

Prevalence of orthodontic malocclusion in schoolchildren in Slovenia. A prospective aepidemiological study



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Abstract

Aim Dental malocclusions present the third-highest prevalence among oral pathologies. The occlusion is evaluated in primary, mixed and permanent dentition. Most orthodontic patients are treated in the early permanent dentition. Early detection of dental anomalies is important to prevent complications and can have short- and long-term benefits. The aepidemiological data on the prevalence of malocclusion are an important determinant in planning appropriate orthodontic services. Dentists have the responsibility to recognise, diagnose, and treat or refer anomalies. Data from previous studies showed that the incidence of malocclusions expands from 11% to 93%. The aim of the study is to find out the prevalence and types of malocclusions in schoolchildren during four school years and how they were registered by four general dentists in their offices.

Methods The research was conducted over four consecutive school years during systematic examinations of schoolchildren from 1st to 9th grade. All primary schools (15 schools) in the area of Health Center Murska Sobota, Slovenia were included in the study. Dentists registered the presence and type of malocclusion. They prepared statistical data on the percentage of children with malocclusion and the percentage of represented malocclusion, as well as the statistical difference between genders.

Results The percentage of malocclusion was the lowest in the 1st grade. The highest percentage of malocclusion was in the 7th grade. The most common types of malocclusions were deep bite, crowding, crossbite and Angle's II Class. The maxillary lateral incisor was the most common tooth agenesis).

Conclusion There is a high percentage of malocclusion in 9th graders (15-year-old), about 50%, and a low number of children undergoing orthodontic therapy.

KEYWORDS Malocclusion; Schoolchildren; Prevalence.

Introduction

Dental malocclusions show the third highest prevalence among oral pathologies [Satinder et al., 2015]. Malocclusions are not a disease *per se* but are notable deviations from ideal occlusion and are considered aesthetically or functionally unsatisfactory [Maraga, 2019]. The assessment of malocclusion has not been defined exactly [Hanna et al., 2015]. There is a

possibility of a subjective identification of malocclusion [Bjork et al., 1964]. The prevalence of malocclusions varies between countries and age groups [Gudipani et al., 2018].

Occlusion means contact between teeth [Davies and Gray, 2001]. Normal occlusion is desirable because it allows proper oral functions, provides the best aesthetics, and is helpful in the prevention of diseases [Parrish Foster, 2020]. Malocclusion is defined as a deviation of the teeth or a relation of the dental arches beyond the normal [Mtaya et al., 2009]. The development of human dentition is a continuous process [Baume, 1950]. An ideal primary dentition is also an indicator of a potentially perfect permanent dentition [Sriram, 2012]. The recognition of normal occlusion in the primary dentition is essential for treatment planning in paediatric dentistry [Bishara, 1988]. Occlusion is evaluated in primary, mixed, and permanent dentition. Most orthodontic patients are treated in the early permanent dentition, around 12–13-year old [Kamatchi et al., 2015]. Early detection of dental anomalies is important to prevent complications [Mostafa et al., 2020] and can have short- and long-term benefits [Sankey et al., 2020]. The origin of anomalies may lie in genetic, inherited, metabolic, mutations, physical, chemical, and biological factors, or a combination of the above [Rohilla, 2017].

A systematic and well-organised dental care programme for any target population in a community requires some basic information, such as the prevalence of the disease [Das et al., 2008]. The aepidemiological data on the prevalence of malocclusions are an important determinant in planning an appropriate level of orthodontic services [Šidlauskas and Lopatienė, 2009]. Dentists have the responsibility to recognise, diagnose, and treat or refer anomalies [AAPD, 2018]. Dentists perform dental examinations on children and youths, they are the first step in detecting malocclusions and referring them to an orthodontist. However, sometimes a malocclusion is detected where orthodontic therapy is not indicated., as in case of a temporary condition during physiological tooth exchange. It can be difficult to access orthodontic therapy for those who need it.

Children are the ideal population for prevention, monitoring development, determining the effectiveness of prevention and preventive programmes based on aepidemiological studies.

Research data have shown that the incidence of malocclusions ranges from 11% to 93% [Vig and Fields, 2000; Hill, 1992] and these variations are difficult to explain [Šidlauskas and Lopatienė,

2009]. The prevalence of malocclusions in primary dentition in Brazilian children was 75,8% [Alonso, 2003]. Gelgö [2007] found in his study that only 10% of adolescents had a correct occlusion.

What is the situation in the area of Murska Sobota, Slovenia? In Slovenia, the health preventive programme is regulated by law [Pravilnik, 2019]. The Health Center in the town of Murska Sobota 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 schoolchildren for decades. Unfortunately, not all of them could be examined in 2020 due to the COVID-19 pandemic. Dentists for children and youths identify the anomalies during the systematic examinations and refer to an orthodontist, if needed. They are the key factor in identifying malocclusions and referring to a specialist, therefore their knowledge and involvement are crucial.

The study aim is to find out the prevalence and types of malocclusions of schoolchildren during four school years registered by general dentists.

Methods

The research was conducted during four consecutive school years, by means of a prospective epidemiology study starting in 2015/16 until 2018/19. The school year in Slovenia starts in September and ends in June of the following year. Schoolchildren start attending school at age 6 (1st grade) and finish their elementary school at around age 15 (9th grade). Data were obtained during systematic dental examinations of schoolchildren conducted once a year. The research comprised all elementary schools in the area of the Health Center of Murska Sobota, Slovenia. Schoolchildren in elementary schools (ES) and their branch schools (BS) were examined: 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. Schoolchildren came to examination after prior arrangement with the school management.

Systematic examinations were performed by four dentists in their offices at the dental chair using regular instruments. The anomalies were registered according to Angle's classification (I, II and III Class), edge-to-edge (tete-a-tete), deep bite, open bite, crossbite, tooth agenesis, crowding, ectopic outgrowth and supernumerary teeth. The condition was noted in a form which included the following data: type of anomaly and whether the schoolchild is undergoing orthodontic therapy, first name, last name, school, class, date, and dentist signature. Schoolchildren with systematic diseases that may influence the occurrence of anomalies were not registered. Children undergoing orthodontic therapy were registered as "undergoing orthodontic therapy", and their anomalies were not registered. The completed form was sent to a specialist in paediatric dentistry, who performed the data processing. The statistical data are the following.

- The percentage of children with malocclusion, for each year.
- The percentage of the representation of types of malocclusions, for each year.
- The number of children undergoing orthodontic therapy.
- Ratio of the gender.

Ethics approval and consent to participate

The study used the data from systematic examinations. The

parents/legal guardians of the schoolchildren signed a statement that their children were participating in the implementation of the programme "Preventive health care at the primary level-dentistry" (written statements are available in the Health Center Murska Sobota, Slovenia). The systematic examinations have been performed following the 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>)

Statistical analysis

Data were processed in Excel and IBM SPSS, version Statistics 25, statistical programme. The ratio between boys and girls was calculated with the Chi-squared test.

Results

During the four school years, 7,579 systematic examinations were conducted on 3,840 boys (50.7%) and 3,739 girls (49.3%); the ratio between boys and girls was approximately equal.

1st school year

The highest percentage of anomalies was found in the 7th grade (13-year-olds). The lowest percentage of anomalies was in the 1st grade (6-year-olds). The most commonly registered anomalies were deep bite (21.7%), crossbite (20%) and crowding (14.7%). The children were treated with orthodontic therapy from the 4th grade (10-year-olds). Most of the treated children were in the 8th grade (14-year-olds) (Table 1).

There were 12 children with agenesis: 1 child had aplasia of teeth 15, 35, 12 and 22; 5 children of teeth 12 and 22; 2 children of teeth 35 and 45; 1 child of tooth 12; 1 child of tooth 22, another of tooth 31 and another of tooth 42. There were 29 children with Angle's III Class.

The Chi-square test showed no statistical difference between genders.

2nd school year

The highest percentage of anomalies was found in the 7th grade (13-year-olds). The lowest percentage of anomalies was in the 1st grade (6-year-olds). The most commonly registered anomalies were deep bite (26.8%), crowding (22.3%) and crossbite (17.6%). The children were treated with orthodontic therapy from the 5th grade (11-year-olds). Most of the treated children were in 9th grade (15-year-olds) (Table 2).

There were 10 children with agenesis: in 3 it involved teeth 12 and 22, in 2 children tooth 12; in 1 child tooth 22, 1 tooth 15, 1 tooth 35, 1 teeth 35 and 45, 1 teeth 15 and 45.

There were 19 children with Angle's III Class.

The Chi-square test showed no statistical difference between genders.

3rd school year

The highest percentage of anomalies was found in the 7th grade (13-year-olds). The lowest percentage of anomalies was in the 1st grade (6-year-olds). The most commonly registered anomalies were Angle's II Class (29%), deep bite (21.8%) and crowding (14.2%). The children were treated with orthodontic therapy from the 5th grade (11-year-olds). Most of the treated children were in the 9th grade (15-year-old) (Table 3).

There were 19 children with agenesis: 6 of teeth 12 and 22; 4 of tooth 12; 2 of tooth 22; 2 of tooth 35; 1 of tooth 31; 1 of

Percentage of the distribution and types of anomalies in the 1st school year (2015/16)					95% CI		Chi-square test between genders: Boys- 44.7% Girls-48.5%					
% malocclusion and types of malocclusion	ETE	DB	II Class	III Class	OB	CB	apl	CR	ect	DS	Total %	Under orthodontic therapy
1st grade	0	15.2	15.2	9.1	6.1	31.8	0	12.1	10.6	0	31.2	0
2nd grade	0	34.6	6.5	4.7	10.3	21.5	0.9	17.8	3.7	0	49.1	0
3rd grade	1.3	15.6	9.1	3.9	15.6	19.5	0	16.9	18.2	0	53.1	0
4th grade	1.1	25.8	22.5	1.1	5.6	24.7	1.1	1.5	4.5	0	48.4	2
5th grade	1.2	23	14.9	4.6	3.4	17.2	1.1	25.3	8.1	1.1	60	1
6th class	8.2	21.3	29.5	0	0	18	0	13.1	9.8	0	36.1	2
7th grade	9.1	22.7	3.6	8.2	20.9	10	0	5.5	17.3	2.7	70.1	4
8th grade	0	12.5	26.8	1.8	8.9	23.2	7.1	7.1	7.1	5.4	46.3	5
9th grade	2.1	10.6	14.9	0	2.1	19.2	10.6	23.4	12.8	4.3	34.8	0
Total	2.7	21.7	14.4	4.1	9.1	20	1.7	14.7	10.1	1.3	47.1	14

TABLE 1 Percentage of the distribution and types of anomalies from 1st to 9th grade in the first school year.

Legend: ETE=edge-to-edge; DB=deep bite, Angle's II Class and III Class, OB=open bite, CB=crossbite, apl=aplasia, CR=crowding (tight condition), ect=ectopic position, DS= supernumerary tooth

Percentage of the distribution and types of anomalies in the 2nd school year (2016/17)					95% CI		Chi-square test between genders: Boys- 45% Girls-45.7%					
% malocclusion and types of malocclusion	ETE	DB	II Class	III Class	OB	CB	apl	CR	ect	DS	Total %	Under orthodontic therapy
1st grade	8	34	4	2	22	10	0	10	10	0	28.9	0
2nd grade	0	27.9	1.6	9.8	14.8	23	0	21.3	1.6	0	38.1	0
3rd grade	1	32.4	9.5	2.6	6.7	20	0	19.1	8.6	0	43.2	0
4th grade	1	33	1	2.1	4.1	19.6	0	23.7	15.5	0	55.7	0
5th grade	3.4	24.7	12.4	0	6.7	19.1	1.1	21.3	11.2	0	46.6	1
6th class	1.1	33.3	7.8	1.1	4.4	13.3	4.4	21.1	13.3	0	51.7	1
7th grade	1.9	29.2	15.1	0	4.7	9.4	2.8	28.3	7.5	0.9	47.5	0
8th grade	0	17.4	16.7	3	9.1	22.7	0	21.2	9.8	0	55	0
9th grade	1.3	14.1	6.4	2.6	11.5	17.9	2.6	29.5	14.1	0	38.2	6
Total	1.6	26.8	9.3	2.4	8.3	17.6	1.2	22.3	10.4	0.1	45.3	8

TABLE 2 Percentage of the distribution and types of anomalies from 1st to 9th grade in the second school year.

tooth 41; 1 of tooth 15; 1 of tooth 45; 1 of teeth 35 and 45.

There were 54 children with Angle's III Class.

The Chi-square test showed no statistical difference between genders.

4th school year

The highest percentage of anomalies was found in the 3rd grade (9-year-olds). The lowest percentage of anomalies was in 1st grade (6-year-olds). The most commonly registered anomalies were Angle's II Class (30.4%), deep bite (22.3%) and crowding (16.9%). The children were treated with orthodontic therapy from the 5th grade (11-year-olds). Most of treated children were in the 7th grade (13-year-olds) (Table 4).

There were 16 children with agenesis: in 7 children it involved teeth 12 and 22; in 1 tooth 31; in 1 tooth 41; in 2 tooth 12; in 2 tooth 22; in one teeth 22 and 42; in 1 tooth 15 and in 1 tooth 45.

There were 43 children with Angle's III Class.

The Chi-square test showed no statistical difference between genders.

Discussion

The highest percentage of anomalies was found at the age of 13. The lowest percentage of anomalies was found at the age of 6. The most common anomalies were deep bite, crossbite, crowding and Angle II Class. The most commonly missing teeth (agenesis) were 12 and 22 (together or separately), 35 and 45 (together or separately). Orthodontic therapy started at the age of 10/11. The highest number of children under orthodontic therapy was at the age of 15. The Chi-Square test showed no statistical difference between genders.

The weakness of the study was that examinations were performed by general dentists who did not perform orthodontic measurements in vertical, transverse, and sagittal planes. However, this was not the aim. It was not known how many children were referred to orthodontists. The strength of the study is that the study lasted for four years and the prevalence and variations of orthodontic anomalies as found by general dentists were determined. They simply were expected to recognise the anomaly and refer to an orthodontist. The study

Percentage of the distribution and types of anomalies in the 3rd school year (2017/18)					95% CI		Chi-square test between genders: Boys- 62.1% Girls-60.5%					
% malocclusion and types of malocclusion	ETE	DB	II Class	III Class	OB	CB	apl	CR	ect	DS	Total %	Under orthodontic therapy
1st grade	4.5	22.7	16.4	5.5	21.8	10	0.9	16.4	0.9	0.9	48.3	0
2nd grade	1.5	30.9	27.2	4.4	14	10.3	0	7.4	4.4	0	63	0
3rd grade	0	25	28.3	3.3	8	17.1	0.7	12.5	5.3	0	66.4	0
4th grade	1.2	28.1	26.9	4.1	2.9	17	0.6	11.1	8.2	0	68.4	0
5th grade	0.7	20	32.9	4.3	5	13.6	1.4	17.9	4.3	0	63.1	1
6th class	1.4	14	42	4.2	5.6	14.7	2.8	11.2	4.2	0	64.1	1
7th grade	0	16.5	31.6	1.5	5.3	13.5	3	18.1	10.5	0	67.2	5
8th grade	0	18.2	26.3	8	0.7	12.4	3.7	17.5	12.4	0	61.2	2
9th grade	0.9	18.4	26.3	4.4	5.3	17.5	0.9	17.5	8.8	0	50.4	11
Total	1.1	21.8	29	4.4	7.2	14.1	1.5	14.2	6.6	0.1	61.3	20

TABLE 3 Percentage of the distribution and types of anomalies from 1st to 9th grade in the third school year.

Percentage of the distribution and types of anomalies in the 4th school year (2018/19)					95% CI		Chi-square test between genders: Boys- 66.4% Girls-63.9%					
% malocclusion and types of malocclusion	ETE	DB	II Class	III Class	OB	CB	apl	CR	ect	DS	Total%	Under orthodontic therapy
1st grade	3.7	23	18.5	3	20	16.3	0	13.3	2.2	0	50	0
2nd grade	2.8	22.7	21	1.1	15.5	14.4	1.7	18.8	2.2	0	70.1	0
3rd grade	3.6	33.7	26.9	4.2	5.2	8.8	0.5	14	3.1	0	75.1	0
4th grade	2.1	26.7	39	3.7	4.3	10.7	0	10.2	3.2	0	73.9	0
5th grade	3.3	17.4	40.8	1.6	3.8	13.6	1.1	15.8	2.7	0	66.9	2
6th class	3.3	18.6	35.5	2.7	2.7	14.2	0	19.7	3.3	0	67.5	6
7th grade	2.1	25	24.3	1.4	7.1	12.9	2.1	24.3	0.7	0	61.1	9
8th grade	4.1	10.9	36.1	2.7	6.1	14.3	2.7	15.7	7.5	0	63.4	6
9th grade	0.7	20.8	27.5	5.4	1.3	12.1	2	22.2	7.4	0.7	58.9	6
Total	2.9	22.3	30.4	2.9	7.1	12.9	1.1	16.9	3.5	0.1	65.3	29

TABLE 4 Percentage of the distribution and types of anomalies from 1st to 9th grade in the fourth school year.

can illustrate the fluctuation of orthodontic anomalies over nine years, the years when the greatest changes in growth and development occur.

The study found that there were cases with aplasia and the most commonly agenetic teeth were maxillary lateral incisor and mandibular second premolar. Although some anomalies were due to a transitional phase resulting to physiological exchange (in the early mixed dentition), there was a big discrepancy between the percentages of anomalies and numbers of children undergoing orthodontic therapy. Thereby, early orthodontic treatment would be beneficial and desirable especially to enhance skeletal and dental discrepancies and correct bad habits, dysfunctions, and malocclusion in their early stages [Ovsenik et al., 2004]. Many studies have been published to describe the prevalence and types of malocclusions, however when examining a specific population, it is difficult to compare (different methods and indexes to assess occlusal relationships) [Silva and Kang, 2001]. The results of the study showed a higher percentage of malocclusions than that of Bandaru's et al. [2019] study. The rate of hypodontia in this study was lower than the one reported by Kazanci's et al. [2011].

To clarify the need for orthodontic treatment and planning, it would be good to add orthodontic findings. Then we would be more likely to get a more accurate answer as to why there were so few children undergoing orthodontic therapy. Monitoring the same children over the years could be a good source of information about development of occlusion (perhaps an idea for the next study).

Conclusions

The lowest percentage of malocclusion was found in the deciduous dentition.

The highest percentage of malocclusion was found in 15-year-olds, accounting for about 50%.

The lowest number of children undergoing orthodontic therapy was found in 15-year-olds.

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

A preventive programme is needed to update and reduce the high prevalence of malocclusions.

It is very important to establish a closer cooperation between a general dentist and a specialist orthodontist. In this way, timely diagnosis and referral of children requiring orthodontic treatment can be achieved.

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Authors' contributions/Conflict of interest

The author declares that he has not any conflict of interest.

Availability of data and materials

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

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