

Prevalence and distribution of developmental enamel defects in the primary dentition of pre-school children

Prevalência e distribuição de defeitos de desenvolvimento de esmalte na dentição decídua de pré-escolares

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ABSTRACT: Developmental defects of the enamel (D.D.E.) are changes in the deciduous dentition that have been little studied in Brazil, although they lead to aesthetic problems, dental sensitivity and may be predictors of dental caries. The objective of this study was to estimate the prevalence and distribution of D.D.E. in the deciduous dentition of pre-school children in the municipality of Itajaí, Santa Catarina, in 2003. A cross-sectional study was carried out with a sample of 431 children aged 3 to 5 enrolled in public day care centres. All of the teeth were examined and the enamel defects were assessed according to the Modified DDE Index (FDI, 1992). The prevalence of D.D.E. was 24.4% (CI 95% 20.3-28.5). Diffuse opacities were the most common defects found (17.9%), followed by hypoplasia (11.1%) and demarcated opacities (6.1%). The most affected teeth were the second molars (44.4%), followed by the first molars (23.5%). Defects were observed more frequently in the upper arch (58.2%). Assessing enamel hypoplasia separately, a prevalence of 15.1% (CI 95% 11.7-18.5) was observed, with the most affected teeth being the canines (33.6%) and second molars (33.6%). One quarter of the pre-school children presented enamel defects, with diffuse opacities being the most prevalent ones.

DESCRIPTORS: Enamel defect; Developmental defect; Dental enamel hypoplasia; Dentition, primary; Prevalence.

RESUMO: No Brasil, os defeitos de desenvolvimento de esmalte (D.D.E.) são alterações pouco estudadas na dentição decídua apesar de acarretarem problemas estéticos, de sensibilidade dentária e serem fatores predisponentes da cárie dental. O objetivo deste estudo foi estimar a prevalência e distribuição de D.D.E. na dentição decídua de pré-escolares do município de Itajaí, Santa Catarina em 2003. Foi realizado um estudo transversal com uma amostra de 431 crianças de 3 a 5 anos de idade matriculadas em creches públicas. Todos os dentes foram examinados e os defeitos de esmalte foram avaliados segundo o "Modified DDE Index" (FDI, 1992). A prevalência de D.D.E. foi 24,4% (IC 95% 20,3-28,5). As opacidades difusas foram os defeitos mais encontrados (17,9%), seguidos das hipoplasias (11,1%) e opacidades demarcadas (6,1%). Os dentes mais acometidos foram os segundos molares (44,4%); seguidos pelos primeiros molares (23,5%). Os defeitos foram observados com maior frequência na arcada superior (58,2%). Avaliando isoladamente as hipoplasias de esmalte, observou-se uma prevalência de 15,1% (IC 95% 11,7-18,5); sendo que os dentes mais atingidos foram os caninos (33,6%) e segundos molares (33,6%). Um quarto dos pré-escolares apresentou defeitos de esmalte, sendo que as opacidades difusas foram os mais prevalentes.

DESCRIPTORES: Defeito de esmalte; Defeito de desenvolvimento; Hipoplasia do esmalte dentário; Dentição decídua; Prevalência.

INTRODUCTION

Developmental defects in the enamel present important clinical significance since they are responsible for aesthetic problems, dental sensitivity, dentofacial anomalies, as well as for a predisposition to dental caries¹¹.

In the field of public health, developmental defects in the enamel have taken on a high level of importance for being predictors of dental caries. Populations affected by these changes require as a priority preventive intervention and early treatment.

There are few epidemiological studies of the prevalence of developmental defects in the enamel of deciduous dentition when compared with the permanent dentition. Furthermore, the prevalence rates present great variability^{3-7,12,14}.

A literature review carried out on the Medline database, covering the period from 1966 to 2003 and using a combination of the following Mesh terms: enamel, defect, developmental, primary and prevalence has failed to show any population-based

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studies of developmental defects in the enamel of deciduous dentition carried out in Brazil.

The objective of this study was to estimate the prevalence of developmental defects in the enamel of deciduous teeth, in children aged 3 to 5 enrolled in public day care centres of the municipality of Itajaí, Santa Catarina, in the year of 2003.

METHODS

A cross-sectional study was carried out to estimate the prevalence of developmental defects in the enamel of deciduous teeth in children from the municipality of Itajaí, State of Santa Catarina, Brazil.

The reference population for the study included 2,484 children aged 3 to 5 years, of both genders, enrolled in public day care centres of Itajaí in 2003. All these children had benefited from the system of fluoridation of the public water supply since 1982. In order to calculate the sample size, a prevalence of enamel defects of 15% was considered, as well as a sampling error of 5% and a confidence level of 95%. As the sample was selected in two stages, first the schools and then the children, a design effect of 2 was used resulting in a minimum required sample of 392 children. A further 10% was added to compensate for dropouts or refusals, totaling 431 children.

Day care centres were classified as small, average and large according to the number of children enrolled⁸. Thus, of the 38 public day care centres available, 20 were selected, 6 of them small, 8 average and 6 large, respecting this proportionality. The process of systematic sampling was used for children sample selection.

The Modified Developmental Defects of Enamel Index (Modified DDE Index)² was used to diagnose and classify changes in the enamel of the deciduous teeth studied. Three surfaces were examined: buccal, occlusal/incisal and lingual/palatal of all deciduous teeth. The enamel defects were assessed according to three clinical aspects: hypoplasia of the enamel, diffuse opacities and demarcated opacities. Other diagnostic criteria were considered, namely, a) a tooth was considered present when any portion of the crown had erupted through the mucosa; b) when an enamel defect was present in the erupted portion, it was recorded; c) in the case of doubt regarding the presence of an abnormality, the dental surface was classified as "normal"; d) a surface with a single abnormality less than 1 mm in diameter was classified as "normal"; e) the dental surfaces that presented marked fractures,

caries and very extensive restorations, or impacting on more than 2/3 of the tooth surface were excluded from the analysis and classified as "excluded" and f) all of the deciduous teeth extracted or exfoliated were considered "excluded".

Clinical examinations were carried out under natural light, by one of the authors (S.E.L.). Children were examined without prior drying and dental prophylaxis of their teeth, but when necessary, for improved visualisation, their teeth were cleaned and dried using gauze. Children were examined by the researcher with both the patient and the examiner seated and with the latter positioned in front of the child. Flat oral mirrors and periodontal probes (CPI) were used for the examination. For the process of calibration, a theoretical study of the criteria for the diagnosis of the index of developmental defects in the enamel was carried out, with the help of coloured photographs of typical examples of hypoplasia, demarcated and diffuse opacities in permanent teeth, contained in the manual of basic presentations in oral health of the World Health Organization (WHO)¹⁵. In a second stage, 150 children from a day care centre not selected for the study were examined and 20 photographs of deciduous teeth with various kinds of enamel defects were taken. These photographs were assessed independently by the researcher and by a standard examiner with experience in the use of the index. When diagnoses did not agree, the photograph was re-examined and discussed by both before deciding by consensus. In a third stage, the children with enamel defects that had been photographed were examined once again by the researcher, to support and confirm the diagnosis.

Prior to the fieldwork, a pilot study was carried out in a day care centre not included in the main study, with a group of 30 children aged 3, 4 or 5. Examinations in duplicate were carried out in 10% of the sample during the fieldwork, using the kappa statistic to check the diagnostic reliability of the examiner.

The project was submitted to and approved by the Committee for Ethics in Research on Humans, Federal University of Santa Catarina (UFSC).

The prevalence of defects in the enamel was calculated with a respective confidence interval of 95% and the distribution of the defects by arch, teeth and type of defect. Statistical significance for differences between proportions was assessed using the chi-squared test while numerical variables were tested using Mann-Whitney U-test and

Kruskal-Wallis H-test. The level of significance was set at 5%.

RESULTS

There were no refusals to participate in the study. Forty-three examinations were carried out in duplicate and the intra-examiner agreement was high ($\kappa \geq 0.8$).

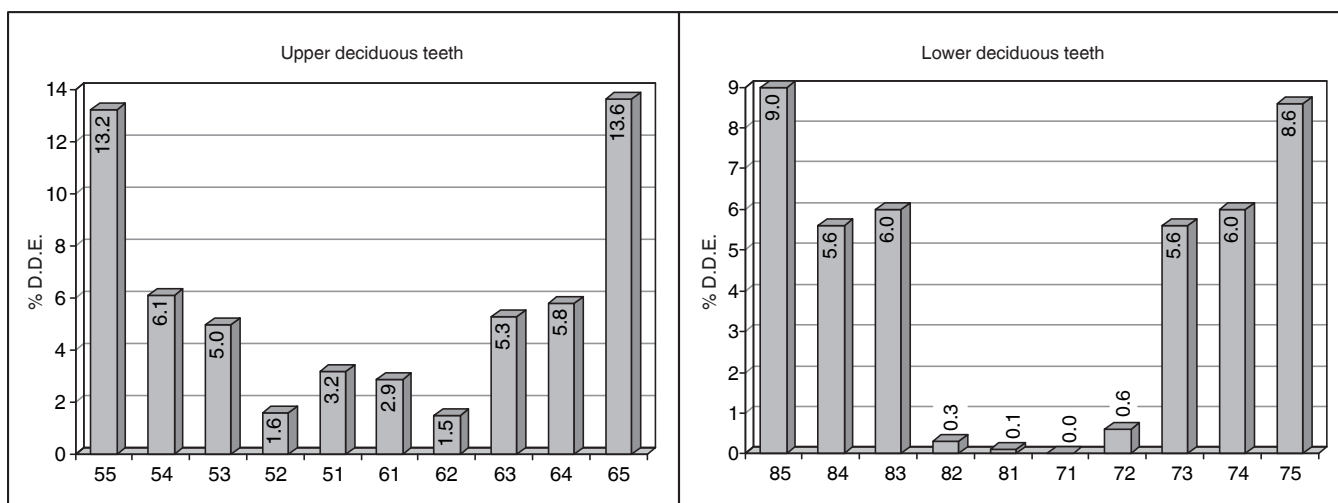
The deciduous dentition of 216 boys and 215 girls aged 3 to 5 were examined. The prevalence of enamel defects observed was 24.4% (CI95% = 20.3-28.5). A total of 25,860 surfaces were examined, of which 568 (2.2%) were excluded due to caries, restorations and/or marked fractures that impacted on more than 2/3 of the surface. The surfaces of extracted or exfoliated deciduous teeth were also excluded. According to these criteria, 26.4% of the children had at least one surface excluded from the examination. The prevalence of affected surfaces was 2.7%, that is, of the 24,616 surfaces that could be examined for DDE, 676 presented at least one defect, varying from 1 to 25 affected surfaces per child.

The teeth most affected by defects were the upper second molars (26.8%), followed by the lower second molars (17.6%), upper first molars (11.9%), lower first molars (11.6%) and lower canines (11.6%), upper canines (10.3%), and upper incisors (9.2%). The least affected teeth were the lower incisors (only 1%) ($p < 0.05$, chi-squared test). Defects were observed with greater frequency in the upper arch (58.2%) than in the lower arch (41.8%) ($p < 0.05$, chi-squared test) (Graph 1).

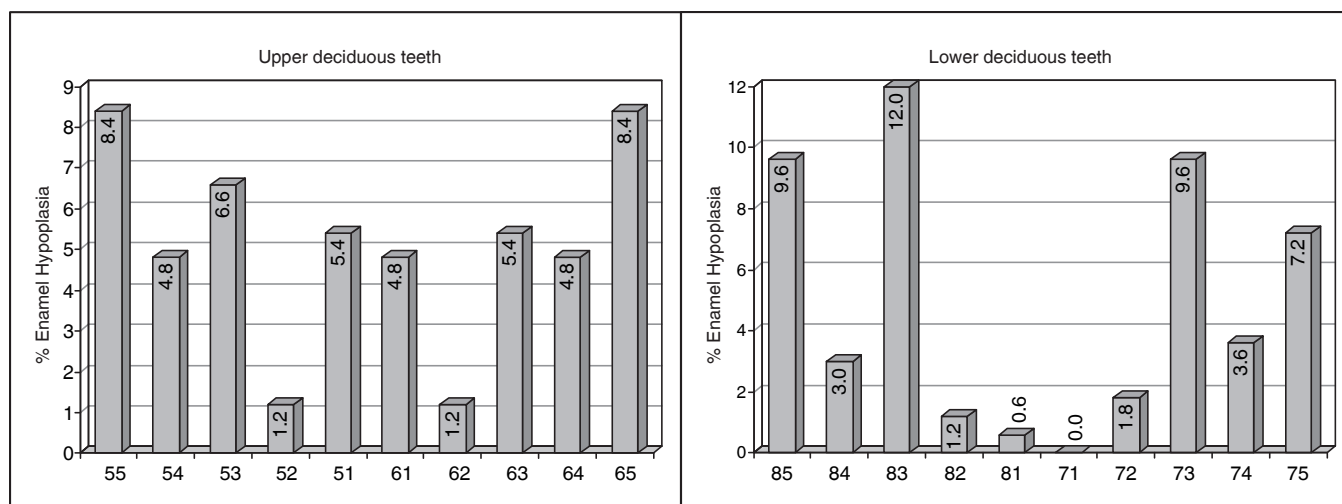
Analysing specifically enamel hypoplasia, a prevalence of 15.1% (CI95% 11.7-18.5) was noted, with each child presenting between 1 and 10 surfaces with hypoplasia. Of the total of 676 surfaces with defects, 166 (24.6%) exhibited enamel hypoplasia.

Graph 2 shows the proportional distribution of surfaces affected by hypoplasia of the enamel according to the deciduous teeth examined. The teeth most affected by hypoplasia were the lower canines (21.6%), followed by upper second molars (16.8%) and lower second molars (16.8%), upper incisors (12.6%), upper canines (12.0%), upper first molars (9.6%), lower first molars (6.6%), and lower incisors (3.6%) ($p < 0.05$, chi-squared test). Hypoplasia was also more frequent in the upper (51.2%) than in the lower arch (48.8%), but the difference was not statistically significant ($p > 0.05$).

Table 1 shows the number and proportional distribution of the various types of enamel defects according to children and surfaces affected. Diffuse opacities were the defects most frequently found in the children (17.9%), followed by hypoplasia (11.1%) and demarcated opacities (6.1%). In relation to the 676 surfaces with defects of the enamel, diffuse opacities were also more prevalent (69.8%), followed by hypoplasia (17.2%) and demarcated opacities (4.6%), which were less frequent than combined defects (diffuse opacities and hypoplasia), present in 7.1% of the surfaces. Analysing the severity of the defects, the average of surfaces with defects in the population studied was 1.57, and, among the children with defects (105), we observed an average of 6.4 surfaces impacted.



GRAPH 1 - Proportional distribution of surfaces affected by developmental defects of the enamel (D.D.E.) according to the deciduous teeth examined.



GRAPH 2 - Proportional distribution of surfaces affected by enamel hypoplasia according to the deciduous teeth examined.

TABLE 1 - Number and percentage distribution of children and surfaces affected according to types of developmental defects of the enamel (D.D.E.), and average of surfaces with D.D.E. for pre-school children from Itajaí, Santa Catarina, Brazil, 2003. Averages (\bar{x}) and standard deviations (SD).

Types of Defects	Children		Surfaces		\bar{x} surfaces with D.D.E. per child affected	\bar{x} surfaces with D.D.E. in the studied sample	SD
	n	%	n	%			
Demarcated opacity	26	6.1	31	4.6	1.2	0.07	3.68
Diffuse opacity	77	17.9	472	69.8	6.1	1.09	
Enamel Hypoplasia	48	11.1	116	17.2	2.4	0.27	
Other Defects	-	-	-	-	-	0.00	
Demarcated and Diffuse Opacity	04	0.9	07	1.0	1.8	0.02	
Demarcated Opacity and Hypoplasia	01	0.2	02	0.3	2.0	0.00	
Diffuse Opacity and Hypoplasia	22	5.1	48	7.1	2.2	0.11	
All 3 defects	-	-	-	-	-	0.00	
Total	-	-	676	100	6.4	1.57	

The average numbers of enamel defects and of hypoplasia were, respectively, higher for females (\bar{x} = 1.66 and \bar{x} = 0.40) than for males (\bar{x} = 1.48 and \bar{x} = 0.37), but these differences were not statistically significant. A significant difference ($p < 0.01$) was detected between the average of DDE and the age of the examined children. The higher the child's age, the lower the average number and proportion of defects (Table 2).

DISCUSSION

Besides being scarce, epidemiological studies on the prevalence of developmental defects in the enamel of deciduous teeth exhibit a wide variability

in prevalence rates. This diversity may be, by and large, explained by specific characteristics of the populations studied and by methodological aspects adopted in the studies, such as the index and criteria used in the examination. For example, whether only hypoplasia was considered as a defect of the enamel or whether enamel opacities were also considered; whether only the front teeth, only the canines or the whole dentition were examined; the type of illumination employed for the examination and whether, prior to the examination, brushing, prophylaxis and drying of the teeth were carried out or not.

Despite the difficulty in comparing the studies, similar values were found for Chinese chil-

TABLE 2 - Surface average (standard deviation) and proportion (%) of developmental defects in the enamel (D.D.E.) and hypoplasia only, according to sex and age of pre-school children from Itajaí, Santa Catarina, Brazil, 2003.

Variable		D.D.E.		% surfaces with DDE [#]	Enamel Hypoplasia		% surfaces with enamel hypoplasia [#]
		Average (Standard deviation)	p		Average (Standard deviation)	p	
Gender	Male (n = 216)	1.48 (3.53)	0.697*	2.46	0.37 (1.18)	0.822*	0.62
	Female (n = 215)	1.66 (3.83)		2.76	0.40 (1.14)		0.67
	Total (n = 431)	1.57 (3.68)		2.61	0.39 (1.16)		0.64
Age	3 years (n = 106)	2.48 (4.73)	0.006**	4.13	0.31 (0.99)	0.245**	0.52
	4 years (n = 153)	1.68 (3.74)		2.80	0.49 (1.29)		0.82
	5 years (n = 172)	0.91 (2.62)		1.51	0.34 (1.13)		0.56
	Total (n = 431)	1.57 (3.68)		2.61	0.39 (1.16)		0.64

*Mann-Whitney U Test. **Kruskal-Wallis H Test. [#]proportion of affected surfaces/total number of examined surfaces × 100.

dren (23.9%)⁵. Both the DDE as a whole and the hypoplasia of the enamel specifically were more prevalent in the maxilla than in the mandible, and tended to present, both in the maxilla and in the mandible, a symmetrical and bilateral form, strengthening the hypothesis of the participation of systemic factors in the aetiology of these defects. These findings are in accordance with those of Li *et al.*⁵ (1995).

Diffuse opacities, among the three types of defects examined, were those most commonly found in children (17.9%), as reported in the study of Weeks *et al.*¹⁴ (1993), in which these defects were more prevalent both in areas with fluoridated water (29%) and in areas without such treatment (14%). The lower prevalence of diffuse opacities observed in our study (17.9%), carried out in a fluoridated area, compared with the prevalence of 29%, may be explained by the fact that in the English study the examination was carried out under artificial illumination and that the teeth, prior to the examination, were dried for 15 seconds with compressed air.

The teeth most affected by defects were the second molars, while the incisors were the least affected ones. This finding differs from those of some studies in which the incisors were the most affected teeth¹ and agrees with those of other studies, in which the molars were equally affected^{7,12,14}. This difference may be related to the differential diagnosis between defects in the enamel of incisors and early caries of infancy, common in these teeth. In our study, when there was doubt regarding the presence of DDE, carious lesions and healthy enamel, the last one was assumed. Furthermore, it is known that linear hypoplasia of the enamel in incisors is more common in very poor

regions, in malnourished populations¹³, which are not characteristics of the population studied here.

The lower canines were the teeth most affected by hypoplasia of the enamel, which is in agreement with the study of Lukacs *et al.*⁶ (2001). These results, on the other hand, differ from those reported by Li *et al.*⁵ (1995), in which the upper incisors were the most affected teeth, a difference that may be explained by the same reasons described above.

We observed that the older the child, the lower the average number of defects. One explanation for this finding may be the fact that the higher the age, the higher the number of teeth affected by dental caries and the fewer surfaces available to be examined for defects in the enamel.

A question raised by this study, which is important to consider, refers to the diagnosis of developmental defects in the enamel. Enamel hypoplasias, as well as demarcated opacities, are easily detected, due to their very characteristic clinical aspect, while diffuse opacities represent more non-specific changes, and do not present a very precise border with the adjacent normal enamel. A study carried out by Seow¹⁰ (1997) also raised this question, stating that the whiter appearance of the deciduous enamel can impede the detection of milder opacities that are common in the deciduous dentition and concluded, in addition, that defects of the enamel can be masked by the saliva, plaque and inadequate illumination, and be mistaken for changes occurring after the eruption of teeth, such as caries and losses of dental structure through wear and trauma.

Rosenzweig, Sahar⁹ (1962) have shown that children with hypoplasia of the enamel present

a significantly higher experience of caries than children without such defects.

Besides its clinical implications in the field of public health, DDE have taken on importance as strong predictors of dental caries. Our study showed that approximately one quarter of the children examined presented at least one tooth with a defect of the enamel. This result highlights the importance of establishing priority programmes of prevention and early treatment for these groups of children both for aesthetic and functional reasons, as well as to minimise the increased risk of dental caries.

CONCLUSIONS

Approximately one quarter (24.4%) of the pre-school children studied presented developmental defects of the enamel in their deciduous denti-

tion; defects were more frequent in the maxilla; the molars were the most affected teeth; diffuse opacity was the most prevalent type of defect and the lower canines were the teeth most affected by hypoplasia of the enamel.

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