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Dental Caries in Childhood after COVID-19 Pandemic in Salvador-BA, Brazil

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Abstract: Introduction: Early childhood caries is a significant public health problem among preschool children. The COVID-19 pandemic, which restricted dental services, altered family dynamics, affected child development, and created new caregiver demands, may have exacerbated this issue. **Objective:** Analyze the occurrence and severity of caries and identify associated factors in preschool children attending public municipal daycare centers in Salvador, Bahia, Brazil, **Methodology:** A cross-sectional epidemiological study was conducted to investigate caries in children aged 2 to 5 years in 2022 and 2023. Caries were assessed using the decayed, extracted, filled, and missing teeth (DEFT) index, and prevalence was calculated. Sociodemographic, family dynamic, dietary, and healthcare utilization data were obtained through a questionnaire. After descriptive and exploratory analyses, robust Poisson multivariable regression was conducted at a 5% significance level, considering socioeconomic, psychosocial, and behavioral aspects. **Results:** 440 preschoolers participated, with a mean age of 55 months. The majority were Black or mixed race (88.86%) and female (52.73%). The prevalence of caries was 30.91% and the mean DEFT score was 1.1. In the multivariable analysis, low family income (up to one minimum wage) and not playing outdoors during the pandemic were associated with a higher prevalence of caries. **Conclusion:** The prevalence and severity of caries remain high, and the pandemic has contributed to the maintenance of this epidemiological scenario. Public health measures and policies promoting social justice should be planned to improve oral health conditions in childhood.

Keywords: oral health; early childhood caries; epidemiology

Introduction

Early childhood caries (ECC) remains a significant public health issue, with profound effects on child development. This condition is defined by the International Association of Paediatric Dentistry[1] as the presence of one or more decayed (cavitated or non-cavitated), missing, or filled tooth surfaces (due to caries) in any primary tooth of a child under six years of age, determined by biological, behavioral, and psychosocial factors related to the individual's environment.

The family context, including all aspects of their lifestyle (socioeconomic factors and lifestyle choices), can influence children's oral health, including the onset of caries. Thus, parental behaviors and knowledge regarding oral health directly impact their children's oral health, in addition to cultural factors and the parents' socioeconomic and educational levels[2].

According to the World Health Organization (WHO, 2019), untreated caries in primary teeth affects 510 million children worldwide, a significant figure that places caries at the top of the most prevalent diseases and, therefore, a major public health issue. In developed countries, the prevalence of caries has shown a downward trend in recent years, and the same has been observed in Brazil. However, there is a polarization in its occurrence due to socioeconomic differences. For example, in Brazil, 60% of the caries burden is concentrated in the North and Northeast regions[3].

The COVID-19 pandemic exacerbated the global situation from a social, political, and economic perspective, directly impacting child development. During the pandemic climax, family dynamics shifted with the suspension of non-essential activities, work moved to a remote format, and schools

transitioned to online (or non-existent) education. This led to unhealthy behaviors, confinement, reduced leisure time and outdoor physical activities, income reduction, and family illness and death. This entire scenario brought various insecurities for families, with parents experiencing peaks of stress, resulting in physical and mental health problems that also affected children's health[4].

Additionally, healthcare services were reduced, and dental professionals had their activities suspended, with a slow recovery in 2021. The consumption of ultra-processed and sugary foods increased as a form of comfort. Children with sleep disturbances increased nighttime bottle use. These dietary changes may have contributed to the rise in obesity, diabetes, cardiovascular diseases, and dental caries[3].

In this context, this study aims to analyze the prevalence of dental caries in preschool-aged children attending public daycare centers in Salvador, Bahia, in the years 2022 and 2023, as well as to identify the associated factors.

Methodology

This is a cross-sectional epidemiological study. Data collection took place in Salvador, Bahia, in 2022 (August to November) and 2023 (March and April). The study was approved by the Research Ethics Committee of the School of Dentistry at UFBA – CAAE: 60817222.6.0000.5024. Furthermore, oral examinations were only conducted after the parents or guardians signed the Informed Consent Form (ICF) and with the child's assent.

A convenience sample of children aged 2 to 5 years, attending municipal public daycare centers, was selected based on the authorization of the Municipal Education Department of Salvador-BA. The choice of daycare centers was made by the department's recommendation and because these centers represent the largest social space for children in half of the city's health districts.

Data collection occurred within the school environment during the academic year and was conducted by trained and calibrated dental professionals and dental students from the School of Dentistry at the Federal University of Bahia (UFBA). In addition to oral exams, a self-administered structured questionnaire was given to the children's guardians to investigate family environment aspects, including socioeconomic, behavioral, and psychosocial factors in the context of the COVID-19 pandemic.

Dental caries were evaluated according to the criteria proposed by the deft index (decayed, missing, and filled teeth), the same index used in the most recent national epidemiological surveys (Brazil, 2004 and Brazil, 2012). ECC was defined as the presence of caries in all examined children with a dmft score greater than zero.

The collected information was entered into an Excel database, and statistical analysis was performed using STATA 14. Data were analyzed descriptively and exploratorily to identify potential associations. The Chi-square test was used with a significance level of 5% to identify variables associated with dental caries. Robust Poisson regression was used to estimate prevalence ratios and their respective 95% Confidence Intervals, considering caries as the dependent variable. In the multivariate analysis, the stepwise forward method was adopted to include the final adjusted models. Independent variables with a p-value <0.20 for each outcome in the univariate analysis were incorporated, and those with a p-value <0.05 were retained in the final models.

Results

A total of 440 preschool children aged 2 to 5 years, attending municipal public daycare centers in Salvador, Bahia, participated in this study during the years 2022-2023. The average age of the study population was 55 months, and the majority were Black or mixed race (88.86%). Female children were more prevalent (52.73%). Most families reported a household income of up to one minimum wage (73.64%), and most of mothers interviewed had completed high school or higher education (58.64%). Most families received financial aid during the pandemic (66.14%), and 72.95% reported that there was no impact on their household income during this period. Additionally, 5% of the children experienced violence during the pandemic (Table 1).

Table 1. Absolute and percentage distribution of preschoolers according to socioeconomic aspects. Salvador-BA, 2022-2023 (n=440).

Variables	N	%
Gender		
Male	208	47,27
Female	232	52,73
Age		
< 55 months	204	46,36
≥ 55 months	236	53,64
Skin color		
Others	49	11,14
Blacks (black and brown)	391	88,86
Family Income		
Greater than 1 minimum wage	116	26,36
Up to 1 minimum wage	324	73,64
Maternal Education		
Completed high school or higher	258	58,64
Until incomplete high school	182	41,36
Receiving assistance during the pandemic		
No	149	33,86
Yes	291	66,14
Impact of the Pandemic on Family Income		
No	321	72,95
Yes	119	27,05
The child suffered from aggression		
No	418	95
Yes	22	5
The child had COVID-19.		
No	405	92,05
Yes	35	7,95

Regarding behavioral aspects and oral health conditions, most children ate daily at the daycare (80.91%), 75% experienced no changes in their diet during the pandemic, 73.41% never had supervised brushing, and nearly 14% did not have dental biofilm. The children spent more time watching television (58.64%), did not play outdoors during the pandemic (65.45%), and did not attend remote classes (63.18%) (Table 2). Caries were present in 30.91% of the sample at the time of the examination. The dmft index was 1.1, and the average number of decayed primary teeth was 0.98.

Table 2. Absolute and percentage distribution of preschoolers according to behavioral aspects and oral health problems. Salvador-BA, 2022-2023 (n=440).

Variables	N	%
Meals at daycare		
Everyday	356	80,91
Sometimes or don't eat	84	19,09
Changes in diet during the pandemic		
No	330	75
Yes	110	25
Presence of Caries		
No	304	69,09
Yes	136	30,91
Tooth brushing habit		
No	8	1,82

Yes		432	98,18
Supervised brushing			
No		323	73,41
Yes		117	26,59
Use of fluoride toothpaste			
No		130	29,55
Yes		310	70,45
Dental Biofilm			
No		380	86,36
Yes		60	13,64
Reduced Sleep			
No		355	80,68
Yes		85	19,32
More screen time			
No		182	41,36
Yes		258	58,64
Played outdoors during the pandemic			
No		288	65,45
Yes		152	34,55
Presented fear in the pandemic			
No		344	78,18
Yes		96	21,82
Remote classes during the pandemic			
No		278	63,18
Yes		162	36,82

Table 3 presents the bivariate analysis regarding the occurrence of ECC (in primary dentition) and its relationship with the investigated covariates. Several factors were associated with this oral health issue: older age (55 months or more), lower household income, receiving pandemic-related financial aid, lower maternal education, the child experiencing violence during the pandemic, and not playing outdoors.

Table 3. Bivariate analysis of the absolute and percentage distribution of preschoolers according to socioeconomic aspects. Salvador-BA, 2022 (n=440).

Variables		Caries		Cáries		P-valor
		Absent		**Present**		
		N	**%**	**N**	**%**	
Gender	Male	141	67,79	68	32,21	0,576
	Female	163	70,26	69	29,74	
Age	< 55 months	159	77,94	45	22,06	0,000
	≥55 months	145	61,44	91	38,56	
Skin Color	Others	39	79,59	10	20,41	0,092
	Black	265	67,77	126	32,23	
Family Income	Greater than 1 minimum wage*	94	81,03	22	18,97	0,001
	Up to 1 minimum wage*	210	64,81	114	35,19	
Maternal Education	Completed high school or higher	188	72,87	70	27,13	0,041
	Until incomplete high school	116	63,74	66	36,26	

Receiving assistance during the pandemic	No	116	77,85	33	22,15	0,004
	Yes	188	64.60	103	35,40	
Impact of pandemic on Family Income	No	217	67,60	104	32,40	0,267
	Yes	87	73,11	32	26,89	
The child suffered aggression	No	293	70,10	125	29,90	0,047
	Yes	11	50,00	11	50,00	
The child had covid.	No	276	68,15	129	31,85	0,145
	Yes	28	80,00	7	20,00	

*Salário mínimo em 2022: R$1.212,00.

In the multivariate analysis, lower household income (up to one minimum wage) (adjusted PR = 1.57; 1.04-2.38, 95% CI) and the fact that the child did not play outdoors during the pandemic (adjusted PR = 1.32; 1.01-1.74, 95% CI) were associated with ECC (Table 5).

Table 4. Bivariate analysis of the absolute and percentage distribution of preschoolers according to behavioral aspects and oral health problems. Salvador-BA, 2022 (n=440).

Variables		Caries Absent		Caries Present		P-valor
		N	%	N	%	
Meals at daycare	Everyday	245	68,82	111	31,62	0,800
	Sometimes or don't eat	59	70,24	25	29,76	
Change in diet during a pandemic	No	225	68,18	105	31,82	0,475
	Yes	79	71,82	31	28,18	
Dental Biofilm	No	262	68,95	118	31,05	0,870
	Yes	42	70,00	18	30,00	
Tooth brushing habit	No	4	50,00	4	50,00	0,238
	Yes	300	69,44	132	30,56	
Supervised Brushing	No	231	71,52	92	28,48	0,067
	Yes	73	62,39	44	37,61	
Use of fluoride toothpaste	No	89	68,46	41	31,54	0,853
	Yes	215	69,35	95	30,65	
Reduced sleep during pandemic	No	244	68,73	111	31,27	0,739
	Yes	60	70,59	25	29,41	
More screen time	No	128	70,33	54	29,67	0,637
	Yes	176	68,22	82	31,78	
Played outdoors during the pandemic	No	208	72,22	56	36,84	0,05
	Yes	96	63,16	82	31,78	
Presented fear in the pandemic	No	235	68,31	109	31,69	0,504
	Yes	69	71,88	27	28,13	
Remote classes during the pandemic	No	198	71,22	80	28,78	0,205
	Yes	106	65,43	80	27,78	

Table 5. Adjusted Prevalence Ratios, respective 95% Confidence Intervals, and p-values, for the association between socioeconomic and behavioral factors and early childhood caries in preschoolers, obtained by robust Poisson regression, Salvador-BA, 2022. (n=440).

Variables	RP (IC=95%)	P-valor
Skin Color		
Others	1	
Black	1,48 (0,85-2,57)	0,163
Family Income		
More than 1 minimum wage	1	0,033
Up to 1 minimum wage	1,57 (1,04-2,38)	
Receiving assistance during the pandemic		
No	1	0,083
Yes	1,36 (0,96-1,93)	
Maternal Education		
Completed high school or higher	1	0,416
Until incomplete high school	1,22 (0,85-1,48)	
The child suffered aggression.	1	
No	1,46	0,080
Yes	(0,97-2,22)	
Supervised Brushing	1	
No	1,22	0,167
Yes	(0,92-1,62)	
Played outdoors during the pandemic	1	
Yes	1,32	0,046
No	(1,01-1,74)	

Discussion

This study involved 440 preschool children, and the prevalence of caries was 30.91%. The average age of the study population was 55 months, predominantly composed of Black and mixed-race individuals. In the multivariate analysis, lower income and the child not playing outdoors during the pandemic were associated with a higher occurrence of caries, a possible proxy variable for poorer nutrition, parental overload, and/or a stressful family environment.

Caries is the most prevalent disease in the world, and although there is a global trend toward a decrease, according to WHO data, its distribution is unequal, leading to a polarization among the most vulnerable populations, thereby presenting a public health challenge, as it is a disease linked to biological, behavioral, and socioeconomic determinants.

Investigations worldwide report that caries leads to various problems in early childhood, including difficulties in socialization, smiling, frequent pain, nutritional impact, school absenteeism, and sleep disturbances. These issues negatively affect the child's quality of life and are psychosocial burdens that require early diagnosis and treatment for caries, as well as subsequent hygiene and nutrition education.

Global literature has revealed an extremely important issue: the polarization of caries among the most vulnerable populations. During the COVID-19 pandemic and post-pandemic period, which exacerbated socioeconomic inequalities, changes in lifestyle and unhealthy eating habits led to increased investigations into the impact of these factors on the occurrence of caries.

In the study by Uribe et al., the prevalence of caries in primary teeth worldwide varies from 30% (Africa) to 82% (Oceania) among continents, with China showing a prevalence of 89% and Singapore

16%. This indicates significant discrepancies within nearby territories. Graesser et al. highlighted a prevalence of caries of 56.6% in Australia, and in that same study, children from unfavorable socioeconomic backgrounds, such as those with health cards, non-English origins, and indigenous backgrounds, showed higher levels of the disease.

In this study, family income and low maternal education were associated with childhood caries in the bivariate analysis (p<0.05); in the multivariate analysis, family income was one of the factors that remained related to this condition (RP=1.57; 1.04-2.38 95% CI). In the European study by Foxman et al., it was observed that lower family income and maternal education (up to high school or less) increased the risk of childhood caries by at least two times. The investigation by Garcia-Pérez et al., conducted with rural children in Mexico, showed that populations with high marginalization indices are more susceptible to caries. Another study conducted in Montevideo, Uruguay, found a higher prevalence of caries among preschoolers in low socioeconomic status populations (74.90%), and for mothers with low education levels, the prevalence of children with caries was 77.90%, which showed statistical significance (p-value <0.01).

Exclusive breastfeeding and adequate family income are protective factors associated with the occurrence of caries. In the survey by Santos et al., conducted with 535 children aged 6 to 36 months in Salvador-BA, in areas covered by Family Health Units, the prevalence of dental caries was 13.64%, where older children's age was also associated with caries, similar to this study, resulting from the cumulative nature of the disease; however, breastfeeding was not investigated in this study.

Almeida et al., when evaluating the oral conditions of 2,788 children attending municipal public preschools and Family Health Units, aged 36 to 60 months in Salvador-BA, observed a prevalence of caries of 38.38% and a dmft index of 1.53. These findings were higher than those observed in this study (prevalence of caries of 30.91% and dmft index of 1.1). In the SB Brazil 2010 survey, the dmft values in the Salvador region were 1.70, in the Northeast state 2.89, ranking third among states with the highest indices, behind the North and Midwest, and the index for Brazil was 2.43.

Tso et al. analyzed the impact of COVID-19 on the mental health of children with special educational needs (SEN) in Hong Kong and the risk of abuse. The authors observed that rates of physical aggression significantly increased during the pandemic: 23.5% of children experienced at least one episode of severe aggression, 1.9% suffered very severe physical aggression, and 80.5% were victims of psychological aggression, demonstrating that the interruption of rehabilitation, medical care, and classes had detrimental effects on the mental health of children and their caregivers/parents. In this investigation, caries was associated with the fact that the child suffered aggression during the pandemic (p=0.047).

Increased parental stress during the pandemic also led to worse stress levels in children, necessitating self-regulation of their energies. Various behavioral changes influenced overall health care for children and also oral health, triggering an increase in the prevalence of caries during this period. In the present study, not going outside to play was associated with caries (adjusted RP=1.32; 1.01-1.74 95% CI).

In the study by Buechel et al., conducted in the context of the COVID-19 pandemic with German families of children aged 0-3 years, it was found that 37.7% experienced parental stress, 18.5% had symptoms of depression, and 30.1% anxiety, where infants and children also showed mental health problems correlating moderately with parental stress. Research conducted in India by Sama et al. revealed that 73.15% of children exhibited signs of increased irritability and 51.25% an increase in anger during the pandemic. All these findings are highly relevant for developing preventive measures and interventions regarding mental health.

This investigation revealed the oral health situation, especially regarding caries, in preschool children (2 to 5 years old) during the COVID-19 pandemic in Salvador-BA. The analysis of its findings must be conducted with caution, as it is not guaranteed that the exposure to the evaluated factors preceded the occurrence of caries; additionally, the interviews conducted with the caregivers were self-administered, which may have contributed to issues in recording information, leading to limitations in classifying the covariates present in the questionnaire.

Conclusion

The COVID-19 pandemic brought various impacts on society, among which significant changes in the material and psychosocial conditions of families stand out. These conditions are fundamental for child development and are directly related to oral health issues. Dental caries remains a public health problem to be addressed in the municipality of Salvador-BA, considering the high prevalence found (30.91%). Moreover, its occurrence was associated with sociodemographic and psychosocial aspects strongly influenced by the pandemic, such as the child's older age (55 months or older), reduced family income, and the child playing outdoors during the pandemic. Public policies that combat social inequalities in our country, as well as programs specifically aimed at children's oral health, are necessary for changes in the epidemiological profile of oral diseases among children.

References

1. Pitts NB, Baez RJ, Diaz-Guillory C, Donly KJ, Alberto Feldens C, McGrath C, et al. Cáries na primeira infância: declaração do IAPD Bangkok. J Dent Child (Chic). 2019;86(2):72.

2. Firmeza LMD, Lima MRP, Evangelista LNF, Freire Junior JLM, Almeida MEL de, Teixeira AKM. Relationship between social network and social support with early childhood caries. RGO [Internet]. 2022;70:e20220037. Available at: http://doi.org/10.1590/1981-86372022003720210003

3. Aguiar BD, Fernandes MEF, Aguiar MHR de, Torquato DSA, Peres EC, Teixeira AKM. Nutritional status and dental caries of schoolchildren from Sobral - Ceará. RGO [Internet]. 2019;67:e20190049. Available at: http://doi.org/10.1590/1981-86372019000493499

4. Buechel C, Nehring I, Seifert C, Eber S, Behrends U, Mall V, et al. A cross-sectional investigation of psychosocial stress factors in German families with children aged 0–3 years during the COVID-19 pandemic: initial results of the CoronabaBY study. Child Adolesc Psychiatry Ment Health [Internet]. 2022;16(37):1-14. Available at: http://dx.doi.org/10.1186/s13034-022-00464-z

5. Sardana D, Galland B, Wheeler BJ, Yiu CKY, Ekambaram M. Effect of sleep on development of early childhood caries: a systematic review. Eur Arch Paediatr Dent [Internet]. 2023;24(1):1–14. Available at: http://dx.doi.org/10.1007/s40368-022-00753-3

6. Ruff RR, Habib R, Godín TB, Niederman R. School-based caries prevention and the impact on acute and chronic student absenteeism. J Am Dent Assoc [Internet]. 2023;154(8):753–9. Available at: http://dx.doi.org/10.1016/j.adaj.2023.05.007

7. Lima LHG, Rocha NB da, Antoniassi CP, Moura MS de, Fujimaki M. Prevalência e severidade da cárie dentária em escolares do Ensino Fundamental de um município vulnerável. Rev Odontol UNESP [Internet]. 2020;49: e20200063. Available at: http://dx.doi.org/10.1590/1807-2577.06320

8. Frankel LA, Kuno CB, Sampige R. The relationship between COVID-related parenting stress, nonresponsive feeding behaviors, and parent mental health. Curr Psychol [Internet]. 2023;42(13):10706–17. Available at: http://dx.doi.org/10.1007/s12144-021-02333-y

9. Uribe SE, Innes N, Maldupa I. The global prevalence of early childhood caries: A systematic review with meta-analysis using the WHO diagnostic criteria. Int J Paediatr Dent [Internet]. 2021;31(6):817–30. Available at: http://dx.doi.org/10.1111/ipd.12783

10. Graesser H, Sore R, Rogers J, Cole D, Hegde S. Early childhood caries in Victorian preschoolers: A cross-sectional study. Int Dent J [Internet]. 2022;72(3):381–91. Available at: http://dx.doi.org/10.1016/j.identj.2021.05.013

11. Foxman B, Davis E, Neiswanger K, McNeil D, Shaffer J, Marazita ML. Maternal factors and risk of early childhood caries: A prospective cohort study. Community Dent Oral Epidemiol [Internet]. 2023;51(5):953–65. Available at: http://dx.doi.org/10.1111/cdoe.12794

12. García-Pérez A, Pérez-Pérez NG, Flores-Rojas AI, Barrera-Ortega CC, González-Aragón Pineda AE, Villanueva Gutiérrez T. Marginalization and fluorosis its relationship with dental caries in rural children in Mexico: A cross-sectional study. Community Dent Health [Internet]. 2020;37(3):216–22. Available at: http://dx.doi.org/10.1922/CDH_00017Perez07

13. García Righetti GA. Caries dental en preescolares: estudio transversal de base poblacional en Montevideo, Uruguay. Odontoestomatologia [Internet]. 2023;25(41):12. Available at: http://dx.doi.org/10.22592/ode2023n41e228

14. Santos MLMF dos, Cangussu MCT, Andrade DJC de. Fatores associados à cárie dentária em crianças de seis a 36 meses, em Salvador-BA. Rev Bras Saúde Materno Infant [Internet]. 2023;23:e20190196. Available at: http://dx.doi.org/10.1590/1806-9304202300000196

15. Frederico TA, Rodrigues APL, Anjos ÁLN, Cabral MBBS, Vianna MIP, Cangussu MCT. Prevalence of dental caries and dental defects of enamel in children aged 3 to 5 years old from Salvador- BA, Brazil, 2018. Acta Sci Paediatr [Internet]. 2020;4(6):25–31. Available at: http://dx.doi.org/10.31080/aspe.2020.03.0255

16. Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Coordenação Nacional de Saúde Oral. SB Brasil 2010. Pesquisa Nacional de Saúde Oral. Resultados Principais. Brasília (DF): Ministério da Saúde; 2012. [Accessed on 2019 Feb 3]. Available at: https://bvsms.saude.gov.br/bvs/publicacoes/pesquisa_nacional_saude_bucal.pdf

17. Tso WWY, Chan KL, Lee TMC, Rao N, Lee SL, Jiang F, et al. Mental health & maltreatment risk of children with special educational needs during COVID-18. Child Abuse Negl [Internet]. 2022;130(105457):105457. Available at: http://dx.doi.org/10.1016/j.chiabu.2021.105457

18. Sama BK, Kaur P, Thind PS, Verma MK, Kaur M, Singh DD. Implications of COVID-19-induced nationwide lockdown on children's behavior in Punjab, India. Child Care Health Dev [Internet]. 2021;47(1):128–35. Available at: http://dx.doi.org/10.1111/cch.12816

19. López-Morales H, Gelpi Trudo R, del-Valle MV, Canet-Juric L, Biota M, Andrés ML, et al. The Pandemial babies: effects of maternal stress on temperament of babies gestated and born during the pandemic. Curr Psychol [Internet]. 2024;43(16):14881–93. Available at: http://dx.doi.org/10.1007/s12144-022-03976-1