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Original Article

Prevalence and Severity of Molar Incisor Hypomineralization in Students of Belém, Brazil

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Abstract

Objective: To measure the prevalence of Molar Incisor Hypomineralization (MIH), its severity and association with dental caries among public school children from Belém/PA, Brazil. **Material and Methods:** This is a cross-sectional study conducted with children enrolled in three public schools of Belém, which were selected by simple random sampling. MIH diagnosis was carried out according to criteria of the European Academy of Pediatric Dentistry. **Results:** Among the 260 students that met the inclusion criteria, 56.92% were male and 43.07% female. The average age was 10.22 years. Of these, 8.84% (n = 23) had MIH, but there was no statistically significant difference in this prevalence between sexes (p = 0.6244). The most affected teeth were the upper first permanent molars, followed by lower first permanent molars and upper permanent central incisors. About 43.48% of students had at least one tooth with severe defect in enamel and 30.43% of students with MIH presented dental caries in the affected teeth. **Conclusion:** Severe MIH was not the most prevalent among schoolchildren, but the relationship with dental caries found demonstrates the importance of knowledge about diagnosis and treatment of enamel defects, which should be part of promotion and prevention actions in oral health due to its epidemiological impact in the demographic change of dental caries.

Keywords: Dental Enamel; School Health; Dental Caries; Child Health.

Introduction

The demographic transition of dental caries has shown a drop in prevalence, especially in the younger population. In Brazil, of children under 12 years of age, 31% were free from dental caries in 2003, in 2010, this number rose to 44%, which means that 1.4 million of children are free from dental caries in that period [1]. Furthermore, there is a high prevalence of changes in enamel formation [2-4]. The International Dental Federation (IDF) ranks enamel defects into two categories: hypoplasia and hypomineralization [5].

The period of amelogenesis in which aggression to ameloblasts occurs has great significance to the damage appearance and location [6,7]. Hypoplasia is defined as quantitative enamel defects where there is involvement of the tooth surface and aggression occurred in the secretory phase of the enamel matrix formation. Hypomineralization or opacities are characterized by qualitative enamel defects occurring in its maturation phase [8].

Molar-Incisor Hypomineralization (MIH) is a systemic defect that can affect one to four first permanent molars, associated or not to incisors [4]. The enamel of teeth affected by MIH is characterized as having white, yellow or brown color with clear definition between sound and defective enamel [7,9]. Soft and porous, the enamel is often compared to chalk or old cheese ("cheese molars") [10]. Enamel that has suffered hypomineralization can easily suffer fracture, leaving dentin exposed and increasing the risk of dental caries [11]. In addition to dental enamel affected by MIH be softer and more porous, the risk of caries increases due to the increased sensitivity to stimuli such as in oral hygiene, making it even more defective [2,12].

Although the national and international literature has no conclusive data on the causes of these changes, it is known that the etiology of MIH is multifactorial with the possibility of genetic susceptibility and can be divided into three periods: prenatal, perinatal and postnatal [13,14]. Urinary tract infections and vitamin D deficiency form the group of potential prenatal factors and recently the use of antiepileptic drugs during pregnancy has also been reported as a possible etiology [15]. In the perinatal period, the following factors were considered: cesarean section, delay in delivery, premature birth, twin pregnancy, among others [14]. In the postnatal period, use of antibiotics, otitis, pneumonia, asthma, chickenpox and use of fluorides have been identified as possible etiological factors [14].

The evaluation of the MIH severity can be performed by following a few criteria: mild MIH presents well-defined opacities areas without chewing pressure and history of hypersensitivity or dental caries associated with the amelogenic defect; moderate MIH presents atypical restorations with presence of fractures and / or dental caries in one or two surfaces without affecting cusps, light dentin sensitivity and aesthetic concern; advanced coronary destruction, widespread destruction by caries and enamel fractures in newly erupted teeth are features of severe MIH [16].

A study conducted in Chile with 334 children aged 6-13 years found that 17% had MIH and almost half (48%) had the four first molars and incisors affected [17]. A study in Brazil found that

19.82 % of the sample had at least one 1st permanent molar with MIH [2]. The prevalence of MIH in different European countries ranges from 2.4% in Germany to 40% in the UK [18,19].

If on the one hand, dentistry shifts its attention from dental caries to amelogenic defects, on the other, the concern is taken up due to clinical and epidemiological studies revealing a close relationship between MIH and risk of caries, such as a study in which children diagnosed with enamel defects were twice more likely to have DMFT > 0 [20].

In clinical practice, MIH has gained attention, either by its possible consequences, either by difficulties in patient management and treatment. The national and international literature needs more precise studies on the etiology, prevalence, severity, and correlation with caries and MIH treatment.

The aim of this study was to evaluate the prevalence of MIH, its severity and correlation with dental caries in schoolchildren enrolled in public schools of Belém/PA, Brazil.

Material and Methods

This is a cross-sectional study approved by the Ethics Research Committee of the Institute of Health Sciences of the Federal University of Para (Protocol 157 141) and carried out from April to June 2013 in the city of Belém, which has 349 public elementary and high schools (300 state and 49 municipal schools), with approximately 186,000 students, excluding the regions of islands [21,22].

For this survey, three public schools were selected for convenience, where actions to promote education and prevention in oral health were performed by Dentistry academicians of the Federal University of Pará.

The selection of schools was through simple random sampling, processed by the BioEstat 5.0 software, according to the listing of students provided by the management of schools and considering a sample previously stipulated by researchers of 300 students, 100 of each school since the European Academy of Pediatric Dentistry (EAPD) recommends that for MIH diagnosis in epidemiological studies, at least 100 people should be examined [23].

Inclusion criteria were: children and adolescents aged 5-17 years, presence of all first permanent molars and permanent incisors fully erupted in the oral cavity, attendance at school in the research days and return of the Informed Consent Form signed by parents or guardians. Exclusion criteria were: refusal to participate in the study, use of orthodontic braces and individuals with special needs.

The epidemiological survey was conducted in the school environment under natural light without previous prophylaxis or tooth brushing with the tooth surface clean and dry with sterile gauze by calibrated examiners.

Four undergraduate Dentistry students with at least 70% of completed curriculum have been trained to carry out clinical examinations. Theoretical training lasting three hours was initially performed, when the criteria for diagnosis of dental caries and differential diagnosis for Enamel Development Defects (EDD) were explained, followed by criteria that would be used to diagnose

MIH and classify it according to the severity degree. The resources used for this moment were visual with the help of projected images of clinical cases. Medical records were accessed to clarify any doubts.

Later, practical training was performed to identify dental caries when each examiner evaluated 10 students aged 5-17 years, always supervised by responsible researchers. In each case of doubt, the entire group participated in the discussion in order to standardize the criteria. Then, for calibration, each examiner evaluated 10 other students aged 5-17 years that had not been examined in the previous step.

Calibration for MIH was held *in lux*, where the four examiners evaluated 30 cases of EDD and for those with MIH diagnosis, examiners classified them according to the severity degree.

Agreement was measured using a gold standard, which was a DDS, PhD in pediatric dentistry and with past experience in epidemiological surveys. The Kappa test was used to analyze intra and inter examiner agreement with values of 0.85 and 0.7, respectively.

Examinations followed the guidelines recommended by the World Health Organization (WHO) [24] for epidemiological surveys in oral health, used flat mirror No. 5, WHO probe to remove possible food debris and sterile gauze. The medical records were filled with name, age, sex, race and school grade.

MIH diagnosis was performed using criteria recommended by the European Academy of Pediatric Dentistry (EAPD) [23]. Opacities greater than 2 mm in diameter were considered. The buccal, lingual / palatal, occlusal / incisal surfaces of all first permanent molars and permanent incisors were examined. The following were observed: demarcated opacities, post-eruptive enamel fractures, atypical restorations, presence of dental caries and severity degree.

Having the student as the unit of analysis, mild MIH was regarded as those whose teeth presented only demarcated opacities greater than 2 mm without need for treatment and atypical restorations. Severe degree was observed when teeth had opacity greater than 2 mm, post-eruptive enamel fractures, atypical restorations, presence of dental caries and persistent hypersensitivity, and generally speaking, teeth in which the enamel defect was associated with present or past treatment needs.

To test the association among variables, the nonparametric chi-square test, with significance level of 5%, and the Fisher's exact test were used.

Results

Of the 300 children and adolescents selected to compose the sample, 260 met the inclusion criteria. The mean age was 10.22 years, 56.92% (n = 148) were male and 43.07% (n = 112) were female. The prevalence of MIH was 8.84% (n = 23), 12 cases in males (52.17%) and 11 in females (47.82%). There were no significant differences in the prevalence of MIH between sexes (p = 0.6244). The average age of students with MIH was 9.73 years (\pm 2.56). When asked about their skin color,

69.56% of those who had MIH declared themselves as brown and 17.39% and 13.04% as white and black, respectively.

Although boys and girls presented similar prevalence, the average number of teeth affected in boys (3.25) was higher than the average number of teeth affected in girls (2.36). In general, the average number of teeth affected by MIH was 2.8 and the average of molars only was 2.26.

Of the total number of teeth affected by MIH ($n = 65$), 37 (56.92%) were of the maxilla and 28 (43.07%) of the jaw. Dental elements of the left hemiarcade ($n = 37$; 65.92%) were more affected by opacity than those of the right hemiarcade ($n = 28$; 43.07%). The most affected teeth were the first upper permanent molars, followed by first lower molars and upper central incisors. Among molars, tooth 26 was the most affected by MIH and among incisors, teeth 21 and 31 were equally affected. No maxillary lateral upper or lower incisor presented opacity (Table 1).

Table 1. Distribution of teeth affected by MIH according to arch and hemiarcade. Belém, 2013.

Tooth affected by MIH	Upper arch (n)			Lower arch (n)		
	Right hemiarcade	Left hemiarcade	Total	Right hemiarcade	Left hemiarcade	Total
Central Incisor	3	4	7	2	4	6
Lateral Incisor	0	0	0	0	0	0
First Molar	12	18	30	11	11	22
Total	15	22	37	13	15	28

Of the total students with MIH, 34.78% ($n = 8$) had defects in first permanent molars and permanent incisors, 60.87% ($n = 14$) had defects only in molars and 4.35% ($n = 1$) only in incisors (Table 2). It was observed that 50% of students who had two permanent molars with opacities also had at least one affected incisor. When three or four molars were affected, the correlation with affected incisors was lower in relation to when one or two molars were affected ($p = 0.0195$).

Table 2. Distribution of MIH in affected arches according to the different groups of teeth and the degree of involvement of molars. Belém, 2013.

Teeth	n	%
Molars only	14	60.87
Incisors only	1	4.35
1 molar-incisor	2	8.70
2 molars-incisors	4	17.39
3 molars-incisors	1	4.35
4 molars-incisors	1	4.35
Total	23	100.00

Of all cases of MIH, only 8.69% ($n = 2$) of students presented post eruptive fractures and the same result was found for atypical restoration, but not in the same students. Of the 65 teeth diagnosed with enamel defect, two (3.07%) had post-eruptive fracture and 3 (4.61%) atypical restoration. As for the presence of dental caries, 30.43% ($n = 7$) of students with MIH had lesions in

the affected teeth, 10 teeth showed cavitation, in addition, 60% were in the upper arch and all were first molars (Table 3).

Table 3. Presence of dental caries in molars affected by MIH. Belém, 2013.

Dental element	Dental element affected by HMI and with dental caries	
	n	%
16	2	20
26	4	40
36	3	30
46	1	10
Total	10	100

In relation to the severity degree, 78.46% ($n = 51$) of affected teeth had mild degree of pathology, i.e., they showed only presence of demarcated opacities greater than 2mm and 21.54% had severe degree.

Discussion

Unlike other studies on the prevalence of MIH carried out in Brazil, the present study showed a lower result [2,3,20]. The first Brazilian investigation involving this condition, held in the city of Rio de Janeiro, showed that 40.2% of children had the defect [3]. The high dental caries rate in the Brazilian northern population compared to other regions could explain this difference in the prevalence rate among the different regions of Brazil, as carious lesions can mask enamel defects, therefore underestimating the results of prevalence of MIH for the Amazonian population [1].

The prevalence found in this study is comparable to results found in Libya and Greece and higher than results reported for the populations of China and Bulgaria [14,25-27]. These differences may be explained by ethnic, socioeconomic and cultural aspects, as well as the age group of samples and the eruption stage of teeth examined [10]. The absence of gender preference of this enamel defect found in this study is corroborated by other authors [10,11,26,28].

In relation to the average number of teeth affected by the defect per individual, the result found in this study was also lower when compared to another study carried out in São Paulo [20]. When comparing the average number of affected molars, the result of this study was the same as that found in a city in the state of São Paulo [29]. Although with no statistically significant difference, it was observed that affected molars were mostly located in the upper arch and left hemiarcade, corroborating results found in Spain and Brazil [20,29].

In different studies, among permanent molars, teeth 26 and 16 were the most affected [17,20]. Among permanent incisors, teeth 21 and 31 were the most frequent found with MIH, but without statistically significant difference [20].

A survey in Greece found that in 71.6% of the sample, when there were molars affected by MIH, at least one incisor also had the defect, collaborating the definition that enamel development defect that there is a molar-incisor relationship [14]. However, this study did not find this strong

relationship, as well as a study carried out in Germany, where 57.8% of opacities were restricted to molars [18].

Corroborating the results of other studies [4,11,14,17], no association between the number of affected first molars and the risk of affecting permanent incisors was found. A study in Chile found that about 50% of students who had two affected molars had at least one incisor also presenting MIH, without increased risk of involvement of incisors when there were three or four affected molars [17].

Children affected by MIH present caries lesions most commonly compared to the general population [4,11,20,30]. The prevalence of caries found in children with MIH in this research was significant, in addition to being restricted to hypomineralized molars.

The fact that enamel opacities as the only feature for MIH diagnosis are the most commonly found and therefore post-eruptive enamel fractures and atypical restorations are not so frequent in our sample was also observed in another study with Brazilian schoolchildren [2].

Some authors have proposed that defects should be divided into mild and severe [14]. Therefore, mild cases would be considered all defects showing only enamel opacity and as severe, those showing, in addition to opacity, atypical restorations, post-eruptive fractures, presence of caries and/or dentin hypersensitivity, according to criteria of EAPD [23].

The rate of teeth with MIH being classified as mild found in this study was lower than that found in a survey in southeastern Brazil, which showed a rate of 90.7% of mild degree of severity [20]. Even when analyzing the student and not the tooth unit, the presence of at least one tooth element with severe MIH was high compared to another study in Brazil [2].

This study has limitations regarding the impossibility of justifying the difference in prevalence and severity of MIH found in students compared to other studies conducted in Brazil [2,3]. For being of transversal nature, this study does not allow making inferences of causes of MIH, so, further longitudinal studies should be carried out in order to clarify possible etiological factors, which, perhaps, may be variable according to the region of the country.

Conclusion

Although the prevalence of Molar Incisor hypomineralization found in school children in a state capital of northern Brazil was lower than that found in other locations, it is significant and requires further studies to compare with data from the Amazon region. A strong relationship with dental caries found demonstrates the importance of knowledge regarding diagnosis and treatment of enamel defects. The degree of severe impairment was not the most prevalent in students, but results were relevant, deserving more attention from the scientific community and health policy makers. Amelogenic defects should therefore be part of actions on promotion and prevention of oral health due to their impact on the national and international epidemiology and demographic change of dental caries.

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Conflict of interest

The authors declare no conflicts of personal or financial interest in the development of this research.

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