EPIDEMIOLOGICAL STUDY OF ACQUIRED DEVELOPMENTAL DEFECTS OF ENAMEL IN CHILDREN BETWEEN 3 AND 19 YEARS OLD FROM DOLJ COUNTY, ROMANIA

Mihai Popescu[1], Veronica Mercuț[2], Mihaela Ionescu[3], Stelian Mihai Sever Petrescu[4], Adela Cenușoiu[5], Adrian Stănuși[5], Marilena Bătăiosu[1]

[1] University of Medicine and Pharmacy of Craiova, Romania, Faculty of Dental Medicine, Department of Pedodontics
[2] University of Medicine and Pharmacy of Craiova, Romania, Faculty of Dental Medicine, Department of Prosthodontics
[3] University of Medicine and Pharmacy of Craiova, Romania, Faculty of Dental Medicine, Department of Medical Informatics and Biostatistics
[4] University of Medicine and Pharmacy of Craiova, Romania, Faculty of Dental Medicine, Department of Orthodontics
[5] University of Medicine and Pharmacy of Craiova, Romania, Faculty of Dental Medicine, Department of Endodontics
Corresponding author; *e-mail:* mihaela.ionescu@umfcv.ro

ABSTRACT

Aim of the study The aim of our study was to determine and compare the prevalence and severity of acquired developmental defects of enamel (DDE) in a group of children coming from a rural area in Dolj County, Romania, aged between 3 and 19 years. Material and methods A total of 213 children were examined using the modified DDE Index, for screening studies. Their assessment included the clinical examination, performed by completing an excel document. Results The prevalence of DDE was 11.27%. Of the 5452 primary and permanent teeth examined, 49 (0.90%) had some form of DDE. Diffuse opacity was the most common type of DDE observed in primary teeth, while in permanent dentition, the number of the 2 forms of opacity was very similar. We did not find any hypoplasia. Conclusions DDE is currently increasing, having major implications for children's lives, which makes it a significant public health problem.

Key words: developmental defects of enamel, children, hypoplasia, well-delimited opacity, diffuse opacity

INTRODUCTION

Developmental defects of enamel (DDE), which occur in the form of hypoplasia or demineralizations, are caused by disruption of odontogenesis, as a result of the action of general and/or local, inherited and/or acquired etiological factors [1]. DDE can be identified in practice and are characterized as changes in the quality and/or quantity of the hard dental tissue, as a consequence of an etiological factor acting during tooth formation [2]. Hypoplasia affects the enamel quantitatively, while opacities affect the translucency of the tissue, giving it an opaque aspect. Opacities may be diffuse or delimited. Their colour varies from white, yellow to brown [3]. Opacities arise as a consequence of the action of pathological factors during the late amelogenesis stage of mineralization [4]. On the other hand, hypoplasia arises when factors act during the secretory phase of amelogenesis [5].

Unlike hereditary defects, the acquired ones are much more frequent and are the consequence of the injuries that occur during the formation of the dental structures, before the eruption of the teeth, never after [6]. Consequently, acquired DDE affecting

temporary teeth are caused by etiological factors which are present during pregnancy and in the first year of the child's life. Regarding permanent teeth, they are generated by etiological factors that act from birth to the age of 7 years.

The nature and appearance of the defect depend less on the type of causative agent, but especially on the moment when it occurs (phase of secretion or apposition of the organic matrix - hypoplasia; phase of maturation or mineralization - opacity), its duration (acute - trauma; chronic - systemic diseases) and its intensity (white spots, lines, grooves, pits, extensive defects).

The incisors with such lesions are aesthetically compromised because of their altered morphology and staining. This is why children with DDE may experience feelings of embarrassment and discomfort [7]. At the same time, they may develop dental hypersensitivity due to dentin exposure [8]. The defective enamel is retentive and uneven, which facilitates bacterial attack and grafting of carious processes [9]. Teeth affected by DDE are also prone to dental wear. Even so, the causes of DDE are ambiguous and the diagnosis is difficult. Furthermore, the clinical aspects and prophylactic and curative treatments are not well mastered by a lot of practitioners. Therefore, lesions should be detected and treated from the early stages. Starting from this desideratum, the objective of the descriptive study was to examine a group of children coming from a rural area in Dolj County, Romania, aged between 3 and 19 years, in order to establish and contrast the prevalence and presentations of the acquired DDE.

MATERIAL AND METHODS

A number of 213 children aged 3-19 years from the rural area, respectively "George Stefan Marincu" Theoretical High School from Poiana Mare, were examined. Children examination was performed by a single examiner in the classroom, under natural light, by simply visualizing the oral cavity. The examined child was seated in front of the examiner, who in turn was seated on a chair. No instruments were inserted into the oral cavity of the children.

Their assessment included the clinical examination, performed by completing an excel document, with dental formula for both dentitions, and the acquired DDE counting was performed with the help of the modified DDE Index (Table 1), for screening studies.

Table 1. Modified DDE Index

	Normal	Demarcated opacity	Diffuse opacity	Hypoplasia	Other defects
Code	0	1	2	3	4

Within the examination document, the following parameters were recorded: group of investigated children (age, sex), prevalence of DDE in the studied children group, DDE distribution on the type of dentition and teeth surface.

Microsoft Excel software was used to regroup all digital records, analyse and interpret the collected data. The same program was used to graphically display our findings, and also to apply various techniques and procedures that completed the descriptive analysis. Results were statistically analysed based on the Chi-square test for group distributions and Student's t-tests for independent variables, considering $p < 0.05$ as statistically significant.

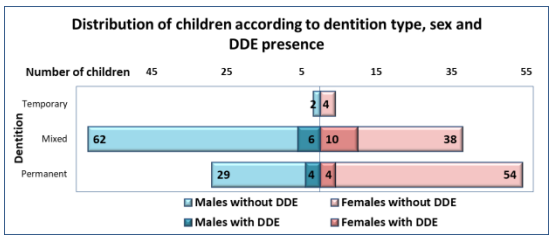
The study was approved by the Ethics Commission of the University of Medicine and Pharmacy of Craiova, and also required the permission of the parents of the examined children, who were asked to fill in an

informed consent.

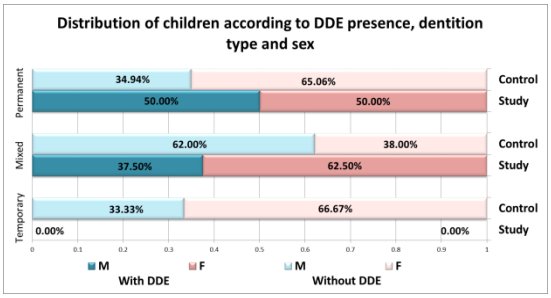
RESULTS AND DISCUSSIONS

The study was performed on a lot comprising 213 children: 110 females (51.64%) and 103 males (48.36%), with ages between 3 and 19 years old. We have created 3 categories of children, according to dentition type: temporary dentition (3-5 years old), mixed dentition (6-11 years old) and permanent dentition (12-19 years old). As Fig. 1a illustrates, there are 6 children included in the first category (2 males and 4 females), 116 children in the second category (68 males and 48 females), and 91 children in the third category (33 males and 58 females).

Of the total of 213 children, 24 were diagnosed with acquired DDE (all of them with enamel opacities, no one presented hypoplasia or other defects), accounting a prevalence of 11.27%, compared with 189 children without acquired DDE, and accounting for 88.73%. Thus, two subgroups were created: a study subgroup (children diagnosed with DDE) and a control subgroup (children without DDE). Among the study subgroup, there were 14 females (58.33%) and 10 males (41.67%).



a



b

Figure 1. a) Distribution of children according to sex, DDE presence and dentition type; b) Percentage of children (males/females) according to study/control subgroups, dentition type and the presence of DDE.

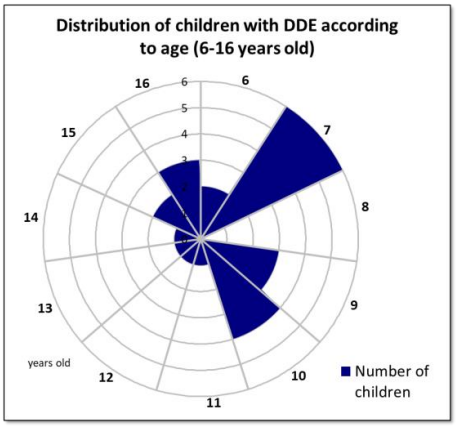
There is no significant difference regarding sex distribution in both subgroups ($p > 0.05$). Among the control subgroup, there were 96 females, representing 50.79%, and 93 males representing 49.21%.

Table 2. Distribution of children according to age, DDE presence and dentition type

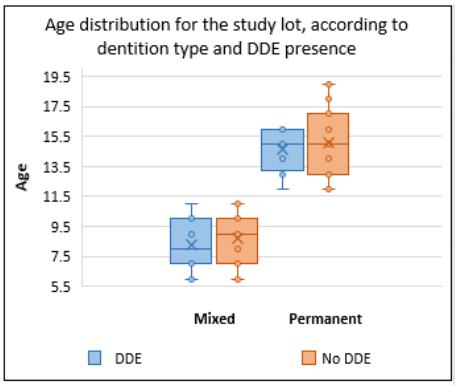
	Dentition			
	Temporary	Mixed	Permanent	TOTAL
Age (years)	3 - 5	6 - 11	12 - 19	
DDE	0 (0%)	16 (7.51%)	8 (3.76%)	24
No DDE	6 (2.82%)	100 (46.95%)	83 (38.96%)	189
Total	**6**	**116**	**91**	**213**

Although the overall sex distribution is quite similar, males with temporary and permanent dentition represent around a third of children from their category, while this proportion is reversed for children with mixed dentition. Fig. 1b indicates that the total female population was more affected than males. Males and females with permanent dentition are equally affected, while females with mixed dentition are majoritarian, compared to males. Children with temporary dentition did not present DDE. According to Table 2, amongst the 116 children with mixed dentition, 16 of them had DDE (7.51% of the entire study lot, 6 males, 10 females) and 100 did not present DDE (46.95%, 62 males, 38 females). The remaining 91 children had permanent dentition, 8 of them presented defects (3.76%, 4 males, 4 females), while 83 did not have any lesions (38.96%, 29 males,

54 females). Comparison of DDE prevalence among the subgroups did not reveal a significant difference ($p > 0.05$). Amongst the study subgroup, there were only children with ages from 6 to 16 years old, who presented enamel defects (Fig. 2a).



a

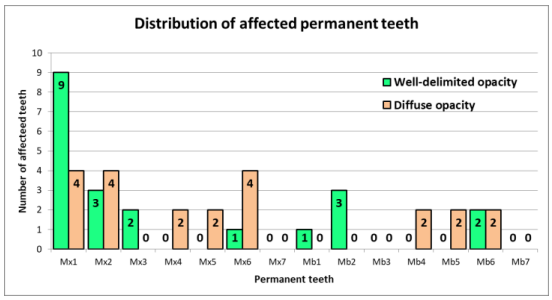


b

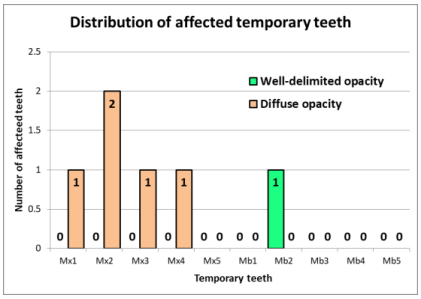
Figure 2. a) Distribution of children with DDE, according to age; b) Age distribution for children included in the study lot, according to dentition type and DDE presence

Most affected ages were 7 years old (6 children) and 10 years old (4 children). No child of 8 years old presented DDE. The average age of children with DDE was 10.38±3.45 (mean ± standard deviation), while the average age of those without DDE was 11.40±3.90 (mean ± standard deviation). There is no significant difference between the two groups ($p = 0.188$). Fig. 2b emphasized the age distribution for all children included in the study lot, divided by dentition type and DDE presence.

For all children included in the study and the control group, we have analyzed 5452 teeth and we have identified well-delimited and diffuse opacities.



a



b

Figure 3. Prevalence of opacities for: a) permanent teeth; b) temporary teeth

For the 24 children with DDE, we have determined that there were 49 affected teeth (representing 0.90% from the total number of teeth), divided as following: 6 temporary teeth (12.24%, children with mixed dentition) and 43 permanent teeth (87.76%, children with both mixed and permanent dentition). Regarding the temporary teeth, 5 of them had diffuse opacity and 1 presented a demarcated opacity. We have identified a similar number of diffuse and well-delimited defects in the affected permanent teeth (22, respectively 21 teeth). Fig. 4a and 4b show the distribution of teeth with DDE, according to dentition, teeth group, and type of enamel defects. Overall, we have recorded 27 teeth with diffuse opacities (55.10%) and 22 teeth with well-delimited opacities (44.90%).

Within the study lot, there were 2 children with both well-delimited and diffuse opacity (1 with mixed dentition, 1 with permanent dentition). Children with opacities at temporary teeth had mixed dentition, but no permanent teeth were affected.

Enamel defects were observed on the following teeth surfaces: vestibular, mesial, oral, distal and occlusal - incisal. Fig. 4 indicates the distribution of enamel defects according to the affected surface.

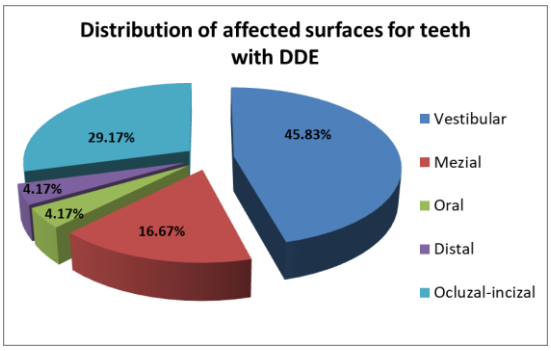


Figure 4. Distribution of affected surfaces for teeth with DDE

Opacities were mainly observed on the vestibular surface, more than 45% of affected teeth being included in this category. For the rest of 55% of teeth, occlusal-incisal category is dominant, with 29.17% of all teeth with DDE. Oral and distal categories are less common, each of them accounting for 4.17% from all affected teeth.

Statistical analysis was carried out in order to determine potential associations between DDE presence and other parameters recorded during patients' examination. However, we have not identified any statistical correlations between parameters recorded in our current data set ($p > 0.05$).

Data from the literature suggest that 9-63% of healthy children in developed countries have permanent teeth with DDE, with temporary teeth being affected in 10-49% of them.

At this moment, there is no information on the prevalence of acquired DDE among children and adolescents in our region. In the current study, the prevalence of DDE was 11.27%. Similar values were reported in another study published in the literature, which was conducted in Nigeria [10]. However, our study group was smaller and we used different indices to quantify the defects.

Robles et al, in a study conducted in Spain, found that the prevalence of DDE amongst the primary dentition of children was 40.2%, while their permanent teeth were affected in a proportion of 52% [11]. In a study that took place in New Zealand, the authors reported a DDE prevalence of 51.6% [12], while African American and Hispanic children from Connecticut USA were affected by this disease in a proportion of 49% [13]. In Brazil, it was reported a prevalence of DDE of 29.9% [14], while in Australia, children with primary and permanent dentition were affected in a proportion of 25% and 58% respectively [15].

Najat Farsi, in a study of 4- and 5-year-olds in Saudi Arabia, reported a prevalence of DDE of 45.4% [16]. All these values found in different continents and states are more or less close, one of the reasons for this desideratum could be represented by the different terms used to characterize the defects and the distinct criteria used to diagnose them.

At the same time, the prevalence varies due to the distinct indices used to quantify the lesions, but also due to the multiple etiological and risk factors involved in the production of the defects. It is also not excluded that ethnicity has its importance in this regard.

Regarding the gender distribution, in our study the female children were more affected, with a prevalence of 58.33%. The data reported by other studies in this regard are contradictory; it is not clear which of the 2 sexes is more affected by DDE [17].

Most affected children had 7 years old (6 children, representing 25%) and 10 years old (4 children, representing 16.67%). The average age of children with DDE was 10.38±3.45 (average ± standard deviation).

The chances of finding DDE increase with the age of the examined child, and also with the number of permanent teeth [18]. At the same time, in the older group, the presence of dental caries, restorations or even the absence of teeth, could mask the underlying enamel defects [19].

All of the defects were opacities; we did not find any hypoplasia. These results are consistent with the ones of many studies, where the percentage of hypoplasia was the lowest [14, 18].

The total number of teeth we analyzed was 5452. For the 24 children with DDE, we have determined that there are 49 affected teeth (representing 0.90% from the total number of teeth), divided as following: 6 temporary and 43 permanent. Other authors found a percentage of 6.1% DDE teeth, but their number of analyzed teeth was a lot bigger [11].

The lower prevalence of enamel defects in the temporary teeth was also confirmed by many studies [9,13,15,20]. Permanent teeth have a higher risk of developing DDE probably because there is a critical period of amelogenesis in the first 2 years of a child's life, when he is prone to some common systemic diseases that can affect odontogenesis [15].

Regarding the temporary teeth, 5 of them had diffuse opacities and only one presented a demarcated opacity. There was a similar number of well-delimited and diffuse defects in the affected permanent teeth. Same findings for the decidual dentition were reported by other researchers [11,21], a cause of this could be the presence of maternal infections during pregnancy [21]. Data from the literature related to which type of opacities is more frequent are quite contradictory.

The reasons for this may be the difficulty in diagnosing diffuse defects, which do not have a clear distinction from the normal adjacent enamel and the fact that temporary teeth have a more whitish coloration that makes them more difficult to evaluate. Furthermore, studies use different teeth and type of light during the diagnosis.

Both primary and definitive maxillary teeth were more affected than their mandibular counterparts, result found by other researchers who studied the prevalence of DDE among temporary teeth [9,18]. The fact that temporary maxillary teeth are more prone is explained by their slower maturation compared to mandibular baby teeth [9].

The teeth with the highest number of occurrences were the permanent central maxillary incisors, with 13 occurrences, representing 26.53% and the first permanent molars, with 9 occurrences, representing 18.36%.

Same results were reported by many recent studies [12,13,15,22,23]. The vestibular (45.83%) and occlusal-incisal (29.17%) surfaces of the DDE teeth were the most affected ones, while the oral and distal surfaces had the lowest prevalence (each with 4.17%), fact confirmed by another author [24].

Our study was conducted in a rural area from Romania, which is known for a lower level of education and socioeconomic status. It is thought that the level of education may influence a number of non-economic aspects, such as manners and health capital [25]. High level of education is related to better living conditions [21], and this is possible to influence teeth development [26]. Some studies have found that injuries and stressors that occur in the pre-, peri-, and postnatal periods can prejudice odontogenesis [24], and their presence is associated with socioeconomic status.

CONCLUSIONS

The prevalence of DDE in our study was 11.27%, but it must be specified that we did

not have a very large number of subjects and, from our knowledge, there is no other data about our region related to this research topic. DDE is growing globally and affects children's quality of life and therapeutic management, requiring future national studies related to the prevalence and both the etiological and risk factors of this disease, the best means of treatment being its prevention.

REFERENCES

1. Salanitri S, Seow WK. Developmental enamel defects in the primary dentition: aetiology and clinical management. Aust Dent J. 2013;58(2): 133-40.
2. Kitasako Y, Sadr A, Shimada Y, Ikeda M, Sumi Y, Tagami J. Remineralization Capacity of Carious and Non-Carious White Spot Lesions: Clinical Evaluation using ICDAS and SS-OCT. Clin Oral Investig. 2019;23(2): 863-872.
3. Cardoso MA, Matijasevich A, Malta MB, Lourenco BH, Gimeno SGA, Ferreira MU, Castro MC; MINA-Brazil Study Group. Cohort Profile: The Maternal and Child Health and Nutrition in Acre, Brazil, Birth Cohort Study (MINA - Brazil). BMJ Open. 2020;10(2): e034513.
4. Jeremias F, Pierri RA, Souza JF, et al. Family-based genetic association for molar-incisor hypomineralization. Caries Res 2016;50: 310-8.
5. Sonmez H, Yildirim G, Bezgin T. Putative factors associated with molar incisor hypomineralisation: an epidemiologica study. Eur Arch Paediatr Dent. 2013;14(6): 375-80.
6. Schiller E. Anomalii dentare. Ed. Mirton, Timișoara, 2007: 31-67.
7. Rodd HD, Abdul-Karim A, Yesudian G, et al. Seeking children's perespectives in the management of visible enamel defects. Int J Paediatr Dent. 2011;21: 89-95.
8. Hong L, Levy SM, Warren JJ, et al. Association between enamel hypoplasia and dental caries in primary second molars: a cohort study. Caries Res. 2009;43: 345-353.
9. Reed SG, Miller CS, Wagner CL, Hollis BW, Lawson AB. Toward Preventing Enamel Hypoplasia: Modeling Maternal and Neonatal Biomarkers of Human Calcium Homeostasis. Caries Res. 2020;54(1) :55-67.
10. Orenuga OO, Odukoya O. An epidemiological study of developmental defects of enamel in a group of Nigerian school children. Pesqui Bras Odontopediatria Clin Integr. 2010;10: 385-391.
11. Robles MJ, Ruiz M, Bravo_PM, Gonzalez E, Penalver MA. Prevalence of enamel defects in primary and permanent teeth in a group of schoolchildren from Granada (Spain). Medicina Oral Patologia Oral y Cirugia Bucal 2013;18(2): e187-93.
12. Mackay TD, Thomson WM. Enamel defects and dental caries among Southland children. N Z Dent J. 2005;101: 35-43.
13. Montero MJ, Douglass JM, Mathieu GM. Prevalence of dental caries and enamel defects in Connecticut Head Start children. Pediatr Dent. 2003;25: 235-9.
14. Correa-Faria P, Martins-Junior PA, Vieira-Andrade RG, Oliveira-Ferreira F, Marques LS, Ramos-Jorge ML. Developmental defects of enamel in primary teeth: prevalence and associated factors. Int J Paediatr Dent. 2013;23(3): 173-9.
15. Seow WK, Ford D, Kazoullis S, Newman B, Holcombe T. Comparison of Enamel Defects in the Primary and Permanent Dentitions of Children from a Low-fluoride District in Australia. Pediatr Dent. 2011;33: 207-12.
16. Farsi N. Developmental enamel defects and their association with dental caries in preschoolers in Jeddah, Saudi Arabia. Oral Health Prev Dent. 2010;8: 85-92.
17. Slayton RL, Warren JJ, Kanellis MJ, Levy SM, Islam M. Prevalence of enamel hypoplasia and isolated opacities in the primary dentition. Pediatr Dent. 2001;23(1): 32-36.
18. Opydo-Szymaczek J, Gerreth K, Borysewicz-Lewicka M, Pawlaczyk-Kamienska T, Torlinska-Walkowiak N, Sniatała R. Enamel defects and dental caries among children attending primary schools in Poznan, Poland. Adv. Clin. Exp. Med. 2018;27: 1535-1540.
19. Casanova-Rosado AJ, Medina-Solis CE, Casanova-Rosado JF, et al. Association between developmental enamel defects in the primary and permanent dentitions. Eur J Paediatr Dent.

2011;12(3): 155-158.
20. Slayton RL, Warren JJ, Kanellis MJ, Levy SM, Islam M. Prevalence of enamel hypoplasia and isolated opacities in the primary dentition. Pediatr Dent. 2001;23: 32-6.
21. Chaves AM, Rosenblatt A, Oliveira OF. Enamel defects and its relation to life course events in primary dentition of Brazilian children: a longitudinal study. Community Dent Health. 2007;24: 31-6.
22. Arrow P. Prevalence of dental enamel defects of the first permanent molars among school children in Western Australia. Aust Dent J. 2008;53: 250-9.
23. Kanagaratnam S, Schluter P, Durward C, Mahood R, Mackay T. Enamel defects and dental caries in 9-year-old children living in fluoridated and nonfluoridated areas of Auckland, New Zealand. Community Dent Oral Epidemiol. 2009;37: 250-9.
24. Oliveira AFB, Chaves AMB, Rosenblatt A. The influence of enamel defects on the development of early childhood caries in a population with low socioeconomic status: a longitudinal study. Caries Research. 2006;40: 296-302.
25. Almeida TF, Vianna MI, Cabral MB, Cangussu MC, Floriano FR. Family context and incidence of dental caries in preschool children living in areas covered by the Family Health Strategy in Salvador, Bahia State, Brazil. Cadernos Saude Publica. 2012;28: 1183-95.
26. Vargas-Ferreira F, Zeng J, Thomson WM, Peres MA, Demarco FF. Association between developmental defects of enamel and dental caries in schoolchildren. J Dent. 2014;42: 540-546.