Prevalence of Orthodontic Malocclusion in School Children in the North East of Slovenia: Retrospective Epidemiology Study

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Research Article

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Abstract

Background: Dental malocclusions exhibit the third-highest prevalence among oral pathologies. The occlusion is evaluated in primary, mixed and permanent dentition. Most orthodontic patients were treated in the early permanent dentition. Early detection of dental anomalies is important to prevent complications and can have short-term and long-term benefits. The epidemiological data on the prevalence of malocclusion is an important determinant in planning appropriate levels of orthodontic services. Dentists have the responsibility to recognize, diagnose, and manage or refer to abnormalities. Data from researches showed that is the incidence of malocclusions from 11% to 93%. **The study aim** is to find out, the prevalence and species of malocclusion of school children in 4 school years, how they are registered by general dentists.

Results: The research was conducted in 4 consecutive school years on schoolchildren from 1. to 9. class. Dentists have registered the presence and type of malocclusion. They are made statistical data percentage of children with malocclusion and percentage of representation malocclusion and statistical difference between genders. The percentage of malocclusion was the lowest in the 1. class. The highest percentage of malocclusion was in 7. class. The most common types of malocclusion were deep bite, crowding cross bite and II class of Angle's. The upper lateral incisive was the most common missing tooth (aplasia).

Conclusion: The high percentage of malocclusion at the end of school (15-year-old) about 50% and the low number of children in orthodontic therapy.

Background

In the implementation of the preventive examination is noted the presence and the species of orthodontic anomalies. Dental malocclusions exhibit the third-highest prevalence among oral pathologies. (1) Malocclusions are not a 'disease' in themselves, but rather appreciable deviations from ideal occlusion that are considered aesthetically or functionally unsatisfying. (2) The assessment of malocclusion has not been uniform (3). They are present subjective weights in the identification of malocclusion (4). The prevalence of malocclusion was different from nation to nation and age groups. (5)

Occlusion, it means contact between teeth. (6) Normal occlusion is desirable as it allows oral functions to operate properly, provides the best esthetics and is helpful in the prevention of disease. (7) Malocclusion is defined as a deviation of the teeth or a malrelationship of the dental arches beyond the normal. (8) The development of the human dentition is a continuous process. (9) An ideal primary dentition likewise is an indicator of potentially perfect permanent dentition. (10) The recognition of normal occlusion in primary dentition is essential for treatment planning in pediatric dentistry. (11) The occlusion is evaluated in primary, mixed and permanent dentition. Most orthodontic patients were treated in the early permanent dentition, at 12/13 years old. (12) Early detection of dental anomalies is important to prevent complications (13) and can have short-term and long-term benefits. (14) The factors of occurrence of anomalies can be genetic, inheritance, metabolic, mutations, physical, chemical, biological factors, or a combination. (15)

A systematic and well-organized dental care program for any target population in a community requires some basic information, such as the prevalence of the condition. (16) The epidemiological data on the prevalence of malocclusion is an important determinant in planning appropriate levels of orthodontic services. (17) Dentists have the responsibility to recognize, diagnose, and manage or refer abnormalities. (18) The source of data is systematic examination of school children. Their examinations do dentists in children and youth dentistry. They are first stairs upon detection of malocclusions and referral to an orthodontist. It is important, that recognize early some malocclusions and refer to orthodontist for therapy. But sometimes is noted and refer malocclusion, which is not for orthodontic therapy. They may be temporarily condition in physiological tooth exchange. Therefore can be difficult access to orthodontic therapy for those who really need it. Children are the ideal population for prevention, development monitoring, determining the effectiveness of prevention programs and it can modification/ update preventive program based on epidemiological studies.

Data of researches showed, that is the incidence of malocclusions from 11–93% (19, 20) and these variations are difficult to explain. (17). The prevalence of malocclusions in primary dentition in Brazilian children was 75,8%. (21). Gelgor was in your study found, that only 10% of adolescents had correct occlusion. (22)

How is it in the area of Murska Sobota, Slovenia? In Slovenia, the preventive program has its legal basis. (23) The Health center in the city Murska Sobota, which is in the north east of Slovenia, takes care of the implementation of preventive examinations for 11 elementary schools and 5 branch schools. The health center has been doing regular systematic examinations of elementary school pupils for more decades. Unfortunately, in 2020 due to COVID-19 pandemic, could not inspect all pupils. Dentists for children and youth at a systematic examination identify the anomaly and, if necessary, refer it to an orthodontist. They are a key factor in identifying malocclusions and referral to a specialist, therefore, their knowledge and involvement are essential.

The aim of the study is to find out, the prevalence and species of malocclusion of school children in 4 school years, how they are registered by general dentists.

Methods

The research was conducted in 4 consecutive school years, retrospective epidemiology study, beginning with 2015/16 (to 2018/19). The school year in Slovenia starts always in September and ends in June the following year. Students start attending school with 6 years (1st class) and end their primary education with approximately 15 years (9th class). In the 6th class, they are 12 years old. Data was obtained after systematic examinations of students, which was done once a year. Examined were school children in elementary schools (ES) and their branch schools (BS): I., II. and III. ES Murska Sobota, ES Tišina, ES Bakovci, ES Fokovci, ES Prosenjakovci, ES Gornji Petrovci, ES Bogojina, ES Šalovci, BS Dokležovje, BS Gederovci, BS Domanjševci, BS Hodoš, and BS Krog. Pupils came to examination by a prior arrangement with the school leadership.

Systematic examinations were carried out by 4 dentists in their ordinations. Pupils were examined on the chair with a dental mirror, a sond, a puster, and the light. Anomalies were registered by Angle's classification (II and III class), edge-to-edge (tete-a-tete), deep bite, open bite, crossbite, aplasia, crowding (tight condition), ectopic outgrowth and dens supernumerary. The condition was noted in the following form and includes the following data: the type of anomaly and is it pupils in orthodontic therapy, pupil's name, pupil's surname, school, class, date, and signature of the dentist. Children with systematic diseases, which may affect the occurrence of anomalies, did not register. Children in orthodontic therapy were registered »in orthodontic therapy«. Their anomalies were not registered. Anomalies, which were registered: The completed form was sent to a specialist in paediatric dentistry, who did the data processing. Statistical data are

- For each year percentage of children with malocclusion,
- For each year the percentage of the representation of types of malocclusions
- Number of children who are in orthodontic therapy
- Genders relationship

Statistical analysis

Data were processed in Excel and IBM SPSS, version Statistics 25, statistical program. The relation of percentage between boys and girls was calculated with the 'Chi-squared test'.

Results

In 4 school years, there have been done 7579 systematic examinations, from that 3840 were boys (5.7%) and 3739 girls (49.3%) - relation between boys and girls was approximately the same.

Legend:

ETE- edge-to-edge; **DB**-deep bite; **II class** and **III class**- by Angle's; **OB**- open bite; **CB**- cross bite; **apl**-aplasia;

CR- crowding (tight condition); **ect**- ectopic position; **DS**- dens supernumerary.

School year 2015/16

Table 1
Percentage of the distribution and types of anomalies from 1st to 9th class.

% malocclusion and types of malocclusion	ETE	DB	II class	III class	OB	CB	apl	CR	ect	DS	together %
1st class	0	15.2	15.2	9.1	6.1	31.8	0	12.1	10.6	0	31.2
2nd class	0	34.6	6.5	4.7	10.3	21.5	0.9	17.8	3.7	0	49.1
3rd class	1.3	15.6	9.1	3.9	15.6	19.5	0	16.9	18.2	0	53.1
4th class	1.1	25.8	22.5	1.1	5.6	24.7	1.1	13.5	4.5	0	48.4
5th class	1.2	23	14.9	4.6	3.4	17.2	1.1	25.3	8.1	1.1	60
6th class	8.2	21.3	29.5	0	0	18	0	13.1	9.8	0	36.1
7th class	9.1	22.7	3.6	8.2	20.9	10	0	5.5	17.3	2.7	70.1
8th class	0	12.5	26.8	1.8	8.9	23.2	7.1	7.1	7.1	5.4	46.3
9th class	2.1	10.6	14.9	0	2.1	19.2	10.6	23.4	12.8	4.3	34.8
Together %	2.7	21.7	14.4	4.1	9.1	20	1.7	14.7	10.1	1.3	47.1

The highest percentage of anomalies was in the 7th class (13-year-old). The lowest percentage of anomalies was in 1st class (6-year-old). The most common occlusal anomalies were deep bite (21.7%), crossbite (20%) and crowding (14.7%) of registered anomalies (Table 1).

In the population were present 12 children with aplasia. 1 child was missing teeth 15, 35, 12 and 22. 5 children were missing teeth 12 and 22. 2 children were missing teeth 35 and 45. 1 child was missing the tooth 12. 1 child was missing the tooth 22. 1 child was missing the tooth 31. 1 child was missing the tooth 42.

In the population were 29 children with the Angle's III class.

Table 2
The number of children, who were in orthodontic therapy.

1st class	2nd class	3rd class	4th class	5th class	6th class	7th class	8th class	9th class	together
0	0	0	2	1	2	4	5	0	14

The children have been treated since 4th class (10-year-old). The most number treated children are in 8th class (14 year-old) (Table 2).

Table 3
Chi-Square test of the relation between gender and
orthodontic malocclusions.

Chi-square test				
anomaly * sex Crosstabulation			Sex	
			boys	girls
anomaly	0	Count	426	368
		% within sex	55,3%	51,5%
	1	Count	345	346
		% within sex	44,7%	48,5%

Chi- Square test showed that percentage of girls with malocclusions was higher than that of boys (Table 3).

School year 2016/17

Table 4
Percentage of the distribution and types of anomalies from 1st to 9th class.

% malocclusion and types of malocclusion	ETE	DB	II class	III class	OB	CB	apl	CR	ect	DS	together %
1st class	8	34	4	2	22	10	0	10	10	0	28.9
2nd class	0	27.9	1.6	9.8	14.8	23	0	21.3	1.6	0	38.1
3rd class	1	32.4	9.5	2.6	6.7	20	0	19.1	8.6	0	43.2
4th class	1	33	1	2.1	4.1	19.6	0	23.7	15.5	0	55.7
5th class	3.4	24.7	12.4	0	6.7	19.1	1.1	21.3	11.2	0	46.6
6th class	1.1	33.3	7.8	1.1	4.4	13.3	4.4	21.1	13.3	0	51.7
7th class	1.9	29.2	15.1	0	4.7	9.4	2.8	28.3	7.5	0.9	47.5
8th class	0	17.4	16.7	3	9.1	22.7	0	21.2	9.8	0	55
9th class	1.3	14.1	6.4	2.6	11.5	17.9	2.6	29.5	14.1	0	38.2
together %	1.6	26.8	9.3	2.4	8.3	17.6	1.2	22.3	10.4	0.1	45.3

The highest percentage of anomalies was in the 7th class (13-year-old). The lowest percentage of anomalies was in 1st class (6-year-old). The most common occlusal anomalies were deep bite (26.8%), crowding (22.3%) and cross bite (17.6%) of registered anomalies (Table 4)

In the population were present 10 children with aplasia. 3 children were missing teeth 12 and 22. 2 children were missing tooth 12. 1 child was missing tooth 22. 1 child was missing tooth 15. 1 child was missing tooth 35. 1 child was missing teeth 35 and 45. 1 child was missing teeth 15 and 45.

In the population were 19 children with the Angle's III class.

Table 5
The number of children, who were in orthodontic therapy.

1st class	2nd class	3rd class	4th class	5th class	6th class	7th class	8th class	9th class	together
0	0	0	0	1	1	0	0	6	8

The children have been treated since 5th class (11-year-old). The most number treated children are in 9th class (15-year-old) (Table 5).

Table 6
Chi-Square test of the relation between gender and orthodontic malocclusions.

Chi-square test				
anomaly * sex Crosstabulation			sex	
			boys	girls
anomaly	0	Count	486	488
		% within sex	55,0%	54,3%
	1	Count	398	410
		% within sex	45,0%	45,7%

Chi-Square test showed that was both genders equally represented (Table 6).

School year 2017/18

Table 7
Percentage of the distribution and types of anomalies from 1st to 9th class.

% malocclusion and types of malocclusion	ETE	DB	II class	III class	OB	CB	apl	CR	ect	DS	together %
1st class	4.5	22.7	16.4	5.5	21.8	10	0.9	16.4	0.9	0.9	48.3
2nd class	1.5	30.9	27.2	4.4	14	10.3	0	7.4	4.4	0	63
3rd class	0	25	28.3	3.3	8	17.1	0.7	12.5	5.3	0	66.4
4th class	1.2	28.1	26.9	4.1	2.9	17	0.6	11.1	8.2	0	68.4
5th class	0.7	20	32.9	4.3	5	13.6	1.4	17.9	4.3	0	63.1
6th class	1.4	14	42	4.2	5.6	14.7	2.8	11.2	4.2	0	64.1
7th class	0	16.5	31.6	1.5	5.3	13.5	3	18.1	10.5	0	67.2
8th class	0	18.2	26.3	8	0.7	12.4	3.7	17.5	12.4	0	61.2
9th class	0.9	18.4	26.3	4.4	5.3	17.5	0.9	17.5	8.8	0	50.4
together %	1.1	21.8	29	4.4	7.2	14.1	1.5	14.2	6.6	0.1	61.3

The highest percentage of anomalies was in the 7th class (13-year-old). The lowest percentage of anomalies was in 1st class (6-year-old). The most common occlusal anomalies were II class- Angle's (29%), deep bite (21.8%) and crowding (14.2%) of registered anomalies (Table 7).

In the population were present 19 children with the aplasia. 6 children were missing teeth 12 and 22. 4 children was missing the tooth 12. 2 children was missing the tooth 22. 2 children was missing the tooth 35. 1 child was missing the tooth 31. 1 child was missing the tooth 41. 1 child was missing the tooth 15. 1 child was missing the tooth 45. 1 child were missing teeth 35 in 45.

In the population were 54 children with the Angle's III class.

Table 8
The number of children, who were in orthodontic therapy.

1st class	2nd class	3rd class	4th class	5th class	6th class	7th class	8th class	9th class	together
0	0	0	0	1	1	5	2	11	20

The children have been treated since the 5th class (11-year-old). The most number treated children are in 9th class (15-year-old) (Table 8).

Table 9
Chi-Square test of the relation between gender and
orthodontic malocclusions.

Chi-square test				
anomaly * sex Crosstabulation			sex	
			boys	girls
anomaly	0	Count	389	391
		% within sex	37,9%	39,5%
	1	Count	637	599
		% within sex	62,1%	60,5%

Chi-Square test showed that percentage of boys with malocclusions was higher than that of girls (Table 9).

School year 2018/19

Table 10
Percentage of the distribution and types of anomalies from 1st to 9th class.

% malocclusion and types of malocclusion	ETE	DB	II class	III class	OB	CB	apl	CR	ect	DS	together %
1st class	3.7	23	18.5	3	20	16.3	0	13.3	2.2	0	50
2nd class	2.8	22.7	21	1.1	15.5	14.4	1.7	18.8	2.2	0	70.1
3rd class	3.6	33.7	26.9	4.2	5.2	8.8	0.5	14	3.1	0	75.1
4th class	2.1	26.7	39	3.7	4.3	10.7	0	10.2	3.2	0	73.9
5th class	3.3	17.4	40.8	1.6	3.8	13.6	1.1	15.8	2.7	0	66.9
6th class	3.3	18.6	35.5	2.7	2.7	14.2	0	19.7	3.3	0	67.5
7th class	2.1	25	24.3	1.4	7.1	12.9	2.1	24.3	0.7	0	61.1
8th class	4.1	10.9	36.1	2.7	6.1	14.3	2.7	15.7	7.5	0	63.4
9th class	0.7	20.8	27.5	5.4	1.3	12.1	2	22.2	7.4	0.7	58.9
together %	2.9	22.3	30.4	2.9	7.1	12.9	1.1	16.9	3.5	0.1	65.3

The highest percentage of anomalies was in the 3rd class (9-year-old). The lowest percentage of anomalies was in 1st class (6-year-old). The most common occlusal anomalies were II class- Angle's (30.4%), deep bite (22.3%) and crowding (16.9%) of registered anomalies (Table 10)

In the population were present 16 children with aplasia. 7 children were missing teeth 12 and 22. 1 child was missing the tooth 31. 1 child was missing the tooth 41. 2 children was missing the tooth 12. 2 children

was missing the tooth 22. 1 child were missing teeth 22 and 42. 1 child was missing the tooth 15. 1 child was missing the tooth 45.

In the population were 43 children with the Angle's III class.

Table 11
The number of children, who were in orthodontic therapy.

1st class	2nd class	3rd class	4th class	5th class	6th class	7th class	8th class	9th class	together
0	0	0	0	2	6	9	6	6	29

The children have been treated since the 5th class (11-year-old). The most number treated children are in the 7th class (13-year-old) (Table 11).

Table 12
Chi-Square test of the relation between gender and orthodontic malocclusions.

Chi-square test				
anomaly * sex Crosstabulation			sex	
			boys	girls
anomaly	0	Count	389	411
		% within sex	33,6%	36,1%
	1	Count	770	726
		% within sex	66,4%	63,9%

Chi-Square test showed that percentage of boys with malocclusions was higher than that of girls (Table 12).

Discussion

The highest percentage of anomalies was at the age of 13. The lowest percentage of anomalies was at the age of 6. The most common anomalies were deep bite, cross bite, crowding and II class of Angle's. The most commonly missing teeth (aplasia) were 12 and 22 (together or separately), 35 and 45 (together or separately). Orthodontic therapy started at the age of 10/ 11. The most number treated children with orthodontic therapy were at the age of 15. Chi-Square test showed that was statistically difference at two groups- boys had more anomalies.

The weakness of the study was that not used orthodontistic measures. But this was not the aim. It was not known how many children were directed to ortodontists. The strengt of the study is that the study lasted four years and was determined the prevalence and variants of orthrhodontic anomalies, as found by general dentists. They had the obligation to recognize the anomaly and to direct to orthodontist. The study

can illustrate the fluctuation of orthodontic anomalies over 9 years, the years when the greatest changes in growth and development are present. In the study was found, that had cases with the aplasias and that are the most commonly missing teeth upper lateral incisor and lower second premolar. If several anomalies were to be attributed to a transitional phase resulting in physiological exchange (in the early mixed dentition), there was a big disparity between percentages of anomalies and numbers of children in orthodontic therapy. Especially if early orthodontic treatment would be beneficial and desirable especially to enhance skeletal and dental discrepancies and correct habits, dysfunction and malocclusion in their early stages. (24)

Many studies were published to describe the prevalence and types of malocclusion, when examining a certain population, it is difficult to compare (varying methods and indexes to assess occlusal relationships). (25) The result in the study showed a higher percent of malocclusion, than Bandaru's study. (26) The percent of hypodontia in that study is lower than in Kazanci's study. (27)

To clarify the need for orthodontic treatment and planning service, it would be good to add orthodontic findings. Then we would more likely get a more accurate answer to what it is a small number of children with orthodontic therapy. The monitoring same children over the years could be a good source of information on the development of occlusion (maybe an idea for the next study).

Conclusion

There was the lowest percentage of malocclusion in deciduous dentition.

The high percentage of malocclusion at the end of school (15-year-old) about 50%.

The low number of children with orthodontic therapy is 15-years-old.

Systematic examinations are a good source of prevalence information and start point for further planning.

A preventive program is needed to update to reduce the high prevalence of malocclusion.

Declarations

Ethics approval and consent to participate

The study used the data from systematic examinations. The parents/ legal guardians of the students signed a statement that the students are participating in the implementation of the program. Written statements can be found in Health center Murska Sobota, Slovenia.

The systematic examinations have been performed in accordance with official legislation of Slovenia and with relevant guidelines and regulations. (Rules on carrying out preventive health care at the primary level <http://www.pisrs.si/Pis.web/pregledPredpisa?id=NAVO59>) (in the references No.23)

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The author declares that he has no competing interests.

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Authors' contributions

BE drafted the manuscript and developed the design and performed statistical analysis. Author read and approved the final manuscript.

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