

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

Diana Baubinienė, Antanas Šidlauskas, Irena Misevičienė¹

Department of Orthodontics, ¹Institute for Biomedical Research, Kaunas University of Medicine, Lithuania

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 4235 children randomly selected from different socioeconomic backgrounds 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). 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 rely 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 cross-bite, 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

Table 1. Index of Complexity, Outcome and Need (ICON) scoring criteria

Component	Score						Weight
	0	1	2	3	4	5	
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

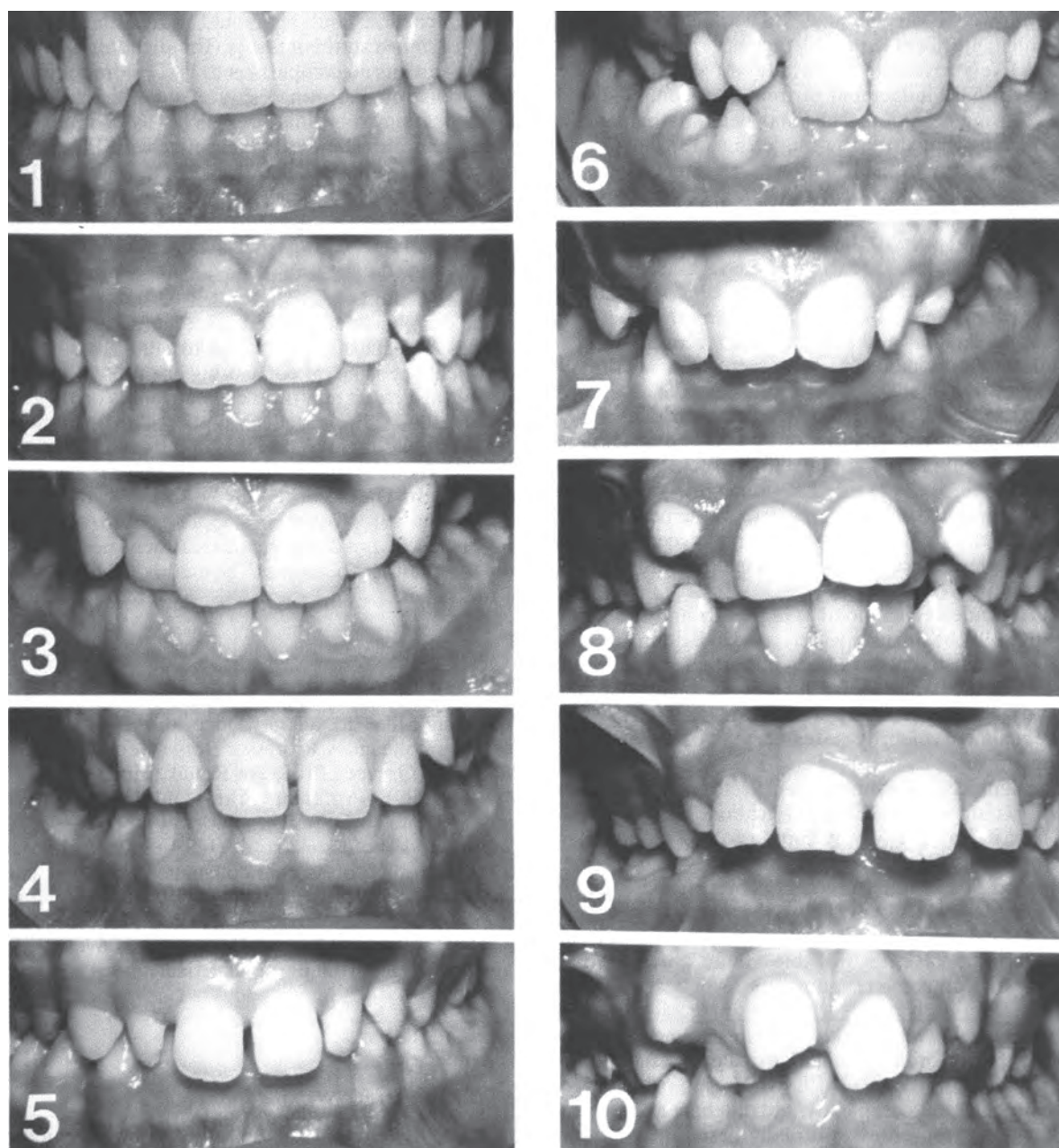


Fig. 1. Ten pictures ranking dental attractiveness and used to assess esthetic component of the Index of Complexity, Outcome, and Need

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 signi-

ficant 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

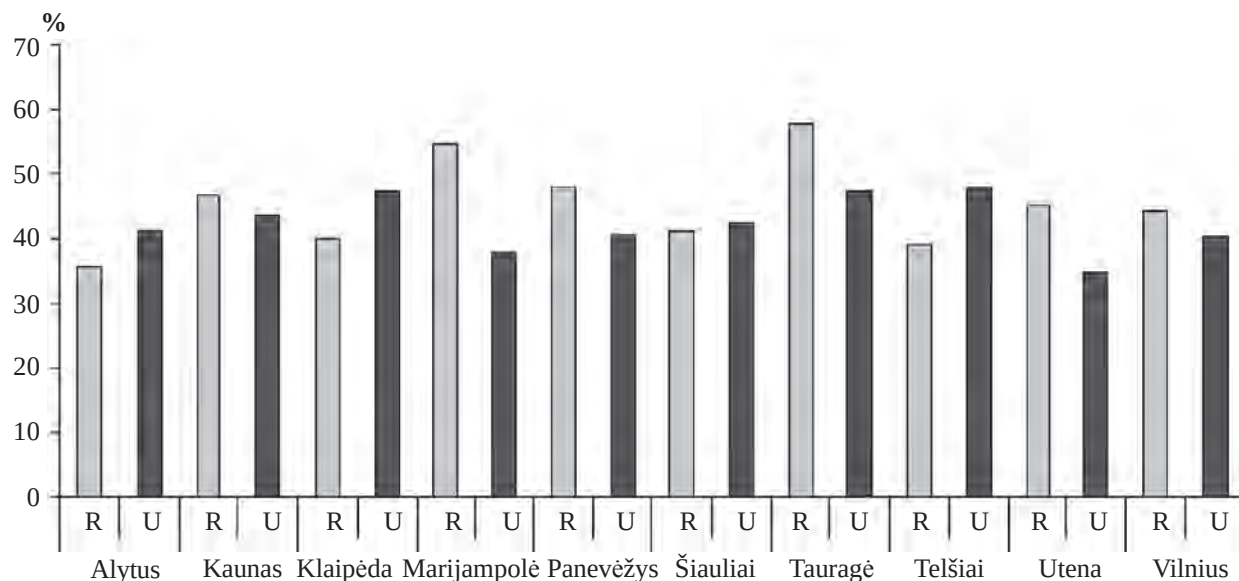


Fig. 2. Percentage need for orthodontic treatment in 10 counties of Lithuania

U – urban settings, R – rural settings.

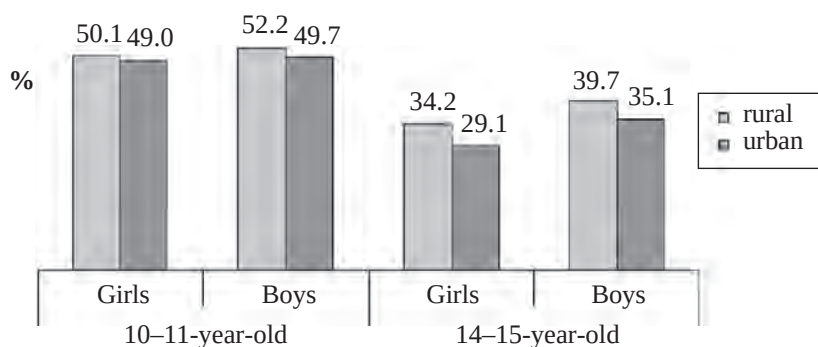


Fig. 3. The need for orthodontic treatment among 10–11- and 14–15-year-old schoolchildren in rural and urban areas

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.

Table 2. Proportions (%) of 10–11-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	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	0.05
	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	23.1	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.

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 attrib-

table 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 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	0.31
	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	0.77
	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	0.94
	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	0.01
	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	0.46
	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	0.76
	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	0.05
	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	0.98
	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	0.66
	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	0.67
	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	0.02

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

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.

Weak 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 children 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

Diana Baubiniienė, Antanas Šidlauskas, Irena Misevičienė¹

Kauno medicinos universiteto Ortodontijos klinika, ¹Biomedicininų tyrimų institutas

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 reikalingumui 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 mergaičių 10–11 metų grupėje, 936 berniukai ir 977 mergaitės 14–15 metų grupėje.

Rezultatai. Ortodontinio gydymo reikalingumas atskirose apskrityse 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 laikotarpiu 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 moksleiviui reikalingas ortodontinis gydymas.

References

1. Liepa A, Urtane I, Richmond S, Dunstan F. Orthodontic treatment need in Latvia. *Eur J Orthod* 2003;25:279-84.
2. Ahmed B, Gilthorpe S, Bedi R. Agreement between normative and perceived orthodontic need amongst deprived multiethnic schoolchildren in London. *Clin Orthod Res* 2001;4:65-71.
3. O'Brien K, McComb L, Fox N, Wright J. Factors influencing the uptake of orthodontic treatment. *Br J Orthod* 1996;23:331-4.
4. Vally I. A comparison of lay and professional opinion on treatment need and treatment outcome [dissertation]. Cardiff: University of Wales; 1997.
5. Mandall A, Wright J, Conboy M, O'Brien K. The relationship between normative orthodontic treatment need and measures of consumer perception. *Community Dent Health* 2001;18:3-6.
6. Espeland L, Ivarsson K, Stenvik A. A new Norwegian index of orthodontic treatment need related to orthodontic concern among 11-year-olds and their parents. *Community Dent Oral Epidemiol* 1992;5:274-9.
7. Heikinheimo K. Need of orthodontic treatment and prevalence of craniofacial dysfunction in Finnish children [dissertation]. Turku: University of Turku; 1989.
8. Daniels C, Richmond S. The development of the Index of Complexity, Outcome and Need (ICON). *J Orthod* 2000;27:149-62.
9. Tausche E, Luck O, Harzer W. Prevalence of malocclusions in the early mixed dentition and orthodontic treatment need. *Eur J Orthod* 2004;26:237-44.
10. World Health Organization (WHO). Oral health surveys – basic methods. 4th ed. Geneva: World Health Organization; 1997.
11. Hamdan A. The relationship between patient, parent and clinician perceived need and normative orthodontic treatment need. *Eur J Orthod* 2004;26:265-71.
12. Firestone A, Beck F, Beglin F, Vig K. Validity of the Index of Complexity, Outcome and Need (ICON) in determining orthodontic treatment need. *Angle Orthod* 2002;72:15-20.
13. Richmond S, Buchanan I, Burden D, O'Brien K, Andrews M, Roberst C, et al. Calibration of dentists in the use of occlusal indices. *Community Dent Oral Epidemiol* 1995;23:173-6.
14. Chestnutt I, Pendry L, Harker R. The orthodontic condition of children. Children's dental health in the United Kingdom, 2003, 2004. National statistics. Available from: URL: <http://www.statistics.gov.uk/STATBASE/Product.asp?vlnk=12918>
15. Heikinheimo K. Need of orthodontic treatment in 7-year-old Finnish children. *Community Dent Oral Epidemiol* 1978;6:129-34.
16. Linder-Aronson S, Bjerrehorn K, Forsberg C. Objective and subjective need for orthodontic treatment in Stockholm County, Sweden. *Swed Dent* 2002;26:31-40.
17. Gabris K, Marton S, Madlena M. Prevalence of malocclusion in Hungarian adolescents. *Eur J Orthod* 2006;28:467-70.
18. Milčiuvienė S, Matulaitienė Z, Narbutaitė J, Vaitkevičienė V, Bendoraitienė E, Timofejeva I. Dental status among schoolchildren in Kaunas and analysis of oral health care. *Medicina (Kaunas)* 2006;42:413-23.
19. Chi J, Johnson M, Harkness M. Age changes in orthodontic treatment need: a longitudinal study of 10- and 13-year-old children, using the Dental Aesthetic Index. *Australian Orthod J* 2000;16:150-6.
20. Väkiparta M, Kerosuo M, Nyström E, Heikinheimo K. Orthodontic treatment need from eight to 12 years of age in an early treatment oriented public health care system: a prospective study. *Angle Orthod* 2004;75(3):344-9.
21. Johnson M, Harkness M, Crowther P, Herbison P. A comparison of two methods of assessing orthodontic treatment need in the mixed dentition; DAI an IOTN. *Australian Orthod J* 2000;16:82-7.
22. Tausche E, Luck O, Harzer W. Prevalence of malocclusion in the early mixed dentition and orthodontic treatment need. *Eur J Orthod* 2004;26:237-44.
23. Bjork A. Variability and age changes in overjet and overbite. *Am J Orthod* 1953;39:779-801.
24. Savuin C, Savara B. The development of an excellent occlusion. *Am J Orthod* 1972;61:345-52.
25. Cooper S, Mandall N, DiBiase D, Shaw W. The reliability of the Index of Orthodontic Treatment Need over time. *J Orthod* 2000;27:47-53.
26. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. *Scand J Dent Res* 1973;81:12-20.
27. Marques C, Couto G, Orestes C. Assessment of orthodontic treatment needs in Brazilian schoolchildren according to the Dental Aesthetic Index (DAI). *Community Dent Health* 2007;24:145-8.
28. Ingervall B, Seeman L, Thilander B. Frequency of malocclusion and need of orthodontic treatment in 10-year old children in Gothenburg. *Swedish Dent J* 1972;65:7-21.
29. Esa R, Razak IA, Allister H. Epidemiology of malocclusion and orthodontic treatment need of 12–13-year-old Malaysian schoolchildren. *Community Dent Health* 2001;18:31-6.
30. Ciuffolo F, Manzoli L, D'Attilio M, Tecco S, Muratore F, Festa F, et al. Prevalence and distribution by gender of occlusal characteristics in a sample of Italian secondary school students: a cross-sectional study. *Eur J Orthod* 2005;27:601-6.

Received 27 June 2008, accepted 5 October 2009
Straipsnis gautas 2008 06 27, priimtas 2009 10 05