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Prevalence of malocclusion and orthodontic treatment needs among adolescents in Najran City, Saudi Arabia

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Abstract

AIM: To determine the prevalence of malocclusions and the need for orthodontic treatment in a sample of school-going adolescents in the Najran city, Kingdom of Saudi Arabia (KSA).

METHODOLOGY: This cross-sectional study was conducted among 1094 school-going Saudi male adolescents. The age range of the sampled adolescents was 13–18 years, and none of them had any history of orthodontic treatment. A survey chart related to malocclusion was designed and filled up after clinical examination by a single experienced and calibrated examiner. The need for orthodontic treatment was assessed using the Index of Orthodontic Treatment Need (IOTN).

RESULT: The present study's findings demonstrated 61.2% of the samples with Angle's Class I malocclusions, 27.5% with Class II, and 11.4% of samples with Class III malocclusion. A significant difference was observed between the different classes of malocclusion ($P < 0.001$). Most samples presented normal overjet, crossbite, and no reverse overjet, deep bite, or open bite. The number of samples with no treatment need was 573 (52.37%), with slight treatment in 185 (16.91%) samples, moderate treatment needs in 123 (11.24%) samples, and severe and extreme treatment needs were 109 (9.96%) and 104 (9.50%), respectively. A significant difference was observed between the samples with no or slight treatment need (grades 1 and 2), moderate need (grade 3), and definite treatment need (grades 4 and 5) ($p < 0.001$).

CONCLUSION: The prevalence of malocclusion and IOTNs among the sample of school-going adolescents in the Najran city was 47.63%. However, 9.63% of those samples required immediate attention for orthodontic treatment.

Keywords:

Angle's classification, malocclusion, orthodontic treatment, prevalence

Introduction

Malocclusion is a worldwide dental health concern that influences the social and psychological welfare of the affected person.[1] The prevalence of malocclusion largely varies from region to region and among different age groups and sex. However, young populations or adolescents remain affected among other people.[1-4] Several studies have been done in different countries to determine the prevalence of different malocclusions. The studies reported malocclusion incidence varying from 30% to 93%.[2] As a result, most countries have an increased demand for orthodontic treatment. The orthodontic treatment needed in different countries is 11% in Sweden[3] to 75.5% in Saudi Arabia.[4]

Epidemiological studies on malocclusion are essential to obtain extensive data

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and knowledge about the prevalence of different malocclusions and the need for orthodontic therapy. This information can be used in each country to design and execute public dental health plans for orthodontic treatment and regulate the available resources in these regions.[5,6] It is assumed that the severity of the malocclusion is always related to treatment needs. This assumption is well accepted when treatment need is estimated for population groups.[7]

In modern-day dentistry, quantitative measures are crucial in quantifying the treatment and comparing it with the standard. Various valid and reliable indices have been developed and adopted for the same purpose to evaluate the treatment need and outcome. However, no single index can be universally accepted.[8,9] Brook and Shaw, 1989, developed the Index of Orthodontic Treatment Needs (IOTNs), which has gained wide acceptance in the U.K. and other parts of Europe.[10] The IOTN is most accepted because of its simplicity and convenience and is recognized as a system to assess IOTNs. The index combines a dental health component (DHC) recommended by Swedish Medical Board[11] and an aesthetic component (AC) developed by Evans and Shaw.[12] The IOTN is objective compared to other indices and allows for comparisons between different population groups.[13,14]

Numerous studies on the prevalence of malocclusion have been reported from different regions of Saudi Arabia.[4,15-18] These studies have concentrated on the central, eastern, western, northern, and southern (Aseer) regions of Saudi Arabia. To the best of the authors' knowledge, there is no representative data on the prevalence of malocclusion from the southern region (Najran) of Saudi Arabia. A steady increase in the number of adolescent patients seeking orthodontic treatment in this region has prompted the authors to perform the present prevalence study to assess the total need for treatment in this population group. The current prevalence study was conducted using IOTN.

Consequently, the present study was designed to determine the prevalence of malocclusion and assess IOTNs among school-going adolescents in the Najran city, Kingdom of Saudi Arabia (KSA).

Methodology

The study protocol conforms to the ethical guidelines of the World Medical Association (WMA) Declaration of Helsinki, 1964, and as amended in 2008. The study was reviewed and approved by the local ethical committee at the specialist dental center, Ministry of Health, Najran. It was conducted over eight months, from Sep 2017 to April 2018. A total of 1094 Saudi male adolescents aged 13–18 years were randomly selected from 12 schools (3 each from east, west, north, and south regions) and were included in the present study. Necessary permission was sought from the school authorities and parents/guardians of the sampled adolescents. The sampled adolescents were informed about their rights to participate in the present study, and consent forms were signed.

The inclusion criteria for the selection of samples are listed below:

(i) The age group of 13–18 years
(ii) Adolescents with no significant local/systemic problems or trauma which could affect the growth and development of facial structures or body and
(iii) No previous history of orthodontic or interceptive treatment.

Any sampled adolescents who had or undergoing orthodontic treatment; presenting with systemic health disorders, developmental anomalies such as cleft lip or palate, ectodermal dysplasia, and down syndrome were excluded from the study. The clinical examination was performed in the respective schools by experienced and calibrated examiners using disposable gloves, a dental mirror, a small light source, gauze, and a plastic ruler. For each sampled adolescent, a survey form related to malocclusion (molar relationship, canine relationship, missing teeth, overjet, reverse overjet, crossbite, scissor bite, open bite, deep bite, contact point displacement, crowding, spacing, and midline deviations) was designed. The survey forms were filled up after a single examiner's clinical examination of each sampled adolescent.

Assessment of orthodontic treatment need

The need for orthodontic treatment was assessed using the DHC of the IOTN.[10] The treatment needs were categorized as grade 1 (no treatment need), grade 2 (slight need), grade 3 (moderate need), grade 4 (severe need), and grade 5 (extreme need) [Table 1].

Statistical analysis

The data was transferred from survey forms to Microsoft Excel files to create a master file for data analysis. The data was analyzed using Statistical Package for Social Sciences, Version 20 (SPSS Inc., Chicago, IL, USA). Mean and standard deviation was used to represent the different measurements. Appropriate statistical tests of significance were employed wherever indicated, and the significance level was set at $P < 0.05$.

Result

Molar and canine relationship

1094 Saudi male adolescents were enrolled for the present study. The mean age of the subjects was 15.24 ± 1.70. Table 2 presents the number and percentage of molar and canine relationships among the surveyed participants.

The majority of the participants showed Angle's Class I (61.2%) molar relationship. 179 (16.4%) participants had Class II division I, and 121 (11.1%) participants had Class II division II molar relationships. Class III molar relationship was found in 125 (11.4%) participants. A significant difference was observed between different classes of molar relationships (P < 0.001). About the canine relationship, Class I relation was found in 634 (55.66%) participants, Class II in 306 (27.97%) participants, and 179 (16.36%) participants had Class III relationship. Also, a significant difference was observed between different classes of canine relationships (P < 0.001).

Among the sampled adolescent, 790 (72.2%) participants presented with no missing tooth (grade I), 162 (14.8%) presented with grade 4 (<1 tooth missing in any quadrant) missing teeth, and 142 (13%) presented with grade 5 (>1 tooth missing in any quadrant). There was a statistically significant difference between the groups (p < 0.001).

Table 1: Index for Orthodontic Treatment Need (IOTN) grading and criteria[19]

Grading	Treatment level	Criteria's
Grade 1	No need	
Grade 2	Slight need	Occlusion outside normal.
		Slight overjet and overbite (<3 mm).
		Mild crowding.
		Slight rotation.
		Slight tipping.
Grade 3	Moderate need	Hyperdivergence/hypodivergence.
		Linguoversion/vestibule version of incisor group.
		Supraocclusion.
		Moderate crowding.
		Moderate rotation or tipping.
Grade 4	Severe need	Reversed anterior articulation.
		Deep bite with gum irritation.
		Extreme overbite and/or open bite.
		Posterior crowding with functional deviation.
		Severe rotation or tipping.
Grade 5	Extreme need	Functional disability.
		Extreme Class II/Class III.
		Extreme hyperdivergence/hypodivergence.
		Extensive aplasia.

Table 2: Number (*n*) and percentage (%) of molar and canine relationships among the participants

Variables		*n*	%	*P*
Angle's molar relationship				
Class I		669	61.2	<0.001*
Class II	Class II division 1	179	16.4	
	Class II division 2	121	11.1	
Class III		125	11.4	
Canine relationship				
Class I		609	55.66	<0.001*
Class II		306	27.97	
Class III		179	16.36	

*indicates statistically significant values

Occlusal parameters

The distribution of occlusal parameters (overjet, reverse overjet, crossbite, and scissors bite) included in the examination is presented in Table 3. In the present study, out of 1094 samples, 747 (68.3%) samples had an average overjet and 35 (3.2%) samples had edge-to-edge overjet. There was a statistically significant difference in the proportion of samples with the distribution of overjet (p < 0.001). The majority (937 (85.6%)) of the samples presented with no reverse overjet, and 13 (1.18%) samples showed with grade 5 reverse overjet, and there was a statistically significant difference in the proportion of samples with a different type of reverse overjet (p < 0.001). Among the samples examined for crossbite, 857 (78.33%) had no crossbite, while the fewer adolescents (18) presented with a crossbite of more than 2 mm. Scissors bite was present in only 31 (2.1%) samples, and 1063 (97.2%) samples did not present any scissors bite signs. The results also indicated that 933 (85.28%) samples had no open bite, and only ten samples had an open bite of more than 4 mm. The majority of the adolescents did not show any deep bite, and only 23 samples presented with traumatic gingival contact.

Contact point displacement

In the present study, out of 1094 samples, 747 (68.3%) samples had grade 1 displacement, 239 (21.84%) samples had grade 2 displacements, 73 (6.7%) samples had grade 3 displacement, and 35 (3.2%) samples had grade displacement. There was a statistically significant difference in the proportion of samples with different grades of displacement (p < 0.001) [Table 4].

Space and midline conditions

Spacing in the upper and the lower arch was observed in 206 (18.8%) and 120 (11%) samples, respectively. On the contrary, upper and lower arch crowding was observed in 158 (14.4%) and 222 (20.29%) samples, respectively. Samples with either no spacing or crowding were 388 (35.5%) [Table 5].

Among the samples, 977 of them had no midline deviation. In the upper arch, the right and left deviation was found in 45 (4.11%) and 36 (3.29%) samples, respectively. In the lower arch, deviation to the right was seen in 21 (1.91%) samples, and the left deviation was seen in 15 (1.37%) samples [Table 5].

Index of Orthodontic Treatment Need (IOTN)

In the sampled adolescents, the DHC of IOTN revealed no treatment need in 573 (52.37%) samples confirming this number of samples had no malocclusion and were considered as ideal or normal cases; slight treatment need was observed in 185 (16.91%) samples, moderate

Table 3: Distribution of occlusal parameters

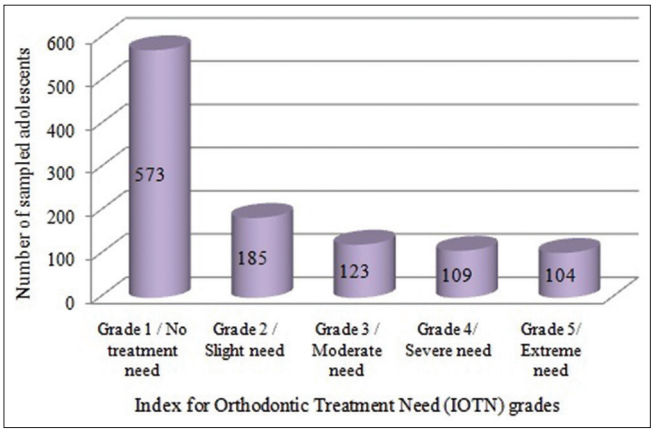
Occlusal traits	Criteria	*n*	%	*P*
Overjet				
Edge to edge	0 mm	35	3.2	<0.001*
Normal	1–2 mm	747	68.3	
Grade 1	>2-<3.5 mm	159	14.5	
Grade 2	3.5–6 mm + competent lips	73	6.7	
Grade 3	3.5–6 mm + incompetent lips	53	4.8	
Grade 4	7–9 mm	27	2.5	
Grade 5	>9 mm	0	0	
Reverse overjet				
No reverse overjet		937	85.64	<0.001*
Grade 2	>0≤1 mm	101	9.23	
Grade 3	>1≤3.5 mm	31	2.83	
Grade 4	>1≤3.5 mm + masticatory and speech difficulties	12	1.09	
Grade 5	>3.5 mm + masticatory and speech difficulties	13	1.18	
Crossbite				
No crossbite		857	78.33	<0.001*
Grade 2	<1 mm	163	14.89	
Grade 3	>1≤2 mm	56	5.11	
Grade 4	>2 mm	18	1.64	
Scissors bite				
No scissors bite		1063	97.2	<0.001*
Grade 4	Scissor bite present	31	2.8	
Open bite				
No open bite		933	85.2	<0.001*
Grade 2	>1-2 mm	95	8.6	
Grade 3	>2-4 mm	56	5.1	
Grade 4	>4 mm	10	1	
Deep bite				
No deep bite		863	78.8	<0.001*
Grade 2	≥3.5 mm with no trauma	121	11.06	
Grade 3	Gingival contact with no trauma	87	7.95	
Grade 4	Gingival contact with trauma	23	2.1	

*indicates statistically significant values

Table 4: Distribution of contact point displacement

Grading	Criteria	*n*	%	*P*
Grade 1	<1 mm displacement	747	68.3	<0.001*
Grade 2	>1–2 mm displacement	239	21.84	
Grade 3	>2–4 mm displacement	73	6.7	
Grade 4	>4 mm displacement	35	3.2	

*indicates statistically significant values



Graph 1: Dental health component (DHC) grades of the Index of Orthodontic Treatment Need (IOTN) in Saudi male adolescents

treatment need in 123 (11.24%) samples. The samples with severe and extreme treatment need were 109 (9.96%) and 104 (9.50%), respectively. Samples requiring mild to severe orthodontic treatment were found to be 47.63%. A significant difference was observed between the samples with no or slight treatment need (grades 1 and 2), moderate need (grade 3), and definite treatment need (grades 4 and 5) ($p < 0.001$) [Graph 1].

Discussion

The present prevalence study comprised 1094 Saudi male adolescents aged 13–18 years randomly selected from 12 schools (3 each from east, west, north, and south regions) to obtain a representative sample of the Najran population. All the participants were in their permanent dentition stage and had no previous history of orthodontic treatment. Several malocclusion studies have been conducted in different regions of Saudi Arabia

Table 5: Distribution of space and midline conditions

	Location	*n* (%)	Location	*n* (%)
Space condition				
Spacing	Upper	206 (18.8%)	Lower	120 (11%)
Crowding	Upper	158 (14.4%)	Lower	222 (20.29%)
Absence of spacing or crowding		388 (35.5%)		
Midline condition				
Upper arch deviation	Right	45 (4.11%)	Left	36 (3.29%)
Lower arch deviation	Right	21 (1.91%)	Left	15 (1.37%)
No midline deviation		977 (89%)		

involving the Saudi population.[4,15-18,20-24] However, the studies on Saudi adolescents are limited, and these studies have demonstrated non-comparable outcomes. The different registration methods could explain these and the sample sizes used in different studies.[25]

The present study employed the widely used and internationally accepted Angles classification to evaluate sagittal relation because of its reduced subjectivity and easiness in classifying malocclusions. In addition, the Canine relationship was also used to assess sagittal relation. We found Angle's Class I occlusion in 61.2% of participants, Angle's Class II occlusion in 27.5%, and Angle's Class III occlusion in 11.4%. Class I had the most prevalent malocclusion, and the least prevalent malocclusion was Class III. This outcome was in agreement with previous studies involving the Saudi population.[4,21,26] The prevalence of Class I malocclusion observed in the Najran population was less than the Lithuanian[27] and Latino[28] counterparts. On the contrary, Class III malocclusion was less prevalent in the Saudi population compared to the Turkish population[29] but more prevalent compared to the Americans[30] and Columbians.[25] Also, the prevalence of Class II malocclusion in the present study was more compared to the Columbians.[25]

27.8% of the participants had one or more missing teeth, either in the maxilla or mandible in relation to missing teeth. These results do not agree with other studies[31-33] reporting a low number of samples with missing teeth. This could be due to congenitally missing teeth or lack of financial sources, or negligence. Also, another possible reason would be the fear associated with dental treatments.

The current study also registered other occlusal traits such as overjet, reverse overjet, crossbite, open bite, deep bite, spacing, and crowding to gather information on occlusal status in different planes (horizontally, vertically, and vertically within maxillary and mandibular arches).

The study showed an increased prevalence of overjet (31.7%) among the permanent dentition participants. These findings agree with the results of other previous studies[25,34] but are contrary to the conclusions from Tschill *et al.*,[35] in which the authors found an overjet rate of 6%. On the contrary, the study had a low prevalence of reverse overjet (14.33%), reflecting the rate of Class III malocclusion. The study showed an increased frequency of crossbite (21.6%) compared to Scissor's bite (2.8%) and agreed with the findings of Perillo *et al.*[6] but contrary to the conclusions from Thilander *et al.*[25] and Ciuffolo *et al.*[34]

In the current study, 14% of the children presented with an open bite, sixfold higher than that found by Al-Huwaizi.[36] This difference may be related to different oral habit practices such as thumb sucking, tongue thrusting, etc., which play an essential role in forming anterior open bite. In a malocclusion study in Nigeria, Otuyemi *et al.*[37] surveyed 12- to 13-year-old children from rural and urban Nigerian communities. They reported that anterior open bite was a common malocclusion trait and occurred in 10.2% of the samples. According to Thilander *et al.*,[25] an anterior open bite is less frequent in white adolescents than in their black counterparts, which raises suspicion of a possible link. The prevalence of normal overbite in this study was 78.8% and was high compared to the Jordanian samples[38] (44.3%) and French[35] (60.8%) samples. There was an increased prevalence of deep bites (14%) among the surveyed participants in the present study was high as compared to Indian (2.75%), Jordanian (5.7%), and Finnish (11%) samples.[39]

The contact point displacement in the current study was 31.74%, contrary to Dias *et al.*[40] This increased prevalence could be due to a high number of carious lesions leading to extractions of deciduous molars, thus favoring the migration of the first permanent molars with possible inclinations and rotations.

The combined spacing in both upper and lower arch was 29.8%, with the upper arch registering more spacing than the lower arch. This prevalence rate among the surveyed participants in the Najran region was in accordance with those surveyed samples from Malaysia,[41] Bogotia,[25] and India.[33] Similar to previous prevalence studies, the surveyed participants in this study presented with more crowding than spacing. The prevalence of crowding (34.7%) in our study was high compared to other study groups from Europe,[6] America,[30] Colombia,[25] and India.[25]

The severity of malocclusion traits may follow the need and demand for orthodontic treatment at an individual level. Treatment in different populations mainly

depends on socioeconomic status and ethnic differences. Thus, IOTNs in a population should not be compared between people and cultures.[25] The need for orthodontic treatment for Saudi adolescents in the Najran region was 19.46%. In Saudi Arabia, orthodontic treatment is free of charge for Saudi nationals. The planning of orthodontic treatment of an individual should prioritize patients with severe malocclusion, control unnecessary referrals by general practitioners, and avoid the burden on healthcare practitioners and a tedious waiting list.[42] Further, implementing suitable school preventive programs and early caries treatment are considered the best means of reducing the high prevalence of malocclusion traits.

Nevertheless, the study had a few limitations; there were no comparison groups, and the study did not include any female participants. Hence, generalizing the study's outcome to the Saudi adolescents in the Najran region cannot be applied. Further studies are advisable with a larger sample size and comparison groups, including participants with various sociodemographic considerations and age-wise grouping of the malocclusion.

Conclusion

The prevalence of malocclusion and IOTNs among the sample of school-going adolescents in the Najran city was 47.63%. However, 9.63% of those samples required immediate attention for orthodontic treatment.

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Conflicts of interest
There are no conflicts of interest.

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