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The prevalence of malocclusion and orthodontic treatment need of school children in Northern Saudi Arabia

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Abstract:

OBJECTIVE: To evaluate the incidence of malocclusion and requirement for orthodontic treatment in the Saudi region of Hail city.

MATERIALS AND METHODS: 520 Saudi participants between 7 and 12 years from Hail city were used in the research, all of whom were selected using a simple randomization method. For every participant, various malocclusion variables such as molar, canine, and incisor relationship, overjet, overbite, open bite, cross bite, scissor cross bite, and the score for the orthodontic treatment need [Index of Orthodontic Treatment Need (IOTN)] were recorded. A light source was used for examination, in addition to mouth mirrors, a calibrated ruler, and a portable dental chair.

RESULTS: The prevalence of class I molar relationship was 70.4%, with class II being 21.3% and class III being 8.3%. As for the incisor relationships, class I was found at a prevalence of 72.5%, class II at 19.8%, and class III at 7.7%. Additionally, the following malocclusion characteristics were also found: deep overbite (>4 mm) (16.2%), increased overjet (>4 mm) (14.4%), posterior cross bite (13.3%), anterior open bite (7.7%), anterior cross bite (5.2%), scissor bite (4%), and posterior open bite (0.6%). A total of 4.4% were identified as requiring orthodontic treatment. Grades 1 and 2 were 25.5% and 58.5%, respectively. There was a significant relationship found between grades 3 and 4, and the anterior open bite, cross bite, and scissor bite.

CONCLUSION: This research showed that class I malocclusion was most dominant, followed by classes II and III, respectively. When the Hail city school pupils in the study were assessed for IOTN index, grades 3 and 4 were found to be highly related to anterior open bite, cross bite, and scissor bite.

Keywords:

Index of Orthodontic Treatment Need index, malocclusion, occlusal parameters, treatment need

Introduction

In recent years, evaluating malocclusion and the related requirements for orthodontic treatment has received a wealth of research attention.[1] Much investigation has been conducted into essential dentition and has found that malocclusion prevalence can vary from mild to severe, depending on the patients and their functional and aesthetic features. Prior studies have indicated that the range of malocclusion prevalence varies between 39% and 93%.[2-5] This is a huge range and can be due to factors such as ethnicity, age, or the methodology used in the assessment.[6] Although high malocclusion prevalence does not necessarily suggest that those with malocclusion need orthodontic treatment, there appears to be a continual yearly increase in the economic value of orthodontic treatment in many countries. To create a suitable orthodontic treatment

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plan, further information must be gathered to verify the prevalence of malocclusion.[7] The recent growth in the population of Kingdom of Saudi Arabia has generated a rise in the amount of individuals seeking orthodontic treatment, especially adolescents.[8] Nonetheless, few reports exist that explore the malocclusion prevalence in Saudi Arabia.[9-13] Malocclusion prevalence was found by Al-Emran *et al*. to be 62.4% for Saudi children, 40% of whom required fixed orthodontic devices.[10] Furthermore, class I was found to be at 60.11% in the Saudi city of Riyadh, with classes II and III at 7.12% and 10.13%, respectively.[9] A prevalence of approximately 16.4% for increased overjet, 6.68% for increased overbite, and 8.4% for anterior open bite were found in the same study. Class I malocclusion was most prevalent in western Saudi Arabian children (67.13%), with overjet and overbite found to be 57.4% and 52.6%, respectively.[11] For the southern regions, class I malocclusion was 61%, class II 16.3%, and class III 7.7%.[12] The prevalence of increased overjet was 19.5%, followed by increased overbite at 19.4% and anterior open bite at 6.1%. Recent research in the north of the country showed 52.8% class I malocclusion among adolescents.[11] The same research also found the following prevalence for other features: overbite (23.4%), excessive overjet (22.2%), reduced overbite (12.2%), and open bite (4.6%).[8]

A number of different indices have been used for assessing orthodontic treatment needs. According to a literature review, Shaw *et al.*'s proposed Index of Orthodontic Treatment Need (IOTN) is one of the most commonly used index.[14] This index is user-friendly and reliable.[15,16] Orthodontic treatment in Europe is provided based on the intensity of the malocclusion need for treatment. Orthodontic treatment in Saudi Arabia is free from all governmental and teaching institutions. This availability has led to a number of people with minor requirements using orthodontic treatment, making it harder for people with severe treatment requirements to access the relevant facilities.

As a result, national guidelines must be put in place to both ensure the best provision of orthodontic treatment based on the severity of the condition and patient needs. These guidelines could largely help clinicians in their decision-making processes, when evaluating patient priority and offering quick and effective orthodontic treatment. They would also aid in determining rational resource distribution and planning to make sure that the best orthodontic treatment is given.

The primary objectives of this research are as follows:

- To estimate the prevalence of malocclusion in the city of Hail
- To use the IOTN to determine the severity of treatment need throughout the early and late mixed dentition period among elementary-aged children in the Saudi region of Hail city.

Materials and Methods

The Scientific Research Ethics Committee at the University of Hail (approval no. H-2018-095) provided their consent for this cross-sectional research. Elementary-aged Hail city school children were the subjects of the study and had to meet these inclusion criteria:

1. Age 7–12 years old
2. No previous orthodontic treatment
3. All in possession of their first permanent molars
4. No significant medical history
5. No developmental issues.

The parents/guardians of the participating children had to give signed consent for their child to partake. The sample size was estimated according to prior research into the prevalence of malocclusion[8] (P = 23%). In all, 500 participants are sufficient to offer a significance level of 5% and 95% confidence interval. Altogether, 240 females and 280 males were recruited to the sample. Three well-trained interns carried out the medical examination and were observed by a qualified clinician. A portable dental chair, light source, mouth mirror, and calibrated ruler were used.

Clinical examination

To evaluate each participant, a chart identifying different malocclusion variables was used. To categorize molar and canine relationships, angle classification was used. To classify the incisor relationships, British Standards Institute classification was used. Other variables such as incisal relations, overjet, overbite, open bite, cross bite, and scissor cross bite were determined and are outlined in Table 1.

The need for orthodontic work was categorized according to dental health components outlined in the IOTN. After coding, the information was inputted

Table 1: Prevalence of molar and incisal relationship

	Male	Female	Total		*P*
n	273 (52.5%)	247 (47.5%)	520		
Age (years)	9.54±1.74	9.25±183	9.40±1.79		
Molar relation					
Class I	214 (78.4%)	152 (61.5%)	366	70.4%	<0.001
Class II	32 (11.7%)	79 (32%)	111	21.3%	
Class III	27 (9.9%)	16 (6.5%)	43	8.3%	
Incisal relation					
Class I	214 (78.4%)	163 (66%)	377	72.5%	<0.001
Class II	32 (11.7%)	71 (28.7%)	103	19.8%	
Class III	27 (9.9%)	13 (5.3%)	40	7.7%	

into the Statistical Package for the Social Sciences software version 21 (SPSS Inc., Chicago, IL, USA), and Pearson's Chi-square test was used to statistically analyze it. In this test, statistical significance (*P*-value) is considered to exist when *P* values are less than or equal to 0.05.

Results

Prevalence of malocclusion

In terms of the molar relationship, a class I malocclusion prevalence of 70.4% (366 participants) was found, as well as 21.3% (111 participants) for class II and 8.3% (43 participants) for class III. In terms of the incisal relationship, class I malocclusion was found at a prevalence of 72.5% (377 participants), class II at 19.8% (103 participants), and class III at 7.7% (40 participants) [Table 1].

Overjet, overbite, open bite, cross bite, scissor bite

In the present sample, overjet was found to be normal in 370 participants (71.2%), increased in 75 (14.4%), decreased in 26 (5%), and reversed in 27 (5.2%). Furthermore, in 22 participants, an edge-to-edge relationship was identified. Females had a higher prevalence of increased overjet (>4 mm) than males (22.7% and 7%, respectively; $P < 0.0001$) [Figure 1]. In 436 (83.8%), overbite was found to be normal, with 57 (11%) being moderate and 27 (5.2%) being deep. Anterior open bite was found in 40 (7.7%) of participants and posterior open bite in 3 (0.6%). The anterior cross bite was found in 27 (5.2%) and posterior cross bite in 69 (13.3%). A total of 21 (4%) participants showed scissor bite [Table 2].

Orthodontic treatment requirement

From the 520 child participants, 4.4% were in severe need of treatment, 11.7% had a moderate need, and 83.9% had little (if any) need. The need for grade 3 and grade 4 treatment was found to be much higher in those with class III malocclusion, deep bite, and anterior open bite ($P < 0.001$) [Table 3].

Gender differences in malocclusion and IOTN prevalence

There was found to be a higher class I malocclusion prevalence in males (78.4%) than females (61.5%) ($P < 0.0001$) [Figure 2]. Nonetheless, females displayed a higher prevalence of moderate overbite (17.8%) that their male counterparts (4.8%) ($P < 0.0001$). Likewise, posterior cross bite was also higher in females (17.4%) than males (9.5%) ($P = 0.027$). There was also evidently a vast difference between girls and boys in the IOTN, with the need for grade 1 treatment being much greater in male children in this study than their female counterparts (male: 67.8% and female: 48.2%; $P < 0.001$).

Table 2: Prevalence of molar and incisal relationship

	Male	Female	Total		*P*
n	273 (52.5%)	247 (47.5%)	520		
Age (years)	9.54±1.74	9.25±183	9.40±1.79		
OJ					
Normal (2-4 mm)	214 (78.4%)	156 (63.2%)	370	71.2%	0.000
Increased (>4 mm)	19 (7%)	56 (22.7%)	75	14.4%	
Decreased (<2)	15 (5.5%)	11 (4.5%)	26	5%	
Reverse OJ	16 (5.9%)	11 (4.5%)	27	5.2%	
Edge to edge	9 (3.3%)	13 (5.3%)	22	4.2%	
Overbite					
Normal (2-4 mm)	247 (90.5%)	189 (76.5%)	436	83.8%	0.000
Moderate (>4-7 mm)	13 (4.8%)	44 (17.8%)	57	11%	
Deep (>8 mm)	13 (4.8%)	14 (5.7%)	27	5.2%	
OB					
Anterior OB	18 (6.6%)	22 (8.9%)	40	7.7%	0.111
Posterior OB	0 (0%)	3 (1.2%)	3	0.6%	
Absent	255 (93.4%)	222 (89.9%)	477	91.7%	
CB					
Anterior CB	16 (5.9%)	11 (4.5%)	27	5.2%	0.027
Posterior CB	26 (9.5%)	43 (17.4%)	69	13.3%	
Absent	231 (84.6%)	193 (78.1%)	424	81.5%	
Scissor bite					
Present	5 (1.8%)	16 (6.5%)	21	4%	0.007
Absent	268 (98.2%)	231 (93.5%)	499	96%	

OJ - Overjet; OB - Open bite; CB - Cross bite

Table 3: Orthodontic treatment need according to the dental health component of the index of orthodontic treatment need in 7-12 years old

	Male	Female	Total		*P*
n	273 (52.5%)	247 (47.5%)	520		
Age (years)	9.54±1.74	9.25±183	9.40±1.79		
IOTN					
Absent	268 (98.2%)	231 (93.5%)	499	96%	
Grade 1	185 (67.8%)	119 (48.2%)	304	58.5%	<0.001
Grade 2	41 (15%)	91 (36.8%)	132	25.4%	
Grade 3	35 (12.8%)	26 (10.5%)	61	11.7%	
Grade 4	12 (4.4%)	11 (4.5%)	23	4.4%	

IOTN - Index of Orthodontic Treatment Need

Discussion

This research used a cross-sectional investigation to find out the prevalence of malocclusion and occlusal traits in Hail city school children. Class I traits were identified at a prevalence of 70.4%, class II at 21.3%, and class III at 8.3%. It is evident that class I malocclusion has a much higher prevalence than other classes. These findings are in line with prior investigations in Saudi Arabia.[8,11-13] For example, Al-Barakati and Taher[13] found a class I malocclusion prevalence rate of 76.9%, similar to the findings of the current research. Nonetheless, it must be noted that Asiry[9] and Gudipaneni *et al*.[8] found a lower proportion of class I malocclusion than was found in the present research. These discrepancies could be due to

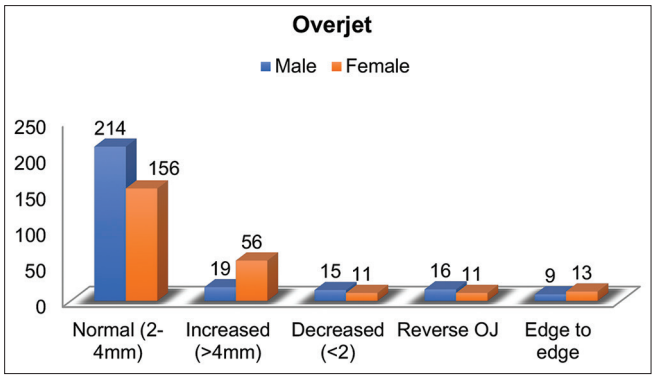

Figure 1: Association between Overjet & Gender

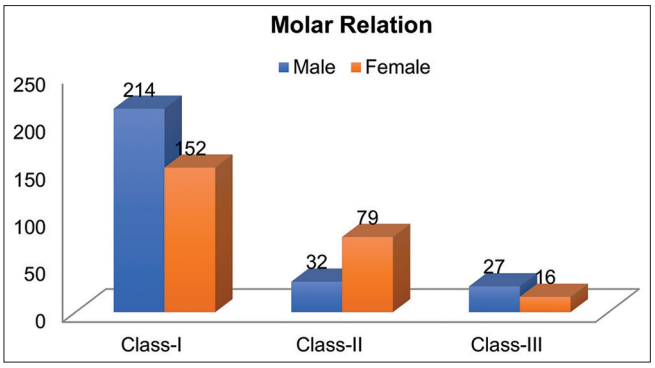

Figure 2: Association between Molar relation & Gender

age difference and individual differences, or perhaps to the transformation from class II malocclusion to normal occlusion that occurs from mesial movement of the first molars in the mandible as the second primary molars exfoliated. This could be especially relevant to the current sample, which is made up of a younger sample than was used in previous studies.[6] For class I malocclusion within males, a prevalence of 78.4% was found, compared with 61.5% in males. This gender difference was considered significant at a level of $P < 0.001$ and is similar to findings of other research conducted in Iran.[17] On the other hand, previous studies conducted with both British and Nigerian school children samples showed a higher prevalence of females having class I malocclusion than their male counterparts.[18,19]

Altogether, 21.3% of children in the sample showed class II malocclusion. Nonetheless, this number is less than that found by another study in the northern region of the country (31.8%),[8] yet it is still greater than the 16.4% and 7.12% found in central regions[9,10] and the 10.9% found in the east.[13] The findings are also lower than similar findings (27.5%) for school-aged children in Iran.[17]

There was a lower prevalence of class A malocclusion found in the present research (8.3%). This is almost the same as findings from a study carried out in central Saudi Arabia, in which class III traits were found at 10.13% prevalence.[9] On the contrary, another study carried out in Saudi Arabia showed a much higher prevalence of 12.1% and 15.4% for class III characteristics.[8,13] However, Borzabadi-Farahani and Eslamipour's research in Iran[17] found results similar to those of the present research, with class III prevalence found to be at 7.8%. Saudi Arabia appears to have a higher prevalence of class III traits than Caucasian people, since the prevalence of class III traits in Caucasian populations has been found to vary from 1% to 4%.[4,18,20-22]

This present research found normal overjet to be at 71.2%, increased overjet at 14.4%, decreased overjet at 5%, and reversed overjet at 5.2%. These results are consistent with other findings in Saudi Arabia.[8,9,13] For example, Borzabadi-Farahani and Eslamipour[17] investigated adolescent Iranians and found that the prevalence of having an overjet greater than 3.5 mm was 28.1%. It was 3.6% for an overjet greater than 6 mm. Furthermore, 4.2% showed a reverse overjet. In the present research, females had a higher incidence of increased overjet (22.7%) than males (7%). This was identified as a significant difference at a level of $P < 0.001$ level and was in line with Iranian studies, which found increased overjet in females. However, in the latter research, the differences were not deemed significant.[17] It has been difficult to compare the findings of the present research to previous investigations in Saudi Arabia, since most other studies failed to report and variations in overjet measurements between genders.

Furthermore, most of the participants in this research (83.8%) were found to demonstrate normal overbite, with 11% showing moderate overbite and only 5.2% showing a severe deep bite. Such findings contradict those of previous studies in the country. For instance, a lower prevalence of deep overbite was found by Assiry[9] and a higher prevalence of moderate overbite (16.9%) and a lesser prevalence of severe deep bite was found by Al-Barakati *et al*.[13]

In terms of anterior open bite, a prevalence of 7.7% was found. For posterior open bite, 0.6% prevalence was identified. This is consistent with other Saudi Arabian studies.[8-10]

This research found the prevalence of anterior crossbite to be 5.2%, which is in line with results of prior research conducted in north and east Saudi Arabia.[8,13] Nonetheless, the posterior crossbite prevalence was found to be 13.3%, and 4% for scissor bite, which is higher than the prevalence identified in previous Saudi Arabian studies.[8-10]

According to the IOTN recordings, only 4.4% (12 male, 11 female) of the sample had moderate need for

treatment (grade 4), and none of the children desperately needed treatment. The sample population was made up of 58.5% grade 1 conditions (185 male and 119 female) and 25.4% grade 2 conditions (41 male and 91 female). A mere 11.7% of the sample children showed grade 3 traits, and of these children, a higher number of males (35 subjects) showed class III traits than their female counterparts (26 subjects). These results are inconsistent with the findings of prior research.[8,23] Gudpanenti *et al*.[8] found IOTN results that showed grades 4 and 5 to be 21%, and this is higher than the prevalence found in the current research. Moreover, these researchers also found a prevalence of 49.4% for grades 1 and 2, which is less than that found in the current research (83.9%). Moreover, Al-Azemi *et al.*'s[23] investigation using a Kuwaiti sample found a prevalence of 31.1% for grade 4 and 5 traits (meaning that treatment was essential). A prevalence of 40.2% for those not needing treatment (grades 1 and 2) was also found, alongside a 28.7% prevalence rate for those with borderline treatment requirement of 28.7%. This, again, contradicts the findings of the present research.

One important limitation of the research was that no examiner's calibration was used. This means that reliability cannot be ensured and thus that the findings may be underpowered. Nonetheless, highly trained investigators supervised by qualified clinician professionals conducted the examinations and this helps ensure accurate recording. Malocclusion evaluation is a very reliable method and is a suitable choice for use in this study, as Ovsenik *et al*.[24] asserts. Nonetheless, they are reported to have poor intra- and interexaminer reliability in crowding evaluations, and this was not taken into account in the present research.

Conclusion

Using a sample of Hail city school children, this research has investigated and emphasized predominance of class I malocclusion, as well as lower prevalence of class III traits. The results pertaining to malocclusion prevalence appear to be in line with findings of other related studies in the region. Moreover, it was found that participants at grades 1 and 2 did not require treatment.

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Conflicts of interest
There are no conflicts of interest.

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