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ETIOLOGICAL FACTORS OF ENAMEL DEVELOMENTAL DEFECTS OF PERMANENT TEETH IN CHILDREN AND ADOLESCENT

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***Abstract*:** Developmental defects of enamel can be caused by many etiological factors. The purpose of this study was to monitor the developmental defects of enamel in permanent teeth in a urban pediatric population of Iaşi and Târgu Frumos and determine the correlation between personal history affections, use of antibiotics in the first four years of life and developmental defects of enamel. The prevalence of developmental defects of enamel obtained in this study is 9.8% lower than the values in the studies described in the literature. The correlation of developmental defects of enamel with antibiotics administered in the first year of life revealed a relative risk of 1.66 times higher, that after four years of administration to reach a relative risk of over two times higher. The odd risk ranged from 2.14 until 24.98 when antibiotic administration is associated with personal medical history of asthma or neurological disorders.

Key words: developmental defects of enamel, child, antibiotics.

INTRODUCTION

Development of permanent incisors and premolars begin in the fifth month in utero and lasts until the tenth month post-natal and ongoing development of permanent molars in first years of life. Dental buds are sensitive durig odontogenesis over a wide range of systemic disorders and in particular whose impairment is permanent for dental enamel (1). Developmental defects of enamel can be caused by many etiological factors from birth to adulthood. They may include features of the host, genetic and environmental factors and behavioral factors or systemic diseases (2). The large number of etiological factors also causes a variety of clinical forms observed in daily practice.

A range of drugs have the potential to induce morphological changes in teeth leading to tooth discoloration, physical damage to tooth structure and alteration in tooth sensitivity. (3,4). Recent studies have suggested that antibiotic use is associated with MIH syndrome (molar and incisor hypomineralization) (5) or development of developmental defects of enamel affecting organic matrix mineralization in the first years of life (6).

β-lactam antibiotics prescribed for common infections in early life for specific infections like otitis media, were considered low-risk drugs for small children. However, it is found that amoxicillin, penicillin or cephalosporins interfere with normal organ development in rats, which suggests that these antibiotics may be toxic in the stages of organ morphological differentiation also for teeth (7,8).

The purpose of this study was to monitor the developmental defects of enamel in permanent teeth in a urban pediatric population of Iaşi and Târgu Frumos and determine the correlation between local and general personal medical history affections and use of antibiotics in the first four years of life of children examined.

MATERIAL AND METHODS

The study group included a total of 1006 children in urban areas – Iaşi and Târgu Frumos, of which 334 children (164 boys and 170 girls) with chronological age between 6-16 years old came from students enrolled in school "Ion Ghica" in Iaşi 2007-2009 school year and 672 institutionalized children (foster care) (377 boys and 295 girls) aged between 5-18 years in Iaşi and Târgu Frumos in 2009-2010 (tab. I). Consent was required from educational institutions to conduct research.

Table I. The gender distribution of study group

Sex	Children number	%
Boys	541	53,8
Girls	465	46,2

Parents/caretakers completed a questionnaire on the child's medical history (childhood diseases - measles, mumps, whooping cough, persistent acute viral infections that occur in upper respiratory tract treated with antibiotics, neurological disorders, allergies, dermatological problems, surgery - planned admissions, acute illness, chronic acquired otitis media, asthma, other infections, temporary teeth trauma, exposure to sodium fluoride in drinking water) and antibiotics administered during the first four years of life (amoxicillin, penicillin, cephalosporins, macrolides).

Children were examined under standard conditions, in daylight, without prior washing or drying of the teeth. Development of enamel defects were recorded using the modified DDE index (9). Data were processed using statistical functions EPIINFO, using EXCEL and SPSS Nonparametric regression and χ^2 test with generally accepted significance threshold of 95%, $p < 0.05$.

RESULTS

Prevalence of developmental defects of enamel in the study group (n = 1006) showed that 9.8% of children had at least one tooth affected, 90 children (90.9%) had at least one anterior tooth affected (tab. II).

The highest frequency was recorded for opacities (69.7%) - diffuse opacities were 49.5% and 20.2% demarcated opacities, followed by hypoplasia 8.1% and 21.2% combination of defects (tab. II).

Table II. Prevalence, location and type of developmental defects of enamel

	Children	
Prevalence of DDE * (n=1006)	**n**	**%**
No DDE	907	90,2
Presence of at least one DDE	99	9,8
Location of DDE (n=99)		
At least one on anterior teeth	90	90,9
Posterior teeth only (none on anterior teeth)	9	9,1
Types of DDE (n=99)		
Demarcated opacities	20	20,2
Diffuse opacities	49	49,5
Hypoplasia	8	8,1
Discoloration	1	1
Combination	21	21,2

***DDE-** developmental defects of enamel

In the study group, antibiotics were administered at a rate of 16.2% in the first year, 36.2% in the first two years, 56.6% in first three years and 80% in the first four years (fig. 1).

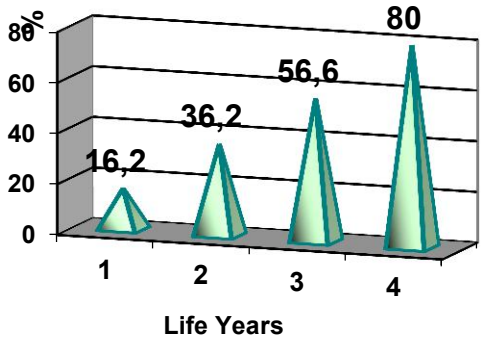

Fig. 1. Distribution of children by antibiotic administration in the first four years of life

Only 20.1% of children have not taken any antibiotic, and 68.5% received two or more different antibiotics. Penicillin V and amoxicillin were the most commonly used antibiotics. During the first year of life, 21.6% of children have been either penicillin or amoxicillin, or both. Of 99 children with enamel defects, 25 (25.3%) took antibiotics during the first year compared with 138 of those 907 children (15.2%) without developmental defects of enamel ($p = 0.015$).

The correlation of enamel defects with antibiotics administered in the first year of life revealed a relative risk of 1.66 times higher (OR = 1.66, IC95%: 1.14 ÷ 2.41), that after four years of administration to reach a relative risk of over two times higher (OR = 2.18, IC95%: 2.02 ÷ 2.36) (tab. III).

Table III. The risk of developmental defects of enamel due to consumption of antibiotics in the first four years of life

Life Years	Antibiotic consumption				OR	IC95%	p
	Children with DDS		Children without DDS				
	n	%	n	%			
1	25	2,5	138	13,7	1,66	1,14÷2,41	0,015
2	64	6,4	300	29,8	1,95	1,64÷2,32	<0,001
3	89	8,8	480	47,8	1,70	1,55÷1,86	<0,001
4	97	9,6	707	70,4	2,18	2,02÷2,36	<0,001

Risk of development of enamel defects due to antibiotics in the first four years of life was statistically significant.

The highest prevalence of diseases in children's personal medical history of this group were persistent acute viral upper respiratory tract infection - 31.1%, followed by acute illness and other infections - 19.28% and 13 71%, mumps, asthma and whooping cough have been less frequent (fig.2).

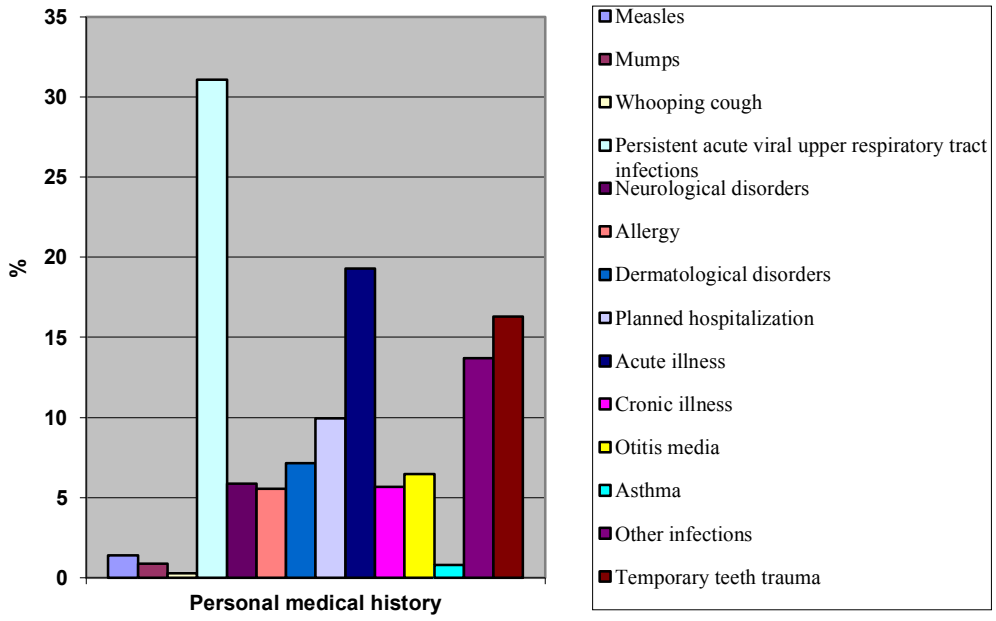

Fig. 2. Distribution of children by diseases in personal medical history

The odd risk ranged from 2.14 until 24.98 when antibiotic administration is associated with personal medical history of asthma or neurological disorders (tab. IV).

Table IV. The risk of developmental defects of enamel due to consumption of antibiotics

Associated Diseases	Antibiotic consumption				OR	IC95%	p
	Children with DDS		Children without DDS				
		%	n	%			
Measles	0	0	14	1,4	-	-	< 0,001
Mumps	3	0,3	6	0,6	2, 2,41	0, 96÷6,08	0, 0,002
Whooping cough	0	0	3	0,3	-	-	0,0006
Persistent acute viral upper respiratory tract infections	28	2,8	202	20,1	8,21	5,81÷11,62	<0,001
Neurological disorders	2	0,2	57	5,7	24,98	6,40÷97,58	<0,001
Allergy	3	0,3	53	5,3	15,74	5,23÷47,34	<0,001
Dermatological disorders	5	0,5	67	6,7	12,32	5,29÷28,71	<0,001
Planned hospitalization	11	1,1	89	8,8	7,96	4,55÷13,90	<0,001
Acute illness	21	2,1	173	17,2	8,91	5,95÷13,34	<0,001
Chronic illness	11	1,1	45	4,5	4,25	2,50÷7,22	<0,001
Otitis media	10	1,0	55	5,5	5,48	3,10÷9,71	<0,001
Asthma	3	0,3	5	0,5	2,14	0,87÷5,24	<0,001
Other infections	21	2,1	117	11,6	5,93	4,00÷8,79	<0,001
Temporary teeth trauma	32	3,2	132	13,1	4,70	3,44÷6,42	<0,001

DISCUSSIONS

Prevalence of DDE in permanent teeth is highly variable depending on the types of defects taken into account and study population characteristics. The prevalence obtained in this study is 9.8% lower than the values in the studies described in the literature (9). Multitude of etiologic factors and types pediatric populations, and variable concentration of fluoride in water are responsible for this wide range of values. Comparisons of our study were made with similar fluoride water concentrations studies as that of Iaşi 0.14-0.95 mg / l.

Since 1941 it has been suggested that the first year of life is the most critical period in relation to the DDE and after sixty years the correlation of enamel defects with drog related factors is

emphasized after a series of recent studies (5,6,8). Beentjes suggest that diseases of the first four years of life, such as upper respiratory tract diseases or antibiotic treatment is associated with DDE (10). Hall incriminate poor general health association with an increased likelihood of developing such defects. It is not clear whether the causal factor is the disease itself or the drugs used to treat it (11). Hong investigate the correlation between amoxicillin during the first years of life and enamel defects to the maxillary central incisors. Amoxicillin use from three to six months doubled the risk and it is significantly increased even after controlling for other risk factors such as fluoride intake, infections such as otitis media or breast feeding (6).

Laisi (2009) performed a clinical trial - 16.3% prevalence of DDE and an experimental one in which the explants of mouse embryonic dental buds have been exposed to amoxicillin. DDE were more common among children who took amoxicillin (OR = 2.06) and erythromycin (OR = 4.14) than in those who did not take these antibiotics in the first year of life; 15% of children have not taken any antibiotic in the first four years of life and 43% had received two or more different antibiotics. The relative risk for the DDE after exposure to penicillin V was 1.71.

In our study it was a slightly higher number of children who have not taken any antibiotic in the first four years of life – 20,1%, but a significantly higher number of children who received treatment with two or more antibiotics – 68,5%. It was found that Penicillin V and amoxicillin are the most commonly used antibiotics, and during the first year of life, 21.6% of children were given either penicillin or amoxicillin, or both from 34.8% in the Finnish study associated with a smaller prevalence of DDE - 9.8%. Also 25.3% of children with DDE have taken antibiotics during the first year, compared with 15.2% of children without ($p = 0.015$), values which are directly proportional to the lower prevalence DDE in the study group compared with the values reported in the Finnish study: 52.2% of children with DDE have taken antibiotics during the first year of life, compared with 33.9% of children without DDE ($P > 0.05$).

CONCLUSIONS

1. The prevalence of DDE obtained in this study is 9.8% lower than the values in the studies described in the literature.
2. Risk of DDE due to antibiotics in the first four years of life was statistically significant.
3. The correlation of DDE with antibiotics administered in the first year of life revealed a risk of 1.66 times higher (RR = 1.66, IC95%: 1.14 ÷ 2.41), that after four years of administration to reach a relative risk of over two times higher (RR = 2.18, IC95%: 2.02 ÷ 2.36). The odd risk ranged from 2.14 until 24.98 when antibiotic administration is associated with personal medical history of asthma or neurological disorders.

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