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Evaluation of Occlusion and Orthodontic Treatment Needs of Iranian Children Using Index for Orthodontic Treatment Need (IOTN): A Cross-sectional Study and Review of the Literature

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ABSTRACT

Introduction: *Awareness of a population's epidemiological state is significant in planning and provision of government's health services. The Index of Orthodontic Treatment Need (IOTN) was developed to grade malocclusion based on the significance of various occlusal traits for esthetic impairment and dental health.*

Aim: *Our investigation aimed to the evaluation of Orthodontic treatment needs among Iranian 7-15-year-old schoolchildren using IOTN.*

Materials and methods: *This retrospective study data collected during the orthodontic treatment screening and prevention programs in Tehran province schools from November 2012 to Nov 2018. The treatment need was measured utilizing the AC and the DHC of the Index of IOTN, also Angle's classification was used to classify malocclusion.*

Results: *A total of 1208 school going children's data were collected for this study, comprising 618 girls and 590 boys. Their ages ranged 7 years and 4 months to 14 years and 2 months, with an average age of 10 years and 3 months. An objective treatment need (grade 5 and grade 4) was recorded in 17.71 percent of schoolchildren's: grade 5 was registered in 62 individuals (5.13 %), and grade 4 was registered in 152 individuals (12.58%).*

Conclusion: *This survey, shows that the prevalence of participants who definitely need an orthodontic treatment plan (grades 4 and 5 of DHC) is of 18.13% and rises to 51.26% if grade 3 were considered. These findings are higher than the cited papers, which is probably due to the participants' age range (7 to 15 years).*

Key words: Index of orthodontic treatment need, Orthodontic, Children

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INTRODUCTION

Healthiness, including the status of the masticatory system, is the result of many characteristics. The guidelines of the World Health Organization regarding oral health for 2020, relate mainly to the prevention, early detection, and treatment of oral and dental disorders. Increased anxiety over dental appearance has been observed during childhood and adolescence to early adulthood [1,2].

Malocclusion, a mal-relation between the teeth of the two dental arches when they approach each other as the jaws close, is not a disease but one of the common chronic conditions seen in all parts of the world that is basically the clinically significant variations from normal morphology and range of growth. This mal-relationship has been described as a Handicapping Dentofacial Anomaly which causes defacement or which hinders function and necessitating treatment "if the mutilation poses an obstacle to the patient's physical or emotional well-being". Malocclusion that is now considered as the third highest oral health priority has an enormous burden on people and society in terms of quality of life and discomfort [3,4].

In recent years, a lot of efforts have been put forward on measuring of the malocclusion the prevalence and severity and orthodontic treatment need worldwide. The measurement of malocclusion as a communal problem is very difficult since most orthodontic treatment is undertaken for esthetic reasons and is very difficult to estimate the extent to which malposed teeth constitute a psychological hazard [5]. Many studies had concluded that high frequency of the oral and dental diseases like dental caries, malocclusion and lack of access to the necessary services leads to important absenteeism and socioeconomic burdens [6-8]. Surveys showed that the main cause of malocclusion is a combination of genetic factors including some stimulus through the development of orofacial structures and environmental factors such as oral and dental health habits, economic and social characteristics, and diet [6,9,10]. The incidence of malocclusion occurs in a large proportion in varying provinces of Iran where religious beliefs, nutritional status, ethnicity and dietary habits play a fundamental role in influencing medical treatments or oral health care behaviors [11-13].

There are various methods for the evaluation of malocclusion but none of these methods has gained universal acceptance. Patients seek orthodontic treatment more often for aesthetic rather than functional consideration on the basis that failure to meet social norms for dental aesthetics may have undesirable psychological effects, as a result, any meaningful index of treatment need must include a component designed to measure aesthetic and by implication the likely level of psychological disadvantages. The Index of Orthodontic Treatment Need (IOTN) was developed to grade malocclusion based on the significance of various occlusal traits for esthetic impairment and dental health [14,15].

Early diagnosis of a developing malocclusion and starting of simple orthodontic therapy technique represent ways to preclude or reduce the number of complex orthodontic management, which can be lengthy and costly. The Ministry of Health and Medical Education (MOHME) recently performs a national program for oral health promotion for children in Iran. The main objective of this national program is to improve the oral and dental health and related quality of life of the population. There are several studies in oral and dental health background in our country. The last study in this background was carried out in 2007 regarding the evaluation of the prevalence of occlusion classification of permanent dentition in Tehran students age 12 to 13 years [8,12]. The aim of the present study was to assess the prevalence of malocclusion and orthodontic treatment needs of Iranian children using Index for Orthodontic Treatment Need (IOTN).

MATERIALS AND METHODS

Study design and sampling method

This retrospective study data collected during the orthodontic treatment screening and prevention programs in Tehran province private schools from November 2012 to August 2017. Schools were chosen randomly within the inner city area of Tehran, Iran. The informed consent obtained from each participant caregivers in order to use clinical data records, analysis of study models and dental radiographs and color photographs, and the study was carried out in accordance with the principals of the Declaration of Helsinki. Inclusion criteria were age as close as possible to 7 or 15 years, informed consent; present the day of screening and no previous orthodontic treatment. Participants with an orthodontic appliance or a positive history of any kind of orthodontic treatment, children with dental and craniofacial anomalies and systematic diseases, subjects with no Iranian citizenship and who were uncooperative during the dental examination were excluded. The sample size was calculated assuming a 50% frequency ratio for any character to be estimated with a 95% CI.

Oral and dental examination

The clinical exam was performed by fifth-year dental students and an experienced supervising orthodontist, using a disposable mirror, Community Periodontal Index (CPI) probe, flashlight, latex gloves, calipers, millimeter rulers, wooden tongue depressor and sterilized gauze following biosafety norms. Participants were examined in a quiet classroom with a chair in an upright position using mouth mirrors and plastic rulers. The examiners were calibrated and trained prior to the commencement of the study to ensure reliability. In order to ensure the accuracy and reproducibility of the records; 50

participants were reexamined by Kappa's method a month after the initial examination. Which was found to be satisfactory (Kappa value=0.8) [16]. The orthodontic examination lasted 18 to 22 minutes per child, following the WHO guidelines [17]. The examination for malocclusion was made according to the molar relationship (Angle) and the criteria laid down by DHC and AC of IOTN. Patients were examined for overjet, overbites, displacement of contact points and crossbites.

Statistical analysis

Data analysis was performed using SPSS (Ver. 17.0). The frequency of malocclusion was assessed by determining the percentage of students affected. The differences between sex groups were assessed by means of chi-square test and the level of significance was established at $p<0.05$. Descriptive statistics were calculated for every measured variable and for DHC grades of the IOTN in order to evaluate the studied sample.

RESULTS

A total of 1208 school going children's data was collected for this study, comprising 618 girls and 590 boys. Their ages ranged 7 years and 4 months to 14 years and 2 months, with an average age of 10 years and 3 months (Table 1). Tooth brushing frequency was such that 63.1% children brushed at least once daily, while 30.9% of them brushed twice daily, whereas 6% did not brush at all. Table 2 shows the percentage scores of individual malocclusion traits according to the DHC of IOTN. Regarding the malocclusion results, class I malocclusion was found in 46.02 % (n=556) of the examined children, class II and class III malocclusion was found in 36.25% (n=438) and 4.38 % (n=53) in participants, respectively. In a general manner, 86.45% of individuals had malocclusion. Table 3 shows the distribution of the sample according to the prevalence of malocclusions. No statistically significant differences with regard to the distribution of malocclusion classes were found between sexes. Table 4 shows the prevalence rates of the IOTN grades in the whole sample. An objective treatment need (grade 5 and grade 4) was recorded in 17.71 percent of schoolchildren's: Grade 5 was registered in 62 individuals (5.13%), and grade 4 was registered in 152 individuals (12.58%). Borderline need, grade 3, was observed in 171 schoolchildren's (14.15%). A weighted kappa value of 0.95 indicated practically perfect inter-examiner agreement, and a value of 0.91 indicated almost perfect intra-examiner agreement.

DISCUSSION

The sternness and severity of malocclusion and its effect on facial aesthetics and oral functions became a great concern to health establishments and families as well 9-16. Present investigation describes the prevalence of orthodontic treatment needs among Iranian 7-15-year-old school going children with the primary aim to achieve a true image of the orthodontic conditions of the Iranian students. The assessment of the need for orthodontic treatments was based on the Aesthetic Component (AC) and Dental Health Component (DHC) of IOTN, a component that its validity and reliability have been proved in previous studies by Beglin et al. [18], De Oliveira et al. [19], Boronat et al. [20] and many other investigations. The orthodontic treatment need was also evaluated in association with sexual category and the connection between

Table 1: Distribution of the sample according to the prevalence of malocclusions.

Study Subjects	Angels Malocclusion Classification																
Age	Male		Female		Total		Class I		Class II				Class III		Total		p value Chi Sqaure
									Div. 1		Div. 2						
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
7	66	11.18	63	10.19	129	10.67	73	13.12	32	8.18	2	4.25	4	7.54	111	10.6	p=0.0339
8	65	11.01	69	11.16	134	11.09	68	12.23	39	9.97	2	4.25	5	9.43	114	10.88	p=0.3033
9	61	10.33	72	11.65	133	11	70	12.58	41	10.48	1	2.12	6	11.32	118	11.27	p=0.1605
10	65	11.01	78	12.62	143	11.83	66	11.87	44	11.25	5	10.63	5	9.43	120	11.46	P=0.9485
11	62	10.5	63	10.19	125	10.43	61	10.97	40	10.23	3	6.38	3	5.66	107	10.21	P=0.5127
12	71	12.03	60	9.7	131	10.84	69	12.41	42	10.74	7	14.89	6	11.32	124	11.84	P=0.7811
13	69	11.69	61	9.87	130	10.76	62	11.15	49	12.53	6	12.76	7	13.2	124	11.84	P=0.9077
14	60	10.16	75	12.13	135	11.17	58	10.43	55	14.06	10	21.27	9	16.98	132	12.6	P=0.0646
15	71	12.03	77	12.45	148	12.25	63	10.67	58	14.83	11	23.4	8	15.09	140	13.37	P=0.0748
Total	590	100	618	100	1208	100	556	100	391	100	47	100	53	100	1047	100	-

Table 2: The percentage scores of individual malocclusion traits according to the DHC of IOTN.

Participants Characteristics			Males		Females		Total		p-value (F/M)
			n	%	n	%	n	%	
Overjet	Increased overjet	-	107	18.13	136	22	243	20.11	p=0.0989
	Negative		53	8.95	65	10.51	118	9.76	p=0.3843
Cross bite	Normal		535	90.67	537	86.89	1072	88.74	p=0.0449*
	Bilateral		18	3.05	32	5.17	50	4.13	p=0.0821
	Unilateral	Right	22	3.74	19	3.07	41	3.39	p=0.6340
		Left	15	2.54	13	2.1	28	2.31	P=0.7034
Overbite	0-4 mm	-	431	73.05	470	76.05	901	74.58	p=0.2349
	>4 mm		101	17.11	114	18.44	215	17.79	p=0.5484
	<0 mm		58	9.83	43	6.95	101	8.36	p=0.0774
Scissor bite	Normal		588	99.68	614	99.36	1202	99.5	p=0.6872
	Bilateral		1	0.16	1	0.16	2	0.16	p=1.000
	Unilateral	Right	1	0.16	2	0.32	3	0.24	p=1.000
		Left	0	0	1	0.16	1	0.08	p=1.000
Crowding	Normal	-	334	56.61	218	35.27	552	45.69	p<0.0001**
	Upper arch, only	mild	73	12.37	87	14.07	160	13.24	p=0.3968
		moderate	24	4.06	36	5.82	60	4.96	p=0.1855
		severe	7	1.18	14	2.26	21	1.73	p=0.1879
	Lower arch, only	mild	33	5.59	39	6.31	72	5.96	p=0.6283
		moderate	20	3.38	16	2.58	36	2.98	p=0.4991
		severe	8	1.35	4	0.64	12	0.99	p=0.2548
	Both arches	mild	53	8.98	111	17.96	164	13.57	p<0.0001**
		moderate	29	4.91	78	12.62	107	8.85	p<0.0001**
		severe	9	1.52	15	2.42	24	1.98	p=0.3058
Diastema	Normal	-	431	73.05	387	62.62	818	67.71	p=0.0001**
	Upper arch	midline	77	13.05	92	14.88	169	13.99	p=0.3629
		spread	47	7.96	53	8.57	100	8.27	p=0.7543
	Lower arch	midline	8	1.35	15	2.42	23	1.9	p=0.2085
		spread	27	4.57	37	5.98	64	5.29	p=0.3050
Impacted teeth		-	35	5.93	38	6.14	73	6.04	p=0.9043
Submerged deciduous teeth			22	3.74	27	4.36	49	4.05	p=0.6621
Anterior spacing			26	4.4	41	6.63	67	5.54	p=0.1023
Supernumerary teeth			1	0.16	20	3.23	21	1.73	p<0.0001**

*:Significant **:highly significant

Table 3: Dental health component of the index for orthodontic treatment need in participants.

IOTN	total		Males		Females		Fisher test		
	n	%	n	%	n	%	OR	95% confidence interval	p value
Grade 1	391	32.36	259	43.89	380	61.48	0.4901	0.3895 to 0.6166	p<0.0001
Grade 2	432	35.76	153	25.93	173	27.99	0.9006	0.6982 to 1.162	p=0.4369
Grade 3	171	14.15	84	14.23	87	14.07	1.013	0.7331 to 1.400	p=1.000
Grade 4	152	12.58	69	11.69	83	15.99	0.8537	"0.6068 to 1.201"	p=0.3861
Grade 5	62	5.13	25	4.23	37	5.98	0.6948	"0.4128 to 1.169"	p=0.1925
Total	1208	100	590	100	618	100	-	-	-

Table 4: The data for various IOTN studies as compared to the present study in terms of IOTN (DHC) grades.

Study	Location/year	Subjects		DHC grades				
		Age	No	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Luzzi et al.	Italy/2017	02-Sep	579	51.00%	29.70%	8.20%	10.90%	0.20%
Vishnoi et al.	India /2017	Jul-16	1029	48.4	22.9	10.8	12.9	5
Singh et al.	India/2016	13-18	2000	4.35%	27.25%	30.85%	27.50%	10.05%
Choi et al.	Korean/2016	21.1	472	8.30%	19.90%	29.00%	28.40%	14.40%
Bilgic et al.	Turkey/2015	Dec-16	2329	12%	33%	26%	21%	8%
Mohamed et al.	Malaysia/2014	08-Oct	106	32.10%	5.70%	54.60%	5.70%	1.90%
Singh et al.	Nepal/2013	Dec-15	2074	15.02%	14.70%	24.07%	24.67%	21.59%
Laganà et al.	Albania/2013	Jul-15	2617	11.70%	14.70%	32.40%	37.30%	3.90%
Rahimi et al.	Iran/2012	13-14	600	19.30%	28.50%	24.30%	26.20%	1.70%
Present study	Iran/2018	Jul-15	1208	32.36%	35.76%	14.15%	12.58%	5.13%

the two components of IOTN was statistically ascertained. The results of the study showed that 17.71% of subjects need an objective and 14.15% need borderline treatment. The results obtained from current survey are similar to the results of Ucuncu et al. who studied orthodontic treatment need in 500 Turkish schoolchildren and found a great need in 38.8%, moderate need in 24% and little or no need in 37.2% 25. In the UK, Brook et al. examined orthodontic treatment need on 333 schoolchildren and came with results similar to our findings, 32.7% for great need and 35.1% for little/no need, according to Angel's classification [21,22]. Based on gender, the frequency of malocclusions Class II and I was almost equal in both sexes but Class III was 1.30 times higher in girls than boys. These differences can be attributed to a series of behavioral and skeletal differences between boys and girls. Approximately 33% of participants had mild crowding; however, 16.79% and 4.7% had moderate and severe crowding, respectively, in upper, lower or both arches. These findings are in line with previous studies in Iran performed by Farahani et al. and Ravanmehr et al. [8,23]. This survey shows that the prevalence of participants who definitely need an orthodontic treatment plan (grades 4 and 5 of DHC) is of 18.13% and rises to 51.26% if grade 3 were considered. These findings are higher than the cited papers, which is probably due to the participants' age range (7 to 15 years). Coetzee et al. reported a prevalence of a deep anterior overbite of 18.7% among 3- to 8-year-old children [24]. In contrast, this was found in 13% of children examined by Kabue et al. [25]. Our results were similar to those reported by Coetzee et al. (17.79% of the children). We were not able to establish with certainly the cause of the overbites in the individuals participating in our survey.

The evidence from this study has shown that dental professionals' assessment of aesthetic acceptability differs from the schoolchildren. No significant difference in orthodontic treatment need was found between gender in our study according to the DHC and AC of the dentist. This is similar to investigations done in Malaysia and Turkey that found that the difference between the IOTN values of adolescents aged 13-14 and 11-14 years, respectively, were not statistically significant [21,26]. Crowding, overjet and tooth impaction were the most frequent orthodontic problems found in this investigation.

CONCLUSION

In conclusion, as we expect, students felt tremendously less need for orthodontic treatment than the examiner. Although the majority of the children were categorized as no or little orthodontic treatment, moderate or severe malocclusions with the definitive need of orthodontic treatment were detected in 18.13% of contributors. Severe cases of over bite, reverse overjet and cross bite should be treated at an early stage. These priorities conform to the hierarchical system of IOTN.

CONFLICT OF INTEREST

None.

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