Orthodontic treatment needs of 12–15-year-old students in Shiraz, Islamic Republic of Iran

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المعالجة المتعلّقة بتقويم الأسنان تحتاج إلى تقييم وضع الطلاب بين 12 و15 عاماً في شيراز بجمهورية إيران الإسلامية

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الخلاصة: اعتمدت الدراسة على مَنْسَب جماليَّة الأسنان بُغْيَةَ تقييم الحاجة إلى تقويم الأسنان لدى المراهقين في المدارس الإعدادية الحكومية في مدينة شيراز، بجمهورية إيران الإسلامية. واختيرت عينة عشوائية قوامها 900 طالب (450 فتاة، و450 فتى) تتراوح أعمارهم بين سن 12 و15 عاماً، ممَّن لم يتلقّوا معالجة لتقويم الأسنان أثناء الدراسة التي استمرت ما يربو على شهرَيْن في عام 2004، أو قبل ذلك. فوجد أن معظم الطلبة (70.1٪) لديهم إطباق طبيعي أو سوء إطباق طفيف لا يستلزم إجراء معالجة لتقويم الأسنان، في حين احتاج 4.2٪ فقط إلى المعالجة بسبب سوء الإطباق الذي يؤدِّي إلى نوع من الإعاقة. وقد اتضح أن درجات سوء الإطباق الوخيمة، والوخيمة للغاية تنتشر بين الفتيان أكثر من الفتيات. ولكن الشباب الإيرانيون في شيراز يتمتَّعون بمظهر أسنان أفضل من سكان المناطق الأخرى، وهم أقل احتياجاً لتقويم الأسنان.

ABSTRACT The study used the Dental Aesthetic Index to evaluate the orthodontic treatment needs of adolescents from state junior high schools in Shiraz city, Islamic Republic of Iran. A random sample of 900 pupils (450 girls, and 450 boys) aged 12–15 years old, who received no orthodontic treatment before or during the study, were selected randomly over 2 months in 2004. Most of the pupils (70.1%) had normal or minor malocclusion indicating no need for orthodontic treatment. Only 4.2% had disabling malocclusion that required treatment. Severe and very severe grades of malocclusion were more common in boys than girls. Iranian youth from Shiraz had better dental appearance and needed less orthodontic treatment than other populations.

Besoins en soins orthodontiques des élèves âgés de 12 à 15 ans à Chiraz (République islamique d'Iran)

RÉSUMÉ L'étude s'est appuyée sur l'index esthétique dentaire pour évaluer les besoins en soins orthodontiques d'adolescents scolarisés dans les collèges (*junior high schools*) publics de la ville de Chiraz en République islamique d'Iran. Un échantillon aléatoire de 900 élèves (450 filles et 450 garçons) âgés de 12 à 15 ans et n'ayant reçu aucun traitement orthodontique avant ou pendant l'étude a été sélectionné sur une période de 2 mois en 2004. La plupart des élèves (70,1 %) présentaient une normocclusion ou une malocclusion mineure ne nécessitant pas de traitement orthodontique. Une malocclusion invalidante exigeant un traitement n'a été observée que dans 4,2 % des cas. On a constaté une plus grande fréquence des malocclusions de grades sévère et très sévère chez les garçons que chez les filles. Les jeunes Iraniens originaires de Chiraz avaient une apparence dentaire plus satisfaisante et réclamaient moins de soins orthodontiques que les autres populations.

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Introduction

Several studies have been reported concerning the epidemiology of malocclusion and need for orthodontic treatment. Although data on orthodontic awareness and treatment needs are very scanty, malocclusion is undoubtedly a public health concern in young populations. The Islamic Republic of Iran has one of the highest proportions of young people in the world [*1,2*]; therefore a study of malocclusion is important from a population health viewpoint. There are few studies to estimate the proportion of the population that requires orthodontic treatment in this country.

There are many orthodontic indices that combine physical and visual elements to provide a measure of the degree malocclusion. The Dental Aesthetic Index (DAI) is an orthodontic index that links clinical and aesthetic components mathematically to produce a single score. It also aims to predict the clinical judgements of orthodontists by separating handicapping from non-handicapping malocclusions [*3*]. Compared with other indices, the DAI is simpler and economical in terms of time [*4*]. The DAI outlines criteria for the assessment of dentofacial anomalies including missing teeth, crowding, spacing, diastema, overjet, reverse overjet, open bite and molar relationship. DAI can be used easily in different communities and populations by dentists and/or dental assistants [*5–7*]. It assists in decision-making about where to allocate government resources for treatment of malocclusion [*8,9*].

An orthodontic needs assessment using DAI has not been performed for Iranian students in the city of Shiraz. This study was designed to determine the orthodontic treatment needs of 12–15-year-old students in the city of Shiraz, Islamic Republic of Iran.

Methods

The study was performed in March and April 2004 in the junior high schools in the city of Shiraz, Islamic Republic of Iran. Approval for the study was obtained from districts board of education as well as from school authorities and it was conducted according to the Shiraz University of Medical Sciences ethical guidelines

In Shiraz, secondary education is divided into 4 districts. Each district has 42–59 state high schools (22–32 for girls and 20–27 for boys). One boys' and one girls' junior high school were randomly selected in each district. At each school, only those who agreed to participate in the study were included. None of the children had a history of orthodontic treatment. A total of 900 students (450 male, 450 female) participated in the study. The participants were also asked to complete a questionnaire about demographic characteristics including sex, family size, parent's education and father's job.

The professional assessment was performed by a dentist using the DAI according to the World Health Organization (WHO) guidelines. All the 10 components were measured (Table 1). The assessment was performed under natural light using disposable gloves, tongue blades and mouth mirrors. A periodontal probe was used for millimetre measurements.

The data were analysed using the Student t-test and chi-squared test. $P \leq 0.05$ was considered as statistically significant.

Results

There was no significant difference between the DAI scores from male and female students: mean (standard deviation) score 24.8 (6.1) versus 22.1 (5.3) respectively.

Table 1 **Standard Dental Aesthetic Index (DAI) scoring**

DAI components		Rounded weights
1	Number of missing visible teeth (incisors, canines and premolars teeth in the maxillary and mandibular arches)	6
2	Crowding in the incisal segments: 0 = no segment crowded, 1 = 1 segment crowded, 2 = 2 segments crowded	1
3	Spacing in the incisal segments: 0 = no spacing, 1 = 1 segment spaced, 2 = 2 segments spaced	1
4	Midline diastema (mm)	3
5	Largest anterior irregularity on the maxilla (mm)	1
6	Largest anterior irregularity on the mandible (mm)	1
7	Anterior maxillary overjet (mm)	2
8	Anterior mandibular overjet (mm)	4
9	Vertical anterior open bite (mm)	4
10	Antero-posterior molar relation; largest deviation from normal either left or right: 0 = normal, 1 = 1/2 cusp either mesial or distal, 2 = one full cusp or more either mesial or distal	3
11	Constant	13
Total		DAI score

Moreover, there was no statistically significant correlation between DAI scores and demographic characteristics such as the family size, parent's occupation or education (data not shown).

The orthodontic treatment needs of all students and for male and female students according to DAI score are shown in Table 2 and 3. Relative to female students a significantly lower percentage of male

Table 2 **Orthodontic treatment needs of students according to Dental Aesthetic Index (DAI) score**

DAI score	Severity levels and treatment	No.	%
≤ 25	Normal or minor malocclusion, No treatment need or slight need	631	70.1
26–30	Definite malocclusions, Treatment needed	160	17.8
31–35	Severe malocclusion, Treatment highly desirable	71	7.9
> 35	Very severe (handicapping) malocclusion, Treatment mandatory	38	4.2
Total		900	100.0

Table 3 **Orthodontic treatment needs of students according to Dental Aesthetic Index (DAI) score**

DAI score	Severity levels and treatment	Male		Female		*P*-value
		No.	%	No.	%	
≤ 25	Normal or minor malocclusion, No treatment need or slight need	280	62.2	351	78.0	< 0.001
26–30	Definite malocclusions, Treatment needed	97	21.6	63	14.0	0.003
31–35	Severe malocclusion, Treatment highly desirable	44	9.8	27	6.0	0.04
> 35	Very severe (handicapping) malocclusion, Treatment mandatory	29	6.4	9	2.0	< 0.001
Total		450	100.0	450	100.0	

students had normal occlusion or minor malocclusion with no need or slight need for treatment (78.0% versus 62.2%). Moreover, compared with female students a significantly higher percentage of male students scored with definite malocclusion and need for treatment (21.6% versus 14.0%). A significantly higher percentage of male than female students were defined with severe malocclusion for whom treatment was highly desirable (9.8% versus 6.0%). The percentage of male students with very severe (handicapping) malocclusion requiring mandatory treatment was significantly higher than that of female students (6.4% versus 2.0%).

The components of DAI score for male and female students are shown in Table 4. The frequencies of male and female students were not significantly different in spacing, diastema, anterior mandibular irregularity, reverse overjet and open bite malocclusions. Relative to female students, a significantly higher percentage of male students had malocclusions including missing teeth, crowding, anterior maxillary irregularity and overjet (Table 4).

Table 5 shows the mean DAI scores of Iranian students in the present study compared with other ethnic populations. DAI scores of Iranian students from the city of Shiraz were higher than Chinese and Nigerian, but less than other populations. Mean DAI for different racial populations were significantly different from each other ($P < 0.001$).

Discussion

The findings of the present study show that the mean DAI score of Iranian students from the city of Shiraz lies within the range reported by others from other parts of the world [*10,12–14,16,17*]. It also shows that a higher proportion of female students than male students were rated as having normal or minor malocclusion, whereas a lower proportion of them scored as having definite malocclusion, severe malocclusion or very severe malocclusion.

The mean DAI score was 23.5 and over two thirds of the secondary school children examined had a dental appearance that re-

Table 4 **Distribution of malocclusion traits according to Dental Aesthetic Index (DAI) score**

DAI component	Criteria	Male (*n* = 450) No.	%	Female (*n* = 450) No.	%	*P*-value
Missing teeth	≥ 1	44	9.8	13	2.9	< 0.001
Crowding	1–2	205	45.6	140	31.1	< 0.001
Spacing	1–2	110	24.4	96	21.3	0.27
Diastema (mm)	≥ 1	74	16.4	75	16.7	0.93
Anterior maxillary irregularity (mm)	> 1	158	35.1	80	17.8	< 0.001
Anterior mandibular irregularity (mm)	> 1	86	19.1	70	15.6	0.16
Overjet (mm)	≥ 4	96	21.3	58	12.9	< 0.001
Reverse overjet (mm)	< 0	4	0.9	9	2.0	0.26
Open bite (mm)	> 0	9	2.0	14	3.1	0.29
Molar relation	≥ 1/2 unit cusp	218	48.4	209	46.4	< 0.001

n = *total number of respondents.*

quired no orthodontic treatment. Statistical analysis showed that the mean DAI scores of Iranian students from the city of Shiraz were less than South Australian [*10*], New Zealand [*10*], local and white American [*17*], Japanese [*17*], Malaysian [*12,13*],

Table 5 **Mean Dental Aesthetic Index (DAI) scores for Iranian students and other populations**

Population [reference]	Sample size No.	Age range (years)	Mean (SD) DAI score		95% CI
Caucasian Americans [*5*]	1337	7–12	26.5	(7.8)	26.1–26.9
Native Americans [*5*]	485	7–12	31.8	–	–
Caucasian (S. Australia) [*29*]	5000	13	28.1	–	–
Japanese [*11*]	409	15–18	30.5	(8.3)	29.7–31.3
Caucasian Australians [*17*]	268	12–16	24.1	(6.4)	23.3–24.9
Poles (Lodz) [*28*]	1000	12–13	24.5	–	–
Malaysian [*13*]	1512	12–13	24.6	(13.6)	–
Chinese (Taiwan) [*17*]	176	18–24	22.3	–	–
Spanish [*14*]	744	14–20	25.6	(7.9)	–
Nigerian [*19*]	703	12–18	22.3	(5.8)	21.9–22.8
Iranians (present study)	900	12–15	23.5	(6.0)	23.1–23.9

SE = standard error; SD = standard deviation; CI = 95% confidence interval.
– = not reported.

Spanish [*14*] and Australian with European origin [*12*], but more than Nigerian students [*16*] (Table 5). Large differences between the mean DAI scores of Iranians and those of Americans and Australians may be due to racial variation. Different studies have also shown that Asian populations generally have dental appearances that require more orthodontic treatment [*12,16,17*]. Also differences may be due to different sample sizes and/or ages ranges. Compared with the study from Nigeria with similar sample size and subject ages, Iranian students from the city of Shiraz had fewer orthodontic needs. Hence, in this study, differences in DAI scores might be attributed to genetic predisposition, differences in lifestyle, variation in growth and facial skeleton development and occlusion.

The mean DAI scores for males and females were 24.8 and 22.1 respectively. Girls tended to have lower DAI scores than boys. This is comparable to mean DAI scores found by Rashida and colleagues in 12–13-year-old Malaysian schoolchildren [*12*]. This contrasts with the reports of Otuyemi et al. and Onyeaso and Sanu which did not find any significant sex differences in the mean DAI score of Nigerian children [*16,18,19*]. Moreover, compared with female students, a significantly higher percentage of male students scored with definite malocclusion for which treatment was needed or highly desirable (31.4% versus 20.0%). Also the percentage of male students with very severe (handicapping) malocclusion requiring essential treatment was significantly higher than the percentage of female students (6% versus 2%). Whether such a small difference is sex-related is uncertain. With regards to different malocclusion traits, hypodontia was found to occur in boys more than girls (9.8% versus 2.9%). However, Moyers mentioned that most studies claimed that women were more likely to have congenitally missing teeth than men [*20*]. This might be attributed to a sex-related malocclusion and needs further investigation. Crowding, the discrepancy between tooth size and arch size, was significantly lower in girls (31.1%) than in the boys (45.6%). Greater crowding distribution in boys agrees with Kerosuo, who reported more crowding distribution in African boys [*21*]. In this regard, X-linkage in relation to tooth size has been documented previously [*20*].

Other malocclusion traits including anterior maxillary irregularity, incisor overjet and molar relationship are consistent with the literature on the Iranian population [*22–24*]. Midline diastema distribution was 16.6%, which is similar to Taherizadeh's [*23*] study, but different from Rashida's study of Malaysians [*12*] and from Otueymi's study concerning Nigerians [*16*] with rates of 9.3% and 25% respectively.

Crowding distribution in this age group was similar to other studies done by Taherizadeh in Shiraz [*23*] and Sadeghi in Tehran [*24*], but was 50.3% and 63% respectively in studies in Malaysia [*12*] and Finland [*25*]. Like most communities, except Nigeria, the population studied in this research had more problems with crowding distribution than extra space. One of the most common features of DAI in the students was a dental irregularity in the maxilla and mandible. Over 26.5% and 16.4% of the subjects showed anterior irregularity > 1 mm, which is comparable with Malaysian schoolchildren, with 40.6% and 22.2% having maxilla and mandible irregularities respectively [*12*]. But compared with Nigerian schoolchildren showing > 1 mm anterior maxillary irregularity and anterior mandibular irregularity (12.1% and 29.2% respectively), it may reflect racial differences in skeletal growth and dental measures in maxillae.

Mandible overjet was observed in 1.4% of the population, which is similar to other populations [*12,16,23,26*]. The frequency of open-bite in this study (2.6%) is similar to other studies [*23,24,27,28*]. Deviation from class I molar relation in 47.4% of subjects in the study (48.4% for males and 46.4% for females) differs from the results of Taherizadeh (32.2%) [*23*], Sadeghi (34.2%) [*24*], Otuyemi (16.2%) [*16*] and Rashida (31.1%) [*12*]. The differences could be because of the examiner's error in distinguishing class I molar relation and half-cusp deviation from the natural situation. Therefore, examining the molar situation with half-cusp or complete cusp deviation may cause doubt and errors in the DAI rate. In the current study half-cusp and complete cusp deviation from class I molar relation was 48.4%, a higher deviation than other studies [*12*].

Notwithstanding its advantages, our study has some limitations. For example, it does not include some occlusion conditions such as extracted molars, posterior crossbites, midline deviations and deep overbite [*8,12*]. Also, as class I molar relationship, distal or mesial deviation are not registered in the DAI components, it is not possible to compare the results of this study with previous ones in which the relations of classes II and III was examined separately in an Iranian population. The DAI is applicable to persons with normal skeleton without abnormalities such as harelip and cleft palate, disproportion of maxilla and mandible, deepbite and crossbite, etc.

It is notable that malocclusion and orthodontic treatment needs vary greatly among different ethnic populations. In general, Iranian students from the city of Shiraz showed better dental appearance and had less need for orthodontic treatment than many other ethnic populations. More studies in other cities of the Islamic Republic of Iran are needed to confirm our study findings.

Conclusions

- Most students (70.1%) had a good dental appearance with no need for orthodontic treatment.
- Some of the population (12.1%) had intense-to-disabling malocclusion which had not received orthodontic care, perhaps because of socioeconomic problems or the cost of orthodontic treatment.
- Male students are more prone to definite malocclusion and the need for orthodontic treatment.
- Iranian students from the city of Shiraz have better dental appearance than American, Japanese, Australian, Malaysian, Greek and South African students and need less orthodontic treatment.

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