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ORIGINAL ARTICLE

Influence of Environmental Factors on the Presence and Severity of Molar Incisor Hypomineralization

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ABSTRACT

Objective: To assess the association between environmental factors during pregnancy and early childhood with the presence and severity of Molar Incisor Hipomineralization (MIH). **Material and Methods:** This cross-sectional study was conducted with 120 patients between 7 and 14 years of age. MIH was evaluated according to EAPD criteria. Data collected included the child's medical history and the mother's health. Chi-square and logistic regression were performed to determine any statistical evidence of the environmental factors, with the significance level set at 5%. **Results:** The participants were divided into groups with MIH (n=60) and without MIH (n=60), with average ages of 9.9 (±1.9) and 9.7 (±1.7) years, respectively. There was a statistically significant difference between intercurrences during pregnancy (OR=3.55; IC95%=1.35-10.57) and medication taken by the child (OR=3.01; IC95%=1.74-8.42) and the presence of MIH. In addition, other variables were also associated with the MIH ($p \leq 0.05$). However, there was no association with variables and degree of MIH severity ($p > 0.05$). **Conclusion:** The use of medications in childhood and complications during pregnancy can be association to the presence of MIH. However, these factors do not interaction to MIH severity.

Keywords: Tooth Abnormalities; Dental Enamel Hypoplasia; Child; Tooth Demineralization.

Introduction

Developmental enamel defects have been the most widely studied dental anomaly over the past few years [1,2]. Molar incisor hypomineralization (MIH) is an example of these defects, which affect one to four permanent molars and is often associated with permanent incisors [3,4]. In addition, hypomineralization lesion has been associated with permanent canines and primary second molars called Hypomineralized Second Primary Molars (HSPMs) [5,6]. The prevalence of this condition varies considerably in different parts of the world, ranging from 2.8 to 44% [7-9].

One of the main characteristics of MIH is enamel porosity and demarcated opacity, which may vary from white/yellowish to brown [4]. Yet another characteristic is that MIH can undergo post-eruptive enamel breakdown due to masticatory forces [4,10], resulting in hypersensitivity of the affected teeth, which makes oral hygiene difficult to perform and may result in caries lesions [10,11]. It can also cause aesthetic problems that may affect an individual's quality of life [12,13]. Owing to the many consequences of MIH to individuals, periodic dental appointments are important to help management hypomineralization lesions [14].

Ever since the criteria for MIH were developed, there has been a great discussion in the literature about its possible etiological factors [15]. It is already known that genes involved in amelogenesis influence the etiology of developmental enamel defects [15,16]. In addition, risk factors associated with the use of medication and severe infections in the pre- and perinatal period or in childhood may lead to the development of MIH [17,18]. Although there is evidence that environmental and genetic [16,18] factors may be associated with this condition, there is still no conclusive relevant data. Greater knowledge concerning the etiological factors and clinical characteristics are essential to allow its management and future prevention. Thus, the purpose of this study was to assess the association between environmental factors during pregnancy and early childhood with the presence and severity of MIH.

Material and Methods

Ethical Clearance

This study was approved by the Committee for Ethics in Research of the Clementino Fraga Filho University Hospital (Protocol No. 44598514.7.00005257). All parents/caregivers read and signed an assent form. In addition, child/adolescent included in this study also signed an assent form.

Study Design

This cross-sectional study was conducted at the Pediatric Dental Clinics of the Universidade Federal do Rio de Janeiro between July 2015 and Abril 2017. A sample consisting of 120 patients of both sexes, between 7 and 14 (9.94±1.67) years of age, was recruited during this period.

The groups were paired by sex and divided into patients with MIH (n= 60) and those without MIH (n=60). The inclusion criteria for this study were patients with fully erupted first permanent molars. The exclusion criteria for both groups were children with syndromes, enamel defects (hypoplastic lesions, fluorosis, amelogenesis imperfecta) and patients undergoing orthodontic treatment.

Training and Calibration Exercise

A calibration exercise was carried out in two stages to assess the intra- and inter-examiner reliability for MIH: theorical and practical activities. The theorical stage consisted of a discussion of the MIH criteria diagnosis among the study technicians. A professor of pediatric dentistry (MCC), who is the gold standard in

the area, coordinated this stage by instructing the examiner on how to perform the clinical examination. The practical stage was performed with 20 clinical images containing several dental enamel alterations, including fluorosis, hypoplasia, amelogenesis imperfecta and MIH with different locations, discoloration and breakdown. Also included image without enamel defects. After an interval of two weeks, the images were reevaluated and Kappa statistics were applied to measure intra-examiner, with values of 0.88 and 0.89, respectively.

Data Collection

The information collected in this study was obtained from face-to-face interviews with the children's guardians through a medical record. The health aspects were recorded through anamnesis, including demographic data (child´s age, sex, place of birth, residence), and information on the mother's health during pregnancy (medications taken, severe infections and complications during childbirth), and the child's medical history (medications taken, severe infections, high fever, asthma, bronchitis).

Clinical Examination

The clinical examination was performed in the dental chair, where the teeth were examined under artificial light, with a mirror and a probe, after prophylaxis. The MIH diagnosis was based on the criteria established by the European Academy of Paediatric Dentistry (EAPD) [2]. The severity of MIH was recorded according to Lygidakis et al. [19] as mild when the tooth presented demarcated opacities, without enamel breakdown, occasional sensitivity to external stimuli (Figure 1A and 1B), and severe when the tooth showed enamel breakdown, caries, restoration and persistent/spontaneous hypersensitivity (Figure 1C).

Figure 1. A) Incisors with mild MIH; B) First permanent molar presenting opacity without loss of structure; C) First permanent molar with opacity and loss of structure.

Statistical Analysis

The data were analyzed using SPSS software version 21.0 (Statistical Package for Social Sciences, SPSS, Chicago, IL). Student's t-test was performed to check the average age between groups with and without MIH (SD). Chi-square test was applied to determine the associations between environmental factors and MIH, and to assess the degree of MIH severity on environmental factors ($p<0.05$). Univariate regression and Odds ratio was performed to assess the relationships and chances between the variables (risk factors during pregnancy period and child first years of life) in relation to the groups (with and without MIH) ($p<0.05$).

Results

All the subjects recruited were included in the study. The participants were divided into children with MIH (n=60) and without MIH (n=60), with average ages of 9.9 (±1.9) and 9.7 (±1.7) years, respectively (Table 1). A total of 283 teeth were affected by MIH, 30.74% (n=87) were first permanent maxillary molars, 28.26 (n= 80) were first permanent mandibular molars, 25.8% (n=73) were permanent maxillary incisors, and 15.5% (n=43) were permanent mandibular incisors.

Logistic regression showed that MIH was statistically associated with complications during the gestational period (serious infections/systemic diseases) (OR = 3, 55; 95% CI=1.35-10.57, p=0.014) and with children using medication (OR=3.01; 95%CI=1.74-8.42, p=0.019). In addition, other variables were also associated with the MIH (Table 1).

Table 1. Interaction between environment factors and Molar Incisor Hypomineralization (MIH).

Variables		MIH		p-value*	OR (95% C.I)	p-value***
		No N (%)	Yes N (%)			
Degree of MIH Severity	Mild	-	35 (58.3)	-	-	-
	Severe	-	25 (41.7)			
Sex	Female	30 (50.0)	30 (50.0)	-	-	-
	Male	30 (50.0)	30 (50.0)			
Mean Age (SD)		9.7 (1.7)	9.9 (1.9)	0.544**		
Intercurrences During Pregnancy and in Early Childhood	Yes	14 (23.3)	32 (53.3)	0.001	3.75 (1.74- 8.42)	0.001
	No	46 (76.7)	28 (46.7)			
Medication Taken in Early Childhood (0-3 years)	Yes	8 (13.3)	19 (31.7)	0.029	3.01 (1.23- 7.95)	0.019
	No	52 (86.7)	41 (68.3)			
Use of Medication During Pregnancy	Yes	7 (11.7)	9 (15.0)	0.788	1.33 (0.46- 3.99)	0.592
	No	53 (88.3)	51 (85.0)			
Intercurrences During Pregnancy - Severe Infections/Systemic Diseases	Yes	6 (10.0)	17 (28.3)	0.020	3.55 (1.35-10.57)	0.014
	No	54 (90.0)	43 (71.7)			
Complications During Childbirth	Yes	5 (8.3)	14 (23.3)	0.045	3.34 (1.18-10.99)	0.030
	No	55 (97.7)	46 (76.7)			

*Chi-square (p<0.05); ** Student's t-test (p<0.05); **** Univariate Regression (p<0.05).

Regarding the prevalence of MIH severity, most participants (58.3%; n=35) had teeth affected by mild MIH. According to the risks facts (during pregnancy and first year's child life), there was no interaction of the variables tested on the degree of MIH severity p≥0.05 (Table 2).

Table 2. Relationship between MIH severity and environmental factors.

Variables		MIH		p-value*
		Mild (N = 35) N (%)	Severe (N = 25) N (%)	
Medication Taken in Early Childhood (0-3 Years)	Yes	8 (42.1)	11 (57.9)	0.146
	No	27 (65.9)	14 (34.1)	
Intercurrences During Pregnancy and in Early Childhood	Yes	17 (53.1)	15 (46.9)	0.540
	No	18 (64.3)	10 (35.7)	
Use of Medication During Pregnancy	Yes	6 (66.7)	3 (33.3)	0.722
	No	29 (56.9)	22 (43.1)	
Intercurrences During Pregnancy	Yes	12 (70.6)	5 (29.4)	0.260
	No	23 (53.5)	20 (46.5)	
Complications During Childbirth	Yes	6 (42.9)	8 (57.1)	0.302
	No	29 (63.0)	17 (37.0)	

*Chi-square (p<0.05).

Discussion

Several different etiological factors have been identified as causing MIH. Some environmental factors and genes involved in enamel formation are associated with MIH [17,20]. In addition, the literature reports that the use of medication and systemic diseases during pregnancy and the first years of a child's life are potential etiological risk factors for MIH [17,18].

This study found an association between MIH and complications during childbirth or during pregnancy. These findings confirm previous studies that also observed an association of MIH with these variables [21,22]. Another significant variable in our study was the association of MIH with the use of medication in the first years of child´s life, and this may be related to the period of formation of the permanent incisors and first molars that begins around the intrauterine life and extends to the third year of life. Theoretically, the use of medications in the first year of life has been reported with the presence of MIH [17]. On the other hand, Allazam et al. [23] reported an association between MIH and type of medication at any time in early childhood. The information collected in this study was obtained from face-to-face interviews with the children's guardians. Although there is evidence suggesting that studies using parent recall provide inadequate evidence, this inadequacy may be related to recall bias. In contrast, our study was mostly comprised of mothers, who are typically better at recalling information related to the early life of their children and their pregnancy [24].

Regarding the degree of severity, there was no association of these risk factors (interferences during pregnancy, complications at childbirth and medication taken in pregnancy and childhood) with MIH. This may be attributed to the assessment of predominantly mild MIH made by the above study. Moreover, their results lead us to suppose that the degree of MIH severity is related to genetic inheritance, mainly in relation to characteristics of MIH-affected teeth (tooth color, loss of structure) [25,26].

Among the limitations of the present study are the large gaps between the ages of the children. This made it difficult for the interviewees to answer many questions on the questionnaire. The suggestion is that studies with children from 7 to 10 years old allow a more accurate collection of information. In contrast, this study includes careful data collection in relation to environmental factors (prenatal and postnatal), and most of the interviewed were composed of mothers who were providing more consistent information. Another positive aspect of this study was clinical aspects of MIH, determined by experience pediatric 'dentist. These points increase the confidence in the results obtained in this study.

MIH may be a multifactorial condition. More than one etiological factor can determine its occurrence, especially complications in pregnancy and medication used during the first years of a child's life. These results suggested that MIH may be influenced by environmental factors; however, the genetically effect cannot be underestimated. Longitudinal studies are needed to evaluate how environmental and genetic factors influences MIH in the long term.

Conclusion

This study suggests that environmental facts, such as the use of medications in childhood and complications during pregnancy, can trigger the development of MIH.

Authors' Contributions

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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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