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Molar incisor hypomineralization in HIV-infected children and adolescents

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ABSTRACT

The objective was to determine the prevalence of molar incisor hypomineralization (MIH) among individuals between 7 and 15 years old infected or noninfected with human immunodeficiency virus (HIV). The study was conducted with 33 HIV-infected individuals (study group; SG) and 66 non-HIV-infected schoolchildren (control group; CG), paired by gender and age. Data collection was based on medical records (SG), a questionnaire for caregivers and oral examination for diagnosis of MIH (European Academy of Pediatric Dentistry criteria) and caries (DMFT index and ICDAS). Data were analyzed with Mann-Whitney, chi-square, and Fisher's exact tests and logistic regression. In SG, MIH (45.5%) and caries (87.9%) had higher prevalence. MIH was associated with use of protease inhibitors in SG (OR: 2.14; 95% CI: 1.21 to 3.77) and incubator need in CG (OR: 2.80; 95% CI: 1.71 to 9.10). HIV-infected patients had a higher prevalence of MIH and dental caries in the permanent dentition.

KEY WORDS: HIV, children, adolescents, enamel hypomineralization, etiology

Introduction

Molar incisor hypomineralization (MIH) is a development defect of dental enamel that affects between one and four first permanent molars and is often associated with hypomineralization of other teeth such as the permanent incisors.[1] This condition is caused by changes in the development of the enamel organ during the transition and calcification stages of amelogenesis.[2,3] The prevalence of MIH varies from 2.4% to 27.7%.[4,5]

Dental enamel with MIH is more porous[6] and prone to disintegration, increasing the susceptibility of the individual to carious lesions and/or dentin sensitivity in missing enamel areas.[7,8] Because the enamel cannot be renewed, development defects become permanent and negatively impact on oral health.[9,10]

The etiology of MIH is unclear,[11] but studies suggest that this change is multifactorial. Several associated factors have been identified, highlighting pregnancy and perinatal complications, early childhood diseases, use of antibiotics in the first 3 years of life and possible genetic implications.[5,11,12]

There are population groups with risk factors for development defects of enamel[13] especially in patients infected vertically by human immunodeficiency virus (HIV), because they are often exposed to these factors such as pregnancy complications, including prematurity and low birth weight, infectious processes, and early and continuous use of antiretroviral drugs.[5,11,14–17]

The HIV infection in children and adolescents affects the functioning of various organs, and the progression of acquired immunodeficiency syndrome is often more aggressive because of the immaturity of the immune system of these patients.[18] Study with HIV-infected patients showed that the delay in the chronology of tooth mineralization of children was associated with the use of antiretroviral therapy.[19]

Because of the high occurrence of factors associated with developmental defects of enamel in children and adolescents infected with HIV and the

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possibility of these events interacting and occasioning changes in the enamel formation process, the aim of this study was to determine the prevalence of MIH and possible etiological factors in HIV-infected children and adolescents. Our hypothesis is that the prevalence of MIH in HIV patients is higher than in healthy children.

Methodology

Ethical aspects

This case control study was approved by the Research Ethics Committee of the Federal University of Piauí (UFPI), Brazil (Opinion 935,449). Parents and guardians of the children and adolescents were informed about the research and asked to sign an informed consent form and participants signed a consent form, in line with the guidelines of the Declaration of Helsinki.

Population and sample

The population of the study group (SG) consisted of children and adolescents infected vertically by HIV, aged 7 to 15 years old and attending a referral centre for infectious diseases located in the city of Teresina, Piauí, Brazil. The sample was consecutive; all patients who met the inclusion criteria and returned for routine visits from October 2014 to July 2015 were examined.

The control group (CG) was composed of healthy children and adolescents enrolled in public schools in the city of Teresina, Piauí, Brazil. The students were selected by stratified random sampling and matched by sex and age, with a ratio of two individuals not infected with HIV to one individual infected with HIV.

The subjects were selected from a draw of five schools from a list provided by the municipal education authority. After contact with educational institutions, the nominal lists with age and gender of the students were obtained, and individuals eligible for the study were selected. A draw was performed to determine the participants. The control was matched for gender and age in the proportion of 1:2 (SG and CG, respectively).

Inclusion and exclusion criteria

In both groups, individuals aged 7 to 15 years, whose first four permanent molars had fully erupted and whose occlusal surfaces were not covered by gingival tissue, were included. Children with dental fluorosis to a moderate or advanced degree, or who had enamel hypoplasia or imperfect amelogenesis, or at the time of evaluation were receiving orthodontic treatment were not eligible for the study.

Pilot study

Before data collection, a pilot study was conducted with 10 children or adolescents attending UFPI's Children's Dental Clinic for evaluation of the proposed methodology and data collection instruments. The pilot study confirmed the design of the original study, so no changes to the proposed methodology were made. The individuals included in the pilot study were not considered for the final results of the study.

Calibration

Calibration was carried out in two stages. The first comprised the training in lux which consisted of slide projections with images of different types of MIH. After a week, the photographs were reassessed and the examiner had to hit at least 80% of clinical diagnoses.[20] In the second stage, 10 patients not participating in the research were examined and, after 2 weeks, they were reexamined. These participants were evaluated by only two examiners (dentists) in all stages of the study and, respectively, obtained kappa index interrater reliability of 0.83 and intrarater reliability of 0.87 and 0.93.

Data collection

Data collection was carried out in three stages. First, questionnaires were given to parents or guardians requesting information about the participants' socioeconomic and demographic background, oral hygiene and other habits, as well as posing questions related to pregnancy and birth, neonatal conditions and the occurrence of primary diseases in childhood. In the second phase, we evaluated the medical records of patients in SG for information related to HIV infection such as viral load, CD4 and CD8 T-cell counts after the start of antiretroviral therapy regimens. The third stage comprised a clinical dental examination after participants had brushed with fluoridated toothpaste. The dental examination was performed in a conventional dental office with a dental mirror (Golgran, São Paulo, Brazil), exploratory probe number 5 (Golgran), and a periodontal probe recommended by WHO (Golgran) under an artificial lighting reflector with clean, dry teeth with a triple syringe.

For the diagnosis of MIH, the criteria proposed by the European Academy of Pediatric Dentistry were used. These criteria include: presence of demarcated opacities, posteruptive disintegration of the enamel, atypical restorations, first molars extracted because of MIH and failed eruption of the first permanent molar or permanent incisor.[1] Demarcated opacities were classified as white, yellow, and brown in tone[21] and severity of defects as mild, moderate, and severe.[22]

Dental caries in children and adolescents were identified with the DMFT index (decayed permanent teeth, extracted because of caries and filled)[23] and the ICDAS index (International System of Detection and Assessment of Caries).[24]

Statistical analysis

Data were analyzed with the Statistical Package for Social Science program (SPSS for Windows, version 20.0, SPSS Inc., Chicago, IL, USA). Descriptive analysis employed prevalence, mean, and standard deviation. In the bivariate analysis, Pearson's chi-square and Fisher's exact tests were used to determine associations between pre-, peri-, and postnatal aspects and the presence of MIH. Variables with $p \leq 0.20$ in bivariate analysis were included in the multivariate logistic regression by stepwise backward method, which only selects the significant variable of each test step. The results were expressed as odds ratio (OR) and 95%

confidence interval (CI) and remained in the model if associations reached $p \leq 0.05$ (Wald test). In all analyses, the significance level was fixed as alpha = 5%.

Results

Thirty-three children and adolescents infected with HIV (SG) with a mean age of 10.55 ± 2.26 years were included in this study. Four (12.12%) patients refused to undergo the medical examination and they were not included in the statistical analysis. The CG consisted of 66 students.

The socioeconomic and demographic characteristics and oral clinical conditions of both groups are shown in Table 1. The prevalence of MIH in the SG was higher than that observed in the CG (45.5% vs. 24.2%, $p = 0.032$).

There was higher caries occurrence in the SG (DMFT index = 2.57 vs. 1.23, $p = 0.003$). In assessment of the ICDAS, significantly higher average lesions were observed in stages 3, 5, and 6 in the SG compared with the CG (Table 2).

Table 1. Socioeconomic and demographic characteristics and oral clinical conditions of HIV-infected (SG) and non-HIV-infected (CG) children and adolescents.

Variables	Groups		*p*
	Study	Control	
	n (%)	n (%)	
Mean Age (μ, SD)	10.55 ± 2.26	10.55 ± 2.25	1.000[a]
Gender			1.000[b]
Male	17 (51.5)	34 (51.5)	
Female	16 (48.5)	32 (48.5)	
Monthly family income (in minimum wages)[d]			0.930[b]
≤2	20 (60.6)	37 (59.7)	
>2	13 (39.4)	25 (40.3)	
Mother's/guardian's education (years of study)			**0.012**[b]
≤8	20 (60.6)	21 (33.9)	
>8	13 (39.4)	41 (66.1)	
Lives with his/her father and mother			**0.008**[b]
No	23 (69.7)	27 (41.5)	
Yes	10 (30.3)	38 (58.5)	
Type of school			0.438[c]
Private	04 (12.1)	04 (6.3)	
Public	29 (87.9)	60 (93.8)	
Number of daily brushings			0.094[b]
01	11 (33.3)	10 (15.1)	
02	10 (30.3)	30 (45.5)	
03 or more	12 (36.4)	26 (39.4)	
Caries experience			**0.047**[c]
No	04 (12.1)	20 (30.3)	
Yes	29 (87.9)	46 (69.7)	
Prevalence of MIH			**0.032**[b]
No	18 (54.5)	50 (75.8)	
Yes	15 (45.5)	16 (24.2)	
TOTAL	**33 (100.0)**	**66 (100.0)**	

[a]Mann-Whitney test.
[b]Chi-square test.
[c]Fisher's exact test.
[d]The family income was categorized based on the monthly minimum wage in Brazil, 2015 (approximately US$ 266.40).
μ = average; SD = standard deviation; MIH = molar incisor hypomineralization; HIV = human immunodeficiency virus.

Table 2. Average teeth with MIH and the DMFT index and its components.

Variables	Study	Control	p^a	Total
	μ (SD)	μ (SD)		μ (SD)
Teeth with MIH[b]	2.67 (±1.59)	2.87 (±1.67)	0.685	2.77 (±1.61)
DMFT	2.57 (±2.45)	1.23 (±1.64)	**0.003**	1.68 (±2.04)
Decayed	1.88 (±1.79)	0.95 (±1.49)	**0.005**	1.26 (±1.65)
Missing	0.03 (±0.17)	0.02 (±0.12)	0.615	0.02 (±0.41)
Filling	0.67 (±1.99)	0.24 (±0.76)	0.995	0.38 (±1.31)
ICDAS 0	18.55 (±5.51)	21.79 (±4.20)	**0.006**	20.71 (±4.89)
ICDAS 1	0.33 (±0.81)	0.38 (±1.03)	0.671	0.36 (±0.96)
ICDAS 2	1.15 (±1.42)	0.92 (±1.24)	0.430	1.00 (±1.30)
ICDAS 3	1.33 (±1.34)	0.71 (±1.11)	**0.009**	0.92 (±1.22)
ICDAS 4	0.06 (±0.35)	0.12 (±0.62)	0.711	0.10 (±0.54)
ICDAS 5	1.24 (±1.39)	0.56 (±0.86)	**0.019**	0.79 (±1.11)
ICDAS 6	2.30 (±3.05)	0.53 (±1.24)	**0.001**	1.12 (±2.19)

[a]Mann-Whitney test.
[b]This average included just teeth affected by MIH.
μ = average; SD = standard deviation; MIH = molar incisor hypomineralization.

The number of teeth affected by MIH and severity in both groups are shown in Table 3. Regarding the color of the opacities of MIH lesions in the SG, 54.4% of lesions were white/beige, 34.8% were yellow, and 10.8% were brown. In the CG, 50% were white/beige, 32.5% were yellow, and 17.5% were brown.

In the bivariate analysis, associations were found between the use of protease inhibitors (PI) and the presence of MIH ($p < 0.039$; Table 4). The analysis of the etiological factors related to MIH in both groups showed, in the CG, an association between preterm birth ($p = 0.049$), birth at term ($p = 0.043$), and the need for an incubator ($p = 0.010$), as described in Table 5.

The multivariate logistic regression model (Table 6) showed that in the SG individuals who used PI were 2.14 (CI: 1.21 to 3.77) times more likely to have MIH, whereas in the CG individuals whose caregivers reported the need for an incubator were 2.8 (CI: 1.71 to 9.10) times more likely to have MIH.

Discussion

This is the first study to investigate a detailed association between MIH and HIV infection in children and adolescents infected with the virus compared with uninfected individuals. A higher frequency of MIH in HIV+ patients was observed, confirming the hypothesis of the study.

Individuals with systemic problems and compromised health are more likely to develop dental enamel defects[25,26] and present late chronology of tooth mineralization.[19] The greater prevalence of MIH observed in the SG may be associated with systemic conditions faced by HIV-infected patients or the medications used.[27]

Individuals infected with HIV have weakened immune systems,[27] are frequently affected by pathological events,[28] and make frequent and continuous use of antiretroviral therapy.[14] It is possible that these conditions act synergistically and cause disturbances in enamel transition or calcification phases.[2,3] Transition stage ameloblasts are most vulnerable and can be sensitive to hypocalcemia, hypoxia, and acidosis.[3,19,29,30]

These disorders can affect the pH of the enamel matrix and oxygen levels due to hypoventilation, inhibiting the action of proteolytic enzymes and leading to function disorders in ameloblasts.[31] Therefore, the disorders act in a negative way in the development of hydroxyapatite crystals, declining the protective capacity of amelogenin, developing a porous enamel, and resulting in hypomineralization.[2,11]

There was a higher caries prevalence in HIV-infected individuals. In these patients, the carious lesions showed greater severity. The ICDAS showed significantly higher average lesions in stage 3, 5, and 6 in the case group compared with the CG. Poor oral hygiene associated with lack of fluoride compounds, frequent exposure to sugars in the diet and medications are the triggering factors of dental caries.[18] Hypomineralized enamel is more porous, and therefore provides greater biofilm retention. Besides, it presents frequently posteruptive enamel breakdown, making it favourable for the development of carious lesions.[32]

This study also reports a significant association between MIH and triple antiretroviral therapy regimens containing PI or a reverse transcriptase inhibitor nonspecific analogue, efavirenz (EFV). Although there is no cause-effect relationship described in the literature

Table 3. Teeth affected by MIH.

CG	Teeth with MIH			Severity		
				Mild	Moderate	Severe
	Number of tooth	N	%	%	%	%
Maxilla	**16**	05	10.9	01 (20.0)	03 (60.0)	01 (20.0)
	12	02	4.3	01 (50.0)	00 (0.0)	01 (50.0)
	11	01	2.2	00 (0.0)	00 (0.0)	01 (100.0)
	21	04	8.7	04 (100.0)	00 (0.0)	00 (0.0)
	22	02	4.3	01 (50.0)	00 (0.0)	01 (50.0)
	26	08	17.4	05 (62.5)	03 (37.5)	00 (0.0)
Mandible	**36**	08	17.4	03 (37.5)	04 (50.0)	01 (12.5)
	32	03	6.5	02 (66.7)	00 (0.0)	01 (33.3)
	31	02	4.3	02 (100.0)	00 (0.0)	00 (0.0)
	41	00	0.0	00 (0.0)	00 (0.0)	00 (0.0)
	42	00	0.0	00 (0.0)	00 (0.0)	00 (0.0)
	46	11	23.9	07 (63.6)	03 (27.3)	01 (9.1)
	Total	46	100.0	26 (56.6)	13 (28.2)	07 (15.2)
SG	**Teeth with MIH**			**Severity**		
				Mild	**Moderate**	**Severe**
	Number of tooth	**N**	**%**	**%**	**%**	**%**
Maxilla	**16**	07	17.5	03 (42.9)	03 (42.9)	01 (14.2)
	12	02	5.0	00 (0.0)	01 (50.0)	01 (50.0)
	11	03	7.5	03 (100.0)	00 (0.0)	00 (0.0)
	21	03	7.5	03 (100.0)	00 (0.0)	00 (0.0)
	22	00	0.0	00 (0.0)	00 (0.0)	00 (0.0)
	26	10	25.0	03 (30.0)	05 (50.0)	02 (20.0)
Mandible	**36**	08	20.0	03 (37.5)	03 (37.5)	02 (25.0)
	32	00	0.0	00 (0.0)	00 (0.0)	00 (0.0)
	31	01	2.5	01 (100.0)	00 (0.0)	00 (0.0)
	41	00	0.0	00 (0.0)	00 (0.0)	00 (0.0)
	42	00	0.0	00 (0.0)	00 (0.0)	00 (0.0)
	46	06	15.0	04 (66.7)	02 (33.3)	00 (0.0)
	Total	40	100.0	20 (50.0)	14 (35.0)	06 (15.0)

MIH = molar incisor hypomineralization.

between the use of these schemes and the presence of MIH, controversy persists regarding the use of medications that may be associated with the development of enamel defects such as MIH.[29]

Some studies have linked the use of PI and EFV for pediatric patients with a decrease in calcium and vitamin D levels[33–35] and these basic substances in the development of tooth enamel.[36] Calcium deficiency is a risk factor for enamel changes in the maturation phase, because calcium ions participate directly in this process as well as regulate cellular activities, such as signal transduction and enzymatic activation.[37–39] Vitamin D deficiency can also have a negative effect on the development of enamel as this vitamin plays important roles during amelogenesis, acting in cell differentiation and mineralization of the tooth enamel.[40] A study of children with vitamin D deficiency found enamel development defects most frequently.[36]

Another significant association was found between the need for an incubator and the presence of MIH. Some perinatal factors such as prematurity, low birth weight, prolonged or difficult labor have been described in previous studies as

Table 4. Factors associated with the presence of MIH in HIV-infected children and adolescents.

Variables	Without MIH	With MIH	*p*
	n (%)	n (%)	
Number of CD8			0.481[a]
≤500 cells/μl	00 (0.0)	01 (100.0)	
>500 cells/μl	14 (53.8)	12 (44.2)	
Number of CD4			0.685[a]
≤500 cells/μl	05 (62.5)	03 (37.5)	
>500 cells/μl	11 (47.8)	12 (52.2)	
Viral Charge			1.000[a]
≤50,000 cópias/ml	09 (52.9)	08 (47.1)	
>50,000 cópias/ml	07 (53.8)	06 (46.2)	
PI			**0.039**[a]
2 ITRN/3 ITRN	07 (87.5)	01 (12.5)	
2 ITRN + 1 PI/2 ITRNN + EFV	09 (40.9)	13 (59.1)	

[a]Fisher's exact test; MIH = molar incisor hypomineralization; HIV = human immunodeficiency virus; ITRN = nucleoside inhibitor reverse transcriptase; PI = protease inhibitor; EFV = efavirenz inhibitor (nonnucleoside reverse transcriptase).

possible factors associated with the presence of MIH. These conditions often lead children in need of an incubator to complete their development.[31,41,42] These conditions may result in reduction of the supply of oxygen to the ameloblasts during enamel formation, which is a risk factor for the emergence of hypomineralization.[43–45]

Because of the high prevalence of MIH and caries in HIV-infected patients, there is a need to implement public policies aimed at improving the oral health of these patients as they are medically compromised individuals, often without access to dental care.[46]

Because of its retrospective nature, the study's investigation of the etiological factors of MIH was affected; it sought information on occurrences some years ago, so it is subject to parents' or guardians' memory bias. Moreover, the demographic and socioeconomic status

Table 5. Factors associated with presence of MIH in HIV-infected (SG) and non-HIV-infected (CG) children and adolescents.

	SG		*p*	CG		*p*
	Without MIH n (%)	With MIH n (%)		Without MIH n (%)	With MIH n (%)	
Pre- and perinatal conditions						
Episodes of fever or infection during pregnancy			0.697[a]			1.000[a]
No	11 (52.4)	10 (47.6)		38 (74.5)	13 (25.5)	
Yes	05 (62.5)	03 (37.5)		09 (81.8)	02 (18.2)	
Gestational hypertension			1.000[a]			0.570[a]
No	14 (53.8)	12 (46.2)		39 (76.5)	12 (23.5)	
Yes	02 (66.7)	01 (33.3)		03 (60.0)	02 (40.0)	
Urinary tract infection during pregnancy			0.663[a]			0.498[a]
No	12 (52.2)	11 (47.8)		38 (77.6)	11 (22.4)	
Yes	04 (66,7)	02 (33.3)		10 (66.7)	05 (33.3)	
Antibiotic use during pregnancy			1.000[a]			0.312[a]
No	10 (52.6)	09 (47.4)		39 (78.0)	11 (22.0)	
Yes	06 (60.0)	04 (40.0)		09 (64.3)	05 (35.7)	
Case of abruption placentae			0.448[a]			1.000[a]
No	16 (57.1)	12 (42.9)		46 (74.2)	16 (25.8)	
Yes	00 (0.0)	01 (100.0)		01 (100.0)	00 (0.0)	
Bleeding during pregnancy			1.000[a]			1.000[a]
No	15 (55.6)	12 (44.4)		45 (75.0)	15 (25.0)	
Yes	01 (50.0)	01 (50.0)		03 (75.0)	01 (25.0)	

Continued

Table 5. Continued.

	SG		*p*	CG		*p*
	Without MIH n (%)	**With MIH n (%)**		**Without MIH n (%)**	**With MIH n (%)**	
Cephalopelvic disproportion			0.192[a]			1.000[a]
No	16 (59.3)	11 (40.7)		45 (73.8)	16 (26.2)	
Yes	00 (0.0)	02 (100.0)		02 (100.0)	00 (0.0)	
Preeclampsia			1.000[a]			1.000[a]
No	15 (55.6)	12 (44.4)		43 (74.1)	15 (25.9)	
Yes	01 (50.0)	01 (50.0)		04 (80.0)	01 (20.0)	
Eclampsia						1.000[a]
No	–	–	–	45 (73.8)	16 (26.2)	
Yes				02 (100.0)	00 (0.0)	
Prolonged delivery			1.000[a]			0.467[a]
No	14 (58.3)	10 (41.7)		38 (77.6)	11 (22.4)	
Yes	02 (50.0)	02 (50.0)		08 (66.7)	04 (33.3)	
Birth						
Preterm	01 (16.7)	05 (88.3)	0.078[a]	05 (50.0)	05 (50.0)	**0.049**[a]
Term	16 (61.5)	10 (38.5)	0.076[a]	39 (83.0)	08 (17.0)	**0.043**[a]
Postterm	00 (0.0)	00 (0.0)	–	04 (66.7)	02 (33.3)	0.622[a]
Birth weight (grams)			0.272[a]			0.124[a]
≤2,500	06 (40.0)	09 (60.0)		23 (65.7)	12 (34.3)	
>2,500	10 (66.7)	05 (33.3)		19 (86.4)	03 (13.6)	
Sepsis history			0.672[a]			1.000[a]
No	13 (54.2)	11 (45.8)		43 (74.1)	15 (25.9)	
Yes	04 (66.7)	02 (33.3)		03 (75.0)	01 (25.0)	
Hypoxia			0.488[a]			1.000[a]
No	14 (51.9)	13 (48.1)		45 (76.3)	14 (23.7)	
Yes	02 (100.0)	00 (0.0)		03 (75.0)	01 (25.0)	
Type of delivery			0.272[a]			1.000[a]
Normal	10 (66.7)	05 (33.3)		28 (73.7)	10 (26.3)	
Cesarean	06 (42.9)	08 (57.1)		16 (72.7)	06 (27.3)	
Respiratory distress after delivery			0.488[a]			0.103[a]
No	14 (51.9)	13 (48.1)		44 (77.2)	13 (22.8)	
Yes	02 (100.0)	00 (0.0)		02 (40.0)	03 (60.0)	
Incubator needed			1.000[a]			**0.010**[a]
No	14 (53.8)	12 (46.2)		44 (80.0)	11 (20.0)	
Yes	02 (66.7)	01 (33.3)		02 (28.6)	05 (71.4)	
Postnatal conditions						
Dehydration/diarrhea			1.000[a]			0.333[a]
No	09 (52.9)	08 (47.1)		36 (78.3)	10 (21.7)	
Yes	09 (56.3)	07 (43.8)		11 (64.7)	06 (35.3)	

Table 5. Continued.

	SG		*p*	CG		*p*
	Without MIH n (%)	With MIH n (%)		Without MIH n (%)	With MIH n (%)	
Varicella/chickenpox			1.000[a]			1.000[a]
No	15 (53.6)	13 (46.4)		44 (73.3)	16 (26.7)	
Yes	03 (60.0)	02 (40.0)		02 (100.0)	00 (0.0)	
Pneumonia			0.732[a]			1.000[a]
No	08 (50.0)	08 (50.0)		43 (74.1)	15 (25.9)	
Yes	10 (58.8)	07 (41.2)		04 (80.0)	01 (20.0)	
Asthma			0.489[a]			1.000[a]
No	16 (51.6)	15 (48.4)		46 (74.2)	16 (25.8)	
Yes	02 (100.0)	00 (0.0)		01 (100.0)	00 (0.0)	
Bronchitis			0.108[a]			0.265[a]
No	14 (48.3)	15 (51.7)		45 (76.3)	14 (23.7)	
Yes	04 (100.0)	00 (0.0)		02 (50.0)	02 (50.0)	
Sinusitis			0.579[a]			1.000[a]
No	17 (56.7)	13 (43.3)		42 (73.7)	15 (26.3)	
Yes	01 (33.3)	02 (66.7)		05 (83.3)	01 (16.7)	
Rhinitis			1.000[a]			0.594[a]
No	16 (53.3)	14 (46.7)		44 (75.9)	14 (24.1)	
Yes	02 (66.7)	01 (33.3)		03 (60.0)	02 (40.0)	
High fever			0.493[a]			0.772[a]
No	06 (46.2)	07 (53.8)		26 (72.2)	10 (27.8)	
Yes	12 (60.0)	08 (40.0)		22 (78.6)	06 (21.4)	
Malnutrition			0.375[a]			1.000[a]
No	16 (59.3)	11 (40.7)		44 (74.6)	15 (25.4)	
Yes	02 (33.3)	04 (66.7)		04 (80.0)	01 (20.0)	
Ear inflammation			0.482[a]			0.312[a]
No	09 (47.4)	10 (52.6)		39 (78.0)	11 (22.0)	
Yes	09 (64.3)	05 (35.7)		09 (64.3)	05 (35.7)	
Use of antibiotics in the first 3 years of life			0.300[a]			0.571[a]
No	05 (41.7)	07 (58.3)		23 (69.7)	10 (30.3)	
Yes	13 (61.9)	08 (38.1)		20 (76.9)	06 (23.1)	
Surgery history in the first 3 years of life						1.000[a]
No	–	–	–	31 (70.5)	13 (29.5)	
Yes				05 (71.4)	02 (28.6)	

[a]Fisher's exact test.
MIH = molar incisor hypomineralization; HIV = human immunodeficiency virus.
In sections for eclampsia and surgery history in the first 3 years of life of the SG, no data were reported in medical conditions about this conditions.

Table 6. Final multivariate logistic regression of the MIH group.

Variables	ORajus (95% CI)	*p*
SG		
PI		
2 ITRN/3 ITRN	1	**0.045**
2 ITRN + 1 PI/2 ITRNN + EFV	2.14 (1.21–3.77)	
CG		
Preterm birth		
No	1	0.086
Yes	1.62 (0.86–3.05)	
Term birth		
No	1	0.067
Yes	0.68 (0.43–1.06)	
Incubator needed		
No	1	**0.014**
Yes	2.80 (1.71–9.10)	

ORajus = adjusted odds ratio; 95% CI = 95% confidence interval; Hosmer and Lemeshow test (final model) $p = 0.99$; p = probability of the Wald chi-square; MIH = molar incisor hypomineralization; ITRN = nucleoside inhibitor reverse transcriptase; PI = protease inhibitor; EFV = efavirenz inhibitor (nonnucleoside reverse transcriptase).

of the subjects may have changed during this period. Furthermore, the high prevalence of dental caries in both groups may mean we underestimated the occurrence of MIH in these individuals. Another limitation of this study lies in the fact that the sample size was too small to allow the extrapolation of the results to the general population. Nevertheless, the results show an association between MIH and HIV infection, suggesting more research is required in this area.

Conclusion

Children and adolescents infected with HIV had a higher prevalence of MIH and greater severity of dental caries. The hypomineralization was associated with the use of PI in the group of HIV-positive patients and with the need for an incubator in the group of HIV-negative patients.

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Conflicts of interest

The authors declare no conflicts of interest.

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