Original Article

Total and Interregional Differences of the Need for Orthodontic Treatment in Turkey: Epidemiologic Surveillance Analysis

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ABSTRACT

Objective: The aim of this study was to identify the need for orthodontic treatment in Turkey and the differences between the 7 geographic regions.

Materials and Methods: In the orthodontic part of the survey, extraoral and intraoral examination of 1023 randomly selected individuals (500 female and 523 male, mean ages 13.10±3.11 years) was performed. The need of orthodontic treatment was evaluated with the aesthetic component (AC) and dental health component (DHC) of the Index of Orthodontic Treatment Need (IOTN). To analyze the data, descriptive statistical methods (mean value, prevalence ratio, and standard deviation) were performed. The significance of regional IOTN differences and gender distributions were assessed by means of chi-square test.

Results: No statistically significant differences were found in gender distribution in the total and different regional samples ($p>0.05$). According to the DHC, 28.7% did not need orthodontic treatment, 16.3% were borderline cases, and 55.0% had severe need for orthodontic therapy. Little or no need for treatment was found in 91.8% of the study group according to the AC. Significant interregional differences were determined by DHC ($p<0.01$). The treatment need was greatest in the Southeastern Anatolia region (72.6%) and least in the Marmara region (34.1%).

Conclusions: Orthodontic treatment need was significantly different between the geographic regions in Turkey. The need for orthodontic treatment was high in the total sample; nevertheless, the lack of awareness of the need for treatment was a worrisome finding. (*Turkish J Orthod* 2014;27:1–8)

KEY WORDS: orthodontic treatment need, epidemiologic analysis

INTRODUCTION

Epidemiologic orthodontic surveys aim to identify the deviations from normal occlusions and the severity of malocclusions in the population. Additionally, in regions where technical and professional resources are limited, it is useful to classify the priority of treatment to select the patients who will most benefit from orthodontic treatment. Therefore, occlusal indices such as Handicapping Labiolingual Deviation Index,[1] Treatment Priority Index,[2,3] Occlusal Index,[4,5] and the Standardized Continuum of Aesthetic Need Index[6] have been developed to assess the orthodontic treatment need in the last decade. The Index of Orthodontic Treatment Need (IOTN), defined by Brook and Shaw[7] and modified in 1995[8] classifies malocclusions in terms of occlusal features of dental health and perceived esthetic impairment and has been used in orthodontic investigations in many countries worldwide such as Italy,[9,10] France,[11] Sweden,[12] UK,[13,14] Saudi Arabia,[15] Spain,[16] Caribbean Islands,[17] and Finland.[18]

A survey of the literature shows that orthodontic treatment need is generally identified in a specific

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region of the related country, and the results are suggested to reflect the whole population. In homogenous and underpopulated regions, the study group may provide an idea regarding the overall population, but this is not true for mosaic multicultural regions like Turkey.

Turkey is divided into 7 geographic regions (Mediterranean, Aegean, Black Sea, East Anatolia, Southeastern Anatolia, Central Anatolia, and Marmara region), originally defined at the first Geography Congress in 1941. These regions are separated according to climate, vegetation, location, flora, human habitat, cultural differences, and topography. Considering all of the factors mentioned above, it is rational to assume that treatment needs might also alter depending on the specific region.

The demand for orthodontic treatment of a study group in Central Anatolia was first investigated by Güray *et al*.[19] in 1997. Uğur *et al*.[20] and Uçüncü and Ertugay[21] also evaluated the orthodontic treatment need in Central Anatolia. Similarly, orthodontic investigations of treatment need were performed in the Mediterranean region of Turkey.[22,23] However, there is yet no study that covers all regions and comparatively evaluates their need for orthodontic treatment.

Therefore, the aim of this study was to assess and compare the need for orthodontic treatment need in 7 different geographic regions in Turkey using the IOTN.

MATERIALS AND METHODS

This study is a part of an oral health survey analysis project being conducted with 3040 individuals in 7 different regions of Turkey for different age groups. The research was approved by the Ethics Committee of Yeditepe University.

The main sample group of 1023 individuals (500 female and 523 male, mean age 13.10±3.11 years) was determined with stratified proportional randomized sampling strategy from different cities and rural areas in every region of Turkey (Marmara, n=199; Black Sea, n=126; East Anatolia, n=85; Southeastern Anatolia, n=127; Mediterranean, n=163; Aegean, n=213; and Central Anatolia, n=176), and intraoral and extraoral examination was performed. Individuals between 8 and 17 years old who themselves as well as their parents and grandparents were born in the examined geographic region were included in the study.

The IOTN was used to identify the treatment need in 7 different regions. The index is composed of 2 parts: the dental health component (DHC) and the aesthetic component (AC).

The clinical component DHC, ranges the need for treatment into 5 grades. Grades 1 and 2 represent no or slight need, grade 3 shows moderate need, and grades 4 and 5 demonstrate need or severe need for orthodontic treatment (Table 1).[7] Every grade was assigned according to the severity of the worst occlusal trait. The examiner evaluated the worst trait of missing teeth, overjet, crossbite, displacement of contact points, and overbite, and the anomaly with the higher rank was recorded.

The aesthetic component consists of a 10-point scale illustrated by a series of photographs. The photographs were arranged from the most to the least attractive. The aesthetic component was also grouped into grades 1–4, grades 5–7, and grades 8–10 as no or slight need, moderate need, and need or severe need for orthodontic treatment, respectively.[7] The scale was shown to every individual in the study group. Afterwards, they were asked to point to the photograph that was most similar to their own dentition.

The results were evaluated and the statistical analyses were performed using SPSS (Statistical Package for Social Sciences) version 15.0. To analyze the data, descriptive statistical methods (mean value, prevalence ratio, and standard deviation) were carried out. The significance of regional IOTN differences and gender distributions were assessed by means of chi-square test. For all statistical analyses, the significance level was set at $p < 0.05$.

RESULTS

The gender distributions for both of the 3 treatment need categories (no/slight, moderate, severe need) of the DHC and AC of IOTN were not statistically significant ($p>0.05$) (Table 2).

The distribution for the DHC of the whole study group was as follows, 28.7% no/slight treatment need, 16.2% moderate need, and 55% severe need for treatment (Table 3). The need for orthodontic treatment need according to the DHC of IOTN presented statistically significant differences between the 7 regions of Turkey ($p<0.01$). The Southeastern Anatolia region had the highest rate of individuals with severe treatment need (72.6%),

Table 1. Dental Health Component of the Index of Orthodontic Treatment Need[a]

Grade	Description
Grade 5 (severe)	Defects of cleft lip and/or palate.
	Increased overjet greater than 9 mm.
	Reverse overjet greater than 3.5 mm with reported masticatory or speech difficulties.
	Impeded eruption of teeth (with the exception of third molars) due to crowding, displacement, the presence of supernumerary teeth, retained primary teeth, and any other pathological cause.
	Extensive hypodontia with restorative implication (more than 1 tooth missing in any quadrant) requiring prerestorative orthodontics.
Grade 4 (need)	Increased overjet greater than 6 mm but less than or equal to 9 mm.
	Reverse overjet greater than 3.5 mm with no reported masticatory or speech difficulties.
	Reverse overjet greater than 1 mm but less than or equal to 3.5 mm with reported masticatory or speech difficulties.
	Anterior or posterior crossbites with greater than 2 mm displacement between retruded contact position and intercuspal position.
	Posterior lingual crossbites with no occlusal contact in one or both buccal segments.
	Severe displacement or teeth greater than 4 mm.
	Extreme lateral or anterior open bite greater than 4 mm.
Grade 3 (borderline)	Increased and complete overbite causing notable indentation on the palate or labial gingivae.
	Patient referred by colleague for collaborative care (e.g., periodontal, restorative, or temporomandibular joint considerations).
	Less extensive hypodontia requiring prerestorative orthodontics or orthodontic space closure to obviate the need for a prosthesis (not more than 1 tooth missing in any quadrant).
	Increased overjet greater than 3.5 mm but less than or equal to 6 mm with incompetent lips at rest.
	Reverse overjet greater than 1 mm but less than or equal to 3.5 mm.
	Increased and complete overbite with gingival contact but without indentations or signs of trauma.
	Anterior or posterior crossbites with less than or equal to 2 mm but greater than 1 mm displacement between retruded contact position and intercuspal position.
	Moderate lateral or anterior open bite greater than 2 mm but less than or equal to 4 mm.
	Moderate displacement of teeth greater than 2 mm but less than or equal to 4 mm.
Grade 2 (slight)	Increased overjet greater than 3.5 mm but less than or equal to 6 mm with competent lips at rest.
	Reverse overjet greater than 0 mm but less than or equal to 1 mm.
	Increased overbite greater than 3.5 mm with no gingival contact.
	Anterior or posterior crossbites with less than or equal to 1 mm displacement between retruded contact position and intercuspal position.
	Small lateral or anterior open bites greater than 1 mm but less than or equal to 2 mm.
	Prenormal or postnormal occlusions with no other anomalies.
	Mild displacement of teeth greater than 1 mm but less than or equal to 2 mm.
Grade 1 (none)	Other variation in occlusion including displacement less than or equal to 1 mm.

[a] Reproduced from Brook PH, Shaw WC. The development of an index of treatment priority. *Eur J Orthod*. 1989;11:309–320.

whereas the Marmara region had the highest rate of individuals with no/slight treatment need (34.1%).

The percentage of perceived treatment need of esthetics by the study subjects was identified as follows: 91.8% no/slight need, 6.2% moderate need, and 2.1% severe treatment need (Table 4). Comparison of the AC in the different regions of Turkey showed statistically significant differences ($p<0.01$). The no/slight treatment need group was statistically different from the moderate and severe need group ($p<0.01$). On the other hand, the moderate and severe treatment need did not show any statistically significant differences ($p=0.793$, $p>0.05$) (Table 4).

DISCUSSION

Epidemiologic orthodontic investigations using several indices to identify the treatment need are evident in the literature. In previous studies, the study samples were collected from one region and assumed to represent the whole population.[9,11,17,21,22,24] This may be true for under-

Table 2. Gender distribution of the Dental Health Component (DHC) and Aesthetic Component (AC) of the Index of Orthodontic Treatment Need in the total study group*

	No/Slight Treatment Need, n (%)	Moderate Treatment Need, n (%)	Severe Treatment Need, n (%)	*p*
DHC				
Female	156 (53.1)	79 (47.6)	265 (47.1)	0.234
Male	138 (46.9)	87 (52.4)	298 (52.9)	
AC				
Female	453 (48.2)	36 (57.1)	11 (52.4)	0.372
Male	486 (51.8)	27 (42.9)	10 (47.6)	

* Significance level set at $p < 0.05$.

populated countries, but not for countries with significant regional differences in terms of human habitat, vegetation, culture, flora, and climate such as Turkey. Josefsson *et al.*[12] suggested that in multicultural countries with individuals originating from different demographic backgrounds, the orthodontic treatment need might also alter. If the regional differences of treatment need are ignored, the orthodontic resources cannot be distributed appropriately. Therefore, the primary aim of the present study was to identify the orthodontic treatment need of Turkey by collecting data from every geographic region. Additionally, the interregional differences in terms of treatment need were also assessed.

The assessment of treatment need for public health purposes has been performed using several indices; however, none of them are accepted worldwide. The IOTN was developed by Brook and Shaw[7] to rank the malocclusions. IOTN is composed of 2 components: the DHC to represent the various occlusal traits and the AC to identify the perceived esthetic of the malocclusion. The underlying objective of the IOTN is to select the patients who would most benefit from orthodontic treatment. In the present study, IOTN was used because of its suggested reproducibility and validity.[25–27] Additionally, using the same assessment methodology allowed the comparison of the results from different countries that selected a similar approach.

In the present study, no significant differences were recorded in the gender distribution of the 3 treatment categories of the DHC and AC of IOTN ($p>0.05$). Güray *et al.*[19] and Uğur *et al.*[20] examined the treatment need in only 1 region using the Treatment Priority Index; however, they also found no differences in gender distribution between the treatment need groups. Additionally, Uçüncü and Ertugay[21] and Kazancı[28] determined no differences in gender distribution in the orthodontic treatment need using IOTN. Similarly, some researches from other countries suggested that treatment need differs between gender and added that gender differences were presented for the AC of IOTN.[10,11,14,16,29]

The orthodontic treatment need for the population in 1 specific region of Turkey was examined in several research studies (Table 5).[19,20,21,22,28] The first investigation on this topic was performed by Güray *et al.*[19] for the Central Anatolia region of Turkey. They examined 483 children, aged between 6 and 12 years, using the Treatment Priority Index and concluded that 60.04% of the study group had

Table 3. Prevalence of the Dental Health Component (DHC) grades of the Index of Orthodontic Treatment Need in the 7 different regions of Turkey

	Region	No/Slight Treatment Need, n (%)	Moderate Treatment Need, n (%)	Severe Treatment Need, n (%)	*p*
DHC	Mediterranean	48 (29.8)	16 (9.9)	97 (60.2)	0.001
	East Anatolia	25 (30.5)	9 (11)	48 (58.5)	
	Aegean	52 (30.2)	60 (34.9)	60 (34.9)	
	Southeastern Anatolia	25 (20.2)	9 (7.3)	90 (72.6)	
	Central Anatolia	44 (25.1)	43 (24.6)	88 (50.3)	
	Black Sea	38 (29.9)	13 (10.2)	76 (59.8)	
	Marmara	62 (34.1)	16 (8.8)	104 (57.1)	
	Total	294 (28.7)	166 (16.2)	563 (55)	

Table 4. Prevalence and comparison of the Aesthetic Component (AC) grades of the Index of Orthodontic Treatment Need in the 7 different regions of Turkey

	Region	No/Slight Treatment Need n (%)	Moderate Treatment Need n (%)	Severe Treatment Need n (%)	*p*
AC	Mediterranean	157 (97.5)	3 (1.9)	1 (0.6)	0.001
	East Anatolia	82 (100)	0 (0)	0 (0)	
	Aegean	122 (70.9)	36 (20.9)	14 (8.1)	
	Southeastern Anatolia	123 (99.2)	1 (0.8)	0 (0)	
	Central Anatolia	152 (86.9)	17 (9.7)	6 (3.4)	
	Black Sea	124 (97.6)	3 (2.4)	0 (0)	
	Marmara	179 (98.4)	3 (1.6)	0 (0)	
	Total	939 (91.8)	166 (6.2)	21 (2.0)	
	Comparison of AC groups				
	No/slight–moderate treatment need group				0.001
	No/slight–severe treatment need group				0.001
	Severe–moderate treatment need group				0.793

Table 5. Comparison between several research studies and the Dental Health Component (DHC)/Aesthetic Component (AC) ratings of this study in Turkey

	DHC (%)	AC (%)
Uçüncü and Ertugay[21] (school population, n=250) (Central Anatolia)		
No/slight need	37.2	90.4
Moderate	24	4.8
Severe need	38.8	4.8
Uçüncü and Ertugay[21] (referred population, n=250) (Central Anatolia)		
No/slight need	4.8	45.2
Moderate	12	17.6
Severe need	83.2	36.8
This study (randomized selected population, n=176) (Central Anatolia)		
No/slight need	**25.1**	**86.9**
Moderate	**24.6**	**9.7**
Severe need	**50.3**	**3.4**
Kazancı[28] (referred population, n=262) (East Anatolia)		
No/slight need	3.1	38.4
Moderate	25.1	24
Severe need	72.9	37.4
This study (randomized selected population, n=85) (East Anatolia)		
No/slight need	**30.5**	**100**
Moderate	**11**	**0**
Severe need	**58.5**	**0**
Doğan *et al*.[22] (referred population, n=208) (Mediterranean region)		
No/slight need	12.1	43.8
Moderate	13.9	23.6
Severe need	74	33.6
This study (randomized selected population, n=163) (Mediterranean region)		
No/slight need	**29.8**	**97.5**
Moderate	**9.9**	**1.9**
Severe need	**60.2**	**0.6**
This study (randomized selected population, n=1023) (total study group)		
No/slight need	**28.7**	**91.8**
Moderate	**16.2**	**6.2**
Severe need	**55**	**2.1**

Bold font values represent the results of this study.

Table 6. Comparison between several research studies in different countries and the Dental Health Component (DHC)/ Aesthetic Component (AC) ratings of this study in Turkey

	DHC (%)	AC (%)
Brook and Shaw[7] (n=333 cases) (England)		
No/slight need	35.1	58.2
Moderate	32.1	36.3
Severe need	32.7	5.4
Nobile *et al.*[9] (n=546) (Italy)		
No/slight need	18.9	91.5
Moderate	21.6	5.4
Severe need	59.5	3.2
Perillo *et al.*[10] (n=703) (Italy)		
No/slight need	35.8	NA
Moderate	36.7	NA
Severe need	27.3	NA
Souames *et al.*[11] (n=511) (France)		
No/slight need	50.1	75
Moderate	28.6	18
Severe need	21.3	7
Manzanera *et al.*[29] (n=363) (Spain)		
No/slight need	46.5	85.4
Moderate	31.7	10.2
Severe need	21.8	4.4
Hassan[15] (n=743) (Saudi Arabia)		
No/slight need	15.2	60.6
Moderate	13.2	23.3
Severe need	71.6	16.1
This study (randomized selected population, n=1023) (total study group)		
No/slight need	**28.7**	**91.8**
Moderate	**16.2**	**6.2**
Severe need	**55**	**2.1**

Bold font values represent the results of this study.
NA: not applicable

acceptable occlusion and no/slight need for treatment, whereas 39.96% had severe malocclusions and definite need for orthodontic treatment. The authors also added that the rating for treatment need increased to 72.26% in case minimal crowding was also considered. One year later, Uğur *et al.*[20] investigated 572 schoolchildren in the same region, and determined that 59.62% of the study sample needed orthodontic treatment. Güray *et al.*[19] collected data from children with low socioeconomic status, whereas Uğur *et al.*[20] included a study group with high socioeconomic standards. This might be the reason for the differences in the treatment need ratings between the 2 studies. In the present study, 74.9% of the examined individuals in the same region (Central Anatolia) had moderate or severe demand for orthodontic treatment according to the DHC of IOTN. It is interesting to note that the percentages of the treatment need are similar to those in the study by Güray *et al.*,[19] despite the usage of different indices. The higher results compared to the study by Uğur *et al.*[20] might be because of the randomized selection of the sample, including the rural areas with very low socioeconomic income. Uçüncü and Ertugay,[21] classified the treatment demand of 250 school children in the Central Anatolia region according to IOTN as severe (38.8%), moderate (24.0%), and no/slight (37.2%) orthodontic treatment need. In the present study, the percentage for the moderate treatment need group was found identical (24.6%) with the results of Uçüncü and Ertugay,[21] whereas the percentage for severe orthodontic treatment need was higher. Although there is a thesis[28] of orthodontic treatment need of the East Anatolia region as well as an investigation for the Mediterranean region,[22] the results are not comparable due to the inclusion of only those individuals who presented to the orthodontic department in the aforementioned areas.

The distribution of the DHC grades of IOTN for all of Turkey was 28.7% no/slight, 16.2% moderate, and 55% severe need for orthodontic treatment. In other populations, the severe demand group was defined in lower percentages ranging between 21.8% and 32.7% (Table 6), as well as in higher percentages between 59.5%[9] and 71.6%.[15]Interestingly, the declared percentage of orthodontic treatment need for 13- to 14-year-old children by the World Health Organization (1985) was also between 21% and 64%.[30]

The orthodontic treatment need of the total study sample in this study increased to 71.2% when severe and moderate need groups were included. Uçüncü and Ertugay[21] mentioned that 325 orthodontists were in practice and 12 universities provided orthodontic treatment in 2001. As a result of the increase in the demand for orthodontic treatment, the official number of orthodontists and universities increased to 705 and 31, respectively, in 2010. When the population of Turkey of approximately 74 million is considered, the orthodontic treatment services are still insufficient to fulfill the demand. Additionally, the services are not evenly distributed between the regions.

As mentioned before, the data of orthodontic treatment need in one of the 7 regions of Turkey have already been published in several research studies. However, to the best of our knowledge, this is the first investigation assessing and comparing the orthodontic treatment need of the 7 regions of Turkey. In fact, the comparison of the DHC results showed significant interregional differences ($p<0.01$). The highest percentage of the severe orthodontic treatment need group was identified in the Southeastern Anatolia region (72.6%). When the moderate treatment group is considered, it can be concluded that more than two thirds of this region had need for orthodontic treatment. On the other hand, more than one third (34.1%) of the examined individuals in the Marmara region had no/slight orthodontic treatment need. In the Aegean region, the distribution of individuals into the 3 groups (no/slight, moderate, and severe need) was similar (30.2%, 34.9%, and 34.9%, respectively). It should be emphasized that the orthodontic treatment need is not the same in every region of Turkey. Epidemiologic study results of this topic should be detailed into regional differences to fulfill the goal of real evaluation of the treatment need.

Assessment of the AC of IOTN by the subjects in this study revealed severe need for orthodontic treatment only for 2.1%, similar to results of epidemiologic studies in Sweden 2.3%,[12] Italy 3.2%,[9] and Jordan 3%.[24] The perceived no/slight treatment need by the subjects was 91.8%. Compared with the severe treatment need group of the DHC of IOTN (55%) in the whole study group, the low percentage of perceived orthodontic treatment need was a worrisome finding. As a result, the lack of awareness of severe malocclusion indicates that if the children have no contact with dental health services, there will be no opportunity for them to recognize their treatment need.

CONCLUSION

Trend differences and prevalence changes of malocclusion in several countries occur with time. Therefore, current and updated epidemiologic data are needed in specific time periods.

This study was a part of an oral health survey analysis project being conducted on a total of 3040 individuals in 7 different regions of Turkey. The subjects were evaluated by multiple disciplines (Dental Public Health, Periodontology, Maxillofacial Radiology, and Orthodontics), and because of the long examination time the subject number was limited. The authors of this study argued that further epidemiologic studies including more subjects are needed to contribute to the knowledge in this area. Nevertheless, the significant interregional differences set out in this study may contribute to the development of the national health policy as well as the priority areas requiring dental health services.

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