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Presence of molar-incisor hypomineralization is associated with dental caries in Brazilian schoolchildren

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Abstract: This study aimed to identify the prevalence of molar-incisor hypomineralization (MIH) in schoolchildren and its association with dental caries experience. This was a cross-sectional study with a sample of 471 children aged 8 to 10 years. Data were collected via a sociodemographic questionnaire. Intra-oral clinical examination was done to identify and diagnose MIH (EAPD Criteria) as well as dental caries (ICDAS Index). Statistical analyses were performed with Person's Chi-square, Fisher's exact, and Mann-Whitney tests, and Poisson regression models were built. Statistical significance was set at an alpha-level of 0.05. The prevalence of MIH in our participants was 9.8%, with lesions being mostly of the mild form (65.2%) and affecting the first permanent molars but not the incisors in 54.2% of the children. Dental caries was observed in 88.1% of subjects. We observed a significant association between dental caries and the following variables: presence of MIH ($p < 0.01$; PR = 1.13), dental visit ($p < 0.02$; PR=0.92), and parents or legal guardians' education level ($p < 0.05$; PR = 1.07). A MIH diagnosis was also significantly associated with family income ($p < 0.05$; PR = 4.09). Children with MIH had more caries lesions on molar surfaces ($p < 0.01$; PR = 4.05). The prevalence of MIH was found to be moderate, based on previous studies, and the presence of enamel defect was associated with dental caries. The teeth most affected by MIH lesions were the first permanent molars.

Keywords: Dental Enamel Hypoplasia; Pediatric Dentistry; Epidemiology.

Introduction

Molar incisor hypomineralization (MIH) is a developmental condition characterized by enamel defects originated during the maturation stage of amelogenesis.[1] It involves hypomineralization of one to four first permanent molars but may also affect permanent incisors.[2]

The etiological factors of MIH remain uncertain,[3] but most studies report an association of MIH with prenatal, perinatal, and postnatal factors, in addition to genetic and environmental conditions.[4] Respiratory diseases during the first year of life and prolonged use of antibiotics are also reported in the literature as factors.[5,6]

Histologically, the microstructure of MIH-affected enamel is preserved but its crystals are less dense and organized.[1] The affected enamel also

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presents a reduction in mineral concentration, which facilitates organic deposition.[1,7] The above factors result in a more porous enamel with altered prismatic morphology and reduced mechanical properties such as hardness and elasticity.[1,7]

Abnormal enamel translucency is a distinct clinical characteristic of MIH, with the affected teeth presenting enamel opacities of colors ranging from white to cream-brown.[2,8] Areas of post-eruptive enamel breakdown can also be found in more severe cases.[2,8] MIH lesions are mostly found on the occlusal and buccal surfaces.[7]

Due to reduced enamel quality, the affected teeth are more prone to breakdown, and may have unusual cavities, leading to a greater deposit of bacterial biofilm and increased susceptibility to dental caries.[9] In fact, enamel hypomineralization can be difficult to identify when affected teeth have extensive caries. This might explain the underreporting of MIH cases.[10] Given that dental hypomineralization is commonly associated with the presence of caries,[11,12] the ideal age to diagnose MIH is 8 years since all first permanent molars and most of the incisors are erupted[2] and comorbidities are not commonly present by that time.[11]

In a systematic review study, a large variation in the prevalence of defects was reported (2.4–40.2%) worldwide.[13] Prevalence rates for MIH in Brazil also vary considerably, with studies reporting prevalence of 2.5%[14] and 20.4%,[15] providing no clear picture about national prevalence patterns of MIH.[12]

Therefore, this study aimed at identifying the prevalence of MIH in Brazilian schoolchildren aged 8 to 10 years and its association with dental caries experience, considering the stages of carious lesion and the relationship with presence of MIH. The null hypothesis was that no significant difference in dental caries experience would exist between children with and without MIH.

Methodology

Study location

The study was carried out in the city of Campina Grande, located in the Northeast Region of Brazil. The city has an area of 593,026 km^2 with an estimated population of approximately 407,000.[16]

Study design and sampling

This work was reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[17] This was a community based cross-sectional study conducted with a cluster sample of 471 children aged 8 to 10 years enrolled in urban public elementary schools. The city of Campina Grande has a total of 286 elementary schools, including public and private institutions, of which 74 were urban public schools.[18]

Sample size was calculated assuming an infinite population and using an estimated prevalence of 20.4%,[15] confidence interval of 95% and sample error of 5%. Even though the formula suggested a sample size of 245 subjects, the final estimated minimum sample size was determined to be 392 given a correction factor of 1.6 to produce greater accuracy of results. We recruited a total of 471 children — 20% above the minimum sample — to compensate for potential dropouts. Since schools are not evenly distributed in the North, South, East, West and Central regions of Campina Grande, we utilized geographical locations known as Sanitary Districts (SDs) instead of subdividing the population into clusters. SDs can be defined as areas with similar epidemiological and social characteristics, as well as health needs as established by local health officials.[19] The city has a total of six SDs from which twelve schools were randomly selected (two per district). To ensure a representative sample, the number of participants recruited in each district was proportional to the number of urban public schools distributed in all six sites. We included children aged 8 to 10 years with fully erupted first permanent molars. Children with fixed orthodontic appliances at the time of data collection and those with special needs who were unable to collaborate were excluded from the study.

Calibration of examiners

Three authors (L.F., I.C.C.L., L.H.F.F) underwent a period of training provided by "gold standard examiners" (*i.e.* experts in Pediatric Dentistry with postdoctoral experience) to bring their diagnostic standards as similar to each other as possible. Training included both theoretical and practical components. The theoretical component on core issues related to

dental caries such as diagnostic criteria and coding was provided online (https://www.iccms-web.com) and through in-person training sessions.[20] The practical component included the examination of 640 dental surfaces. The theoretical component on MIH included information on the clinical presentation of hypomineralized lesions and on differential diagnosis to rule out other enamel defects as well as white spot lesions.[21] The *in lux* calibration process was performed using a collection of exercises developed by Ghanim et al.[22] Cohen's Kappa coefficients for inter- and intra-rater reliability were 0.86 and 0.73 for dental caries, and 0.65 and 0.77 for MIH, respectively.

A convenience sample of 47 schoolchildren was used in a pilot study developed by the authors to assess the proposed study methods and data collection process in advance. The results of the pilot study demonstrated that there was no need for substantial changes in the proposed methods. Changes were only made to the format of the sociodemographic questionnaire

Data collection

Data were collected via a sociodemographic questionnaire completed by the students' parents or legal guardians. Information about the children (*i.e.* sex and age) and their parents or legal guardians (i.e. education level and family income – minimum salary equivalent to US$264 during the study period) was obtained using the survey. We also collected data related to the students' oral health, such as number of dental visits and presence of toothache and sensitivity in the past six months. Parents or legal guardians were asked to fill out blank spaces in case of missing data.

Prior to dental exams, toothpaste and a toothbrush were distributed to the participants, information on oral hygiene was given, and supervised tooth brushing sessions took place. The clinical examinations were carried out in reserved rooms under natural light conditions with the aid of headlamps (JWS Lanternas, São Paulo, Brazil) using WHO probes (Trinity Indústria e Comércio Ltda., São Paulo, Brazil), mouth mirrors (Golgran Indústria e Comércio de Instrumental Odontológico, São Caetano do Sul, Brazil) and sterile gauze (Gnatus Equipamentos Médico-Odontológicos Ltda., Barretos, Brazil). Clinical examinations were performed with the children sitting in regular chairs facing the examiners.[8] Personal protective equipment was used.

The diagnosis of MIH was determined using the MIH Index proposed by Ghanim et al.,[21] which follows the European Academy of Paediatric Dentistry (EAPD) guidelines and addresses the differential diagnosis between MIH and other developmental defects of enamel, such as diffuse opacities, hypoplasia, amelogenesis imperfecta, and hypomineralization defects other than MIH. The MIH Index assesses clinical status, defect extent, and tooth eruption status. A tooth diagnosed with only demarcated opacities was considered as "mildly affected", while a tooth diagnosed with enamel breakdown and / or atypical restoration / atypical caries / missing due to MIH was considered as severely affected.[22] Children were considered as having MIH when at least one first permanent molar was affected. The MIH severity was determined from index scores.[2,23,24]

The occurrence of dental caries was assessed in deciduous and permanent teeth using the International Caries Detection and Assessment System (ICDAS II). This system classifies different stages of caries progression using seven distinct codes and determines the presence of either preventive or restorative treatments. The ICDAS II consists of two digits, each covering a specific description of the carious lesion. The first digit refers to the "surface condition", while the second reflects the "carious type". The system codes are categorized as follows: healthy tooth – code 0; early stage – codes 1 and 2; moderate stage – codes 3 and 4; advance stage – codes 5 and 6[22]. The diagnosis of caries was confirmed when study participants scored greater than 0 in at least one ICDAS item, and the severity of caries was given by the highest code observed.[23]

Statistics

Statistical analyses were performed using IBM SPSS Statistics 22 (Armonk, New York, USA). To perform the statistical analysis, the following independent variables were categorized: Schooling of guardian (≤ 8 years of study; > 8 years of study); history of toothache in the past six months (yes; no/don't know [as to whether pain was experienced]); history of tooth sensitivity in the past six months (yes; no/don't

know [as to whether sensitivity was experienced]); dental caries status (early stage; moderate/advance stage [early stage: codes 1 and 2, non-cavitated enamel lesions; moderate/advance stage: codes 3 to 6, enamel lesions with cavity formation and/or dentin involvement and/or pulp exposure]).

Descriptive statistics included absolute frequency and percentages values. Bivariate Person's Chi-square and Fisher's exact tests were performed to assess relationships between dependent (*i.e.* dental caries and MIH) and independent variables (*i.e.* sociodemographic data and study participants' oral health). We also performed a Kolmogorov-Smirnov normality test was used to assess the distribution of age, number of teeth, and affected surfaces of first permanent molars across our sample. Since data distribution was not normal, we used Mann-Whitney tests when analyzing the study outcomes. Variables presenting $p < 0.20$ were tested in the Poisson regression model with robust variance. Measures of association included prevalence ratios and confidence intervals (95%). Statistical significance was set at an alpha level of 0.05.

Ethical aspects

Following the guidelines established by Resolution number 466/12 of the National Health Council of the Ministry of Health, the project was approved by the Research Ethics Committee of Paraíba State University, in accordance with the Declaration of Helsinki (Number: 3.155.847).

Results

A total of 597 schoolchildren were found to be eligible to participate in the study, of which 471 obtained consent from their parents or legal guardians, who completed the sociodemographic questionnaire (response rate: 78.9%). All the children who were willing to take part in the study and obtained consent were present at the time of clinical examination.

Most of the schoolchildren who participated in the study were girls (56.3%) aged 8 years (37.6%). Socioeconomic status information revealed that 82.3% of parents/legal guardians had monthly family income of up to one Brazilian minimum wage (approximately U$ 264) and 57.4% of them had completed up to 8 years of education. As to the participants' oral health, almost half of the children complained of toothache (43.4%) and tooth sensitivity (43.0%) in the past 6 months, and most of them visited the dentist in the past semester (61.3%). Among the study participants, 88.1% had dental caries of which 92.6% were lesions classified as moderate/severe (Table 1).

Table 1. Frequency and distribution of clinical and socioeconomic variables of the study population.

Variables	n (%)
Sociodemographics	
Sex	
Female	265 (56.3)
Male	206 (43.7)
Age (years)	
8	177 (37.6)
9	162 (34.4)
10	132 (28.0)
Monthly family income	
≤ 1 minimum wage*	343 (82.3)
> 1 minimum wage*	74 (17.7)
Schooling of parents/guardians	
≤ 8 years of study	261 (57.4)
> 8 years of study	194 (42.6)
Oral health outcomes	
Complaint of tooth pain	
Yes	201 (43.4)
No/don't know	262 (56.6)
Complaint of tooth sensitivity	
Yes	200 (43.0)
No/don't know	265 (57.0)
Visit to dentist	
Yes	285 (61.3)
No	180 (38.7)
Presence of caries	
Yes	415 (88.1)
No	56 (11.9)
Presence of MIH	
Yes	46 (9.8)
No	425 (90.2)
Stage of caries	
Early	31 (7.4)
Moderate/Avanced	384 (92.6)
Severity of MIH	
Mild	30 (65.2)
Severe	16 (34.8)

*Equivalent to US$264.

The prevalence of MIH was 9.8%, and 65.2% of the observed lesions were found to be mild, while 34.8% were classified as severe lesions (17.3% atypical breakdown; 13.5% atypical caries; 2.0% atypical restoration; 2.0% missing due to MIH). In all, 121 affected teeth were identified of which 82 were first permanent molars (67.8%) and 39 were permanent incisors (32.2%). Defective enamel was observed in 141 molar areas being located mainly in occlusal (34.3%) and buccal surfaces (27.8%), but also present in other surfaces such as lingual (21.4%), mesial (8.6%) and distal (7.9%). In the 51 affected incisors, the defect was mainly located in buccal surfaces (96.0%), followed by the mesial (2.0%) and lingual surfaces (2.0%).

A MIH diagnosis was significantly associated with family income (p = 0.028). We also observed significant associations between dental caries and the following variables: toothache in the past 6 months (p = 0.001), tooth sensitivity in the past 6 months (p = 0.013), dental visit in the past 6 months (p = 0.008), parents or legal guardian's education level (p = 0.025), and presence of MIH (p = 0.029) (Table 2).

Table 2. Associations between dental caries and molar-incisor hypomineralization with clinical and socioeconomic variables.

Variables	Caries***		p-value	MIH		p-value
	+	-		+	-	
	n (%)	n (%)		n (%)	n (%)	
Sex						
Female	237 (89.4)	28 (10.6)	0.319 *	26 (9.8)	239 (90.2)	1.000 *
Male	178 (86.4)	28 (13.6)		20 (9.7)	186 (90.3)	
Age (years)						
8	159 (89.8)	18 (10.2)		20 (11.3)	157 (88.7)	
9	139 (85.8)	23 (14.2)	0.507 **	19 (11.7)	143 (88.3)	0.125**
10	117 (88.6)	15 (11.4)		7 (5.3)	125 (94.7)	
Family income						
≤ 1minimum wage	301 (87.8)	42 (12.2)	0.564 *	38 (11.1)	305 (88.9)	0.028 *
> 1 minimum wage	63 (85.1)	11 (14.9)		2 (2.7)	72 (97.3)	
Schooling of guardian						
≤ 8 years of study	239 (91.6)	22 (8.4)	0.025 *	29 (11.1)	232 (88.9)	0.344 *
> 8 years of study	164 (84.5)	30 (15.5)		16 (8.2)	178 (91.8)	
Complaint of tooth pain						
Yes	192 (955)	9 (4.5)	0.001 *	24 (11.9)	177 (88.1)	0.214 *
No/don't know	215 (82.1)	47 (17.9)		22 (8.4)	240 (91.6)	
Complaint of tooth sensitivity						
Yes	185 (92.5)	15 (7.5)	0.013 *	23 (11.5)	177 (88.5)	0.270 *
No/don't know	225 (84.9)	40 (15.1)		22 (8.3)	243 (91.7)	
Visit to dentist						
Yes	260 (91.2)	25 (8.8)	0.008 *	29 (10.2)	256 (89.8)	0.748 *
No	149 (82.8)	31 (17.2)		16 (8.9)	164 (91.1)	
Presence of MIH						
Yes	45 (97.8)	1 (2.2)	0.029 *		–	
No	370 (87.1)	55 (12.9)				
Stage of caries						
Early		–		9 (8.4)	98 (91.6)	0.348 *
Moderate/Advanced				36 (11.7)	272 (88.3)	
Severity of MIH						
Mild	30 (100.0)	0 (0.0)	0.348 *		–	
Severe	15 (93.8)	1 (6.2)				

* Fisher's exact test; ** Pearson's chi-square test (χ^2); *** ICDAS >0.

Children with MIH had greater mean number of dental caries in first permanent molars as well as greater affected surfaces in the same group of teeth; a MIH diagnosis was found to be associated with the number of affected surfaces in first permanent molars ($p < 0.05$) (Table 3). More than half of the children solely presented with hypomineralized molars (54.2%), of which 32.6% had only one affected molar (Table 4).

Multivariate analysis (Table 5) revealed that the prevalence of dental caries in our sample was positively associated with the presence of MIH ($p < 0.01$; PR = 1.13), negatively related to parents or legal guardian's education ($p < 0.05$; PR = 1.07), and positively associated with the number of dental visits in the past 6 months ($p < 0.02$; PR = 0.92). We also observed that the children whose family had a monthly income of up to one Brazilian minimum wage were 4.09 times more likely to have MIH ($p < 0.05$; PR = 4.09), while those with decayed first permanent molar surfaces were 4.05 times more likely to have defective enamel ($p < 0.01$; PR = 4.05).

Table 3. Association between children with and without MIH and quantitative variables: average number of first permanent molars with positive experience of tooth caries and decayed surfaces.

MIH	FPM*	Surfaces of FPM
Present		
n	45	45
Average±(SD)	1.96 ± 1.59***	4.26 ± 3.49**
Absent		
n	370	370
Average ±(SD)	1.89 ± 1.54***	3.05 ± 2.72**
Total		
n	415	415
Average ±(SD)	1.9 ± 1.55***	3.19 ± 2.83***

SD: standard deviation; *FPM: first permanent molar;
**$p < 0.05$ Mann-Whitney test; ***$p > 0.05$ Mann-Whitney test.

Discussion

The prevalence of MIH in our study was 9.8%. A similar finding was reported in another study performed in Brazil,[25] which found a prevalence of 9.5% of MIH in their sample. Like in our study, they utilized the EAPD diagnostic criteria and examined children in the 8–10 age group enrolled in public schools.[25] In contrast, other authors who used a similar methodology reported higher prevalence rates of 16.1%[26] and 20.4%.[15]

Even though the simplicity of EAPD criteria has aided in the reproducibility of clinical examinations for the recording of enamel defects,[1] other factors might have contributed to the disparity of findings, such as experience, training and calibration of examiners[1]. Exam conditions such as the use of artificial light sources,[8] dry[15] or wet tooth surfaces,[8] and whether[15] or not[8] prophylaxis was performed prior to the diagnosis are factors that may result in different prevalence findings.

A growing number of studies recently reported in the literature have investigated the prevalence of MIH.[27,28] Such greater interest in this subject may be related to the similarity of MIH with other oral pathologies, such as dental caries in its initial clinical presentation with white spots, and also to the negative impact it has on the oral health of patients as well as their quality of life.[29]

Better understanding of prevalence trends is important to assess oral health changes over time, set priorities for action, and direct existing resources to prevention and treatment interventions.[6] This study selected schoolchildren aged 8 to 10 years following EAPD guidelines, given that first permanent molars and permanent incisors have usually erupted at that age. Also, other comorbidities such as dental caries that may confound the diagnosis of MIH may not be

Table 4. Number of children with molar hypomineralization and molar-incisor hypomineralization.

Variable	Number of hypomineralized molars – n (%)				
	1	2	3	4	Total
HM*	15 (32.6)	5 (10.8)	3 (6.5)	2 (4.3)	25 (54.2)
MIH	9 (19.6)	7 (15.4)	3 (6.5)	2 (4.3)	21 (45.8)
Total	24 (52.2)	12 (26.2)	6 (13.0)	4 (8.6)	46 (100.0)

*Hypomineralization of molar.

Table 5. Poisson regression model for association between clinical and socioeconomic variables and their corresponding dependent.

Variables	Crude model			Adjusted Model		
	PR	95%CI	p-value	PR	95%CI	p-value
Dental caries						
Visit to dentist						
No	0.907	(0.84–0.97)	< 0.02	0.92	(0.82–0.99)	< 0.03
Yes	1			1		
Schooling of guardian						
≤ 8 years of study	1.08	(1.01–1.16)	< 0.05	1.07	(1.005–1.15)	< 0.05
> 8 years of study	1			1		
Presence of MIH						
Yes	1.12	(1.06–1.18)	< 0.01	1.13	(1.09–1.182)	< 0.01
No	1			1		
MIH						
Family income						
≤ 1 minimum wage	4.09	(1.01–16.61)	< 0.05		–	
> 1 minimum wage	1					
Decayed surface of FPM*						
MIH						
Present	4.05	(1.59–12.72)	< 0.01		–	
Absent	1					

*FPM: first permanent molar.

present in this age group.[2,11,28] This is the first study to investigate the prevalence of MIH in the State of Paraíba, Brazil. Most of the children who presented with hypomineralized teeth in our study had mild lesions, in agreement with findings reported in previous studies.[8,27,29] Also, the enamel defects were mainly found in permanent molars but not in incisors, similar to recently reported data[29]. Nonetheless, other authors have reported hypomineralization associated with both molars and incisors as their most common findings.[12,30]

Our findings revealed that the occlusal and buccal surfaces were the most affected in permanent molars, while lesions were mainly found on buccal surfaces in permanent incisors. This result was similar to others found in literature.[31,32] It is worth noting, however, that studies have shown that dental caries can mask hypomineralized lesions on occlusal surfaces resulting in a more difficult diagnosis.[10] MIH defects are more easily distinguished from dental caries on buccal surfaces given the areas of dental biofilm accumulation,[21,22] which are distinct from the demarcated opacities in MIH.

MIH and dental caries affecting the same dental surface can be easily differentiated when examiners are well-trained and calibrated. The occurrence of demarcated opacities next to carious lesions or the presence of extensive lesions of indefinable cause in teeth with otherwise low caries activity can be used to discriminate both conditions.[21,22] Pediatric dentists should, therefore, be qualified and capable of making a correct differential diagnosis for each case.

Our findings suggest that presence of dental caries is significantly associated with a MIH diagnosis – children whose enamel is defective are more prone to experience caries. Several studies have also found a significant and positive association between the conditions.[12,26,33,34] A systematic review also found a greater prevalence of dental caries in children with MIH when compared to those without the condition.[7] Nevertheless, these conclusions must be interpreted with caution given the many methodological differences among the studies. Also, even though the prevalence of dental caries is found to be high in several studies, one cannot assume they primarily occurred in index teeth.

A total of 80% of the schoolchildren with a MIH diagnosis had moderate/severe dental caries, including cavitated lesions or lesions with dentin

involvement according to the ICDAS and prompting the need of restorative treatment. On the other hand, 73.5% of the schoolchildren without a MIH diagnosis also had moderate/severe dental caries. In all, children with MIH had a higher prevalence of carious lesions that required restorative treatment. A case-control study also found a greater presence of cavitated dentin lesions in subjects with MIH when compared to the ones in the control group.[35] First permanent molars with MIH were more prone to have decayed surfaces in our study, regardless of MIH severity. This finding is consistent with the data reported by a recent study[33] and may be associated with the presence of hypomineralized enamel in more than one dental surface, which contributes to greater biofilm deposit. Carious lesions may be more present in hypomineralized dental elements with post-eruptive breakdown since these areas could favor larger accumulation of biofilm when compared to areas in which there are only demarcated opacities. Further investigation into this association is warranted.

Dental caries was significantly and negatively associated with parents or legal guardian's education levels, while MIH was significantly and negatively associated with family income. The above variables can be used as determinants of socioeconomic status and can influence the children's health outcomes.[34] As socioeconomic status plays an important role in the etiology of dental caries in childhood, it should be considered a confounding factor.[34,36] Possibly, no association was found between family income and dental caries because all children in the sample were studying in public schools and had similar family income in general.

The experience of dental caries was associated to the demand for dental services, since most of the affected participants had had at least one dental visit. This might be explained by the high prevalence of toothache (47.2%) and tooth sensitivity (45.1%) observed in children with caries. It can be suggested that students may have sought care mainly due to the need for restorative treatment, not for preventive or routine care. In a recent study, most of the children only sought care when restorative treatment was needed.[37]

Our findings also revealed that more than half of the schoolchildren (51.1%) had complained of both tooth sensitivity and pain (52.2%) recently, which are MIH-related symptoms commonly reported in the literature.[7,26,35] However, no significant association was observed between the above variables and MIH. This might be due to the small sample of schoolchildren with hypomineralized teeth in our study, resulting in insufficient statistical power.

Hypersensitivity and toothache are more frequently reported in severe cases than in mild lesions with only demarcated opacities.[35] Acute pain and hypersensitivity are commonly described in severe MIH[26] because oral bacteria penetrate through the hypomineralized enamel into the dentinal tubules, leading to inflammatory reactions in the pulp.[7] The fact that most of the study participants had only mild MIH may explain the lack of significant associations among the above variables.

It is worth noting that data on dental sensitivity and pain were reported by the children's parents or legal guardians and collected via questionnaire. They may have experienced difficulties in understanding the differences between these conditions and, therefore, the present data may have been underestimated. Also, parents or legal guardians should have received such information from their children at some point to be able to report it.

A limitation of this study was that the questionnaire was administered only to the children's parents or legal guardians, indicating their own perspective. We tried to address this issue by providing only clear questions about a recent period. The questionnaires were also sent home with the children so the parents could have enough time to go through and reflect on the questions, answering them accordingly. In addition, the identification process of dental caries and MIH was not blinded as the examiners assessed and documented the conditions and observation bias may have occurred. However, steps to reduce bias were taken such as the calibration of the examiners and the conduction of a pilot study prior to the present study.

This study provided further understanding and evidence on the association between MIH and other variables. We examined schoolchildren enrolled

in urban public schools and, therefore, the results can only be generalized to this target population. Since this was a cross-sectional study, cause and effect relationship cannot be established. Further investigation in a longitudinal manner is likely to provide more information on the relationships reported above.

Conclusion

A moderate prevalence of MIH was found and a positive association was observed between MIH and dental caries, with children with hypomineralized lesions being more prone to carious lesions.

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