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## Enamel Developmental Defects and Associated Factors in Childhood in Salvador, Bahia, Brazil, 2022-2023

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### Abstract

**Objective:** To analyze the occurrence of enamel developmental defects (EDD) and associated factors in the post-COVID-19 pandemic context in preschoolers from Salvador-BA who attended public daycare centers.

**Methodology:** Cross-sectional epidemiological study that investigated the prevalence and types of EDD in preschool children (02 to 05 years old), and associated psychosocial, behavioral and other oral health factors, in the years 2022 and 2023. Descriptive and exploratory analyses were carried out, using the Chi Square test to analyze associations, with a significance level of 5%.

**Results:** 440 preschoolers took part; the prevalence of EDD was 11.36%. In the bivariate analysis, the covariates aggression during the pandemic (p-value: 0.054), lack of brushing supervision (p-value: 0.028) and enamel caries (p-value: 0.019) were associated with EDD.

**Conclusions:** EDD affected children at an early age and were associated with psychosocial and behavioral aspects and with early childhood caries. Healthpromotion strategies, including public policies to reduce psychosocial problems in our environment, as well as specific programs to prevent and control oral problems need to be planned more effectively in the country, including improving the diagnosis of EDD, which can contribute to an increased risk of childhood caries.

**Keywords:** Enamel Developmental Defects, Preschoolers, Covid-19

### Introduction

Enamel developmental defects (EDD) are anomalies that affect the formation of enamel and are observed during the process of tooth development. This damage can occur due to a number of factors, including nutritional deficiencies, the use of certain medications, infections during childhood, trauma or genetic conditions. It can manifest itself in a variety of ways, such as white, yellowish or brown spots on the teeth, grooves or roughness on the enamel surface or even flaws in the tooth structure [1].

According to the IDF (International Dental Federation), EDDs are alterations resulting from disturbances in the process of amelogenesis and can be classified as qualitative (diffuse or demarcated opacities) and/or quantitative (hypoplasia).

For IDF, demarcated opacity is an alteration in the translucency of the enamel, with defined edges from the normal adjacent enamel, with a white, beige, yellow or brown color. Diffuse opacity is an abnormality in the translucency of the enamel, in which there is no clear boundary between the adjacent normal enamel and the opacity referred to. Hypoplasia is a localized reduction in enamel thickness with or without dentin exposure [2].

They can make teeth more susceptible to tooth decay, sensitivity and other dental problems, which justifies the importance of early identification and appropriate treatment to ensure longevity in children's oral health. The prevalence of EDD in the deciduous dentition reported in international studies, which used the IDF diagnostic criteria, varies between 5.3 and 74.2% [1]. In a study carried out by Paiva et al., the prevalence of EDD in preschoolers in Salvador-BA was around 9.24% [3].

During the COVID-19 pandemic, children's health has been placed at the epicenter of a complex network of impacts. According to the WHO (World Health Organization), by October 2021, children under five accounted for 2% of cases and 0.1% of global deaths. In 2022, global data revealed that children under five accounted for 2.47% of COVID-19 cases [4,5].

In a study carried out by Lima (2023), the author found that the pediatric manifestations of long COVID appeared at a frequency of 25.24%, with mood swings (1.6%), fatigue (9.66%) and sleep disorders (8.42%) being the main ones [5]. In another investigation, carried out by Chagas et al. (2023) to assess the impact of the COVID-19 pandemic during the strictest isolation, children showed high percentages for consumption of fermented sugars (74%), sedentary lifestyle (72%) and adequate oral hygiene care, including use of fluoridated toothpaste (98.9 %) [6].

Childhood, traditionally considered a phase of growth and development, has faced late challenges as a result of the pandemic. The closure of schools due to social isolation, although necessary to contain contamination by the virus, has led to unfavorable changes in children's health behaviors. Sedentary behavior, increased screen time, sleep time and consumption of unhealthy foods have contributed to body weight gain, since school is the setting for social interaction, learning and direct and indirect physical exercise [7,8].

This study aimed to analyze the occurrence of EDD and associated factors in the post-COVID-19 pandemic context in preschoolers from Salvador-BA who attended municipal public daycare centers in the years 2022 and 2023.

## Methodology

This is a cross-sectional epidemiological study that investigated the oral health situation of children between the ages of 2 and 5, with data collected in Salvador-BA in 2022 (August to November) and 2023 (March and April). The study was approved by the Research Ethics Committee of the UFBA School of Dentistry- CAAE: 60817222.6.0000.5024. In addition, the oral examinations were only carried out after the parents or guardians had signed the Informed Consent Form (ICF) and the child had agreed.

The study was carried out in municipal daycare centers (Centros Municipais de Educação Infantil - CMEI). The nurseries were chosen for convenience in the Barra-Rio Vermelho, Brotas, Boca do Rio, Itapoã, Cabula and Pau da Lima health districts. Data collection took place inside the CMEI during the school year and was carried out by dental surgeons and undergraduate dental students from the School of Dentistry at the Federal University of Bahia (UFBA), who were duly trained and calibrated to carry out the examinations ( $Kappa=0.92$ ). In addition to the oral examinations, a self-administered structured interview was carried out with the children's guardians in order to investigate aspects of the family environment, such as socioeconomic aspects (gender, skin color, age, family income, help during the pandemic, impact of the pandemic on family income); behavioral aspects (changes in diet during the pandemic, tooth brushing, supervised tooth brushing, use of fluoride toothpaste) and psychosocial aspects (aggression during the pandemic).

EDDs were assessed based on the criteria defined by the Commission on Oral Health, Research and Epidemiology of the World Dental Federation (FDI, 1992). The presence of any changes related to enamel defects according to the FDI criteria was considered the presence of enamel change during data analysis. The presence of caries in childhood (deciduous dentition) was assessed according to the criteria of the CAST (Caries Assessment Spectrum and Treatment) index proposed by Frencken et al. (2011) [9].

To analyze and tabulate the data, the information collected was initially entered into an Excel database and statistically analyzed using STATA 14. The data was analyzed descriptively and exploratorily in search of potential associations. The Chi-square test was used, with a significance level of 5% in order to identify covariates associated with EDD.

## Results

Just over half of the children were female (52.73%) and aged 55 months or more (53.64%). There was a predominance of blacks (88.86%). The most common family income was up to 1 minimum wage (73.64%), and the majority received aid during the pandemic (66.14%).

According to the findings of the interviews with the children's guardians, the majority said that the pandemic had had no impact on their family income (72.95%). The level of schooling reported by the mothers was complete high school or more (58.64%). Ninety-five percent of the children evaluated had not suffered aggression during the pandemic (Table 1).

Variables	n	%
<b>Sex</b>		
Male	208	47.27
Female	232	52.73
<b>Skin color</b>		
Others	49	11.14
Black	391	88.86
<b>Age</b>		
Under 55 months	204	46.36
55 months or more	236	53.64
<b>Family Income</b>		
More than 1 minimum wage	116	26.36
Up to 1 minimum wage	324	73.64
<b>Aid in the pandemic</b>		
Did not receive	149	33.86
Received	291	66.14
<b>Impact of the pandemic on family income</b>		
No impact	321	72.95
There was an impact	119	27.05
<b>Maternal Schooling</b>		
Completed high school or more	258	58.64
Up to incomplete high school	182	41.36
<b>The child was assaulted during the pandemic</b>		
No	418	95
Yes	22	5

**Table 1: Absolute and Percentage Distribution of Preschoolers According to Socioeconomic and Psychosocial Aspects and the Occurrence of COVID-19. Salvador-BA (n=440).**

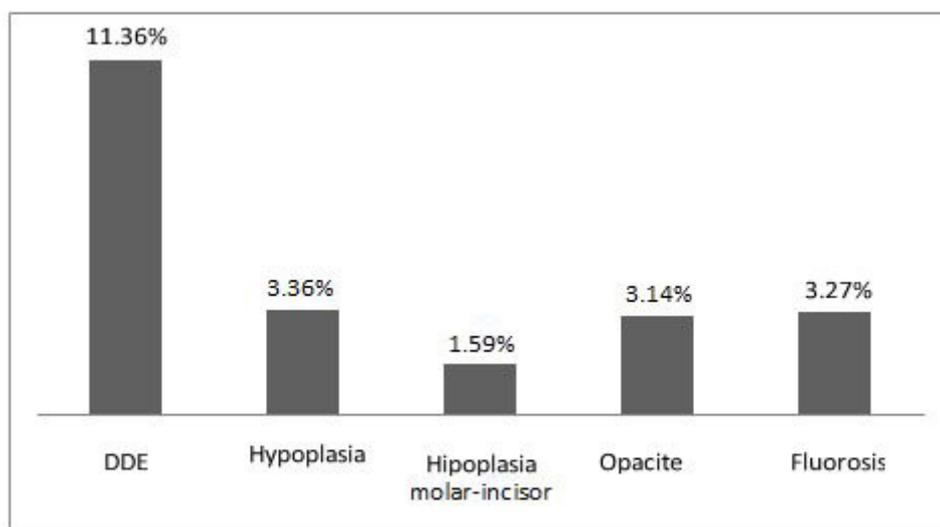
Variables	n	%
<b>Food has changed during the pandemic</b>		
No	330	75
Yes	110	25
<b>Brush your teeth today</b>		
No	8	1.82
Yes	432	98.18
<b>Supervised brushing</b>		
Children brush by themselves	323	73.41
Accompanied/supervised	117	26.59
<b>Use fluoride toothpaste</b>		
No	130	29.55
Yes	310	70.45
<b>Tooth decay</b>		
Absent	304	69.09
Present	136	30.91
<b>Enamel caries</b>		
Absent	390	88.64
Present	50	11.36

DDE		
Absent	394	88.64
Present	46	11.36
No	418	95
Yes	22	5

**Table 2: Absolute and Percentage Distribution of Preschoolers According to Behavioral and Psychological Aspects and Oral Problems. Salvador-BA (n=440).**

Table 2 shows the distribution of the sample according to behavioral, psychosocial and other oral problems. The vast majority brushed their teeth (98.18) and used fluoride toothpaste (70.45%). Most children's brushing was unsupervised (73.41%). With regard to dental caries, 30.91% of them had this oral problem and 11.36% had

incipient caries (dental enamel lesions). With regard to EDD, 11.36% of the individuals examined were affected by these alterations, of which 3.36% had hypoplasia, 1.59% had molar-incisor hypoplasia (MIH), 3.14% had opacity and 3.27% had fluorosis (Graph 1).



**Graph 1: Prevalence of Enamel Development Defects (EDD) in Preschoolers in Salvador-BA (n=440).**

Variables		DDE		DDE		p- value
		Absent		Present		
		no.	%	no.	%	
Sex	Male	189	90.87	19	9.13	0.392
	Female	205	88.36	27	11.64	
Age	< 55 months	181	88.73	23	11.27	0.601
	55 months or more	213	90.25	23	9.75	
Skin color	Others	45	91.84	4	8.16	0.578
	Blacks	349	89.26	42	10.74	
Family income	More than 1 minimum wage	107	92.24	9	7.76	0.269
	Up to 1 minimum wage	287	88.58	37	11.42	
Aid in the pandemic	Did not receive	133	89.26	16	10.74	0.889
	Received	261	89.39	30	10.31	
Impact of the pandemic on family income	No	288	89.72	33	10.28	0.845
	Yes	106	89.08	13	10.92	

Maternal education	Completed high school or more	230	89.15	28	10.85	0.745
	Up to incomplete high school	164	90.11	18	9.89	
Aggression in the pandemic	No	377	90.19	41	90.19	0.054
	Yes	17	77.27	5	22.73	

**Table 3: Bivariate Analysis of Socioeconomic and Psychosocial Aspects and the Occurrence of COVID-19 According to the Occurrence of Enamel Development Defects (EDD) in Preschoolers in Salvador-BA (n=440).**

Table 3 shows the bivariate analysis of the presence of EDD according to socioeconomic and psychosocial aspects. The occurrence of aggression during the pandemic was associated with EDD, with statistical significance (p-value: 0.054).

Variables		DDE		DDE		p- value
		Absent		Present		
		no.	%	no.	%	
Food has changed during the pandemic	No	291	88.18	39	11.82	0.105
	Yes	103	93.64	7	6.36	
Brush your teeth today	No	6	75	2	25	0.175
	Yes	388	89.81	44	10.19	
Supervised brushing	Alone	283	87.62	40	12.38	0.028
	Accompanied	111	94.87	6	5.13	
Use fluoride toothpaste	No	118	90.77	12	9.23	0.587
	Yes	276	89.03	34	10.97	
Tooth decay	Absent	277	91.12	27	8.88	0.107
	Present	117	86.03	19	13.97	
Enamel caries	Absent	354	90.77	36	9.23	0.019
	Present	40	80	10	20	

**Table 4: Bivariate Analysis of Behavioral Aspects and Oral Problems According to the Occurrence of Enamel Development Defects (EDD) in Preschoolers in Salvador- BA (n=440).**

Table 4 shows the bivariate analysis of the presence of EDD according to behavioral covariates and oral problems. The covariates absence of supervised brushing (p-value: 0.028) and occurrence of enamel caries (p-value: 0.019) were associated with EDD, with statistical significance.

## Discussion

A total of 440 preschoolers from Salvador-BA took part in this study and the prevalence of EDD was 11.36%. The study population had an average age of 55 months and was predominantly black and brown. The exploratory analysis of factors associated with EDD showed that the covariates aggression during the pandemic (p-value: 0.054), lack of supervision at brushing (p-value: 0.028) and presence of enamel caries (p-value: 0.019) were positively associated with EDD.

The prevalence of EDD in the deciduous dentition has been discussed all over the world. The literature has shown different rates in similar age groups. In a study carried out by Andrade et al. (2021) [1] in the city of Teresina-PI, with a sample of 566 preschoolers, it was observed that the prevalence of EDD in the deciduous dentition was 33.7%. Another study by Lunardelli et al. (2023) found a prevalence of 44%, similar to the previous study [10]. In another study carried out in Thuringia, Germany, with 307 preschoolers, the prevalence reached 5.3%, a result that was closer to the prevalence found in the present study [11].

The COVID-19 pandemic has had a profound and multifaceted impact on families around the world. Social isolation measures have altered family dynamics, with many facing the need to reconcile remote work with raising children at home. Economic uncertainty has brought insecurity and instability, exacerbating financial stress. As a result, families have faced mental health challenges, with a significant increase in cases of anxiety in both adults and children. During the interval between the pandemic and the post-pandemic period, the growth of socio-economic inequalities, along with changes in lifestyle and habits became more evident. This scenario has led health researchers to investigate the possible consequences of the pandemic for childhood oral health problems [4,5,7,8].

The worldwide literature has shown the negative effects of COVID-19 on stress and anxiety in the general population. Rates of physical aggression have increased significantly during the pandemic. Tso et al. (2022) [12] showed the impact of COVID-19 on the mental health of children with special educational needs and risk of maltreatment: 23.5% of the children evaluated suffered at least one episode of severe aggression, 1.9% very severe and 80.5% were psychologically attacked, clarifying that the discontinuity of care and face-to-face classes had harmful effects on the health of children and their parents/guardians, due to social isolation. In this study, enamel development defects were associated with the fact that the child had suffered aggression during the pandemic (p-value: 0.054), revealing that aspects related to care were damaged in the family environment. Damage to family care has consequences for children's general and oral health.

The lack of brushing supervision for preschoolers during the COVID-19 pandemic has had serious implications for pediatric oral health, including the increased occurrence of EDD. With the closure of schools and the suspension of oral health programs, many children missed out on the daily guidance and brushing supervision provided by professionals, essential for ensuring good oral health. At home, parents faced additional challenges as they tried to balance their responsibilities with remote work and raising children with taking care of their children's oral hygiene. Research by Bentinho and Katz (2022) [13] found that around 56.6% of children had changes in oral hygiene, including forgetting to brush their teeth a few times and sleeping without brushing their teeth, reinforcing the lack of supervision from parents/guardians. In this study, lack of supervision in brushing was associated with defects in enamel development (p-value: 0.028). It is possible that this finding is related to the development of fluorosis, one of the types of EDD found in the sample examined, since lack of supervision when brushing may be related to increased intake of fluoridated dentifrice in childhood.

It is noteworthy that the relationship between EDD and the presence of enamel caries among children has been observed. The increased vulnerability of teeth affected by EDD to caries is possibly due to enamel defects presenting as retentive and irregular sites, which are favorable to cariogenic bacteria. Furthermore, in a study carried out by Andrade et al. (2021), they reported that susceptibility to caries may be a consequence of the morphological and structural dental changes caused by EDD, such as color changes, lower mineral content, irregularities on the tooth surface and loose arrangement of enamel prisms, leading to greater accumulation of biofilm, difficulty in hygiene and loss of tooth structure [1]. In this same study, carried out with 566 preschoolers aged 5 years old in Teresina-PI, there was a positive association between EDD and experience of caries, similar to what was observed in this study. In addition, in a study carried out by Paiva et al. (2022) it was also possible to observe a positive association between EDD and the presence of caries in the deciduous dentition in preschoolers in the city of Salvador [3].

This investigation revealed the oral health situation, especially of the DDE, in children in the pre-school age group (02 to 05 years old) in the post-COVID-19 pandemic period in Salvador-BA. The analysis of its findings needs to be done with caution, as it is not guaranteed that the factors evaluated will be exposed in relation to the oral problems evaluated, considering the cross-sectional approach of the epidemiological design. It should also be noted that the interviews with the guardians were self-administered, which may have caused problems in recording the information, generating limits in the classification of the covariates present in the questionnaire.

## Conclusions

EDD affected preschool children in Salvador-BA and was associated with psychosocial aspects (aggression during the COVID-19 pandemic), behavioral aspects (lack of supervision during brushing) and early childhood caries. Public policies that encourage health promotion, including the reduction of social inequalities, as well as programs for the prevention and control of oral problems need to be planned more effectively in the country. In this sense, it is important to reinforce the importance of diagnosing and monitoring EDD, which can increase the risk of caries in the deciduous dentition [14].

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