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A population-based survey on interarch malocclusion and background determinants

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ABSTRACT

Background: Genetics, environment, and ethnic factors are major contributors to the prevalence and variations of malocclusion.

Aim: The aim of study was to determine the prevalence of interarch problems in school-aged children, 9 – 11 years, living in Tehran; and to describe the role of ethnicity, education, and economic status on them.

Methods: The present data were part of the Comprehensive Evaluation of Skeleto-Dental Anomalies (CESDA) study conducted in 2015 among children living in Tehran, Iran. Cluster random sampling was applied among 19 districts of Tehran. A total of 38 schools were selected, and out of 1585 participants, the data of 1429 children were collected (response rate = 90%). The Chi-square test and binary logistic regression analysis were used for statistical analyses.

Results: Of all participants, 758 were boys and 671 were girls. The mean age was 121 ± 8 months. The most significant background determinants associated with molar relationship were ethnicity and place of residence. Class I right molar relationship was seen in 57.9% of the children and was generally more frequent in boys. Normal overjet was observed in 47.1%; 41.5% had an increased overjet, 16.2% had an anteroposterior cross-bite, and 11.8% had a lateral cross-bite. Midline discrepancy was seen among 61.1% of the children. Ideal anteroposterior, vertical, and horizontal relationship were observed in 31%, 53%, and 34% of the children, respectively. Only 10% of the children aged 9 – 11 years old had an ideal interarch relationship. Gender and place of residence had persistently significant association with having an ideal anteroposterior, vertical, horizontal, and interarch relationships ($P < 0.002$) in all four binary logistic regression models.

Conclusions: The majority of the children aged 9 – 11 years old have at least one interarch problem, although it is commonly preventable.

Relevance for Patients: Early detection of children's orthodontic problems may help with effective prevention of further advanced anomalies.

1. Introduction

Preventive or interceptive orthodontic treatment starts early in primary or mixed dentition to enhance dental and skeletal development before the establishment of permanent dentition [1-3]. It is less costly, more effective, and simpler than routine fixed orthodontic treatments. Studies have shown positive results in complying cases [3,4].

Epidemiological data are necessary for planning appropriate orthodontic treatment strategies and providing public preventive orthodontic services. The reported prevalence of malocclusion varies between genders, age groups, ethnic groups, and countries. In Saudi

Arabia, the reported prevalence of malocclusion was 62.4% in Arab children [5]. About 88% of Colombian children and adolescents showed degrees of malocclusion [6]. The prevalence was reported 93% in Latino adolescents [7].

One study showed that 75.8% of Italian schoolchildren needed moderate and severe orthodontic treatments [8], while the reported prevalence was lower in countries such as Germany (26.2%) [9] and France (21%) [10]. The differences might be explained by the study design, diagnostic criteria, sampling method, and participants' age.

The Third National Health and Nutrition Examination Survey (NHANES-III) is one of the most comprehensive studies in the field of prevalence of malocclusion in the United States. In this survey, malocclusions were divided into two types of intra- and inter-arch problems. Regarding interarch abnormalities, 20% of the U.S population had deviation from ideal occlusal relationship and 2% of them showed deviations requiring treatment for correction. About <10% of the participants had a posterior cross-bite, either overjet more than 6 mm or overbite more than 6 mm. A molar anteroposterior discrepancy more than 6 mm was also found in 11 – 15% of the study population [11].

In comparison, a meta-analysis done in Iran, in 2016, showed the prevalence of Class I, Class II, and Class III malocclusion as 54.6%, 24.7%, and 6.01%, respectively [12].

Furthermore, the prevalence of Class I, Class II division 1, Class II division 2, and Class III malocclusion was reported 41.8%, 24.1%, 3.4%, and 7.8% in Isfahan; and 55%, 17.6%, 4.3%, and 17.1% in Tabriz, respectively [12].

A number of studies evaluated the prevalence of malocclusion and treatment need among schoolchildren in Iran. However, due to small sample size, they lacked a good statistical power. Moreover, the participants of these studies are too old to start preventive orthodontics. In addition, none of these articles assessed the effect of socioeconomic status and ethnicity on the development of different types of malocclusions.

The aim of this study was to determine the prevalence of interarch problems (Angle's molar relationship), cross-bite, overbite, overjet, and midline shift in schoolchildren aged 9 – 11 years old in Tehran and to describe the effect of ethnicity, educational level, and economic status on these problems.

2. Methods

The present data were part of Comprehensive Evaluation of Skeleto-Dental Anomalies (CESDA) survey conducted in 2015 in Tehran, Iran, and granted by Deputy for Research, Tehran University of Medical Sciences. The Ethics Committee of Tehran University of Medical Sciences approved the present study (letter number: IR.TUMS.REC.1394.1757).

2.1. Sampling

The population of elementary schoolchildren in Tehran exceeds 7,700,000 children. Tehran is divided to 19 administrative districts according to the Ministry of Education zones. The target population of the present study were children in mixed dentition

before growth spurt and included all children aged 6 – 12 years old in elementary schools (Grades 1 – 6). In the present study, students in the fourth and fifth grades were selected as the study population. The Research Deputy of the Department of Education in Tehran coordinated the activities in the selected schools.

The present study was a population-based cross-sectional study. To have a representative sample, cluster random sampling was applied. In each district, one boys' school and one girls' school were selected from a list of all schools, and in each school, students in grades four and five were selected. In 19 districts of Tehran, a total of 38 schools were selected, and out of 1585 participants, the data of 1429 children were collected (response rate = 90%). Participation was voluntary and informed consent was obtained from the participants' parents or legal guardians. Any participant requiring emergency service was examined and referred to a dentist.

The examiners were four orthodontists who were previously calibrated during examination on 25 students by a lead principal investigator (M SH) for molar relationships, cross-bites, midline shift, overjet, and overbite ($Kappa \geq 0.95$). Examinations were carried out in schools in a suitable place under natural daylight.

In each grade, a brief questionnaire including background information and a written anonymous consent form was given to the students to deliver to their parents to be completed and signed for further clinical examination.

Background information included gender, age (calculated by month and categorized as 120 months or less (10 years or less), and more than 120 months (more than 10 years), mother's and father's level of education (unfinished high school education, high school diploma, and university education), mother's and father's ethnicity (Fars, Turk, Guilak and Mazan, Lor, Afghan, Kurd, and others), and place of residence (affluent: districts 1 – 8, non-affluent: districts 9 – 19) [13].

Clinical examinations included the most important interarch relationship indices. Sagittal interarch relationship was measured by molar relationship and overjet, vertical interarch relationship was measured by overbite, and horizontal interarch relationship was evaluated by anteroposterior, lateral, and buccal cross-bite, as well as midline discrepancy or shift.

2.2. Sagittal dimension

The Angle's classification was used to define molar relationship as follows: Angle's Class I (the mesiobuccal cusp of the first upper molars occludes in the buccal groove of the first lower molar), Class II (the lower first molar is distally positioned relative to the upper first molar), or Class III (the lower first molar is positioned mesially relative to the upper first molar) [14].

Overjet (OJ) was defined as the distance between the most labial point of the incisal edge of the maxillary incisors to the most labial surface of the mandibular incisors and was recorded as increased, if an obvious overjet (more than 3 mm) was observed, and decreased, if overjet tended to be edge-to-edge but not reversed. A reverse overjet was recorded when the lower incisors were in front of the upper incisors [15,16].

2.3. Vertical dimension

Overbite was characterized as the vertical overlap of the incisors [17]. An edge-to-edge incisors relationship was recorded if the maxillary and mandibular incisors occluded on their incisal edges. Normal overbite defined as 0 – 50% coverage of the lower incisors, increased overbite was defined as half but not fully covered lower incisors, and deep bite was defined as fully covered or more. An open bite was recorded if the upper and lower incisors were vertically separated

2.4. Transverse dimension

Anteroposterior cross-bite recorded when the incisal edge of one or more anterior maxillary teeth had edge-to-edge or lingual occlusion with their mandibular antagonists.

Lateral cross-bite recorded when one or more maxillary posterior teeth had edge-to-edge or lingual occlusion (uni- or bilateral) with their mandibular antagonists. Buccal cross-bite was recorded when any of the maxillary premolars or molars occluded with the buccal surface of the mandibular antagonist teeth.

A midline shift recorded when maxillary and mandibular midlines did not deviate.

The eight indices for the assessment of interarch relationship used in the present study comprised three sets of indices showing three dimensions of anteroposterior (right and left molar relationship and overjet), vertical (overbite), and horizontal relationship (cross-bite and midline shift). Accordingly, four new binary variables were used to assess whether the participant had an ideal relationship, that is, ideal anteroposterior relationship (right and left CL I molar relationships and normal overjet), ideal vertical relationship (normal overbite), ideal horizontal relationship (no cross-bite and no midline shift), and ideal interarch relationship (all three aforementioned variables were ideal).

2.5. Statistical analyses

Data were analyzed by SPSS version 20 [18]. The Chi-square test was used to compare frequency between subgroups. $P < 0.05$ was considered statistically significant. Anteroposterior, vertical, horizontal, and interarch relationships were evaluated using binary logistic regression analysis.

3. Results

Of all participants (N = 1429), 758 were boys and 671 were girls. The mean age was 121 ± 8 months.

The most significant background determinants associated with molar relationship were the place of residence and ethnicity of the parents. Gender was correlated only with the left molar and similar bilateral molar relationship (Table 1). Children with Fars, Afghan, and Kurd parents showed higher prevalence of the right and left molar relationship.

Class I right molar relationship was seen in 57.9% of the participants, and 35.5% and 6.2% of the children had Class II and Class III right molar relationship, respectively. The prevalence of Class I, Class II, and Class III left molar relationship was 58.2%,

34.3%, and 7.1%, respectively. One-fifth of the participants had dissimilar molar relationships between the left and right. Class I molar relationship was more prevalent in boys and Class II was more frequent in girls.

Normal overjet observed in 47.3% of all children in Tehran and 42.7% of the children had increased overjet. The prevalence of normal overbite was 52.6%. Gender, mother's ethnicity, educational level, and place of residence had a significant association with vertical and horizontal incisors relationship. Overbite had a significant relationship with all background determinants. Children with Turk parents showed the lowest frequency of normal overjet and overbite (Table 2).

Of all children, 16.2% had anteroposterior cross-bite, 11.8% had lateral cross-bite, and 1.6% had buccal cross-bite. Place of residence and mother's ethnicity showed a significant relationship with anteroposterior and buccal cross-bite. Except for gender, lateral cross-bite showed no significant relationship with background determinants (Table 3).

According to Table 4, midline discrepancy was seen in 61.1% of the children. A higher rate of midline discrepancy was seen in those who lived in affluent areas (72.1%), boys (67.6%), and those who were older than 10 years (64.3%) as compared to their counterparts.

According to Table 5, Class II molar relationship was more frequent in girls under 10 years old than older girls, while the frequency was similar for both age groups in boys.

Ideal anteroposterior, vertical, and horizontal relationship was observed in 31%, 53%, and 34% of the children, respectively. Only 10% of the children aged 9 – 11 years old had an ideal interarch relationship.

According to binary logistic regression analysis, only two variables of gender and place of residence were persistently significant for having an ideal anteroposterior, vertical, horizontal, and interarch relationships ($P < 0.002$) in all four models.

4. Discussion

In this study, interarch relationship indices (Angle's molar classification, overjet, overbite, cross-bite, and midline shift) were evaluated in schoolchildren in mixed dentition by four calibrated orthodontists. Class I molar relationship was the most prevalent finding, followed by Class II and Class III molar relationship. Overall, based on the number of significant relationships found between background determinants and interarch indices, place of residence showed the highest level of significant relationships (eight out of nine relationships tested in the present study), followed by gender (7/9), mother's ethnicity (6/9), mother's and father's ethnicity (4/9), and father's education and age (2/9), respectively.

For a valid skeletal analysis, radiography is usually necessary. However, in the present study, interarch relationships were assessed by clinical examination. Performing the examinations by four orthodontists previously highly calibrated enhanced the validity of data.

The data presented in this paper are part of a big and comprehensive orthodontic population-based epidemiological

Table 1. Weighted prevalence (%) of molar Angle classification among 9- to 11-year-old children (N=1429), Tehran, Iran, 2016

Background determinants	Right molar relationship				P	Left molar relationship				P	Similar bilateral molar relationship			P
	No	CI I	CI II	CI III		No	CI I	CI II	CI III		CI I	CI II	CI III	
Gender														
Boys	0.4	59.0	33.3	7.3	0.153	0.5	60.5	30.6	8.4	0.006	50.2	23.6	5.2	0.014
Girls	0.4	56.6	37.9	5.1		0.3	55.5	38.5	5.7		46.8	30.1	3.0	
Age (year)														
10 or less	0.6	56.9	36.9	5.6	0.206	0.6	57.1	36.9	5.4	0.067	47.3	28.3	3.7	0.707
More than 10	0.2	59.0	34.0	6.8		0.2	58.9	31.9	9.0		50.2	25.6	4.4	
Mother's education														
Under diploma	0.7	58.5	34.6	6.2	0.322	0.7	55.6	35.8	7.9	0.094	47.0	26.0	4.3	0.064
High school diploma	0.5	59.7	34.6	5.2		0.5	61.5	32.6	5.4		51.1	25.1	2.8	
University education	0.0	54.6	37.6	7.8		0.0	55.5	35.5	9.0		46.6	29.6	6.0	
Father's education														
Under diploma	0.7	58.6	33.6	7.1	0.153	0.5	56.6	34.5	8.4	0.026	46.8	24.8	4.5	0.227
High school diploma	0.6	56.3	37.7	5.4		0.4	59.6	36.1	3.9		49.2	28.8	3.0	
University education	0.2	58.8	34.4	6.6		0.4	57.7	32.2	9.7		49.7	26.0	5.1	
Mother's ethnicity														
Fars	0.0	55.2	42.9	1.9	0.069	0.0	57.1	36.2	6.7	0.012	47.6	30.5	1.0	0.012
Turk	0.0	37.1	51.5	11.4		0.0	37.1	51.5	11.4		27.8	41.7	11.1	
Guilak and Mazan	0.0	47.1	39.7	13.2		0.0	57.4	27.9	14.7		36.8	22.1	5.9	
Lor	1.0	53.9	38.2	6.9		0.0	50.5	43.7	5.8		44.1	32.4	5.9	
Afghan	0.8	60.4	34.5	4.3		0.4	64.6	30.3	4.7		54.7	25.2	3.1	
Kurd	0.4	59.2	33.7	6.7		0.5	58.3	33.8	7.4		49.3	26.0	4.3	
Others	0.0	72.7	27.3	0.0		4.5	59.1	36.4	0.0		50.0	18.2	0.0	
Father's ethnicity														
Fars	0.0	61.4	37.7	0.9	0.024	0.0	62.8	30.5	6.7	0.028	53.8	25.5	0.0	0.001
Turk	0.0	38.9	50.0	11.1		0.0	38.9	50.0	11.1		30.6	41.7	11.1	
Guilak and Mazan	0.0	50.0	37.5	12.5		0.0	54.8	30.1	15.1		35.6	20.5	5.5	
Lor	0.9	49.1	42.2	7.8		0.0	52.1	41.1	6.8		43.6	34.2	6.8	
Afghan	0.7	56.2	39.6	3.5		0.4	60.4	34.4	4.8		49.8	29.1	2.8	
Kurd	0.4	60.9	31.9	6.8		0.6	59.4	33.2	6.8		50.4	24.6	4.2	
Others	0.0	60.9	30.4	8.7		4.2	37.5	45.8	12.5		39.1	30.4	8.7	
Place (district)														
1-8 (affluent)	0.1	53.4	37.6	8.9	0.000	0.1	53.3	36.1	10.5	0.000	41.8	26.7	5.7	0.000
9-19 (non-affluent)	0.7	62.3	33.3	3.7		0.7	62.7	32.7	3.9		55.1	26.7	2.6	
Total	0.4	57.9	35.5	6.2		0.4	58.2	34.3	7.1		48.6	26.7	4.1	

Results are weighted according to population of each district and boy/girl ratio

survey. Evaluation of orthodontic problems includes assessment of skeletal, dental, soft tissue, and functional indicators. The original survey assessed all these parameters, but only interarch relationship indicators in sagittal, vertical, and transverse planes were reported in the present study. An exclusive characteristic of this study is assessment of the indicators in a detailed categorized manner according to the most important background determinants influencing skeleton-dental condition. This enables us to propose a baseline for future comparative studies and improve the prognosis of further treatments.

Tehran, the study site of the original survey, is a large populated city with people of different social, economic, ethnicity, cultural, and educational statuses. To have a representative sample, in

each district, two clusters of boys and girls in Grades 4 and 5 were randomly selected from a list of all schools in the district. To improve the accuracy of the survey estimates, the data were weighted according to gender distribution and population of primary schoolchildren in each district.

To evaluate the validity and applicability of clinical examinations to show the real skeleto-dental status, a pilot study was conducted in which at least 30 children were first clinically examined and then referred to the dental school for providing a study cast and radiographic analysis. The level of agreement between the clinical examination and further paraclinical examinations was 100%. The calibration of four examiners was done on 20 children and a high agreement (95%) was attained.

Table 2. Weighted prevalence (%) of incisors relationships among 9- to 11-year-old children (N=1429), Tehran, Iran, 2016

Background determinants	Overjet				P	Overbite					P
	Normal	Increased	Decreased	Reversed		Normal	Increased	Deep bite	Edge to edge	Open bite	
Gender											
Boys	42.0	44.1	12.3	1.6	0.000	46.7	23.0	14.8	12.7	2.8	0.000
Girls	53.3	38.5	7.2	1.0		59.3	23.4	9.4	6.6	1.3	
Age (year)											
10 or less	47.6	41.6	9.9	0.9	0.320	50.0	23.8	12.1	10.8	3.3	0.046
More than 10	45.9	41.5	10.9	1.7		54.4	22.6	13.4	8.7	0.9	
Mother's education											
Under diploma	43.9	41.7	11.8	2.6	0.022	58.9	20.4	7.7	11.1	1.9	0.001
High school diploma	48.0	42.8	8.5	0.7		49.7	23.1	14.5	11.1	1.6	
University education	49.3	39.2	10.4	1.1		50.2	26.0	13.8	6.8	3.2	
Father's education											
Under diploma	45.5	41.4	10.8	2.3	0.063	57.5	23.0	7.0	10.9	1.6	0.001
High school diploma	49.9	41.3	7.9	0.9		50.3	23.4	16.4	8.0	1.9	
University education	45.7	41.9	11.6	0.8		50.4	22.9	12.6	11.0	3.1	
Mother's ethnicity											
Fars	50.0	47.1	2.9	0.0	0.022	58.5	28.3	7.5	5.7	0.0	0.000
Turk	33.3	58.4	8.3	0.0		38.9	38.9	5.6	8.3	8.3	
Guilak and Mazan	36.8	44.1	16.2	2.9		60.9	18.8	2.9	14.5	2.9	
Lor	39.4	43.3	13.5	3.8		53.8	19.3	14.4	8.7	3.8	
Afghan	48.8	41.7	8.7	0.8		49.0	27.3	15.8	7.1	0.8	
Kurd	48.6	39.8	10.4	1.2		53.0	21.4	12.6	10.6	2.4	
Others	52.3	30.4	13.0	4.3		34.8	21.8	13.0	30.4	0.0	
Father's ethnicity											
Fars	49.1	42.4	8.5	0.0	0.066	62.9	21.7	5.7	8.7	1.0	0.001
Turk	36.2	44.4	19.4	0.0		40.0	31.4	5.8	11.4	11.4	
Guilak and Mazan	36.1	41.7	19.4	2.8		63.0	17.8	2.7	13.8	2.7	
Lor	45.7	41.4	10.3	2.6		47.9	24.8	17.9	7.7	1.7	
Afghan	46.8	43.7	8.8	0.7		50.5	24.2	15.8	8.4	1.1	
Kurd	49.0	41.0	8.7	1.3		52.7	22.7	12.0	10.2	2.4	
Others	40.9	31.8	22.7	4.6		34.8	21.7	21.7	21.8	0.0	
Place (district)											
1 – 8 (affluent)	39.7	46.1	13.3	0.9	0.000	59.3	18.8	10.9	8.9	2.1	0.000
9 – 19 (non-affluent)	54.3	37.2	6.7	1.8		46.0	27.3	13.8	10.8	2.1	
Total	47.3	42.7	9.9	0.1		52.6	23.2	12.3	9.8	2.1	

Results are weighted according to population of each district and boy/girl ratio

Children in Grades 4 and 5 are in a narrow age range of 9 – 11 years, which is a typical age for observation of skeleto-dental anomalies. The skeleto-dental anomalies in this age range are usually preventable and can be easily treated or controlled.

Dental relationship was reported according to the Angle's classification of molar relationship. In the present study, the distribution of Class I molar relationships (58%) was lower than reports from countries such as Denmark (72%), Norway (71.4%), Poland (82%), and China (65.9%) [17].

In the NHANES-III, the prevalence of Class I molar relationship was 80 – 85%. This percentage included Class I malocclusion (50 – 55%) and normal occlusion (30%) [11]. A systematic review in Iran in 2016 showed that the prevalence of Class I molar

relationship was 54.6% (46.5 – 62.7%), which is consistent with our findings [12].

About one-third of the children in our study had Class II molar relationship that was higher than in the results of other studies in Iran (24.7%, range: 20.8 – 28.7), the United States (15%), Denmark (24%), Norway (21.3%), Poland (24.4%), and China (21.5%) [11,12,17].

The prevalence of Class III malocclusion was reported less than 1% in the US population that was the lowest prevalence in malocclusions [11]. The results of the systematic review in Iran showed that the prevalence of Class III malocclusion was 6%, which is very similar to our results [12]. The prevalence is reported to be 4%, 7.3%, 14.4%, and 12.6% in Denmark, Norway,

Table 3. Weighted prevalence (%) of cross-bites among 9- to 11-year-old children (N=1429), Tehran, Iran, 2016

Background determinants	Anterior-posterior cross-bite				P	Lateral cross-bite			P	Buccal cross-bite			P
	No	Ant	Post	Ant and Post		No	Unilateral	Bilateral		No	Unilateral	Bilateral	
Gender													
Boys	82.2	10.4	6.3	1.1	0.032	90.3	6.9	2.8	0.004	98.0	1.3	0.7	0.460
Girls	85.5	7.5	6.9	0.1		85.7	8.2	6.1		98.8	0.9	0.3	
Age (year)													
10 or less	83.3	9.3	6.5	0.9	0.847	87.5	7.1	5.4	0.226	98.2	1.1	0.7	0.608
More than 10	83.8	8.7	7.0	0.5		88.8	7.5	3.7		98.6	1.1	0.3	
Mother's education													
Under diploma	81.1	10.7	7.7	0.5	0.042	87.2	9.4	3.4	0.263	98.8	1.2	0.0	0.467
High school diploma	83.9	9.4	5.4	1.3		89.4	6.2	4.4		98.2	1.0	0.8	
University education	86.0	6.7	7.3	0.0		87.4	7.3	5.3		98.3	1.2	0.5	
Father's education													
Under diploma	82.2	10.5	6.4	0.9	0.477	87.1	9.5	3.4	0.054	98.7	1.1	0.2	0.191
High school diploma	86.0	7.5	5.8	0.7		89.7	6.7	3.6		98.5	1.3	0.2	
University education	82.2	9.5	7.9	0.4		87.6	6.2	6.2		98.2	0.7	1.1	
Mother's ethnicity													
Fars	89.5	7.6	2.9	0.0	0.002	94.2	4.8	1.0	0.153	100	0.0	0.0	0.000
Turk	80.6	0.0	19.4	0.0		75.0	13.9	11.1		97.2	0.0	2.8	
Guilak and Mazan	72.1	16.1	10.3	1.5		88.2	7.4	4.4		97.1	2.9	0.0	
Lor	86.4	9.7	3.9	0.0		92.3	5.8	1.9		99.0	1.0	0.0	
Afghan	87.9	8.2	3.9	0.0		88.6	7.1	4.3		98.0	2.0	0.0	
Kurd	82.5	8.8	7.6	1.1		86.9	8.1	5.0		98.9	0.9	0.2	
Others	77.3	22.7	0.0	0.0		100.0	0.0	0.0		82.6	0.0	17.4	
Father's ethnicity													
Fars	83.6	13.5	1.9	1.0	0.332	90.4	4.8	4.8	0.937	100	0.0	0.0	0.265
Turk	85.7	2.9	11.4	0.0		85.7	5.7	8.6		97.2	0.0	2.8	
Northern	73.6	15.3	9.7	1.4		88.9	6.9	4.2		97.2	2.8	0.0	
Lor	86.4	8.5	5.1	0.0		90.5	5.2	4.3		99.1	0.9	0.0	
Afghan	86.6	7.0	6.0	0.4		88.4	7.7	3.9		97.9	2.1	0.0	
Kurd	82.8	9.1	7.2	0.9		87.4	8.2	4.4		98.3	0.9	0.8	
Others	91.6	4.2	4.2	0.0		91.3	8.7	0.0		100	0.0	0.0	
Place (district)													
1 – 8 (affluent)	79.7	8.7	10.5	1.1	0.000	87.5	8.7	3.8	0.181	99.2	0.8	0.0	0.020
9 – 19 (non-affluent)	87.5	9.4	2.8	0.3		88.8	6.4	4.8		97.6	1.4	1.0	
Total	83.8	9.0	6.6	0.6		88.2	7.5	4.3		98.4	1.1	0.5	

Results are weighted according to population of each district and boy/girl ratio

Poland, and China, respectively [17]. The prevalence of Class III malocclusion is high in China and Southeast Asia.

The difference in the reported prevalence of molar relationship between different studies might be due to differences in the prevalence of caries, participants' age, and mesial movement of upper or lower molars. Molar relationship might be also affected by skeletal relationship and oral habits.

Overjet is another indicator of the horizontal dental relationship that has been reported rarely or differently in other studies, making comparison difficult [5-7]. The prevalence of overjet shows a clear view of the studied population. The high prevalence of increased overjet (42.7%) in late mixed dentition will decrease following mandibular horizontal growth during growth spurt. However, the

high prevalence of increased overjet might be related to maxillary excess or mandibular deficiency.

Detailed examination of vertical incisors relationship is a critical diagnostic and prognostic element for a successful orthodontic treatment. No other study has reported a detailed profile of overbite.

The high prevalence of increased and deep overbite (35.5%) in late mixed dentition might be due to incomplete ramus growth as noted by Flaming [19]. Other studies have reported different prevalence rates for overbite such as 17% in Lithuanian children aged 10 – 12 years old, and 43.5% for increased and deep overbite in a local study in Tabriz [12].

According to Table 5, Class II molar relationship was more prevalent in girls under 10 years old than older girls while the

Table 4. Weighted prevalence (%) of midline shift among 9- to 11-year-old children (N=1429), Tehran, Iran, 2016

Background determinants	Midline shift		P
	No	Yes	
Gender			
Boys	32.4	67.6	0.000
Girls	46.1	53.9	
Age (year)			
10 or less	40.2	59.8	0.017
More than 10	35.7	64.3	
Mother's education			
Under diploma	37.9	62.1	0.768
High school diploma	38.6	61.4	
University education	40.3	59.7	
Father's education			
Under diploma	37.9	62.1	0.846
High school diploma	39.7	60.3	
University education	38.7	61.3	
Mother's ethnicity			
Fars	39.8	60.2	0.359
Turk	38.2	61.8	
Guilak and Mazan	26.1	73.9	
Lor	35.6	64.4	
Afghan	42.4	57.6	
Kurd	39.1	60.9	
Others	40.9	59.1	
Father's ethnicity			
Fars	45.2	54.8	0.142
Turk	42.9	57.1	
Guilak and Mazan	26.4	73.6	
Lor	36.8	63.2	
Afghan	43.2	56.8	
Kurd	37.7	62.3	
Others	40.9	59.1	
Place (district)			
1 – 8 (affluent)	27.9	72.1	0.000
9 – 19 (non-affluent)	49.9	50.1	
Total	38.9	61.1	

Results are weighted according to population of each district and boy/girl ratio

Table 5. Bilateral molar relationship (%) by gender and age categories among 9- to 11-year-old children (N=1429), Tehran, Iran, 2016

Age	Similar bilateral relationship			Dissimilar
	CI I	CI II	CI III	
Gender				
Boys				
10 or less	48.4	23.8	4.7	23.1
More than 10	51.1	23.7	5.0	20.2
Girls				
10 or less	45.3	32.9	2.2	19.6
More than 10	50.2	26.5	3.8	19.5

Results are weighted according to population of each district and boy/girl ratio

prevalence was similar for both age groups in boys, indicating that the role of growth factor on the mandible is more efficient in girls than boys during 10 – 12 years of age.

The reported prevalence of midline shift in the present study speaks out of either dissimilar space loss due to dental caries or extracted teeth or mandibular deviation. These if left untreated result in deviated mandible or probably temporomandibular disorders. The presence of cross-bite might be related to dental inclination or skeletal discrepancy. Both conditions are preventable and if left untreated result in severe and stabilized skeleto-dental problems that are difficult and costly to be treated.

5. Conclusion

The majority of children aged 9 to 11 years old have interarch problems, which are commonly preventable. Gender and place of residence (affluent or non-affluent) had persistently significant association with having an ideal interarch relationship.

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Conflicts of Interest

All authors declare that they have no conflicts of interest.

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