

# The Need for Orthodontic Therapy for Children and Adolescents in the Health Center Mostar According to the IOTN Index

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## ABSTRACT

**Background:** Orthodontic anomalies or malocclusions are modifications in the development of the orofacial system, caused by genetic, environmental or evolutionary factors.

**Methods:** The purpose of the research is to determine the need for orthodontic therapy with regard to gender and age characteristics. The sample consisted of 46 children aged 10-13 and 30 adolescents, aged 14-16, who use the services of the Health Center in Mostar. The Index of Orthodontic Treatment Need (IOTN) which consists of a dental health component (IOTN-DHC) and an aesthetic component (IOTN-AC) was used. Seventy-six participants who had not previously undergone orthodontic therapy were examined. An assessment of the need for orthodontic therapy was made by two examiners across both IOTN components.

**Main findings:** Frequencies (%) in each category were calculated in relation to the data, and differences were tested with chi-square tests. According to the IOTN-DHC, the need for orthodontic therapy was present in 19.5% of male subjects and in 26.7% of female subjects, considering that 28.2% of children and 33.3% of adolescents need orthodontic therapy. According to the IOTN-AC, there was a need for orthodontic therapy in 10.8% of male participants and 13.2% of female participants, and with regard to age, in 13% of children and 10% of adolescents. A statistically significant difference in the need for therapy related to gender or age was not determined.

**Principal conclusions:** The obtained results indicate the need for orthodontic therapy for children and adolescents. Such data can provide an insight into planning preventive measures in public health, to make patients aware of their orthodontic irregularity.

**Key words:** aesthetic component, dental health component, Index of Orthodontic Treatment Need

## Article processing history:

Received January 16, 2023

Revised January 25, 2023

Accepted June 1, 2023

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Cite this article as: Tomić K, Čarapina

Zovko I, Jelavić R, Tomić V, Musa

Trolić I, Ivanković Buljan Z. The Need

for Orthodontic Therapy for Children

and Adolescents in the Health Center

Mostar According to the IOTN Index.

Annals of Biomedical and Clinical

Research. 2023;2:63-71.

[https://doi.org/10.47960/2744-](https://doi.org/10.47960/2744-2470.2023.1.2.63)

2470.2023.1.2.63

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## INTRODUCTION

Orthodontic anomalies or malocclusions are deviations from ideal dental or skeletal characteristics, and are caused by environmental, genetic or evolutionary factors. They are the most common reason for requesting orthodontic therapy. In order to determine the criteria for the need for therapy, numerous measuring instruments or questionnaires have been developed to quantify and numerically express degrees of deviation from normal occlusion (1). One of the first indexes was developed in Great Britain (2) known as the IOTN. This is made up of two elements, the (IOTN-DHC) and the (IOTN-AC), which enable a simple assessment of the health of the subjects' teeth and their esthetic deficiency due to malocclusion. The IOTN-DHC component is an objective component of the index and contains various features important for occlusion, which are divided into five categories: the first and second grades indicate that there is no or little need for therapy, the third grade indicates a moderate need for therapy, the fourth grade indicates that therapy is necessary and the fifth grade demonstrates a significant need for therapy (see Appendix).

The esthetic component of the IOTN (IOTN-AC) is a subjective component and consists of 10 colored, intraoral photographs of different malocclusions, showing varying degrees of tooth attractiveness, from the most attractive to the least attractive looking teeth. The esthetic impressions of the patients' teeth are compared with the photographs. In this way, it is possible to determine how much the orthodontic irregularity affects the overall appearance of the face. The photographs are graded into three categories of need for therapy: the first (photographs 1-4) indicates no need for therapy, the second (photographs 5-7) indicates a moderate need for therapy, while the third (photographs 8-10) indicates a significant need for therapy (see Appendix).

Many studies use the IOTN index to deal with the question of the impact of dental esthetics on

the need for orthodontic therapy and the psychosocial status of the patient. In a study conducted on 105 patients among whom the psychosocial impact of malocclusion on orthodontic patients aged 12-17 years in Australia was examined, the results showed a more negative impact on female patients than male patients (3). Masood et al. investigated the impact of malocclusions on the quality of life of 323 people with malocclusions aged 15-25 (4). The results showed that the presence of malocclusions measured by the IOTN-DHC had a negative impact on the quality of life. This influence was particularly pronounced among younger people and among those with a higher level of education. However, the severity of the clinical picture of malocclusion did not lead to an increased level of impairment of the quality of life, neither did it affect the increased number of requests for orthodontic treatment (5). A study conducted in Sarajevo, Bosnia and Herzegovina 10 years ago investigated the need for orthodontic therapy in children, through IOTN and determined that 53.6% of respondents required therapy according to the dental component (6).

The goal of the research was to gain an insight into oral health and the selection of patients (children and adolescents) who were in great need of orthodontic therapy in the Health Center in Mostar, as research of this kind has never been conducted on this topic in Herzegovina. Moreover, an additional goal was to determine the state of IOTN-DHC in relation to the dental component and IOTN-AC with regard to the aesthetic component, according to the IOTN index. In accordance with this goal, the following hypotheses were set:

H1: Regarding the greater awareness of the population of oral health care, it is assumed that the smallest number of participants will form part of the group requiring therapy on both the IOTN-DHC and IOTN-AC components according to the IOTN index.

H1.1. It is assumed that there will be no gender differences according to the categories requiring therapy.

H2: It is assumed that younger patients (children) will be represented significantly more in the categories requiring therapy and in both the IOTN-DHC and IOTN-AC components compared to adolescents who have already developed dental habits.

## PARTICIPANTS AND METHODS

### Participants

The research was conducted on a sample of 76 participants, of which 46 were children aged 10 to 13 years; 30 were adolescents aged 14 to 16 years.

Detailed characteristics of the sample are shown in Table 1.

### Methods

Ethical approval for participation in the research was requested from all research participants, as well as from their guardians, given that they are minors. Instead of names and surnames, the participants entered codes which were created according to the author's instructions for the purpose of preserving anonymity: the initial letter of the guardian's first name, the initial letter of the guardian's surname, the date of birth of the respondent and the month of birth of the respondent. The same code was used on all questionnaires, as well as the anomaly assessment for each participant. Consent for conducting the research was obtained from the Ethics Committee of the Health Center in Mostar (Reg. No.: 734-37-276/22 of March 10, 2022). The research was conducted during March and April 2022. The next step was to assess the degree of the anomaly using the IOTN, through which the assessment of the need for therapy was determined.

One examiner was an experienced orthodontist, and the other was instructed on the Index. The examination lasted a few minutes approximately, and was performed by inspection and a dental mirror, on the dental chair. Regarding the IOTN-DHC, both examiners recorded the value of bite and overbite, the class on molars and canines, the

existence of reverse, cross or open bite, hypodontia or ankylosis of teeth, improperly positioned teeth and cleft lip or palate.

Table 1. Sociodemographic characteristics of the study sample (n= 76)

		N	%
Gender	M	46	60.5
	F	30	39.5
School performance	Very good	20	26.3
	Excellent	54	71.1
	Repeater	2	2.6
Mother's education	HS	15	19.7
	UHS	2	2.6
	CO	41	53.9
	MD	7	9.2
	DR/SPEC	1	1.3
	DK	10	13.2
Father's education	HS	27	35.5
	UHS	4	5.3
	CO	31	40.8
	MD	2	2.6
Mother's employment status	DK	12	15.8
	Unemployed	9	11.8
	In permanent employment	2	2.6
	Employed	62	81.6
	Other	1	1.3
Father's employment status	DK	2	2.6
	Unemployed	3	3.9
	In permanent employment	1	1.3
	Employed	64	84.2
	Retired	5	6.6
Monthly income	DK	3	3.9
	250-500 BAM	12	15.8
	500-750 BAM	19	25.0
	750-1000 BAM	19	25.0
	1000- 1250 BAM	11	14.5
	1250-1500 BAM	9	11.8
	>1500 BAM	6	7.9

HS - High school, UHS - Unfinished high school CO - college MD - Master's degree, DR/SPEC - Doctorate/specialist, DK - Don't know, BAM - The convertible mark

The esthetic component of the IOTN included 10 colored photographs, showing the different

degrees of tooth attractiveness, and the patients determined to which category they felt they belonged. In addition to the above, the participants also filled out a sociodemographic questionnaire, consisting of 10 questions related to age, gender, parents' education and monthly income. After 10 days, 20 subjects were re-examined for the intra-examiner agreement. In the meantime, they did not have any dental intervention.

### Statistical analysis

The absolute and relative frequencies were displayed to determine the basic descriptive parameters. The chi-square test was used in order to determine the differences between the variables of the IOTN-AC. The limit of statistical significance was set at  $p < 0.05$ . SPSS for Windows (17.0, SPSS Inc., Chicago, Illinois, USA) and Microsoft Excel (Office 2016, Microsoft Corporation, Redmont, WA, USA) programs were used in the statistical analysis of the obtained data.

## RESULTS

Among the sub-sample of men, most were in the category of little need for therapy (37%) and fewest were in the category of required mandatory therapy (2.1%). Among the sub-sample of women, most were in the category of little need for therapy (33.3%) and fewest were in need of mandatory therapy (6.7%). No statistically significant differences were found with regard to gender in the categories of need for therapy ( $\chi^2=2.371$  df=4,  $p=0.688$ ) (Table 2). In the sub-sample of men, most were in the category of no need for therapy (84.8%) and fewest were in the category of borderline need for therapy (4.4%).

Among the sub-sample of women, most were in the category of no need for therapy (80.1%) and fewest were in the category of borderline need for therapy (6.7%). No statistically significant differences were found with regard to gender in the categories of need for therapy ( $\chi^2=4.876$  df=2,  $p=0.675$ ) (Table 3).

Table 2. Need for therapy with regard to gender in relation to the IOTN-DHC

		n	%
Male	No need for therapy	9	19.6
	Limited need for therapy	17	37.0
	Moderate need for therapy	11	23.9
	Therapy necessary	8	17.4
	Mandatory therapy needed	1	2.1
Female	No need for therapy	3	10.0
	Limited need for therapy	10	33.3
	Moderate need for therapy	9	30.0
	Therapy necessary	6	20.0
	Mandatory therapy needed	2	6.7

Table 3. Need for therapy with regard to gender in relation to the IOTN-AC

		n	%
Male	No need for therapy	39	84.8
	Borderline need for therapy	2	4.4
	Significant need for therapy	5	10.8
Female	No need for therapy	24	80.1
	Borderline need for therapy	2	6.7
	Significant need for therapy	4	13.2

Among the sub-sample of children, most had a moderate need for therapy (30.5%) and fewest were in the category of required mandatory therapy (4.3%). In the sub-sample of adolescents, most had little need for therapy (50%) and fewest had a mandatory need for therapy (3.3%). No statistically significant differences were found with regard to age in the categories of need for therapy ( $\chi^2=5.654$  df=4,  $p=0.227$ ) (Table 4).

In the sub-sample of children, most were in the category of no need for therapy (80.5%) and fewest were in the category of borderline need for therapy (6.5%).

Table 4. Need for therapy with regard to age in relation to the IOTN-DHC

		n	%
Children	No need for therapy	7	15.2
	Limited need for therapy	12	26.1
	Moderate need for therapy	14	30.5
	Therapy necessary	11	23.9
	Mandatory therapy needed	2	4.3
Adolescents	No need for therapy	5	16.7
	Limited need for therapy	15	50.0
	Moderate need for therapy	6	20.0
	Therapy necessary	3	10.0
	Mandatory therapy needed	1	3.3

In the sub-sample of adolescents, most were in the category of no need for therapy (86.7%) and fewest were in the category of borderline need for therapy (3.3%). No statistically significant differences were found with regard to age in the categories of need for therapy ( $\chi^2=6.271$   $df=2$ ,  $p=0.508$ ) (Table 5).

## DISCUSSION

Esthetics and the desire to improve appearance are increasingly important to patients of all ages. Consequently, the need for orthodontic therapy has increased in recent years. The data collected by the IOTN show the clinical condition of patients numerically and thus act as a clear indicator when planning the needs and capacities of public health (7).

The IOTN-DHC in the current research, according to gender, showed that the majority of respondents did not require therapy, represented by 56.6% of men, with a slightly lower percentage of women at 43.3%. With regard to a moderate need for therapy, there were slightly fewer males (23.9%) than females (30%), while in the category of those

Table 5. Need for therapy with regard to age in relation to the IOTN-AC

		n	%
Children	No need for therapy	37	80.5
	Borderline need for therapy	3	6.5
	Significant need for therapy	6	13
Adolescents	No need for therapy	26	86.7
	Borderline need for therapy	1	3.3
	Significant need for therapy	3	10

who needed or necessarily required therapy, there were fewer male (19.5%) than female (26.7%) respondents. Most studies did not find a statistically significant difference in the need for therapy between genders (8, 9). By comparison, a study conducted 10 years ago in Bosnia and Herzegovina found a statistical difference between girls and boys according to the dental component of this index (6). In that study, more than 53% needed therapy, which is a significantly higher percentage than in our study. The state of oral health was also investigated according to the presence of permanent molars, and oral health was assessed as being very poor. One could assume that these different results were recorded because the need for orthodontic therapy was investigated by taking a random sample of elementary school students, who had never undergone orthodontic therapy, whereas the current research was conducted on patients who were sent by their dentists for an orthodontic examination.

Although the prevalence of malocclusion is very high and affects both genders equally (10, 11), orthodontic irregularity seems to have a greater impact on the quality of life of girls than on the functions of the orofacial region or on their social contacts (12). Research was conducted according to the IOTN-AC and ratings were given by both therapists and respondents; a significant statistical difference between the categories was determined.



Therapists assessed that the need for orthodontic therapy was present in 7.52% of male respondents and 8% of females, while the respondents, who assessed themselves, believed that therapy was only needed in 0.38% of males and 2% of females (13). These results indicate that there is a difference between the subjective criteria of the respondents who have a different perception of esthetics, versus the objective criteria of the therapist, which are clearly and expertly defined. In our study, this percentage is slightly higher because more female (13.2%) subjects demonstrated a greater need for therapy than males (10.8) according to the IOTN-AC.

It would appear that 30-50% of adolescents worldwide have severe or very severe malocclusion (IOTN-DHC grade 4 or 5) (14), but in European countries, this percentage is 20-40% (15). This result is in agreement with the current research according to the IOTN-DHC, which found that a certain number of adolescents (33.3%) have a need for necessary or mandatory therapy, whereas a slightly lower percentage of children (28.2%) belong to these categories. The majority of adolescents (66.7%) are in the category of little or no need for therapy, as are 41.3% of children. Another study in Turkey showed that 38.8% of the Turkish school population indicated a significant need for treatment and, similar to our study, a moderate need for treatment was required by 24.0%, whereas 37.2% of subjects either had no need or a limited need for treatment (11).

A recent study in Spain investigated the need for orthodontic therapy among 539 12-year-olds and 460 15-year-olds. Based on the IOTN-AC, this study found a need for therapy among 4.3% of 12-year-olds and 0.9% of 15-year-olds, which are significantly lower percentages than those we obtained from children under the age of 13 (13%) and adolescents under the age of 16 (16). This variance could be due to a different perception of esthetics, which can be subjective in different environments. In a meta-analysis from 2015, Kragt et al. (17) concluded that the least heterogeneity in determining the objective

need for orthodontic therapy was highlighted in the IOTN-DHC.

The difference in results between the present and previous studies could be attributed to the different samples of subjects, depending on whether they were randomly selected from schools or were patients of dental or orthodontic offices, universities or hospitals. There are also differences in the understanding of esthetics due to religious, cultural or age differences, as well as differences between the interviewee's criteria and the therapist's criteria, which can be subjective and objective. Such studies serve to make patients aware of the need for therapy which they may not recognize themselves if they are not cognizant of the seriousness of their malocclusion.

## CONCLUSION

By using the IOTN, it is possible to confirm the real need for therapy using the dental and aesthetic components. The obtained data confirm that the fewest number of participants are in the group requiring therapy in relation to both the IOTN-DHC and the IOTN-AC components, according to the IOTN index. A statistically significant difference with regard to gender, according to the categories of need for therapy, is not determined.

Regarding the difference in the results obtained from current research in Herzegovina and the study conducted 10 years ago in Bosnia, it is necessary to take into account the time period, after which it is possible that the oral health of that population improved, and consequently, the awareness of the need for orthodontic therapy increased. It is certainly useful to make comparisons on a regional level, in order to evaluate the need for therapy and to plan public health policy and direct resources to provide support in areas where the need is greatest.

The hypothesis that young patients will be represented to a greater extent in the categories of need for therapy, according to the IOTN-DHC component, was not confirmed. There were younger patients, but no significant

difference was determined according to the aesthetic or dental component.

## ACKNOWLEDGMENTS

None

## FUNDING

The authors received no financial support for the research, authorship and/or publication of this study.

## CONFLICT OF INTEREST

Author Z.I.B. declares that she has no conflict of interest; author I.Č.Z. declares that she has no conflict of interest; author K.T. declares that he has no conflict of interest; author V.T. declares that he has no conflict of interest; author I.M.T. declares that he has no conflict of interest; author R.J. declares that he has no conflict of interest.

## AUTHORS' CONTRIBUTIONS

K.T.: literature review, writing of the paper, acquisition of data; I.Č.Z.: contribution to study conception and design, supervision, review, critical revision of the paper; Z.I.B.: study conception and design supervision, critical review, literature review; R.J., V.T., I.M.T.: collecting of the data. K.T., I.Č.Z., Z.I.B., R.J., V.T. and I.M.T. approved the final version of the manuscript.

## ETHICAL BACKGROUND

**Institutional Review Board Statement** The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the Health Center in Mostar for conducting research (Reg. number: 734-37-276/22 dated March 10, 2022).

**Informed consent statement:** Informed consent was obtained from all subjects involved in the study.

**Data availability statement:** We deny any restrictions on the availability of data, materials and associated protocols. Derived data supporting the findings of this study are available from the corresponding author on request.

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## Appendix:

## 1. The IOTN - The IOTN-DHC

IOTN DHC		Overbite ( <i>Overjet</i> , OJ)	Reverse overbite Crossbite	Rotation	/ Dystopia	Open bite	Overbite ( <i>Overbite</i> , OB)	Class	Hypodontia	Eruption	IOTN DHC Need for therapy	Ankylosis of primary tooth
Need for therapy												
1	None	—	—	—	Contact point distance <1 mm	—	—	—	—	1	—	—
2	Limited	3.5-6 mm Competent lips	0-1 mm	<1 mm	1-2 mm	1-2 mm	<3.5 mm without gingival contact	II/III without other disturbances	—	2	—	—
3	Moderate	3.5-6 mm Incompetent lips	1-3.5 mm	1-2 mm	2-4 mm	2-4 mm	Increased OB with gingival touch	—	—	3	—	—
4	Necessary	6- 9 mm	>3.5 mm without masticatory/speech dysfunction  1-3.5 mm with dysfunction	>2 mm scissors or bite	>4 mm	>4 mm	Enlarged OB with gingival/palate	—	Treatment needed to open/close space before prosthetics	4	—	—
5	Mandatory	>9 mm	>3.5 mm with masticatory and speech dysfunction	—	—	—	—	—	Min. 1 tooth in the quadrant, mandatory prosthetics	5	Mandatory therapy	Mandatory therapy



## 2. The IOTN - The IOTN-AC

