Pesquisa Brasileira em Odontopediatria e Clínica Integrada

ISSN: 1519-0501

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Brasil

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Pesquisa Brasileira em Odontopediatria e Clínica Integrada, vol. 15, núm. 1, 2015

Universidade Estadual da Paraíba

Paraíba, Brasil

Brazilian Research in Pediatric Dentistry and Integrated Clinic 2015, 15(1):271-278
DOI: http://dx.doi.org/10.4034/PBOCI.2015.151.29
ISSN 1519-0501

Original Article

Molar-Incisor Hypomineralization in Schoolchildren of São Luis, Brazil Maranhão: Prevalence and Associated Factors

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Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 25 August 2014 / Accepted: 20 April 2015 / Published: 11 August 2015

Abstract

Objective: To determine the prevalence of molar-incisor hypomineralization (MIH) in the permanent dentition and assess the factors associated with these change in schoolchildren of São Luís, Brazil. **Material and Methods:** Overall, 1179 students aged 7-14 years of both sexes were included, all with permanent first molars and incisors erupted in the oral cavity. Oral clinical examination to assess the prevalence of HMI was held at school, under natural light. In the second stage, to assess factors associated with HMI, a case-control study was conducted, in which cases were children diagnosed with HMI (n = 14) and as controls, the schoolchild's brother (family control, n = 10) and another schoolchild in the same age group born in the same locality (community control, n = 14). A semistructured questionnaire was completed by mothers to identify possible factors associated with HMI, such as maternal education, family income, data from pregnancy and child's medical history in the first three years of life. Logistic regression analysis was used to estimate odds ratios (Odds Ratio - OR) and their confidence intervals at 95% (CI 95%) to assess crude and adjusted associations for confounders. **Results:** A prevalence of 2.5% of HMI was estimated. No association was found for the etiologic factors surveyed. **Conclusion:** The prevalence of HMI was lower than that reported in other cities in Brazil, but similar to data from other countries. At the difficulty and complexity in establishing the etiologic factors of HMI, cohort studies are required to clarify this change.

Keywords: Dental Enamel; Dental Hypomineralization; Prevalence.

Introduction

The first reports of teeth affected by a fragile hypomineralized enamel that was easily broken under the influence of masticatory forces, with no known cause emerged In the 70s [1,2]. In 2001, it the term molar-incisor hypomineralization (MIH) was first used, referring to a pathological entity systemic origin which causes changes in the first permanent molars, often with the occurrence of simultaneous involvement of permanent incisors [3].

Teeth affected by MIH show soft and porous enamel that looks like chalk or "Dutch cheese" [4]. In its initial stage, this enamel has a high degree of brittleness, which can easily break, causing severe discomfort and sensitivity, especially to temperature changes, air and tooth brushing [5]. Lesions may progress and cause dentin exposure, exacerbating tooth sensitivity and facilitating the progression of carious lesions [2,6]. In more severe cases, it can even lead to tooth loss [1.2].

Regarding the etiology of MIH, systemic changes during odontogenesis, in the perinatal period or first years of life could result in changes in the dental enamel formation [1,3,7,8]. Perinatal complications in the last trimester, low birth weight, lack of oxygen in the birth moment, metabolic disorders of calcium and phosphate, asthma, respiratory tract infections, otitis media, use of antibiotics, high fever history, tonsillectomy and exposure to environmental pollutants are mentioned as possible etiological factors for this alteration [9-11]. More recently, genetic factors were also identified as involved in this change. [12].

Up to the moment, the etiology of MIH has not yet been elucidated, possibly due to its complexity, involving exposure to medical and/or environmental conditions during pregnancy or in the first years of life [12-15].

Although little known and often confused with other enamel disorders or even with dental caries, studies have shown that MIH is prevalent worldwide, and prevalence in Europe varies around 3-25% [12], 2.9 to 13.5% in Africa [16,17] and 2.8% in China. [18] In Brazil, studies have shown prevalence from 12.3% [14] to 40% [19]. Different prevalence rates among studies may be due to the different locations in which they were carried out, but it is possible that different diagnostic criteria may also contribute to these different results [5].

Whereas no MIH prevalence studies were found in northeastern Brazil and the etiology of this change is still quite controversial in literature, this study aimed to determine the prevalence of MIH in a group of schoolchildren aged 7-14 years of São Luís, MA, Brazil and assess possible etiologic factors associated with this change.

Material and Methods

Ethical considerations and Sampling

The project was approved by the Ethics Research Committee of the Federal University of Maranhão (UFMA) (No. 23115-006733/2011-10). All subjects participated in this research after previous clarification from parents or guardians and by signing the informed Consent Form.

The sample size was calculated to estimate the prevalence of MIH, reaching the minimum sample of 1066 schoolchildren that would be necessary for the study. For this purpose, considering prevalence of MIH of 50% (value overestimates the sample size), sampling error of 3% and confidence interval (CI) of 95%. To assess factors associated with MIH in the case-control study linked to the sectional study, it was estimated that minimum sample of 14 cases and 28 controls had 80% power to estimate the difference in prevalence of 45.2% among groups considering that controls exhibited 50%, 95%, and the proportion of 2 controls per case.

This study had a convenience sample and was carried out in three public education institutions of São Luís, state of Maranhão. There were 1480 students aged 7-14 years of interest to the study. Students who had all permanent first molars and incisors erupted in the oral cavity with the crown free from gum tissue have been included. Those who were using fixed orthodontic appliance have been excluded for obstructing the clinical examination of changes of interest to the study (n = 0). Overall, 1179 oral clinical examinations in schoolchildren for the diagnosis of MIH were performed. Twenty-one students were excluded because they were absent on the day of data collection or showed fear during clinical examination.

Data collection

The oral clinical examination for the registration of MIH was held at the school, under natural light, without drying, using all personal protective equipment and wooden spatula for removal of soft tissue.

The first molars and permanent incisors were examined to assess opacities demarcated according to protocol recommended according to protocol recommended by the FDI in 1992 - modified index of enamel development defects (modified DDE) [20], which correspond to enamel defects with translucency alterations. The injury could present white, cream, yellow or brown color, without clear limits, considering opacities largest than 2.0 mm in diameter [8]. Atypical restorations, extractions due to opacities were also included in the study as case of MIH. Diffuse opacities were not recorded.

The differential diagnosis of cases of MIH with imperfect amelogenesis and dental fluorosis was needed. The differentiation to imperfect amelogenesis was based on the opacity distribution because in this change all the teeth are affected and there is genetic involvement, while in MIH, only molars and / or incisors are affected, but rarely at the same intensity [15]. With respect to differentiation with dental fluorosis, opacities this alteration are more diffuse and symmetrical while in HMI, they are unchecked and asymmetric [9].

The oral clinical examination for the registration of MIH and differential diagnosis of MIH with imperfect amelogenesis and dental fluorosis was performed by a single calibrated examiner and evaluated in intra-examiner agreement (k> 0.91), using patients treated at the Clinic of Pediatric Dentistry of UFMA as pilot.

After diagnosis and assessment of the prevalence of MIH, a case-control study was conducted to assess possible etiologic factors associated with this change. Cases correspond to children diagnosed with was conducted (Group 1), family control was a brother undiagnosed with MIH (Group 2) and Community control was a student of the same age born in the same locality of the case (Group 3).

A semi-structured questionnaire was answered by mothers in order to identify data from pregnancy such as maternal education (0 = complete or incomplete higher education; 1 = complete or incomplete high school 2 = primary education or no education), type of childbirth (normal and caesarean), prenatal site (SUS network or private) , hypertension during pregnancy (yes or no), alcohol use and smoking in the last trimester of pregnancy (yes or no). In addition, the child's medical history data were collected in the first three years of life: infection of throat and ear, cold or flu, asthma, pneumonia, anemia, chickenpox, intestinal manifestation and reflux / vomiting, all of these variables categorized as yes or no.

Statistical Analysis

Information obtained were consolidated into the Microsoft Office Excel 2007 program databases and subsequently transferred to the BioEstat 5.3 program. The prevalence of MIH was estimated. In case-control study, groups were compared using paired analysis tests, comparing the three groups through the Friedman test. Considering that not all case individuals have brothers, another analysis was performed using the Wilcoxon test for comparing case group (Group 1) and community control (Group 3).

Associations were estimated between MIH and variables of period pregnancy and the first three years of life through logistic regression univariate and multivariate analyses, calculating the odds ratio (odds ratio = OR) and their confidence interval 95% (95%). A forward modeling was adopted, including in the adjusted model only variables that presented $P < 0.2$ in the univariate analysis. These analyses were performed using Stata, version 12 (Stata Corp., College Station, TX, USA). Significance level of 5% was adopted as criterion for rejection of the null hypotheses.

Results

Of the total of 1179 students, 2.5% (n = 30) were recorded with MIH. Of these, only 14 (46.78%) had filled the questionnaire, being included in the case-control study. As a family control, 10 brothers of schoolchildren were selected and as a community control, another child of the same age born in the same locality of the case was selected (n = 14).

The description of the frequency of factors related from the gestational period and birth to the first three years of life in cases / controls are described in Table 1.

Variables related to the gestational period studied were not associated with MIH. Similarly, those related to the health of children in the first three years of life are generally not associated with MIH (Table 2).

In univariate analysis, no variable was associated with the occurrence of MIH. **:** Variables with p-value less than 0.2 were selected to compose the final multivariate model: use of alcoholic beverages during pregnancy (p = 0.198), throat infection in the first three years of life (p = 0.091), and reflux in childhood (p = 0.091). Even after adjusting, no variable studied was associated with MIH, confirming the findings of paired analysis.

Table 1. Descriptive table of frequencies of cases of MIH and controls in relation to factors associated with pregnancy and birth in the first three years of life.

		Group MIH (n=14)		Group * I.C. (n=10)		Group **C.E. (n=14)	
	Variable	Yes	%	Yes	%	Yes	%
Gestational Period	Normal birth	12	85,7	7	70	9	64,2
	Cesaria	2	14,2	3	30	4	35,7
	Full term	14	100	9	90	14	100
	Preterm	dont have		1	10	dont have	
	Prenatal location (SUS)	13	92,8	8	80	11	78,5
	smoking habits	2	14,2	2	20	4	28,5
	Alcohol consumption	1	7,1	2	20	4	28,5
	hypertension	dont have		2	20	2	14,2
0 a 3 years of life	Throat infection	11	78,5	5	50	7	50
	Ear infection	1	7,1	1	10	2	14,2
	Cold or flu	13	92,8	10	100	13	92,8
	asthma	3	21,4	2	20	1	7,1
	pneumonia	3	21,4	3	30	2	14,2
	anemia	2	14,2	1	10	dont have	
	chickenpox	2	14,2	2	20	6	42,8
	intestinal manifestation	9	64,2	9	90	10	71,4
	Reflux / vomiting	3	21,4	5	50	7	50

*I.C.: Internal Control; **E.C.: External Control

Table 2. Factors associated will MIH compared to external control (Wilcoxon test, n = 14) and internal and external control (Friedman test, n = 10), alpha = 5%.

		Wilcoxon Test (MIHGroup and * E.C group) p-value	Friedman Test (all groups) P
Gestational Period	**normal birth/ cesaria**	0,3	0,2
	Full term/ preterm	-	0,9
	Prenatal location (SUS)	0,3	0,5
	smoking habits	0,4	1,0
	Alcohol consumption	0,2	0,9
	hypertension	0,1	0,7
0 a 3 years of life	**Throat infection**	0,06	0,7
	Ear infection	0,7	0,5
	Cold or flu	1,0	0,9
	Asthma	0,1	0,7
	Pneumonia	0,5	0,5
	Anemia	0,1	0,7
	chickenpox	0,2	0,5
	intestinal manifestation	0,7	0,5
	Reflux / vomiting	0,2	0,1

*E.C.:External Control

Discussion

In the present study, it was observed that 2.5% of the examined students showed MIH. These results were obtained in São Luís – MA, which are similar to 2.9% obtained in Africa [17] and 2.8% in China [21]. However these data are lower than those observed in other Brazilian cities like Araraquara - SP [14], with prevalence of 12.3%, Botelhos - MG [22], 19.8% and Rio de Janeiro 40% [19].

Some justifications may be cited as explanations for the different results obtained among studies in Brazil. The study conducted in the city of Botelhos – MG [22] evaluated 918 schoolchildren and used the criteria of the European Academy of Pediatric Dentistry, considering as cases opacities greater than 1mm , which may have contributed to the higher prevalence than that observed in this study, which considered the FDI criterion, with opacities greater than 2mm. In the study in Araraquara – SP [14], the sample size and age (n = 1151, 6-12 years) were similar to this study including the used of the same FDI criteria to identify cases, but the authors evaluated schoolchildren from public (n = 893) and private (n = 264) schools selected by complex probability sampling (conglomeration and equiprobabilistic stratification). However, the authors found no difference in the prevalence of MIH among students from public (11.98%, n = 107) and private schools (13.25%; n = 35) (p = 0.579). So, it is possible that regional differences might explain differences in the results found. The study conducted Rio de Janeiro evaluated 292 children, with the highest prevalence of MIH reported in literature to date [19]. Possibly, methodological differences - such as small sample size, selection of a single public elementary school supported by the State University of Rio de Janeiro, exclusion of almost half of the sample, probably without MIH - should partially explain the different results obtained.

This case-control study found no associations between variables of pregnancy period and early years with cases of MIH, confirming results from previous studies that also found no such association [23,24].

Although no association between health status in the first three years of life of schoolchildren and MIH was found , it is noteworthy that throat infection was more frequent in the case group (78.5%) than in control groups (50%), including p-value of 0.06, close to the significance limit the matched analysis comparing case groups and community control (Table 2). It is possible that the small number of cases (n = 14) may have contributed to the lack of association of variable throat infection and cases of MIH. Another study showed association between infection in the upper respiratory tract and MIH in a sample using 22 cases of MIH [25].

The strength of evidence of factors associated with MIH is low, with data collected transversally seeking association with data collected retrospectively, subject to high risk of recall bias. The determination of etiologic factors associated with these changes is complex because there are possibilities that they have occurred in two distinct periods, during pregnancy or in the first years of life. Furthermore, systemic conditions may influence the enamel defects [26]. Thus,

identifying possible etiologic agents for MIH involves relationship between the time estimated for the formation of enamel defects with the time of injury occurrence [27].

A limitation of the present study was the convenience sample involving schoolchildren of São Luis, which limits the external validation of the prevalence of results presented here. However, our sample was composed of public schools in a city with low HDI, possibly selecting vulnerable children, thereby showing lower prevalence of MIH when compared to other Brazilian cities. These data suggest that socioeconomic factors do not appear to be associated with increased risk for the development of this change.

As a limitation of the cross-sectional design, the retrospective nature of data collection can be mentioned, which may have contributed to the lack of association between study factors and the outcome. Furthermore, the sample size and the loss of students with MIH reduced the study power to identify differences between groups. However, the selection of controls of the same family and neighborhood cases reduced potential confounders, requiring a smaller sample size.

As strengths of this study, the use of the FDI criterion to standardize the diagnosis of opacities and diagnosis made by a single calibrated evaluator with a high degree of agreement stands out (k> 0.91). In addition, the conduction of the case-control study linked to the cross-sectioal study allowed investigating in greater depth the potential predictors of the outcome of interest, with paired sampling, increasing the power to assess variables in different periods of tooth formation (gestational and after delivery).

In relation to difficulties and complexity in establishing the etiological factors of MIH, prospective cohort studies are needed, including other areas of research in association with the epidemiology of MIH, for example, genetic polymorphism studies in an attempt to elucidate these factors.

Conclusion

The prevalence of MIH in a group of schoolchildren of São Luís - MA was lower than that reported in other Brazilian cities and factors related to the gestational period or the child's medical history in the first three years of life associated with this enamel change were not found.

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