orthodontic treatment, age 12–19 years, and signed the consent form.

Exclusion criteria

Students who had or were undergoing orthodontic treatment and those with any type of craniofacial anomaly.

Demographic data were collected from all the participants, including age, sex, date of birth, type of schooling, and educational level.

Assessment of orthodontic treatment need and participants' perception of orthodontic treatment need (subjective need)

In this study IOTN was used to assess the orthodontic treatment need. It is composed of two components, the DHC and AC. The DHC consists of different traits of malocclusion, ranked according to the severity into five grades as follows: 1 and 2 indicate no or little treatment

need, 3 moderate or borderline treatment need, and 4 and 5 severe to extreme treatment need. The AC is composed of 10 photographs,[13] representing different levels of anterior malocclusion severity and attractiveness. After the self-evaluation of malocclusion severity grade from 1 to 10, data were recorded using the following scale: grades 1–4 no or slight need, grades 5–7 borderline or moderate need, and grades 8–10 definite need for orthodontic treatment.[13]

The researchers assessed the students' need for orthodontic treatment and the severity of their malocclusions under natural light, using the DHC of the IOTN. After that, the AC of the IOTN was presented to the participants to measure their aesthetic self-perception. The participants selected the photograph that was most similar to their dental appearance. The examiners also chose the photograph that represented the student's dental appearance. The examiners (the authors) were calibrated before examining the participants to reduce inter- and intraexaminer errors. The intraexaminer kappa values for the DHC and AC were 0.91 and 0.85, respectively, which indicated good intraexaminer reproducibility.

Statistical analyses

Statistical analyses were performed using SPSS 20 (Statistical Package for the Social Sciences, version 20; SPSS Inc., Chicago, IL, USA) as follows:
1. Descriptive analyses of the data were performed
2. Cohen's kappa statistics test was used to measure the interrater agreement of IOTN-AC for both the clinicians and the students. Cohen's kappa interpretation system was adopted from the Viera and Garret article (0.01–0.2 slight, 0.21–0.4 fair, 0.41–0.6 moderate, 0.61–0.8 substantial, 0.81–0.99 perfect)[18]
3. Spearman's correlation coefficient (r) was used to assess the association between student aesthetic component (SAC) and IOTN-DHC, and between SAC and clinician aesthetic component (CAC). Spearman's correlation coefficient interpretation system was adopted from the Schober article (0.1–0.39 weak, 0.4–0.69 moderate, 0.7–0.89 strong, 0.9–1 very strong)[19]
4. The level of significance was set at 0.05.

Results

The agreement between CAC and SAC in age group 1 (12–15 years old) was fair and statistically significant (kappa statistics = 0.343, $P < 0.001$). The association (Spearman's correlation coefficient) between CAC and SAC was positive, moderate, and statistically significant ($r = 0.487$, $P < 0.001$); 76.4% of the students who rated themselves as having a mild malocclusion severity agreed with their examiner that the level of their orthodontic need was also mild [Table 1].

The agreement between CAC and SAC in age group 2 (16–19 years old) was also fair and statistically significant (kappa statistics = 0.334, $P < 0.001$). The association between CAC and SAC was positive, moderate, and statistically significant ($r = 0.517$, $P < 0.001$); 76.7% of the students who rated themselves as having a mild malocclusion severity agreed with their examiner that the level of their orthodontic need was also mild. Likewise, 55.4% of the students who rated themselves as having a moderate malocclusion severity agreed with their examiner that the level of their orthodontic need was also moderate [Table 2].

The association between normative and subjective need (IOTN-DHC and SAC) in both age groups was positive, weak, and statistically significant ($r = 0.336$ and 0.360, respectively; $P < 0.001$); 58.9% of the students in age group 1 who rated themselves as having a mild malocclusion severity agreed with their examiner that the level of their orthodontic need was also mild, whereas 61.5% of the students in age group 2 who rated themselves as having a mild malocclusion severity agreed with their examiner that the level of their orthodontic need was also mild [Table 3].

The scatterplot of the SAC and CAC assessments for the whole sample is shown in Figure 1. It was clear that most of the agreement is at the no-need/mild-need level.

Figure 1: Scatterplot matrix between the students' Aesthetic Component and clinician Aesthetic Component

Table 1: Agreement and association between CAC assessment and SAC assessment in the age group 1 (12-15 years old), showing, number (*n*), percentage (%), kappa value, Spearman's correlation coefficient, and *P* values

	CAC			Total	Kappa coefficient	P	Spearman's correlation coefficient	P
	Mild*, *n* (%)	Moderate*, *n* (%)	Severe*, *n* (%)					
SAC								
Mild*	**188 (76.4)**	50 (20.3)	8 (3.3)	246	0.343	<0.001	0.487[†]	<0.001
Moderate*	20 (31.7)	**33 (52.4)**	10 (15.9)	63				
Severe*	3 (23.1)	3 (23.1)	**7 (53.8)**	13				
Total	211	86	25	322				

CAC – Student aesthetic component; SAC – Student aesthetic component; IOTN-AC – Index of Orthodontic Treatment Need-aesthetic component *Mild=1–4 IOTN-AC grades, moderate=5–7 IOTN-AC grades, severe=8–10 IOTN-AC grades [†]Significant positive moderate correlation. Bolded values indicate the category with the most agreement between the variables

Table 2: Agreement and association between CAC assessment and SAC assessment in the age group 2 (16-19 years old), showing, number (*n*), percentage (%), kappa value, Spearman's correlation coefficient, and *P* values

	CAC			Total	Kappa coefficient	*P*	Spearman's correlation coefficient	*P*
	Mild*, *n* (%)	Moderate*, *n* (%)	Severe*, *n* (%)					
SAC								
Mild*	**211 (76.7)**	55 (20.0)	9 (3.3)	275	0.334	<0.001	0.517†	<0.001
Moderate*	14 (25.0)	**31 (55.4)**	11 (19.6)	56				
Severe*	5 (29.4)	6 (35.3)	**6 (35.3)**	17				
Total	230	92	26	348				

CAC – Student aesthetic component; SAC – Student aesthetic component; IOTN-AC – Index of Orthodontic Treatment Need-aesthetic component *Mild=1–4 IOTN-AC grades, moderate=5–7 IOTN-AC grades, severe=8–10 IOTN-AC grades †Significant positive moderate correlation. Bolded values indicate the category with the most agreement between the variables

Table 3: Association between IOTN-DHC and SAC assessment in AG1 and AG2, showing number (*n*), percentage (%), Spearman's correlation coefficient (*r*), and *P* value

	IOTN-DHC						Total		Spearman's correlation coefficient		*P*
	Mild*, *n* (%)		Moderate*, *n* (%)		Severe*, *n* (%)						
	AG1	AG2	AG1	AG2	AG1	AG2	AG1	AG2	AG1	AG2	
SAC											
Mild†	**145 (58.9)**	**169 (61.5)**	64 (26.0)	55 (20.0)	39 (15.8)	51 (18.5)	246	275	0.336‡	0.360‡	<0.001
Moderate†	19 (30.2)	12 (21.4)	**14 (22.2)**	**17 (30.4)**	30 (47.6)	27 (48.2)	63	56			
Severe†	5 (38.5)	5 (29.4)	1 (7.7)	3 (17.6)	**7 (53.8)**	**9 (52.9)**	13	17			
Total	178	186	68	75	76	87	322	348			

IOTN-DHC – Index of Orthodontic Treatment Need-dental health component; SAC – Student aesthetic component; AG1 – Age group 1; AG2 – Age group 2 *Mild=1–2 IOTN-DHC grades, moderate=3 IOTN-DHC grades, severe=4–5 IOTN-DHC grades †Mild=1–4 IOTN-AC grades, moderate=5–7 IOTN-AC grades, severe=8–10 IOTN-AC grades ‡Significant positive weak correlation. Bolded values indicate the category with the most agreement between the variables
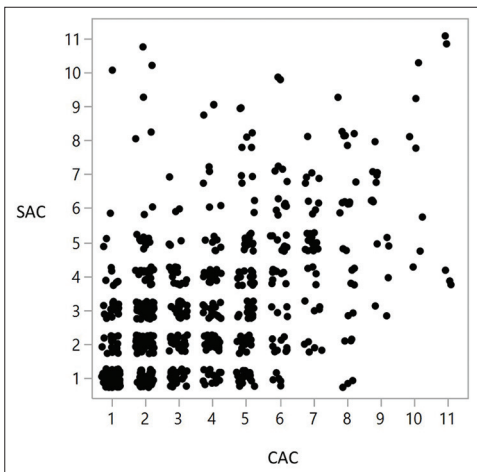
Figure 1: Scatterplot matrix showing the relation between the students' Aesthetic Component and clinician Aesthetic Component

Discussion

A better understanding of patients' perception of their malocclusion severity and how much this understanding agrees with the normative need is an essential step for excellence in orthodontic treatment planning. It would give the orthodontist an idea of the patient's expectations. These expectations should be reasonably in line with the normative level of the orthodontic problem; this would help patients understand their case better and, thus, improve cooperation and compliance.

Comparison of CAC and SAC assessments

The students and examiners showed a significant positive agreement at the no-need/mild-need level in 76% of the cases in both age groups; however, as the severity of the malocclusion increased, this agreement decreased. This could be due to the participants' lack of experience. In a study conducted by Al-Barakati[20] in the eastern region of the Kingdom of Saudi Arabia, she found that the investigator's scoring showed that 46% of the participants fell into the "slight need for treatment" category, whereas 29.1% of the participants graded themselves as having a "slight need for treatment."

In the study by Aikins *et al.*,[5] 71 of 108 cases were in agreement at the no-need/mild-need level; this represented 65.4% of the cases. The cultural and ethnic differences might be the reason for the difference in percentage.

This study showed a fair but statistically significant agreement with a moderate positive correlation between IOTN-AC of the students and that of the clinicians in both age groups. This correlation coefficient is almost identical to the results of the study by Siddiqui *et al.* ($k = 0.339$, $r = 0.516$, $P = 0.001$). However, Badran's study[21] found a weak but significant correlation between the examiners and students ($r = 0.360$, $P = 0.001$). Aikins *et al.*[5] also showed a weak correlation coefficient ($r = 0.24$). Cultural and age group similarities could contribute to this resemblance of the results. However, as these

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correlation coefficients were <0.6, we can conclude that the agreement between the clinicians' and students' perceptions is clinically irrelevant.[14,21]

However, when Soh and Sandham[22] studied Asian male army recruits age 17–22 years, they found no correlation between the participants and the examiners ($r = 0.027$, $P > 0.05$). This difference could be due to the substantial differences in the sample related to the participants' interest, culture, and ethnicity, as suggested by Asgari *et al.*,[6] who also found no agreement regarding IOTN-AC ($k = 0.124$). Al-Barakati[20] found a statistically significant but weak correlation ($P < 0.05$), with no agreement between orthodontists and patients using kappa statistics ($k = 0.076$).

Several other studies concur with this study in that the assessments of both the participants and the examiners using IOTN-AC are inclined toward the attractive end, perhaps because adolescents want to be socially appealing to fulfill their psychosocial needs.[16,17,20,23,24] However, other studies showed different results.[22,25]

Comparison of normative (IOTN-DHC) and subjective (SAC) orthodontic needs

This study showed that self-perceived and normative needs for treatment are in agreement in 58.9% and 61.5% of the cases in age groups 1 and 2, respectively, at the no-need/mild-need level. However, Hassan's study showed that 60.6% of participants thought they slightly need or do not need orthodontic treatment, whereas examiners thought that 15.2% of the sample was at the no-need/mild-need level.[15] This difference could be a result of both an overestimation of the severity of the case as a result of the nature of the IOTN itself and the participants' lack of awareness of the severity of their malocclusions, as claimed by the author.[15] This difference between normative and subjective needs for treatment was also observed in a study conducted in Peru, where they found that DHC grades 1 and 2 accounted for 35.2% of the sample, whereas AC showed that almost 87% of the sample fell into the no-need/mild-need category.[26] The results of other studies were in accordance with those of this study.[5,27]

This study shows a statistically significant but weak association ($r = 0.336$ and 0.360, $P < 0.001$) between the subjective and normative perceptions of the orthodontists (IOTN-AC and IOTN-DHC) in both age groups; several other studies also found similar associations.[14,28,29] This could be because the DHC takes into consideration posterior malocclusion, which is not reflected in the aesthetic evaluation of the IOTN-AC, which is considered to be one of the shortcomings of the aesthetic indices.[30] Similar results were obtained in the study by Aikins *et al.*,[5] who also found a weak but

significant correlation when they evaluated Nigerian public school students age 12–18 years ($r = 0.24$, $P < 0.001$).

Hassan[15] published a study conducted in the same area as that of this study. He showed that the subjective and normative needs were significantly different, and a Spearman's test revealed no association between the two components ($r = -0.045$). Hassan suggested that this absence of association was due to the lack of awareness among Saudis. Almost 12 years later, this study shows a substantial difference to Hassan's study findings,[15] which reflects the increase in awareness among the Saudis population about aesthetic perceptions and the severity of current malocclusions. Furthermore, in their study that included 597 Iranian adolescent students (mean age, 14.9 years), Asgari *et al.*[6] also found slight agreement between DHC and the self-perceived AC ($k = 0.124$); their explanation was that young adults lean toward showing themselves in a perfect state.

Conclusion

1. A significant but fair level of agreement was found between the students' and the examiners' perception of malocclusion, indicating that both the students and examiners are inclined to evaluate malocclusions toward the attractive end
2. A statistically weak association was found between the normative (IOTN-DHC) and subjective (IOTN-AC) orthodontic needs, indicating that the students were unable to fully understand their clinical conditions
3. Owing to this lack of understanding, this study suggests the enhancement of public understanding of orthodontic need and consequences through more educational aids and audiovisual media.

Conflicts of interest
There are no conflicts of interest

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