Original Article

Prevalence of Orthodontic Malocclusion and Evaluation Criteria in 7 Geographic Regions of Turkey

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ABSTRACT

Objective: The aim of this study was to identify the prevalence of malocclusion and orthodontic evaluation criteria in Turkey and determine differences among the 7 regions.

Materials and Method: In our research, extra- and intraoral examination of 1023 randomly selected persons from rural and central parts of different regions (500 female subjects and 523 male subjects; mean age = 13.10 ± 3.11) were performed. To analyze the data, descriptive statistical methods (mean value, prevalence ratio, standard deviation) were carried out. The significance of regional differences of the evaluation criteria and gender distributions were assessed by means of a χ^2 test.

Results: Comparison of the classification of malocclusion, crossbite, chin deviation asymmetry, smile line, cleft lip and palate, and profile among the regions showed significant differences ($p < 0.05$). Class I, II, and III malocclusion was most frequently noted in the Marmara, Aegean, and Central Anatolia regions, respectively. Crossbite was found more frequently on the posterior side (27,4%). Of those with a high smile line, 29.1% were found in the Aegean region. Persons with cleft lip and palate were more frequently identified in the Black Sea, Southeastern Anatolia, and Aegean regions. Midline diastema (6.5%) and openbite (2.9%) in the study group showed no differences between gender and the 7 regions ($p > 0.05$).

Conclusion: Malocclusion and all orthodontic evaluation criteria except midline diastema ($p < 0.05$) and openbite ($p < 0.01$) demonstrated statistically significant differences among the 7 regions of Turkey. As a result, we suggest that the distribution of orthodontic anomalies in the different geographic areas should be examined separately to give a more accurate picture of the actual occurrence rate and, therefore, contribute to the development of targeted health policies. (*Turkish J Orthod* 2014;26:154–161)

KEY WORDS: Epidemiological Survey, Malocclusion, Orthodontic criteria, Regional Differences

INTRODUCTION

Malocclusion is defined as abnormal alignment in or abnormal occlusal relationships between the dental arches.[1,2] A large number of epidemiologic studies on the prevalence of malocclusion and intra- and extraoral evaluation criteria, such as Angle classification, crossbite, chin asymmetry, cleft lip and palate, midline diastema, and openbite, in different populations have been published.[3–8] The objective of epidemiologic studies in different geographic regions is to contribute to the development of preventive dental programs and to plan the distribution of health services according to treatment need.[9]

The need for orthodontic treatment, the prevalence of malocclusion, and evaluation criteria have also been investigated for the Turkish population.[10,11] Sarı et al.,[12] determined that more than half of the subjects in a study group in the Central Anatolia region showed Class I malocclusion. Four

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To cite this article: Nur B, İlhan D, Fişekçioğlu E, Oktay İ, Arun T. Prevalence of orthodontic malocclusion and evaluation criteria in 7 geographic regions of Turkey. *Turkish J Orthod.* 2014;26:154–161 (DOI: http://dx.doi.org/10.13076/TJO-D-13-00008)

Date Submitted: August 2013. Date Accepted: December 2013.

years later, however, after the orthodontic evaluation of 2329 persons in the same region, Gelgör et al.[13] argued that the most frequent malocclusion was Class II and calculated the incidence of openbite, posterior crossbite, and midline diastema as 8.2%, 9.5%, and 7.0%, respectively. Çelikoğlu et al.[14] undertook a survey os 1507 orthodontic patients and found a high rate of Class I malocclusion in the East Anatolia region. They reported a higher prevalence of openbite (10%) and posterior crossbite (31.5%) and a lower prevalence of midline diastema (4.5%) than did Gelgör et al.[13] All of the present epidemiologic orthodontic studies in the literature collected samples from one region of Turkey; none compared the interregional orthodontic evaluation trait differences.

When the 74 million population of Turkey is considered, the 31 universities and 705 orthodontists providing orthodontic treatment are inadequate to address the need. Therefore, health policies that focus on the regions where malocclusion is more frequent have must be developed to get maximum output from the limited resources.

The 1st Geography Congress, held in Ankara in 1941, divided Turkey into 7 separate regions according to climate, flora and fauna, human habitat, agricultural diversity, and topography.[15] The aforementioned differences may also cause variations in prevalence and frequency of malocclusion and orthodontic evaluation criteria among the regions.

Consequently, the aim of the present study was to document the prevalence of malocclusion and intra- and extraoral evaluation criteria, such as openbite, crossbite, soft tissue chin asymmetry, smile line, and midline diastema, in every region of Turkey and to determine any interregional differences.

MATERIALS AND METHOD

This study is part of an oral health survey analysis project being conducted on 3040 persons in 7 different regions. It was approved by the Ethics Committee of Yeditepe University.

The main sample group of 1023 persons (500 female subjects and 523 male subjects; mean age = 13.10 ± 3.11 years) was determined using a stratified proportional randomized sampling strategy from different cities and rural areas in every region of Turkey (Marmara region, n = 199; Black Sea region, n =126; East Anatolia region, n =85; Southeastern Anatolia region,n = 127; Mediterranean region, n = 163; Aegean region, n = 213; and Central Anatolia region, n =176) and intra- and extra oral examination was performed. Subjects aged 8–17 years old who, along with their parents and grandparents, were born in the examined geographic region were included in the study.

A brief history was taken from every person and cleft lip and palate were noted. Subjects who had already undergone or were undergoing orthodontic treatment were excluded from the study.

In extraoral observation, chin deviation from midline, a line passing through glabella perpendicular to the pupiller plane, was measured. Less than 4 mm deviation was defined as symmetric, whereas deviation ≥4 mm was classified as asymmetric.[16,17] Furthermore, the subject's profile in natural head position was categorized as convex, straight, or concave according to glabella-subnasale-soft tissue pogonion angle.

Molar relationship of the sample group was checked according to Angle classification (Class I, Class II, Class III) to define the malocclusion. Cases with right-left different molar relations (subdivison malocclusion) were categorized as Class 4. Crossbite was defined as buccal or lingual malposition of anterior and/or posterior teeth and were classified according to location as anterior, unilateral posterior, bilateral posterior, or circular.[18] Additionally, midline diastema was recorded when there was a space of at least 2 mm between the upper central incisors.[3,6,7,13,14] Overjet and overbite were measured in centric occlusion. Overjet, was defined as the distance parallel to the occlusal plane between the labial surfaces of the maxillary and mandibular central incisors; it was considered negative if the upper central incisors were located in lingual occlusion. Overbite, on the other hand, was defined as the distance between the incisal edges of upper and lower incisors perpendicular to the occlusal plane and was considered negative if the upper central incisor did not overlap the lower incisors.[7] Moreover, if there was a gap between the upper and lower incisors, the subject was included into the openbite group.[3,6,13,14]

Statistical Analysis

The results were evaluated and the statistical analyses were performed by using statistical software (SPSS version 15.0, Chicago, IL, USA). To analyze the data, descriptive statistical methods (mean value, prevalence ratio, standard deviation) were carried out for regional differences; gender distributions were compared by means of a χ^2 test.

Table 1. Prevalance of orthodontic malocclusion and evaluation criteria

		n	%
Malocclusion classification	**1**	403	39,4
	2	495	48,4
	3	117	11,4
	4	8	0,8
Crossbite	**none**	743	72,6
	anterior	37	3,6
	Posterior (unilateral)	157	15,3
	Posterior (posterior)	59	5,8
	Circular	27	2,6
Profile	**concave**	218	21,3
	straight	378	37,0
	convex	427	41,7
Asymmetry	**(+)**	377	36,9
	(-)	646	63,1
Smile line	**Low**	343	33,5
	Normal	625	61,1
	High	55	5,4
Cleft	**(+)**	6	0,6
	(-)	1017	99,4
Midline diastema	**(+)**	66	6,5
	(-)	957	93,5
Lateral openbite	**(+)**	16	1,6
	(-)	1007	98,4
Anterior openbite	**(+)**	13	1,3
	(-)	1010	98,7

For all statistical analyses, the significance levels was set at $p < 0.05$.

RESULTS

Prevalence of malocclusion according to Angle classification in the main sample group was calculated for Class I, II, III, and IV as 39.4%, 48.4%, 11.4%, and 0.8%, respectively (Table 1). When the malocclusion groups were considered, no statistically differences were found in gender distribution ($p > 0.05$) (Table 2), whereas interregional differences were significant ($p < 0.01$) (Table 3). Class I malocclusion was most common in the Marmara region (22.8%) but was rarely recorded in the East Anatolia region (7.4%). Class II malocclusion was highest in persons from the Aegean region (18.2%), Class III malocclusion in the Central Anatolia region (19.7%), and Class IV in Mediterranean Region (37.5%). No persons evaluated in East Anatolia, Central Anatolia, and Black Sea regions showed Class IV malocclusion.

The minimum, maximum, and mean (± standard deviation) values were −5 mm, 10 mm, and 2.65 ± 2.06 mm, respectively, for overjet and were −10 mm,

Table 2. Gender distribution of orthodontic malocclusion and evaluation criteria

		Gender		*p*
		Female	Male	
		n (%)	n (%)	
Malocclusion classification	**1**	210 (%52,1)	193 (%47,9)	***0,385***
	2	229 (%46,3)	266 (%53,7)	
	3	57 (%48,7)	60 (%51,3)	
	4	4 (%50,0)	4 (%50,0)	
Crossbite	**none**	364 (%49,0)	379 (%51,0)	***0,597***
	anterior	18 (%48,6)	19 (%51,4)	
	Posterior (unilateral)	75 (%47,8)	82 (%52,2)	
	Posterior (posterior)	26 (%44,1)	33 (%55,9)	
	Circular	17 (%63,0)	10 (%37,0)	
Profile	**concave**	101 (%46,3)	117 (%53,7)	***0,028****
	straight	195 (%51,6)	183 (%48,4)	
	convex	239 (%56,0)	188 (%44,0)	
Asymmetry	**(+)**	183 (%48,5)	194 (%51,5)	***0,870***
	(-)	317 (%49,1)	329 (%50,9)	
Smile line	**Low**	160 (%46,6)	183 (%53,4)	***0,468***
	Normal	315 (%50,4)	310 (%49,6)	
	High	30 (%54,5)	25 (%45,5)	
Cleft	**(+)**	4 (%66,7)	2 (%33,3)	***0,442***
	(-)	496 (%48,8)	521 (%51,2)	
Midline diastema	**(+)**	37 (%56,1)	29 (%43,9)	***0,227***
	(-)	463 (%48,4)	494 (%51,6)	
Lateral openbite	**(+)**	10 (%62,5)	6 (%37,5)	***0,272***
	(-)	490 (%48,7)	517 (%51,3)	
Anterior openbite	**(+)**	7 (%53,8)	6 (%46,2)	***0,718***
	(-)	493 (%48,8)	517 (%51,2)	

8 mm, and 2.71 ± 2.01 mm, respectively, for overbite.

Comparison of distribution of crossbite, asymmetry, smile line, and cleft lip and palate groups interregionally showed statistically significant differences ($p < 0.01$), whereas no differences existed in terms of gender ($p > 0.05$).

In total, 743 subjects (72.6%) from the study group had neither transversal anomalies nor negative overjet. Crossbite (27.4%) was diagnosed more frequently on the posterior side unilaterally (15.3%). Persons without any transversal anomaly were mostly observed in the Marmara (19.1%) and Aegean (19.0%) regions (Table 3). More than one third of the

Table 3. Geographic distribution of orthodontic malocclusion and evaluation criteria

		Geographic Region							
		Mediterranean	East Anatolia	Aegean	South-Eastern Anatolia	Central Anatolia	Black Sea	**Marmara**	***p***
		n (%)	**n (%)**	**n(%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Malocclusion classification	**1**	76 (%18,9)	30 (%7,4)	65 (%16,1)	32 (%7,9)	65 (%16,1)	43 (%10,7)	92 (%22,8)	***0,009***
	2	67 (%13,5)	42 (%8,5)	90 (%18,2)	71 (%14,3)	87 (%17,6)	68 (%13,7)	70 (%14,1)	
	3	15 (%12,8)	10 (%8,5)	15 (%12,8)	19 (%16,2)	23 (%19,7)	16 (%13,7)	19 (%16,2)	
	4	3 (%37,5)	0 (%0,0)	2 (%25,0)	2 (%25,0)	0 (%0,0)	0 (%0,0)	1 (%12,5)	
Crossbite	None	97 (%13,1)	62 (%8,3)	141 (%19,0)	70 (%9,4)	137 (%18,4)	94 (%12,7)	142 (%19,1)	***0,001***
	Anterior	10 (%27,0)	3 (%8,1)	3 (%8,1)	10 (%27,0)	2 (%5,4)	4 (%10,8)	5 (%13,5)	
	Posterior (unilateral)	34 (%21,7)	11 (%7,0)	15 (%9,6)	32 (%20,4)	23 (%14,6)	17 (%10,8)	25 (%15,9)	
	Posterior (Bilateral)	10 (%16,9)	4 (%6,8)	12 (%20,3)	8 (%13,6)	12 (%20,3)	3 (%5,1)	10 (%16,9)	
	circular	10 (%37,0)	2 (%7,4)	1 (%3,7)	4 (%14,8)	1 (%3,7)	9 (%33,3)	0 (%0,0)	
Profile	concave	29 (%13,3)	25 (%11,5)	24 (%11,0)	37 (%17,0)	37 (%17,0)	33 (%15,1)	33 (%15,1)	***0,001***
	straight	51 (%13,5)	15 (%4,0)	86 (%22,8)	27 (%7,1)	81 (%21,4)	43 (%11,4)	75 (%19,8)	
	convex	81 (%19,0)	42 (%9,8)	62 (%14,5)	60 (%14,1)	57 (%13,3)	51 (%11,9)	74 (%17,3)	
Asymmetry	(+)	84 (%22,3)	42 (%11,1)	33 (%8,8)	76 (%20,2)	25 (%6,6)	55 (%14,6)	62 (%16,4)	***0,001***
	(-)	77 (%11,9)	40 (%6,2)	139 (%21,5)	48 (%7,4)	150 (%23,2)	72 (%11,1)	120 (%18,6)	
Smile line	Low	42 (%12,2)	27 (%7,9)	70 (%20,4)	40 (%11,7)	65 (%19,0)	35 (%10,2)	64 (%18,7)	***0,025****
	Normal	108 (%17,3)	54 (%8,6)	86 (%13,8)	78 (%12,5)	101 (%16,2)	87 (%13,9)	111 (%17,8)	
	High	11 (%20,0)	1 (%1,8)	16 (%29,1)	6 (%10,9)	9 (%16,4)	5 (%9,1)	7 (%12,7)	
Cleft	(+)	0 (%0,0)	0 (%0,0)	1 (%16,7)	2 (%33,3)	0 (%0,0)	3 (%50,0)	0 (%0,0)	***0,049****
	(-)	161(%15,8)	82 (%8,1)	171 (%16,8)	122 (%12,0)	175 (%17,2)	124 (%12,2)	182 (%17,9)	
Midline diastema	(+)	15 (%22,7)	3 (%4,5)	11 (%16,7)	6 (%9,1)	5 (%7,6)	14 (%21,2)	12 (%18,2)	***0,063***
	(-)	146(%15,3)	79 (%8,3)	161 (%16,8)	118 (%12,3)	170 (%17,8)	113 (%11,8)	170 (%17,8)	
Lateral openbite	(+)	3 (%18,8)	0 (%0,0)	0 (%0,0)	1 (%6,3)	4 (%25,0)	3 (%18,8)	5 (%31,3)	***0,288***
	(-)	158(%15,7)	82 (%8,1)	172 (%17,1)	123 (%12,2)	171 (%17,0)	124 (%12,3)	177 (%17,6)	
Anterior openbite	(+)	4 (%30,8)	2 (%15,4)	2 (%15,4)	0 (%0,0)	4 (%30,8)	0 (%0,0)	1 (%7,7)	***0,222***
	(-)	157(%15,5)	80 (%7,9)	170 (%16,8)	124 (%12,3)	171 (%16,9)	127 (%12,6)	181 (%17,9)	

subjects showed soft tissue chin asymmetry, and two-fifths of the asymmetry group originated from the Mediterranean and Southeastern Anatolia regions. For the high smile line group, 29.1% were recorded in the Aegean region. Of 1023 subjects examined. 6 had cleft lip and palate. Cleft lip and palate was most commonly diagnosed in the Black Sea, Southeastern Anatolia, and Aegean regions.

The prevalence of midline diastema, anterior openbite, and lateral openbite was 6.5%, 1.3%, and 1.6%, respectively (Table 1). Both the midline diastema and openbite group showed no gender and no interregional significant differences ($p > 0.05$) (Tables 2 and 3). The results of the ratings for convex, straight, and concave profiles were 21.3%, 37.0%, and 41.7%, respectively, and presented significant differences between gender ($p < 0.05$) and regions ($p < 0.01$). Convex profile was more frequently diagnosed in girls and in the Mediterranean Region (19.0%), whereas concave profile was common in boys and in the South Eastern and Central Anatolia Region (17.0%).

DISCUSSION

Malocclusion prevalence should be the subject of preventive and protective national health policies.[9] The genotype of persons with malocclusion shows hereditary transmission and does not change, whereas phenotype can modify by environmental factors. Geographic regions in a country are grouped by their similar environmental differences in such conditions as climate, flora and fauna, human habitat, agricultural diversity, and topography. Therefore, subjects should be selected from the same geographic region and should be compared between the regions to perform an actual national epidemiologic survey. Likewise, Başçiftçi et al.[19] argued that different malocclusion variations can be identified in different geographic regions. That is why the aim of the present study was to determine the prevalence of orthodontic malocclusion and evaluation criteria in randomized selected subjects from 7 different geographic regions of Turkey and to compare the differences between the regions.

In the present study, the rating of Class I, II and III malocclusion was 39.4%, 48.4%, and 11.4%, respectively. The higher prevalence of Class I malocclusion in studies of other populations might be due to ethnic variations.[18,20,21] Nevertheless, Josefsson et al.[22] separated the main study group in their study into 4 groups: the Swiss group, the East Europe group, the Asian group, and a group composed of subjects who originated from other countries; they reported that only minor and statistically insignificant differences in the prevalence of malocclusion were found between the groups despite the variation in origin.

Several studies have investigated the prevalence of orthodontic malocclusion and evaluation criteria for the Turkish population in one geographic region.[12–14] Although in some studies the Class I malocclusion rate was higher than the rate in our study,[13,14] Çelikoğlu et al.[14] found similar results in the East Anatolia region (41.5%). Additionally, Gelgör et al.[13] found Class III malocclusion rates (10.3%) similar to those in our study but found higher Class II rates (44.7%) in their subjects from the Central Anatolia region. Moreover, Sarı et al.[12] examined 1602 persons and found Class III malocclusion rates (10.0%) identical to those of Gelgör et al.[13] in the same geographic region. In the present study, the malocclusion classification showed statistically significant differences among the 7 regions of Turkey ($p < 0.01$). Class I malocclusion was most commonly identified in the Marmara region (22.8%) and occurred least frequently in the East Anatolia region (7.4%). Class II malocclusion was found rarely in the East Anatolia region (8.5%) and was more frequent in the Aegean region (18.2%) and the Central Anatolia region (17.6%) (Table 3).

Openbite can show inherent transmission and prevalence differences between races.[3] The present study assessed the Turkish population and determined a rate of 2.9% (anterior 1.3%, lateral 1.6%) for openbite incidence. In their study of 1601 children in Tanzania, Mtaya et al.[18] reported rates of 15.0% for anterior and 1.1% for lateral openbite. In contrast, similar to our results, in a study in which 810 children were observed in Italy, the rate was 2.0%.[7] Souames et al.,[23] who studied a French population, and Profitt et al.,[24] who studied an American population, published rates similar to ours for openbite. Çelikoğlu et al.[14] rated openbite as 10.0% in the East Anatolia region, whereas in the present study, 15.4% of all openbite cases were from the East Anatolia region (Table 3). Furthermore, Sarı et al.[12] calculated an openbite incidence of 2.7% in Central Anatolia. Similarly, in the present study the rate was 2.3% in the Central Anatolia region.

In the main study group, 27.4% showed crossbite. Crossbite was most frequently on the posterior side unilaterally (15.3%). The prevalence of bilateral posterior crossbite was 5.8%. Crossbite prevalence in other populations has been found to be lower than we found in the present study.[18] After observing 511 subjects in the French population, a study reported similar results for anterior (2.2%) and bilateral posterior (4.1%) crossbite, but the rate for unilateral posterior crossbite (4.3%) was only one-fourth of the rate of the present study (15.3%).[23] Çelikoğlu et al.[14] determined a unilateral crossbite rate of 15.0% in

East Anatolia region, whereas in the present study, 7.0% of the crossbite group was found in the East Anatolia region and 13.4% of the subjects evaluated in East Anatolia region presented crossbite (Table 3). Crossbite showed significant differences between the geographic regions ($p < .01$). No crossbite was most frequently identified in the Marmara and the Aegean regions.

Cleft lip and palate is the second most common major congenital anomaly in Turkey.[25] The malformation is also influenced by environmental factors and usually shows inherent transmission and cluster in families with first-degree consanguineous marriage, in which the risk increases 40 times compared with general population.[26] Tunçbilek[27] found a 1.0% incidence of cleft lip and palate in Turkey. In the present study, the incidence for cleft lip and palate was lower (0.6%) and was recorded in the Black Sea, Southeastern Anatolia, and Aegean regions.

Consanguineous marriage was found in 22.0% of the Turkish population, most frequently in the Southeastern Anatolia region (41.6%) and the Black Sea region (32.9%).[28] The high rate of consanguineous marriage in these regions might be the cause of the frequency of subjects with cleft.

Smile line, one of the important factors in evaluating oral aesthetics, is classified into three groups: normal, low, and high.[29,30] In the present study, the rate for normal, low, and high smile line was 61.1%, 33.5%, and 5.4%, respectively. High smile line was most frequently found in the Aegean region ($p < 0.05$) (Table 3).

Of the main subject group, 6.5% showed midline diastema. Ciuffolo et al.[7] recorded an identical rate for midline diastema in the Italian population. Likewise, Proffit et al.[24] determined 6.0% midline diastema after the National Health and Nutrition Estimates Survey III (NHANES III) in the American population. However, this rate is higher than that the 4.0% prevalence Çelikoğlu et al.[14] found in the East Anatolia region and less than the 7.0% prevalence Gelgör et al.[13] found in the Central Anatolia region. It is interesting to note that in the present study, the rates for the East and Central Anatolia regions were 4.5% and 7.6%, respectively, which is similar to the findings of Çelikoğlu et al.[14] and Gelgör et al.[13]

Convex profile was more common in girls ($p < 0.05$), whereas concave profile was observed significantly more frequently in boys ($p < 0.01$). Subjects with convex, straight, and concave profile were recorded most frequently in the Mediterranean region (19.0%), the Aegean region (22.8%), and the Southeastern and Central Anatolia regions (17.0%), respectively. Profitt et al.,[24] argued that concave profile presents skeletal Class III and convex profile skeletal Class II. Despite the dental evaluation in the present study, the distributions of the profile and malocclusion classification were coherent among the geographic regions. Class III malocclusion and concave profile were most common in the Central Anatolia and Southeastern Anatolia regions, whereas Class I malocclusion and straight profile were found at a high rate in the Aegean region ($p < 0.01$).

CONCLUSION

In the present study, the distribution of orthodontic malocclusion and evaluation criteria, except midline diastema ($p < 0.05$) and openbite ($p < 0.01$), showed statistically significant differences among the 7 geographic regions of Turkey. This might be due to the differences in climate, flora and fauna, human habitat, agricultural diversities, and socioeconomic status among the regions. Therefore, epidemiologic surveys examining the geographic regions separately will contribute more to the development of national health policies and beneficial distribution of health services.

REFERENCES

1. Proffit WR, Fields HW, Sarves DM. *Contemporary Orthodontics*. 4th ed. St Louis, MO: Mosby Elsevier; 2007.
2. Whalter DP, Houston WJB, Jones ML, Oliver RG. *Whalter and Houston's Orthodontic Notes*. 5th ed. Oxford, Wright; 2004.
3. Thilander B, Pena L, Infante C, Parada SS, de Mayorga C. Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogotaì, Colombia. An epidemiologic study related to different stages of dental development. *Eur J Orthod*. 2001;23:153–167.
4. Lauc T. Orofacial analysis on the Adriatic islands: an epidemiological study of malocclusions on Hvar Island. *Eur J Orthod*. 2003;25:273–278.
5. Mugonzibwa EA, Eskeli R, Kuijpers-Jagtman AM, Laine-Alava MT, van't Hof MA. Occlusal characteristics during different emergence stages of the permanent dentition in Tanzanian Bantu and Finnish children. *Eur J Orthod*. 2004; 26:251–260.
6. Onyeaso CO. Prevalence of malocclusion among adolescents in Ibadan, Nigeria. *Am J Orthod Dentofacial Orthop*. 2004;126:604–607.
7. Ciuffolo F, Manzoli L, D'Attilio,Tecco S, Muratore F, et al. Prevalence and distribution by gender of occlusal characteristics in a sample of Italian secondary school students: a cross-sectional study. *Eur J Orthod*. 2005;27:601–606.

8. Komazaki Y, Fujiwara T, Ogawa T, Sato M, Suzuki K, et al. Prevalence and gender comparison of malocclusion among Japanese adolescents: a population-based study. *J World Fed Orthod*. 2012;1: e67–e72.
9. Foster TD, Menezes DM. The assessment of occlusal features for public health planning purposes. *Am J Orthod Dentofacial Orthop*. 1976;69:83–90.
10. Güray E, Orhan M, Ertas E, Doruk C. Konya yöresi ilkokul çocuklarında Treatment Priority Index (TPI) uygulaması (Epidemiyolojik Çalışma). *Türk Ortodonti Derg*. 1994;7:195–200.
11. Üçüncü N, Ertugay E. The use of the index of orthodontic treatment need (IOTN) in a school population and referred population. *J Orthod*. 2001;28:45–52.
12. Sarı Z, Uysal T, Karaman Aİ, Basçiftçi FA, Usumez S, Demir A. Ortodontik maloklüzyonlar ve tedavi seçeneklerinin değerlendirilmesi: epidemiolojik çalışma. *Türk Ortodonti Derg*. 2003;16:119–126.
13. Gelgör IE, Karaman AI, Ercan E. Prevalence of malocclusion among adolescents in central anatolia. *Eur J Dent*. 2007;3:125–131.
14. Çelikoğlu M, Akpinar S, Yavuz I. The pattern of malocclusion in a sample of orthodontic patients from Turkey. *Med Oral Patol Oral Cir Bucal*. 2010;15:e791–e796.
15. Birinci Coğrafya Kongresi (Kitabı), BİRİNCİ COĞRAFYA KONGRESI (Kitabı). Raporlar, müzakereler, kararlar. Maarif Vekâleti neşr. Ankara, 6–21 Haziran 1941.
16. Haraguchi S, Takada K, Yasuda Y. Facial asymmetry in subjects with skeletal Class II deformity. *Angle Orthod*. 2002, 72:28–35.
17. Haraguchi S, Iguchi Y, Takada K. Asymmetry of the face in orthodontic patients. *Angle Orthod*. 2008, 78: 421–426.
18. Mtaya M, Brudvik P, Astrøm AN. Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries, and oral hygiene in 12- to 14-year-old Tanzanian schoolchildren. *Eur J Orthod*. 2009;31:467–476.
19. Başçiftçi FA, Demir A, Sarı Z, Uysal T. Konya Yöresi Okul Çocuklarında Ortodontik Maloklüzyonların Prevelansının Araştırılması: Epidemiyolojik Çalışma. *Türk Ortodonti Derg*. 2002:15;92–98.
20. Ahangar Atashi MH. Prevalence of malocclusion in 13–15 year-old adolescents in Tabriz. *J Dent Res Dent Clin Dent Prospects*. 2007;1:13–18.
21. Perillo L, Masucci C, Ferro F, Apicella D, Baccetti T. Prevalence of orthodontic treatment need in southern Italian schoolchildren. *Eur J Orthod*. 2010;32:49–53.
22. Josefsson E, Bjerklin K, Lindsten R. Malocclusion frequency in Swedish and immigrant adolescents—influence of origin on orthodontic treatment need. *Eur J Orthod*. 2007;29:79–87.
23. Souames M, Bassigny F, Zenati N, Riordan PJ, Boy-Lefevre ML. Orthodontic treatment need in French schoolchildren: an epidemiological study using the Index of Orthodontic Treatment Need. *Eur J Orthod*. 2006;28:605–609.
24. Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodonthic treatment need in the United States: estimates from the NHANES-III survey. *Int J Adult Orthod Orthogn Surg*. 1998;13:97–106.
25. Tomatr AG, Demirhan H, Sorkun HÇ, Köksal A, Özerdem F, Çilengir N. Major congenital anomalies: a five-year retrospective regional study in Turkey. *Genet Mol Res*. 2009;13; 8:19–27.
26. Thompson MW, McInnes RR, Willard HF. Thompson and Thompson: Genetics in medicine. 5th ed., Toronto: WB Saunders; 1991.
27. Tunçbilek E. *Türkiye'de Konjenital Malformasyon Sıklığı, Dağılımı, Risk Faktörleri, ve Yenidoğanların Antropometrik Değerlendirmesi*. Ankara, Turkey: Tübitak Matbaası; 1994.
28. Koç İ. Prevalence and sociodemographic correlates of consanguineous marriages in Turkey. *J Biosoc Sci*. 2008; 40:137–148.
29. Legan HL, Burstone CJ. Soft tissue cephalometric analysis for orthognatic surgery. *J Oral Surg*. 1980;38:744–751.
30. Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning. Part I. *Am J Orthod Dentofacial Orthop*. 1993;103:299–312.