Orthodontic treatment need in a group of 6–12-year-old children in Szczecin

Ortodontyczna potrzeba leczenia w grupie 6–12-letnich dzieci w Szczecinie

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ABSTRACT

Introduction: The aim of the study was to assess orthodontic treatment need in a population of children in Szczecin, Poland, and to determine possible factors associated with this need.
Materials and methods: The sample comprised 532 children who had not undergone orthodontic treatment, that were divided into 2 groups: 279 aged 6–8 years and 253 aged 9–12 years. Orthodontic treatment need was assessed using both the dental health component (DHC) and the aesthetic component (AC) of the Index of Orthodontic Treatment Need. Results were analysed using a χ^2 test. Multivariate logistic regression analysis was performed to identify relationships between treatment need and independent variables.
Results: Statistically significant differences in definite treatment need based on both components together (DHC ≥ 4 and/or AC ≥ 8) were observed between the 6–8-year-olds and the 9–12-year-olds (14% and 20.6%, respectively; p = 0.044). Factors such as dental abnormalities, Angle's II molar relationship, increased overjet, crossbite, as well as contact point displacements, were significantly related to a definite need for treatment (DHC grades 4 and 5).
Conclusions: In the analysed population, orthodontic treatment need is similar or lower than that reported in various other European populations. The greater need for orthodontic treatment observed in the 9–12-year-olds highlights the importance of early identification of malocclusions and a timely referral of patients for treatment.
Keywords: Index of Orthodontic Treatment Need; malocclusion; orthodontic indices.

ABSTRAKT

Wstęp: Celem pracy była ocena ortodontycznej potrzeby leczenia w populacji dzieci w Szczecinie oraz określenie możliwych czynników związanych z tą potrzebą.
Materiały i metody: Badaniem objęto 532 dzieci nieleczonych ortodontycznie, podzielonych na dwie grupy: 279 6–8-latków i 253 9–12-latków. Ortodontyczną potrzebę leczenia oceniono za pomocą komponenty zdrowotnej (DHC) i komponenty estetycznej (AC) wskaźnika ortodontycznej potrzeby leczniczej. Wyniki poddano analizie za pomocą testu χ^2. Analizę wieloczynnikowej regresji logistycznej przeprowadzono w celu ustalenia związku między potrzebą leczenia a zmiennymi niezależnymi.
Wyniki: Pomiędzy grupami 6–8-latków i 9–12-latków zaobserwowano istotne statystycznie różnice na podstawie dwóch komponent wskaźnika (DHC ≥ 4 i/lub AC ≥ 8) w ocenie wyraźnej potrzeby leczenia (odpowiednio 14% i 20,6%; p = 0,044). Czynniki takie jak nieprawidłowości zębowe, II klasa Angle'a, zwiększony nagryz poziomy, zgryz krzyżowy, a także przemieszczenie punktów kontaktu były istotnie statystycznie związane z wyraźną potrzebą leczenia (DHC stopień 4 i 5).
Wnioski: W badanej populacji ortodontyczna potrzeba leczenia była zbliżona lub mniejsza w porównaniu z innymi populacjami europejskimi. Większa potrzeba leczenia zaobserwowana w grupie 9–12-latków podkreśla znaczenie wczesnej diagnozy wad zgryzu oraz konieczności zgłaszania się pacjentów do leczenia we właściwym czasie.
Słowa kluczowe: wskaźnik ortodontycznej potrzeby leczniczej; wada zgryzu; wskaźniki ortodontyczne.

INTRODUCTION

Dentistry is a domain that makes use of objective indices to measure the deviation of different oral health components from the ideal, e.g., dental plaque or periodontal indices [1, 2]. However, objective assessments of malocclusions have varied, since malocclusions are a developmental condition and a deviation from the norm. Moreover, the treatment of malocclusions involves a high degree of subjectivity and distorted perceptions of treatment need [3, 4].

Orthodontic treatment need can be defined as the degree to which a person needs treatment because of certain features of his or her malocclusion, the functional dental health or aesthetic impairment it occasions, and the negative psychological and social repercussions to which it gives rise [5]. The orthodontic treatment need indices are occlusal criteria used to prioritize a treatment need. They make it possible to decrease the degree of subjectivity involved in the diagnosis, outcome and complexity assessment of orthodontic treatment [3, 6, 7].

Several orthodontic treatment need indices have been developed throughout the history of orthodontics [8, 9, 10, 11, 12, 13]. Epidemiology requires the use of easily applied indices that are very reliable and valid. A well-developed index should be quick and simple to use, comply with cultural norms, and, finally, be adaptable to the resources available [3]. Although a universally accepted index for detecting orthodontic treatment need does not exist, the Index of Orthodontic Treatment Need (IOTN), since its development by Brook and Shaw [12], has been widely applied in many epidemiological studies to assess orthodontic treatment need in children and adults [14, 15, 16, 17].

The advantage of IOTN is that it consists of one component connected with dental and functional health (dental health component – DHC), and another concerning the aesthetic impairment of malocclusions (aesthetic component – AC), thereby reflecting the socio-psychological need for orthodontic treatment. The index ranks a malocclusion according to the presence of particular occlusal features considered important for dental health and aesthetics, with the aim of identifying those who would likely benefit from orthodontic treatment [11, 12].

In relation to previous methods, the IOTN is an objective standard, which enables comparisons to be made between different population groups. Its reliability and validity have been widely demonstrated, it is simple and easy to use, and it is one of the most often cited indices in literature [7, 18, 19, 20]. Recent studies based on IOTN have been conducted in numerous European countries, including Germany, the United Kingdom, Ireland, France, Italy, Sweden, and Spain [15, 16, 17, 21, 22, 23, 24]. Until now, the IOTN has not been used on a large scale in Poland [25, 26, 27].

As the demand for orthodontic treatment increases, the importance of performing epidemiological studies with a view to obtaining knowledge about the prevalence of malocclusions and the need for orthodontic treatment among populations is becoming clear. These estimates are important for planning community dental health resources, and also for monitoring the oral health programs being offered [28]. However, any evaluation of orthodontic treatment need should consider not only the severity of the malocclusion traits, but also the age group, the dentition period, and the accelerated growth of the children to be treated. No similar study of Polish children in these developmental phases has been found in literature.

The purpose of the present study was to evaluate the need for orthodontic treatment in children in Szczecin aged between 6 and 12 years, as well as determine the possible factors associated with this need. Another aim was to compare the results with those from studies of other populations and to relate them to the gender and age of the subjects.

MATERIALS AND METHODS

Ethical approval

The study was approved by the Local Ethics Committees of the Pomeranian Medical University in Szczecin in Poland (number BN-001/134/07). Parental consent was obtained for subjects to be examined prior to the survey. After the examination, the parents received a letter indicating whether orthodontic treatment was necessary.

Study population

A study population (n = 614) comprising 2 age groups – 6–8-year-olds (early mixed dentition) and 9–12-year-olds (late mixed and permanent dentition) – was selected on the basis of a stratified random sampling of subjects from primary schools in Szczecin. Ten primary schools were randomly selected from the area's 59 primary schools. The schools were chosen from 4 districts covering different socio-economic backgrounds. All selected schools provided lists of all the children, their ages and gender. Three classes were randomly selected from each school. Only consenting subjects were included in the study. The selected children fulfilled the inclusion criteria by falling within one of the specified age groups. A total of 614 children 6–12 years of age participated in the study. Eighty-two children (13.4%) were excluded because either they had received orthodontic treatment or were currently undergoing orthodontic treatment (10.3% of the initial sample of 6–8-year-olds and 16.5% of 9–12-year-olds). The final sample comprised 532 children (245 boys and 287 girls), divided into 2 groups: 279 6–8-year-olds (130 boys and 149 girls) and 253 9–12-year-olds (115 boys and 138 girls) from the Szczecin primary school community.

Clinical examination

The study followed the World Health Organization (WHO) recommendations with regard to the aims, selection of samples, authorization, calibration, training and assessment of the examiners, materials used, examination area and conditions [29]. The examination was performed in a specially reserved room arranged by each school under natural or artificial illumination. The subjects' dental occlusion was assessed using latex gloves, a WHO-type periodontal probe, a number 5 plain mouth mirror and millimetric rulers. No radiographs, study casts, or previous written records of the children were used. The examiner, an orthodontist who had been previously trained in the use of the IOTN scale, undertook the screening. The IOTN was calculated on the basis of a direct examination over a period of 4 weeks. One month after the examination, approximately 10% of the sample was retested to ensure the repeatability of the study and test intra-examiner reproducibility.

Intraoral examinations were conducted to register all the necessary malocclusion features to determine the DHC scale (overjet, overbite, anterior and posterior crossbite, open bite, displacement of teeth, impeded eruption of teeth, cleft lip and palate defects, class II and class III molar relationship, hypodontia), as well as personal details (name, age and gender). The DHC comprises 5 grades: grades 1 and 2 represent little/ no need for treatment; grade 3 indicates a borderline need for treatment; and grades 4 and 5 show that treatment is a high priority. Grades are allocated according to the severity of each trait. However, only the highest scoring trait is recorded. The grade for this trait constitutes the treatment priority [12].

The AC is designed to complement the DHC by recording the severity of the anterior aesthetic tooth arrangement. It

comprises a scale of 10 color photographs of anterior teeth displaying varying degrees of malocclusion, ranging from No. 1, which represents the most attractive smile, to No. 10, which representing the least attractive smile [11, 12]. The cut-off points regarding the aesthetic need for orthodontic treatment were as follows: grades 1–4 represent little/no need for treatment; grades 5–7 indicate a borderline need for treatment; and grades 8–10 point to a definite need for treatment. The IOTN components were determined in percentage terms separately.

Treatment need was also determined according to a modified IOTN [30]. According to this index, treatment is definitely needed when the IOTN DHC is grade 4 or 5 and/or the IOTN AC is grade 8, 9 or 10.

Statistical analysis

The collected data were analysed using STATA version 11.0 software program with the level of statistical significance set at p = 0.05. A χ^2 test was used to determine differences in treatment need between the different subgroups of participants. Multivariate logistic regression was performed to identify relationships between orthodontic treatment need and independent variables. The results were reported using the odds ratio (OR), a 95% confidence interval (CI) and the p-value.

The intra-examiner reliability of the normative orthodontic treatment need was examined using the kappa statistic method. The observed percentage agreement and unweighted kappa statistics were used to analyse the agreement between the DHC and AC components of the IOTN. This provided the basis for determining the treatment need, or the absence of such a need, for the total sample. This agreement was determined using the Landis and Koch scale [31].

RESULTS

The intra-examiner reliability of the DHC and AC components of the IOTN scale was almost perfect, with the kappa values of 0.88 and 0.82, respectively.

Table 1 shows the different IOTN DHC levels. Orthodontic treatment need grades 4 and 5 were noted in 12.9% of the 6–8-year-olds and 18.6% of the 9–12-year-olds, according to this index. No significant differences with regard to age or gender were found (p > 0.05).

Table 2 shows the distribution of the sample according to the IOTN AC scale. A definite treatment need (grades 8–10) was noted in 3.6% of the schoolchildren at 6–8 years and 3.5% of

TABLE 1. Distribution of dental health components (DHC) of the Index of Orthodontic Treatment Need (IOTN) in the study population: frequency by gender and age

DHC grades	6–8 years			9–12 years		
	boys n = 130	girls n = 149	total n = 279	boys n = 115	girls n = 138	total n = 253
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
1	26 (20.0)	38 (25.5)	64 (22.9)	18 (15.6)	22 (15.9)	40 (15.8)
2	54 (41.5)	44 (29.5)	98 (35.1)	35 (30.4)	41 (29.7)	76 (30.0)
3	35 (26.9)	46 (30.9)	81 (29.1)	37 (32.2)	53 (38.5)	90 (35.6)
4	11 (8.5)	14 (9.4)	25 (9.0)	21 (18.3)	14 (10.1)	35 (13.8)
5	4 (3.1)	7 (4.7)	11 (3.9)	4 (3.5)	8 (5.8)	12 (4.8)

TABLE 2. Distribution of aesthetic components (AC) of the Index of Orthodontic Treatment Need (IOTN) in the study population: frequency by gender and age

AC grades	6–8 years			9–12 years		
	boys n = 130	girls n = 149	total n = 279	boys n = 115	girls n = 138	total n = 253
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
1–4	93 (71.5)	103 (69.2)	196 (70.2)	97 (84.3)	118 (85.5)	215 (85.0)
5–7	36 (27.7)	37 (24.8)	73 (26.2)	11 (9.6)	18 (13.0)	29 (11.5)
8–10	1 (0.8)	9 (6.0)	10 (3.6)	7 (6.1)	2 (1.5)	9 (3.5)

TABLE 3. Index of Orthodontic Treatment Need (IOTN) results considering the aesthetic component (AC) and dental health component (DHC) together (modified IOTN) in the study population: frequency by gender and age

Treatment need	6–8 years			9–12 years		
	boys n = 130	girls n = 149	total n = 279	boys n = 115	girls n = 138	total n = 253
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
No need*	115 (88.5)	125 (83.9)	240 (86.0)	86 (74.8)	115 (83.3)	201 (79.4)
Definite**	15 (11.5)	24 (16.1)	39 (14.0)	29 (25.2)	23 (16.7)	52 (20.6)

*IOTN DHC < 4 and IOTN AC < 8; **IOTN DHC ≥ 4 and/or IOTN AC ≥ 8

those in the 9–12 year age group. The differences between males and females were statistically significant for both age groups (p = 0.018 at 6–8 years, and p = 0.047 at 9–12 years). No significant differences between age groups were found (p > 0.05).

With regard to the modified IOTN, the definite treatment need (IOTN DHC ≥ 4 and/or IOTN AC ≥ 8) was 14.0% in the 6–8-year age group, and 20.6% in the 9–12-year age group (Table 3). Statistically significant differences in definite treatment need based on both components together were observed between the 6–8-year-olds and the 9–12-year-olds (p = 0.044). There were no statistically significant gender differences using the modified IOTN (p > 0.05).

The percentage of agreement between the DHC and AC components of the IOTN scale as a basis for determining the treatment need, or the absence of such need, for the sample as a whole, was 85% with a kappa of 0.17, indicating slight agreement.

Multivariate logistic regression analysis (Table 4) showed that Angle's II molar relationship, increased overjet, anterior or posterior crossbite, contact point displacements, hypodontia and other malocclusions including supernumerary teeth, impeded eruption of teeth, submerged deciduous teeth, partially erupted, tipped or impacted teeth, were all factors associated with a definite need for treatment (DHC grades 4 and 5).

DISCUSSION

This is the first report focused on a comparison of orthodontic treatment needs based on the IOTN index in children at different developmental phases in Poland. The primary goal of this epidemiological survey was to identify orthodontic treatment need via IOTN in a broad, randomized sample of children from one region of Poland (Szczecin). The results obtained provide a platform for making comparisons with recent studies carried out in European countries.

In the present study, 12.9% of children aged 6–8 required orthodontic treatment, according to the IOTN DHC index. This result is similar to the figure of 14.7% noted for a group of 7-year-old children in Albania [32]. Tausche et al. [22] found a much higher percentage for a sample of 6–8-year-olds in Germany (26.2%). We also found that 18.6% of children aged 9–12 required orthodontic treatment with regard to the IOTN DHC.

TABLE 4. Multivariate logistic regression analysis for the groups with definite need for orthodontic treatment (dental health component – DHC 4 and 5)

Variables	n (%)	OR	95% CI	p
Gender				
male (n = 245) ref	40 (16.3)	1.00		
female (n = 287)	43 (15.0)	0.90	0.57–1.44	0.670
Age				
6–8 years (n = 279) ref	36 (12.9)	1.00		
9–12 years (n = 253)	47 (18.6)	1.54	0.96–2.47	0.073
Angle's molar relationship				
class I (n = 350) ref	47 (13.4)	1.00		
class II (n = 162)	34 (21.0)	1.71	1.05–2.79	0.030
class III (n = 20)	2 (10.0)	0.72	0.16–3.19	0.661
Increased overjet				
none (n = 369) ref	49 (13.3)	1.00		
yes (n = 163)	34 (20.9)	1.72	1.06–2.79	0.028
Reverse overjet				
none (n = 512) ref	81 (15.8)	1.00		
yes (n = 20)	2 (10.0)	0.59	0.13–2.60	0.486
Contact point displacements				
none (n = 317) ref	37 (11.7)	1.00		
yes (n = 215)	46 (21.4)	2.06	1.28–3.31	0.003
Open bite				
none (n = 495) ref	76 (15.4)	1.00		
yes (n = 37)	7 (18.9)	1.29	0.55–3.03	0.565
Increased overbite				
none (n = 371) ref	51 (13.8)	1.00		
yes (n = 159)	31 (19.5)	1.52	0.93–2.48	0.095
Crossbite				
none (n = 458) ref	64 (14.0)	1.00		
yes (n = 74)	19 (25.7)	2.13	1.19–3.82	0.011
Hypodontia				
none (n = 509) ref	66 (13.0)	1.00		
yes (n = 23)	17 (73.9)	19.02	7.24–49.97	0.000
Other dental abnormalities				
none (n = 511) ref	63 (12.3)	1.00		
yes (n = 21)	20 (95.2)	142.22	18.76–1078.15	0.000

OR – Odds Ratio; 95% CI – Confidence Interval; ref – reference category

This result is similar to the figure of 18.9% noted for a sample of 8–12-year-olds in the Lesser Poland region [27]; 15.4% in a sample of 9-year-old Spanish children in Valencia [14]; 21.3% in a sample of 9–12-year-olds in France [16]; and 21.8% along with 20.9% in the case of a group of 12-year-olds in Spain [14, 17, 33]. Other studies have reported higher percentages: 59.5% in 11–15-year-old Italian children [21]; 44.8% in 11–12-year-old British children [34]; 37% in 12–13-year-old Swedish children [23]; 36% in 11–12-year-olds in Northern Ireland [35].

As regards the AC, the results of the present study (3.6% of the 6–8-year-olds and 3.5% of the 9–12-year-olds) are similar to those obtained in other studies: Nobile et al. [21] – 3.2–8.6%; Manzanera et al. [17] – 4.4%; Almerich-Silla et al. [33] – 5.5%; Mandall et al. [34] – 2.7%; Josefsson et al. [23] – 2.2–3.9%; and Souames et al. [16] – 7%; although Tausche et al. [22] and Niedziejko et al. [27] found a much higher percentage (21.5% and 13.5%, respectively).

Taking the 2 components together (modified IOTN) the data obtained (14% at 6–8 years and 20.6% at 9–12 years) indicating a definite need are similar to those noted in Spain (23.5%) [17] however the results are below the figure of 35% observed in a British population at 12 years [15].

When interpreting the results, it should be noted that 82 (13.4%) subjects had received orthodontic treatment or were currently undergoing orthodontic treatment and were excluded from the study. This led to a reduction in the overall assessment of the treatment need of the population being studied, a fact that needs to be taken into account when making comparisons. It should also be noted that the index is not cumulative: the DHC only takes into account the most severe occlusal feature and directly classifies the patient accordingly with the appropriate grade. In the same way, it largely ignores the cumulative effect of less severe occlusal features and, consequently, can undervalue certain malocclusions in some individuals [12].

Distribution of orthodontic treatment need with respect to males and females has also been analysed in several studies. In most of these, no significant differences between males and females – in terms of their AC and DHC grades – were observed [16, 17, 36]. In our study, we found significant gender differences with regard to the need for aesthetic treatment (AC). Similar findings were reported by Kerosuo et al. [37].

We observed statistically significant differences between age groups in terms of treatment need based on a modified IOTN. This need was greater in 9–12-year-olds than in 6–8-year-olds. This emphasises the importance of the early identification of a malocclusion and the timely referral of patients for treatment. Early intervention and orthodontic treatment help prevent the progression and severity of a malocclusion.

According to the hierarchical system of the IOTN (DHC) [12], dental anomalies, such as missing teeth, supernumerary teeth, impeded eruption of teeth, submerged deciduous teeth, partially erupted, tipped or impacted teeth, Angle's II molar relationship, increased overjet, anterior or posterior crossbite, as well as contact point displacements, were all strongly associated with a definite need for treatment (DHC grades 4 and 5). The IOTN data justify the need for early diagnosis and treatment of both these anomalies and progressive malocclusion symptoms.

Agreement between the 2 components of the IOTN was very low (kappa 0.17). The correlation observed in the Spanish population was also weak [17]. This difference reflects the fact that the AC assesses the aesthetic aspects of a malocclusion from a frontal view only, and highlights its subjective nature, whereas the DHC offers an objective analysis of the occlusal characteristics of the dentition. For example, some malocclusions are defined as harmful to oral health according to the DHC index, despite the absence of any aesthetic impairments, such as posterior crossbite, deep traumatic overbites or impacted canines and premolars. In the case of AC, the use of frontal photographs of dentition limits overjet and lip-incisor evaluations [12, 38]. Moreover, the AC scale only illustrates an individual's permanent dentition. Very often some forms of temporary malocclusion, i.e. dental relationships caused by sucking-habit, correct themselves with age. These findings suggest that, if an aesthetic scale is to be used to appraise mixed dentition, a more appropriate scale should be developed [16]. In general, assessing aesthetic impairment is a complex task and is difficult to measure [22, 39]. On the other hand, according to Burden et al. [30], the use of a modified IOTN, which takes into account the 2 components together and identifies a treatment need when a subject's IOTN DHC score is 4 or more and/or their AC score is 8 or above, seems to be more suitable for epidemiological studies than an approach in which the 2 components are treated separately [3].

It should also be noted that the demand for orthodontic treatment depends on many factors such as perceptual, functional and social needs, which may not always coincide with a professional evaluation of treatment need [20, 40]. Therefore, further studies should be carried out to investigate a patient's perception and his or her concerns regarding orthodontic treatment.

In Poland, orthodontic treatment is funded by the National Health Care System for patients up to 12–13 years of age. As a consequence, indices of orthodontic treatment need may be very useful in promoting assessments of the prevalence of malocclusion treatment need as well as for planning community dental health resources. The IOTN is simple to use and allows researchers to compare their results with those obtained by others, and thus may be adequate tools for public health planning purposes.

CONCLUSIONS

1. In the population analysed in the present study, orthodontic treatment need is similar or lower to that reported in various other European populations. However, it should be noted that 13.4% of children in the initial sample were receiving or had received orthodontic treatment.

2. The need for orthodontic treatment was greater in 9–12-year-olds than in 6–8-year-olds, and both an early diagnosis and the timely orthodontic referral of patients for treatment can help reduce the progression and severity of a malocclusion.

3. Dental abnormalities, Angle's II molar relationship, increased overjet, anterior or posterior crossbite, as well as contact point displacements, were significantly related to a definite need for treatment.

4. The IOTN represents a simply to use tool for measuring the orthodontic treatment need and may be adequate for public health planning and epidemiological purposes.

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