PRENATAL AND NEONATAL VARIABLES ASSOCIATED WITH ENAMEL HYPOPLASIA IN DECIDUOUS TEETH IN LOW BIRTH WEIGHT PRETERM INFANTS

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ABSTRACT

*T*his study investigated possible prenatal and neonatal variables that may influence the prevalence of tooth enamel hypoplasia in preterm and low birth weight children (LBW) and a matched control group of term children with normal birth weight (NBW). The study sample consisted of 61 children born preterm and with LBW examined at 18-34 months of age. The control group was formed by 61 infants born full term and with NBW examined at 31-35 months of age. All children were born at the Center of Integrated Attention of Women's Health (CAISM-UNICAMP). FDI criteria were followed for dental examination. Medical data was collected retrospectively from hospital records. Among preterms, 57.4% had some type of developmental defects of enamel (DDE), 52.5 % had opacities and 21.3 % presented hypoplasia. Among full-term children, 24.6% presented DDE, 24.6% had opacities and 3.3% had hypoplasia. LBW preterm infants presented a higher prevalence of hypoplasia than NBW controls. The deciduous teeth most affected by hypoplasia were maxillary incisors. There was no significant association with prenatal variables; among neonatal variables there was a significant association with respiratory distress syndrome and neurological examination at discharge with an altered result.

Uniterms: Dental enamel hypoplasia; Deciduous tooth; Preterm birth; Low birth weight.

INTRODUCTION

Developmental defects of enamel (DDE) can be defined as alterations of dental enamel that result from several disturbances during amelogenesis[7]. Since dental enamel does not remodel, the defects that occur during its formation will be permanently recorded on tooth surface[1]. According to their clinical appearance, DDE can be classified into demarcated opacity, diffuse opacity and hypoplasia[7]. Opacity is a qualitative defect involving an alteration in translucency of enamel and may present a white, yellow or brown color. It can be classified as demarcated or diffuse opacity. Hypoplasia is a quantitative defect associated with a reduced thickness of enamel.

DDE, especially hypoplasia, are clinically important since they can result in increased caries risk, dental sensitivity, increased tooth wear as well as esthetic implications[12,13,14,20,21].

Previous studies have described a higher prevalence of DDE in children born preterm, with low birth weight (LBW, <2,500 g) and very low birth weight children (VLBW, <1500 g)[1,11,15,18]. A frequency of 35% was reported in a descriptive Brazilian study with preterm infants[4]. In a cohort of healthy children, the prevalence rate for hypoplasia was 6% and 27% for opacities[21]. A Brazilian epidemiological study reported a prevalence of 24.4% for DDE and 11.1% for enamel hypoplasia in primary dentition of pre-school children[12]. The prevalence rates vary considerably due to differences in methods, such as the teeth examined, age at examination, diagnose criteria and whether hypoplasia and/or opacities were included.

DDE in deciduous teeth have been described in prematurity, low birth weight, respiratory distress syndrome, malnutrition, mineral deficiencies, hypocalcemic conditions, hyperbilirubinemia, infections during fetal life and neonatal period and after local traumatic injury by laryngoscopy and endotracheal intubation[1,8,9,10,16,17,19].

Preterm is defined as a neonate whose birth occurred before 37 completed weeks (less than 259 days) of gestation. Term is defined as a neonate born from 37 completed weeks to less than 42 completed weeks (259 to 293 days) of gestation[22].

The purpose of this study was to investigate possible prenatal and neonatal variables that may influence the prevalence of enamel hypoplasia in preterm and low birth weight children and a matched control group of term children with normal birth weight (NBW).

MATERIAL AND METHODS

Patient Selection and Study Design

All children included in this retrospective cohort study were born at the Center of Integrated Attention of Women's Health (CAISM-UNICAMP), between January, 2002 and April, 2003. The selection was made from the neonatology register list in which is recorded the mother's name, birth weight, sex and birth date. Birth weight was the selection criterion for recruiting infants. Invitation letters were sent to parents of 112 infants with BW <2,500 g, and 159 with BW =2,500 g. Among those with BW <2,500 g, 71 (63.39 %) attended and 10 were excluded (2 full terms with BW <2,500 g and 2 with somatic malformations). Among those with BW =2,500 g, 67 (42.14 %) attended and 6 were excluded (3 preterms and 3 were large for gestational age). This study was conducted at the Neurology Department of the State University of Campinas (UNICAMP). The research project was approved by the Ethics in Research Committee of the State University of Campinas and written informed consent was obtained from the parents or guardians.

Inclusion Criteria

Inclusion criteria for the study group were: BW <2,500 g, preterm birth, i.e., with gestational age under 37 weeks, adequate or small for gestational age (AGA or SGA, respectively) and age between 18 and 35 months at the moment of dental examination. Controls were NBW full-term children (BW =2,500 g and gestational age ≥37 and ≤41 weeks) and AGA. Children with genetic syndromes and malformations diagnosed in the neonatal period were excluded. For preterm infants, corrected age was considered, i.e., chronological age reduced by the number of weeks born before 40 weeks of gestation[6].

Clinical Examination

Dental examinations were performed at the Center of Pediatric Investigation (CIPED, UNICAMP) by one of the authors (KMDF), before collecting retrospective medical history. Parents answered a query regarding breastfeeding and/or nursing bottle patterns, previous dental trauma, dietary habits, toothbrushing frequency and medication taken. Preventive dental instructions were given thereafter.

In order to avoid masking of defects by dental plaque, teeth were cleaned with a toothbrush[15]. Teeth were evaluated under artificial light using a dental mirror and dental probe without previous drying. Evaluations were undertaken in the presence of the parent or guardian, with the children seated in front of the researcher. Dental examination was performed in accordance with FDI criteria (modified DDE Index)[7]. A tooth was considered erupted if any portion of

the crown had penetrated the mucosa. If more than 2/3 of the tooth surface was restored, decayed or fractured the tooth was considered excluded. A single defect measuring less than 1 mm in diameter was not recorded. In case of doubt about the existence of a defect, it was scored as normal. The buccal, lingual and occlusal surfaces were examined. When enamel defects were diagnosed, their type and extent were noted. Hypoplasias had the localization registered. Opacities were differentiated from white spot carious lesions based on color, texture, demarcation and relationship to gingival margin[15]. The number of teeth present was also registered. The percentages of teeth affected by DDE were computed by dividing the number of teeth presenting the defect by the total number of teeth present. When permitted, photographs were taken.

Medical History

Maternal and neonatal medical histories were obtained from hospital records (CAISM – UNICAMP). The data collected retrospectively included the following independent variables: a) Maternal history: hypertension during pregnancy, urinary tract infection, antibiotics, antepartum hemorrhage, premature placental displacement, preterm labor, acute fetal suffering; b) Neonatal history: gender, gestational age, birth weight, 1st and 5th minute Apgar score, sepsis, intraventricular hemorrhage, respiratory distress syndrome, cerebral ultrasound and neurological examination at discharge. The dependent variable was DDE.

Statistical Analysis

The data were analyzed using SPSS for Windows version 11.0 (SPSS Inc, Chicago, IL, USA) and SAS System for Windows version 8.02 (SAS Institute Inc, 1999-2001, Cary, NC, USA). Chi-square test and Fisher's exact test, wherever appropriate, were used for data analysis. The significance level was set at 0.05.

RESULTS

Demography of Subjects

Table 1 shows the characteristics of the study group (n=61 infants) and control group (n=61 infants). Among the group of preterms, 16 (26.2%) had extremely low birth weight (<1,000 g), 22 (36.1%) had VLBW (<1,500 g) and 23 (37.7%) had LBW (<2,500 g).

In the preterm group, 24 (39.3%) children were SGA and 37 (60.7%) were AGA. All infants born full term were AGA.

Prevalence of Enamel Defects

As shown in Table 2, significantly more preterm infants presented DDE than the full terms (p<0.001). Among preterms, 35 (57.4%) children had some type of DDE, opacities were present in 32 (52.5%) and hypoplasia in 13 (21.3%). Of the 61 controls examined, 15 (24.6%) presented DDE on at least one deciduous tooth, 15 (24.6%) had opacities and only 2 (3.3%) infants presented hypoplasia, these two children also presented opacities.

TABLE 1- Demographic data of the subjects enrolled in the study

	Preterm	Term
Boys (%)	32 (52.5%)	32 (52.5%)
Girls (%)	29 (47.5 %)	29 (47.5 %)
Mean birth weight (g ± SD)	1352.79±391.43	3114.26±332.46
(Range)	(515-2475)	(2500-3580)
Mean gestational age (weeks ± SD)	30.7±2.7	39.4±1.2
(Range)	(25.1-36.7)	(37.1-41.9)
Mean age at exam (months ± SD)	27.75±4.17	32.97±3.91
(Range)	(18-34)	(21-35)
Mean age at exam (months ± SD)	27.75±4.17	32.97±3.91
(Range)	(18-34)	(21-35)

TABLE 2- Enamel defects in deciduous dentition in children born preterm with low birth weight compared to full-term controls

		Preterm	Term	p value*	OR (95% CI)
Hypoplasia	present	13 (21.3%)	2 (3.3%)	0.002	7.99 (1.59-54.04)
	absent	48 (78.7%)	59 (96.7%)		
Opacity	present	32 (52.5%)	15 (24.6%)	0.002	3.38 (1.47-7.88)
	absent	29 (47.5%)	46 (75.4%)		
DDE	present	35 (57.4%)	15 (24.6%)	<0.001	4.13 (1.78-9.66)
	absent	26 (42.6%)	46 (75.4%)		

* Chi square test. **DDE =** developmental defects of enamel.
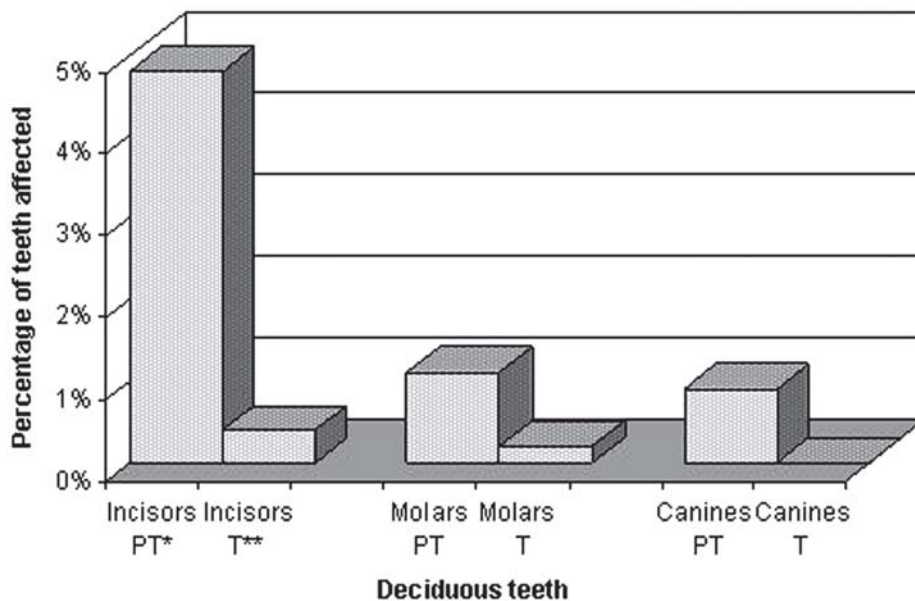
*Preterm group ** Term group

FIGURE 1- Percentage of incisors, molars and canines of the preterm and full-term groups affected by hypoplasia according to number of teeth examined

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In the preterm group, a total of 1073 teeth were examined, of which 4 (0.4%) were excluded due to extensive caries and/or fractures. Regarding the total of 1069 teeth that were considered for the study, 106 (9.9%) teeth presented DDE and 29 (2.7%) had hypoplasia. In the full-term group, 1173 teeth were examined and 24 (2%) were excluded. In relation to the total of 1149 teeth that were considered in the study, 35 (3%) teeth presented DDE and only 4 (0.3%) were affected by hypoplasia.

Distribution of Hypoplasia

Hypoplasia was more frequent in the maxillary arch (5.1%, 27 teeth of the 532 examined) of preterm infants than in the lower arch (0.4%, 2 teeth of the 537), with a statistically significant difference (p<0.001, chi square test). Although hypoplasia was slightly more frequent in the maxillary arch (0.4%, 2 teeth out of 565 examined) than in the lower arch (0.2%, 1 tooth out of 584) of term children, the difference was not significant (p = 0.6, Fisher's exact test). The percentages and distribution of tooth series affected by hypoplasia are shown in Figure 1. In the group of preterm infants, 480 incisors, 372 molars and 217 canines were examined: 23 (4.8%) incisors, 4 (1.1%) molars and 2 (0.9%) canines presented hypoplasia. In the term group, 478 incisors, 436 molars and 235 canines were examined: 2 incisors (0.4%), 1 (0.2%) molar and 0 canine showed hypoplasia. The difference was only significant among incisors (p<0.001, chi square).

Association of Prenatal and Neonatal Variables with Hypoplasia

Table 3 presents the prenatal and neonatal variables present among those infants that had hypoplasia.

In the group of children born preterm, the results obtained for the association between hypoplasia and the maternal prenatal independent variables hypertension, urinary tract infection, antepartum hemorrhage, premature placental displacement, preterm labor and antibiotics taken during pregnancy were not statistically significant. When associations between the different neonatal independent variables and dependent variable hypoplasia were made, the following proved statistically significant: respiratory distress syndrome and neurological examination at discharge with an altered result (Table 4). Although the associations with intraventricular hemorrhage (p = 0.06, Fisher exact test) and sepsis (p = 0.07, Fisher's exact test) were not significant they may indicate a trend. In the term group, the associations

TABLE 3- Description of variables present for children with hypoplasia

Variables	Groups			
	Preterm		**Term**	
Prenatal	**n**	**%**	**n**	**%**
Preterm labor	8	61.5	0	-
Hypertension	7	53.8	1	50
Acute fetal suffering	4	30.8	1	50
Urinary tract infection	3	23.1	1	50
Antibiotics	3	23.1	0	-
Premature placental displacement	2	15.4	0	-
Antepartum hemorrhage	2	15.4	0	-
Neonatal n % n %				
Male	8	61.5	1	50
Female	5	38.5	1	50
Small for gestational age	5	38.5	0	-
Adequate for gestational age	8	61.5	2	100
1st Apgar score <7	9	69.2	2	100
5th Apgar score <7	0	-	0	-
Sepsis	6	46.2	1	50
Intraventricular hemorrhage	4	30.8	0	-
Respiratory distress syndrome	12	92.3	0	-
Cerebral ultrasound (with alteration)	4	30.8	0	-
Neurological examination at discharge (with alteration)	8	61.5	1	50

TABLE 4- Association between enamel hypoplasia, respiratory distress syndrome and neurological examination at discharge in preterm children

		Hypoplasia present	Hypoplasia absent	p value*	OR (95% CI)
Respiratory distress syndrome	present	12 (92.3%)	26 (54.2%)	0.002	10.15 (1.19-225.58)
	absent	1 (7.7%)	22 (45.8%)		
Neurological examination**	altered	8 (61.5%)	8 (17%)	0.003	7.8 (1.70-38.21)
	normal	5 (38.5%)	39 (83%)		

* Fisher's exact test   ** 1 missing value

between the independent variables and hypoplasia were not significant.

Previous Preventive Dental Guidance

When parents were questioned about previously received preventive dental guidance, 44 (72.1 %) in the preterm group answered that they had never received any sort of dental counseling related to their children. In the control group 50 (82 %) also answered negatively.

DISCUSSION

The optimum time to evaluate DDE is soon after tooth eruption due to the lack of stability of these findings, which can be lost by dental trauma, attrition or caries[3,15]. In order to minimize the loss of data, the children of the present study were between 18 and 35 months of age at the moment of dental examination. It is worth remarking that in both groups of the present study only a few teeth were excluded due to extensive caries. To avoid misleading results when comparing preterms and full terms, the corrected age was considered for infants born preterm.

Previous investigations have indicated a high prevalence of DDE in preterm and low birth weight children ranging from 20 to 96%[1,10,11,18], with the highest frequency in very low birth weight children.

Despite limitations in comparing studies due to methodological differences, the current study found a statistically significant higher prevalence of defects in preterms in agreement with earlier reports. This paper contributes to prevalence data of enamel defects in Brazil since few studies have examined DDE in Brazilian preterm infants[4].

In accordance with other studies[1,10], hypoplasia was more frequent in the maxillary arch of preterm infants than in the lower arch, with a statistically significant difference. In term children, the difference was not significant. In the group of preterms, incisors were the most affected teeth by

hypoplasia followed by molars and canines, which agrees with the findings of Fearne[8]. Aine and Funakoshi also found enamel defects mainly in maxillary incisors[1,9]. According to Lai, et al., molars were the most frequently affected teeth by hypoplasia [11]. In the present study, the young age of examination minimized the loss of findings but, on the other hand, in some infants second molars were not yet erupted. Evaluation at a more advanced age could reveal a higher frequency in molars. It is interesting to note that the pattern of frequency of hypoplasia seems to be associated with the chronology of calcification of teeth. Deciduous maxillary incisors are the first teeth to start calcification, which occurs between the third and fourth month of intrauterine life [2]. Amelogenesis of deciduous incisors is nearly completed at term birth, while crown development of deciduous canines and molars is still far from completion[2,5].

Since the birth at the CAISM-UNICAMP was an inclusion criterion for the study group and controls, the authors had the full hospital records for both groups at disposal, making the analysis of etiological factors possible. The association between hypoplasia and prenatal variables was not significant statistically. Although many systemic factors have been associated with enamel hypoplasia, it is difficult to isolate the relative importance of each because they may be concurrent[19]. Seow, et al.[1] outlined that mineral deficiency could act as a central mechanism underlying systemic disturbances, whereas Aine, et al.[19] found that mineral supplementation did not reduce the prevalence of DDE. The neonatal variable respiratory distress syndrome when associated with hypoplasia was statistically significant, which is in agreement with the study of Johnsen[10]. Yet many reports have investigated etiologic systemic factors, no study has made the association with a neonatal finding such as neurological examination at discharge. An altered result is this exam may indicate that the newborn is prone to present neurological disorders.

In the term group, associations were not significant probably due to the small number of full-term children that presented hypoplasia.

Hypoplasia has been considered a significant predictor of dental caries[12,13,14,20,21]. Lai, et al.[11] found that mild enamel defects, such as opacities without hypoplasia, did not increase caries prevalence, but severe enamel hypoplasia was strongly associated with enamel decay[11]. Fearne,[8] found a lower caries prevalence in the study group, but stated that this finding may be associated with the fact that the LBW infants were of higher social class and took fluoride supplements. Preterm infants have a higher prevalence of hypoplasia that may predispose to plaque accumulation and tooth decay[20]. In our study group, 70.1% of the parents affirmed never having received any sort of preventive dental counseling. Therefore, the results of the present study reinforce the importance of preventive dental measures directed towards preterm infants in order to prevent dental caries.

CONCLUSIONS

LBW preterm infants presented a higher prevalence of hypoplasia than NBW controls. The most affected deciduous teeth by hypoplasia were maxillary incisors. There was no significant association with prenatal variables. Among neonatal variables, there was a significant association with respiratory distress syndrome and neurological examination at discharge with an altered result.

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