The need for orthodontic treatment among 10–11- and 14–15-year-old Lithuanian schoolchildren

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Key words: Index of Complexity, Outcome, and Need; treatment need; malocclusion.

Summary. The aim of this study was to evaluate the need for orthodontic treatment among 10–11- and 14–15-year-old schoolchildren in Lithuania.

Material and methods. A total of 4,235 children randomly selected from different socioeconomic backgrounds were examined. The schoolchildren were divided into two age groups: first group, 10–11-year olds (1,142 boys, 1,180 girls) and second group, 14–15-year olds (936 boys, 977 girls). The normative orthodontic treatment need was assessed using the Index of Complexity, Outcome, and Need.

Results. The need for orthodontic treatment ranged from 37.4 to 48.9% in 10 counties of Lithuania. The study demonstrated that the need of orthodontic treatment significantly depended on age and to some extent on gender of the schoolchildren examined. This study has shown reduction in the need for orthodontic treatment from 49.9% in the late mixed dentition stage to 33.9% in the permanent dentition stage.

Conclusions. The need for orthodontic treatment is high in Lithuania: almost half of 10–11-year-old and every third of 14–15-year-old schoolchildren need orthodontic treatment.

Introduction

The demand for orthodontic treatment over the last decade has been substantially growing in Lithuania. The available resources for publicly funded orthodontic care are not sufficient to provide these demands. Therefore, the effective management of the public health care system requires assessing not only demand, but also need for orthodontic treatment (1). Selection of patients to ensure that treatment is provided to subjects with the greatest need is especially important for countries with limited human and financial resources.

There are no universally accepted measures to assess the need for orthodontic treatment. Criteria for treatment need are different in many countries and depend on prevalence of malocclusion, health care system, socioeconomic factors, and cultural background (2). Definition of criteria assessing cutoff points for those needing and not needing orthodontic treatment always is problematic. It is generally accepted that treatment priority mostly is given to the patients with malocclusion associated with a high risk of tissue damage, functional disturbances, or psychological problems (3). However, patient’s perceived need for orthodontic treatment is often not in agreement with objective measurements. There is some controversy concerning objective and subjective assessment of the need for orthodontic treatment. Some authors found that specialists tend to recommend more treatment by 10–12% than lay persons (4). The others state that self-perceived scoring of malocclusion was higher than normative measure of need (5).

Nevertheless, majority of public health care systems prioritize orthodontic treatment based on objective assessment rather than relay on consumer-based information. Occlusal indices have been used to measure the need for orthodontic treatment from a normative or orthodontist specialist’s viewpoint. Majority of these indices (Index of Orthodontic Treatment Need, IOTN; Peer Assessment Rating, PAR; Dental Aesthetic Index, DAI; Norwegian Orthodontic Treatment Index, NOTI) are developed and used for different national health care systems, and very few have gained international recognition (6, 7). The Index of Complexity, Outcome, and Need (ICON) was derived by 97 orthodontists from eight European countries and the United States. This index is based on international orthodontic opinion and proposed to assess treatment need, complexity, and outcome (8). The assessment of the need for orthodontic treatment is not only a question of the severity of malocclusion,
but also schoolchildren’s age and mixed or permanent dentition periods (9). All components of ICON can be measured on study casts as well as on patients, and it can be used in the late mixed and permanent dentition period.

The aim of this study was to evaluate the need for orthodontic treatment among 10–11- and 14–15-year-old schoolchildren in Lithuania by means of ICON.

**Material and methods**

The study was carried out in 41 randomly selected schools in 10 counties of Lithuania (Alytus, Kaunas, Klaipėda, Marijampolė, Panevėžys, Šiauliai, Tauragė, Telšiai, Utena, and Vilnius). The survey included 23 urban and 18 rural schools according to the guidelines of the World Health Organization for oral health surveys (10). A total of 4235 children were examined. The schoolchildren were divided into two age groups: first group, 10–11-year olds (1142 boys, 1180 girls) and second group, 14–15-year olds (936 boys, 977 girls). Schoolchildren wearing orthodontic appliances and with a history of previous orthodontic treatment were excluded from the study.

The need for orthodontic treatment was assessed using the ICON (8). The ICON consists of five components: the esthetic component, assessment of upper and lower arch crowding/spacing, presence of a crossbite, degree of incisor open bite/overbite, and anterior-posterior fit of buccal segment (Table 1). The protocol of ICON scoring was as follows: first, we measured all five components, then obtained a set of scores, and multiplied the scores by their respective weights. The sum of the weighted scores is the ICON score for the case. The esthetic assessment was made by selecting the picture from the set of 10 pictures of dental attractiveness (Fig. 1), most similar to child’s to be assessed occlusion. The need for orthodontic treatment was defined as having an ICON score of 44 or greater. This cutoff point is internationally recognized and recommended by the index authors (8).

All children were examined by one orthodontist (D.B., the author of the article) in dental settings of schools. The examiner had been previously trained and calibrated to use ICON index. Using 30 dental casts, the calibration of examiner was performed. The mean difference from gold standard was less than 5 ICON points and root mean square less than 9 ICON points.

Chi-square test was used to evaluate dependence of treatment need and complexity on various qualitative factors, such as county, type of living area, gender, and age. The ICON scores among the schools were compared using one-way analysis of variance, having tested the scores for normality.

The study approval was obtained from the Ministry of Education and Science of Lithuania, the National Bioethics Committee, and school headmasters. Parents’ consent was obtained before clinical examination of the children.

**Results**

The overall percentage of individuals needing orthodontic treatment in Lithuania was 42.6% and

| Component | Score | Weight |
|-----------|-------|--------|
| 1. Esthetic assessment | Score 1–10 | 7 |
| 2. Upper arch crowding | <2 mm | 2.1 to 5 mm | 5.1 to 9 mm | 9.1 to 13 mm | 13.1 to 17 mm | >17 mm | 5 |
| Upper arch spacing | <2 mm | 2.1 to 5 mm | 5.1 to 9 mm | >9 mm | Impacted tooth | 5 |
| 3. Crossbite | Not present | Present | 5 |
| 4. Incisor open bite | Complete bite | <1 mm | 1.1 to 2 mm | 2.1 to 4 mm | 4 |
| Incisor overbite | <1/3 lower incisor covered | 1/3 to 2/3 covered | 2/3 up to fully covered | Fully covered | 4 |
| 5. Buccal segment antero-posterior | Cusp to embrasure only; Class I; II or III | Any cusp relation up to but not including cusp to cusp | Cusp to cusp | 3 |
Fig. 1. Ten pictures ranking dental attractiveness and used to assess esthetic component of the Index of Complexity, Outcome, and Need

ranged from 37.4% to 48.9% in 10 counties (Fig. 2); however, the differences among counties were not statistically significant ($P=0.09$).

More detailed analysis revealed that the need for orthodontic treatment significantly depends on age and to some extent on gender of examined schoolchildren. The need for orthodontic treatment in the group of 10–11-year-old children was higher than in the group of 14–15-year olds (49.9 and 33.9%, respectively; $P<0.01$).

The gender has an impact on the orthodontic treatment need with increasing age. There were no significant differences in the need for orthodontic treatment between boys and girls in the younger children group (49.3% among girls and 50.4% among boys, $P=0.59$), but in 14–15-year age group, more boys than girls (36.9% versus 31.0%) needed this treatment.

There were no significant differences in the need for orthodontic treatment comparing 10–11-year-old schoolchildren living in urban and rural areas (Fig. 3). However, the difference was significant in the group of 14–15-year-old schoolchildren (32.0% of subjects living in cities and 36.9% in rural areas, $P=0.03$).

The ICON index contains not only information
concerning treatment need, but also information about treatment complexity (Tables 2 and 3). The analysis of treatment complexity between two age groups demonstrated that younger schoolchildren need treatment that is more complex. Children aged 10–11 years more frequently needed treatment of “very difficult” (6.7 and 4.1%, respectively; \(P<0.01\)), “difficult” (15.6 and 11.0%, respectively; \(P<0.01\)), and “moderate” complexity (20.7 and 14.0%, respectively; \(P<0.01\)). There were no significant differences in the complexity of orthodontic treatment comparing 10–11-year-old children living in urban and rural areas (\(P=0.39\)), boys and girls (\(P=0.37\)), or different counties (\(P=0.70\)). However, significant differences were found comparing 14–15-year-old children living in urban and rural areas. The schoolchildren living in the rural areas needed more complex treatment than those living in the cities (\(P=0.02\)).

**Discussion**

The effective management of a public dental health system requires accurate data on the treatment need of the population. The individuals with the greatest need should be assigned to the treatment priority, especially when resources are limited, and treatment availability is unevenly spread across the country (11). To assess the need for orthodontic treatment, occlusal indices have been successfully used in many countries over the world. The most popular indices are IOTN, PAR, DAI, and ICON. The ICON gained international recognition, and several studies reported its validity and reliability (12, 13). Our choice to use ICON was based on the prominent characteristics mentioned above and index simplicity while using in large screenings.
The average treatment need (42.6%) in Lithuania is similar to the results of corresponding studies in neighboring countries in Europe. The need for orthodontic treatment using ICON index was reported to be 35.3% in Latvia (1) and 38% in UK (14). The results of studies carried out in Nordic countries revealed slightly lower need for orthodontic treatment: 23.5% in Finland (15) and 28.9% in Sweden (16). The differences in the need for orthodontic treatment between Lithuania and Nordic countries might be attributable to the indices employed: ICON was used in our study and IOTN in Finland and Sweden. However, probably other factors than assessment methods are more liable to explain differences. Prevalence of malocclusion and treatment need is closely related to dental caries and level of oral hygiene (17). The prevalence of dental caries is very high (98%) among schoolchildren in Lithuania comparing to Scandinavia (18). This may explain to some extent the higher need for orthodontic treatment in Lithuania.

Table 2. Proportions (%) of 10–11-year-old schoolchildren needing orthodontic treatment of different complexity in 10 counties of Lithuania

| County   | Area     |容易 | 轻微 | 中等 | 困难 | 非常困难 | N  | P   |
|----------|----------|-----|-----|-----|------|---------|----|-----|
| Alytus   | rural    | 33.3| 16.7| 16.7| 23.3 | 10.0    | 30 | 0.08|
|          | urban    | 16.9| 37.7| 22.7| 16.2 | 6.5     | 154|     |
|          | total    | 19.6| 34.2| 21.7| 17.4 | 7.1     | 184|     |
| Kaunas   | rural    | 20.2| 40.3| 28.4| 9.0  | 2.2     | 134|     |
|          | urban    | 15.5| 37.0| 22.7| 16.6 | 8.3     | 181|     |
|          | total    | 17.5| 38.4| 25.1| 13.3 | 5.7     | 315|     |
| Klaipėda | rural    | 18.0| 43.0| 21.0| 11.0 | 7.0     | 100| 0.46|
|          | urban    | 15.9| 38.4| 17.7| 18.9 | 9.2     | 164|     |
|          | total    | 16.7| 40.2| 18.9| 15.9 | 8.3     | 264|     |
| Marijampolė | rural  | 21.4| 35.7| 21.4| 14.3 | 7.1     | 14 | 0.99|
|          | urban    | 19.2| 40.1| 16.8| 16.2 | 7.8     | 167|     |
|          | total    | 19.3| 39.8| 17.1| 16.0 | 7.7     | 181|     |
| Panevėžys | rural    | 23.4| 23.4| 28.1| 20.3 | 4.7     | 64 | 0.53|
|          | urban    | 20.2| 33.9| 21.1| 17.4 | 7.3     | 109|     |
|          | total    | 21.4| 30.1| 23.7| 18.5 | 6.4     | 173|     |
| Šiauliai | rural    | 24.0| 36.0| 18.0| 18.0 | 4.0     | 50 | 0.82|
|          | urban    | 23.5| 37.3| 16.7| 13.7 | 8.8     | 102|     |
|          | total    | 23.7| 36.8| 17.1| 15.1 | 7.2     | 152|     |
| Tauragė  | rural    | 14.3| 28.6| 22.9| 25.7 | 8.6     | 35 | 0.61|
|          | urban    | 21.1| 29.7| 21.3| 16.4 | 9.4     | 286|     |
|          | total    | 22.1| 29.6| 21.5| 17.4 | 9.3     | 321|     |
| Telšiai  | rural    | 19.8| 48.2| 19.8| 11.1 | 1.2     | 81 | 0.28|
|          | urban    | 21.3| 32.5| 26.3| 16.3 | 3.8     | 80 |     |
|          | total    | 20.5| 40.4| 23.0| 13.7 | 2.5     | 161|     |
| Utena    | rural    | 17.0| 46.8| 17.0| 8.5  | 10.6    | 47 | 0.38|
|          | urban    | 21.7| 44.7| 17.4| 12.4 | 3.7     | 161|     |
|          | total    | 20.7| 45.2| 17.3| 11.5 | 5.3     | 208|     |
| Vilnius  | rural    | 15.4| 37.1| 21.7| 17.5 | 8.4     | 143| 0.18|
|          | urban    | 24.6| 36.8| 18.6| 15.6 | 4.6     | 220|     |
|          | total    | 20.9| 36.9| 19.8| 16.3 | 6.1     | 363|     |
| Overall  |          | 20.0| 37.0| 20.7| 15.6 | 6.7     | 2322| 0.70|

Statistical significance (P) of the differences in treatment complexity between rural and urban areas in each county was calculated by chi-square test.

P – value in the overall row indicates dependence of complexity on area among counties.
This study has shown reduction in the need for orthodontic treatment from 49.9% in case of late mixed dentition stage to 33.9% in case of permanent dentition. These findings are in line with the results of other studies. A 6% reduction of a “mandatory” need for orthodontic treatment from the age of 10 to 13 years was found in New Zealand (19). The study in Finland demonstrated that of the 29 children with definite treatment need at age of eight, only two had treatment need at age of twelve (20). Despite extensive research, there is no conclusive agreement yet; does self-correction of the malocclusion really take place? Some authors with reference to the validity of occlusal indices in different dentition periods suggest that symptoms in the mixed dentition might be slightly overestimated between ages of 10 and 13 years (21). In addition, there are some data that transitional stages during the early and middle mixed dentition are difficult to assess for esthetics (8). The esthetic component of occlusal indices always should be interpreted

### Table 3. Proportions (%) of 14–15-year-old schoolchildren needing orthodontic treatment of different complexity in 10 counties of Lithuania

| County   | Area     | Treatment complexity | N  | P       |
|----------|----------|----------------------|----|---------|
|          |          | easy    | mild    | moderate | difficult | very difficult |    |
| Alytus   | rural    | 23.3    | 55.8    | 9.3      | 7.0       | 4.7            | 43  |
|          | urban    | 38.0    | 38.6    | 11.7     | 7.6       | 4.1            | 171 |
|          | total    | 35.0    | 42.1    | 11.2     | 7.5       | 4.2            | 214 |
| Kaunas   | rural    | 29.9    | 39.2    | 11.3     | 17.5      | 2.1            | 97  |
|          | urban    | 33.5    | 35.6    | 15.2     | 13.6      | 2.1            | 191 |
|          | total    | 32.3    | 36.8    | 13.9     | 14.9      | 2.1            | 288 |
| Klaipėda | rural    | 30.0    | 39.2    | 11.7     | 14.2      | 5.0            | 120 |
|          | urban    | 32.8    | 40.6    | 9.4      | 10.9      | 6.3            | 64  |
|          | total    | 31.0    | 39.7    | 10.9     | 13.0      | 5.4            | 184 |
| Marijampolė | rural | 17.6    | 35.3    | 29.4     | 5.9       | 11.8           | 17  |
|          | urban    | 36.8    | 38.7    | 12.3     | 11.0      | 1.2            | 163 |
|          | total    | 35.0    | 38.3    | 13.9     | 10.6      | 2.2            | 180 |
| Panevėžys | rural    | 35.8    | 29.9    | 16.4     | 14.9      | 3.0            | 67  |
|          | urban    | 32.8    | 39.4    | 15.3     | 8.0       | 4.4            | 137 |
|          | total    | 33.8    | 36.3    | 15.7     | 10.3      | 3.9            | 204 |
| Šiauliai | rural    | 39.1    | 23.4    | 15.6     | 17.2      | 4.7            | 64  |
|          | urban    | 44.3    | 27.8    | 13.9     | 11.4      | 2.5            | 79  |
|          | total    | 42.0    | 25.9    | 14.7     | 14.0      | 3.5            | 143 |
| Tauragė  | rural    | 17.2    | 34.5    | 17.2     | 24.1      | 6.9            | 29  |
|          | urban    | 43.3    | 31.3    | 14.9     | 9.0       | 1.5            | 67  |
|          | total    | 35.4    | 32.3    | 15.6     | 13.5      | 3.1            | 96  |
| Telšiai  | rural    | 27.4    | 36.8    | 19.8     | 9.4       | 6.6            | 106 |
|          | urban    | 24.3    | 37.1    | 22.9     | 8.6       | 7.1            | 70  |
|          | total    | 26.1    | 36.9    | 21.0     | 9.1       | 6.8            | 176 |
| Utena    | rural    | 29.1    | 38.2    | 12.7     | 12.7      | 7.3            | 55  |
|          | urban    | 40.2    | 33.1    | 12.6     | 8.7       | 5.5            | 127 |
|          | total    | 36.8    | 34.6    | 12.6     | 9.9       | 6.0            | 182 |
| Vilnius  | rural    | 34.4    | 40.8    | 11.2     | 10.4      | 3.2            | 125 |
|          | urban    | 33.9    | 39.7    | 14.0     | 6.6       | 5.8            | 121 |
|          | total    | 34.1    | 40.2    | 12.6     | 8.5       | 4.5            | 246 |
| Overall  |          | 33.9    | 37.0    | 14.0     | 11.0      | 4.1            | 1913|

Statistical significance (P) of the differences in treatment complexity between rural and urban areas in each county was calculated by chi-square test.

P – value in the overall row indicates dependence of complexity on area among counties.

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with some caution, but in our study, only late mixed gathered and permanent dentition stages were analyzed, and the same calibrated examiner gathered the data, so bias was eliminated. Therefore, other factors possibly responsible for this phenomenon should be taken into consideration. Occlusal development at that age is of primary concern. Occlusion of a growing child changes over the time, and some self-correction is possible. Deep bite and increased overjet predominate at the age of 8–9 years and may be reduced by prominent growth of the mandible some year later (22). Reduction in overjet was found during adolescence by several researchers (23, 24). The biggest part of this reduction in overjet is likely to occur between 11 and 15 years (25). Perhaps these improvements in overjet and overbite are essential in influencing changes in ICON scores over the time as the individuals get more mature.

Week associations were found between differences for treatment need and gender in the group of 10–11-year-old schoolchildren. This is in agreement with earlier studies, which showed little or no gender-based differences with respect to normative treatment need (26, 27). Nevertheless, at the permanent dentition stage (group of 14–15-year olds), it was found that boys needed the treatment more frequently than girls (28, 29). The reason for this is not understood, but it might be related to fact that male growth starts later and does not reach maximum at the age of 14–15 years. Males at the age of 11–14 years are more likely than females to show both an increased overbite and an increased overjet (30).

Regarding treatment complexity, the degree of difficulty does not vary significantly between schools. The results showed that all younger children and 14–15-year-old schoolchildren in the rural areas needed more complex treatment. The reason for this is not understood, but there are some data that younger children and living in rural areas have poorer level of dental health than schoolchildren living in cities (18).

Conclusions
1. The need for orthodontic treatment is high in Lithuania: almost half (49.6%) of 10–11-year-old and every third (34.1%) of 14–15-year-old schoolchildren need orthodontic treatment.
2. There were no significant differences in the need for orthodontic treatment among 10 different counties of Lithuania.
3. The treatment need in the group of 10–11-year-old children was higher than in the group of 14–15-year-old (49.9 and 33.9%, respectively; P<0.01).
4. The need for orthodontic treatment was higher among boys than girls in the group of 14–15-year olds (36.9 and 31.0%, respectively; P=0.01), but no difference was found in the group of 10–11-year olds.
5. Schoolchildren aged 10–11 and 14–15 years living in rural areas needed treatment that is more complex.

10–11 ir 14–15 metų Lietuvos moksleivių ortodontinio gydymo reikalingumas

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Raktažodžiai: ICON indeksas, ortodontinio gydymo reikalingumas, ortodontinės anomalijos.

Santrauka. Tyrimo tikslas. Nustatyti ortodontinio gydymo reikalingumą 10–11 ir 14–15 metų amžiaus Lietuvos moksleivių grupėse.

Medžiaga ir metodai. Gydymo reikalingumai nustatyti taikytas ICON indeksas (ang. Index of Complexity, Outcome, and Need). Ortodontinis gydymas reikalingas, kai ICON indekso balų suma lygi arba didesnė už 44. 41 Lietuvos mokykloje buvo patikrinti 4235 mokiniai: 1142 berniukai ir 1180 berniukai ir 1180 mergaičių. Rezultatai. Ortodontinio gydymo reikalingumas atskirose apskričiose svyravo nuo 37,4 iki 48,9 proc. Tyrimas parodė, kad ortodontinio gydymo reikalingumas gana reikšmingai priklauso nuo tiriamųjų amžiaus, kiek mažiau nuo lyties. Mišraus sąkandžio laikotarpiu gydymo reikalingumas siekė 49,9 proc., o vyresnių moksleivių grupėse pastovaus sąkandžio laikotarpio ortodontinis gydymas buvo reikalingas tik 33,9 proc. tiriamųjų.

Išvada. Ortodontinio gydymo reikalingumas tarp Lietuvos moksleivių gana aukštas: beveik pusei 10–11 metų moksleivių ir kas trečiam 14–15 metų amžiaus moksleivių reikalingas ortodontinis gydymas.
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