Oral Conditions in Very Low and Extremely Low Birth Weight Children

Fabiana Rennó D´Oliveira Ferrini, DDS,MS
Sérgio Tadeu Martins Marba, MD PhD
Maria Beatriz Duarte Gavião, DDS, MS, PhD

ABSTRACT

Purpose: The purpose of this study was to evaluate the oral conditions in very low birth weight (VLBW) and extremely low birth weight (ELBW) children.
Methods: Fifty-two VLBW and ELBW 2- to 4-year-old children (V/ELBW group) were evaluated and compared with 52 normal birth weight children (NBW group). The oral examination was performed in accordance with World Health Organization criteria. The parents/guardians answered a structural questionnaire about the children's feeding and oral habits. The prenatal, natal, and neonatal information was obtained from the hospital files.
Results: The enamel defects, such as demarcated opacity and hypoplasia, had a significant association with prematurity and VLBW and ELBW. The breast-feeding and bruxism were more often in the NBW group, whereas nocturnal bottle-feeding, pacifier use, and high frequency of oral hygiene were associated with prematurity and lower birth-weight. V/ELBW group children were at a 12.5 and 6.6 times greater risk of presenting demarcated opacity and hypoplasia, respectively, than NBW children. The risk of presenting nocturnal bottle-feeding, good oral hygiene, and enamel defects was significantly higher for the V/ELBW group.
Conclusions: Very low birth weight and extremely low birth weight were indicators of enamel defects and contributed to an increase in non-nutritive suction habits, being necessary the establishment of early preventive and interceptive measures, to avoid future severe problems.
(J Dent Child 2008;75:235-42)

Received May 15, 2007; Last Revision June 23, 2007; Revision Accepted July 11, 2007.

KEYWORDS: PRETERM CHILDREN, BIRTH WEIGHT, EXTREMELY LOW BIRTH WEIGHT, ORAL HEALTH, PRIMARY TEETH

The long-term and immediate consequences of prematurity and/or low, very low, and extremely low birth weight (**LBW**, **VLBW**, and **ELBW**, respectively) to the child's physical and psychological growth and development are of considerable interest. Premature births are defined as those occurring before 37 completed weeks of gestation. Included in this group are infants born at less than 1,500 g who are termed very low birth weight (VLBW) and extremely low birth weight (ELBW), defined as a birth weight less than 1,000 g.[1] In these infants, many serious complications are found in almost all the main organs and systems, such as the respiratory, cardiovascular, renal, gastrointestinal systems, metabolic, hematological, immunological, and cerebral alterations[2] and in other body tissues.[1] The oral structures can also be affected by prematurity and birth weight. Usually, these alterations are manifested in enamel and palate malformation and can determine delayed growth and development of the primary and permanent dentition.[3-7]

Dr. Ferrini is student, Children and Adolescent Health Graduate Program, School of Medical Sciences (FCM), and Dr. Marba is Chief, Neonatology Area and the Center of Woman Health (CAISM), Department of Pediatrics, Maternity Hospital of Campinas, both at the University of Campinas (UNICAMP), Campinas, São Paulo, Brazil. Dr. Gavião is professor, Department of Pediatric Dentistry, Piracicaba Dental School, University of Campinas, Piracicaba, São Paulo, Brazil. Correspond with Dr. Gavião at mbgaviao@fop.unicamp.br

Enamel formation of primary teeth begins up to the 14th week of intrauterine life and continues up to the first year of postnatal life, and any alteration in the prenatal, perinatal, and postnatal periods, when the secretion or maturation of enamel matrix is occurring, can result in enamel defects.[7] The exact mechanism and etiological factors underlying these defects are not fully understood.[3] There are hypotheses that mineral supply deficiency could be an etiological factor. Systemic factors, however, such as metabolic and nutritional disturbances and infections associated with the mineral loss, could cause alterations.[4] These defects are usually located on the primary teeth undergoing mineralization around the time of the premature birth—that is, the primary incisors, canines and first molars, although the second primary molars may also be involved. It was previously thought that enamel defects were limited to the primary dentition only, as the permanent teeth have not yet begun their formation at the time of the preterm birth. Other studies,[2,8] however, have indicated that the effects of birth prematurity may extend into the permanent dentition as well. As the permanent teeth are thought to commence their mineralization a few months after the preterm birth, it was hypothesized that there was persistence of metabolic derangements in the VLBW children well past the neonatal period which affected mineralization of the first few permanent teeth.[7,8]

Local traumatic factors can also be accountable for some enamel defects in VLBW and ELBW children. The pressure exerted on the alveolar ridge during intubation can determine alterations in the dental germs[9] and inhibit the jaw growth process. This promotes deviations of tooth eruption due to lack of space and favors malocclusion.[6] Metrically, the palates of orally intubated infants remain narrower posteriorly, beginning at the second primary molar, until 11 years of age.[5]

The nutritional factors exercise influence on the odontogenesis and on tooth eruption.[3,10] Vitamin lack during the formation and dental eruption can determine predisposition to tooth decay and delay in tooth formation and eruption.[11]

Considering the predisposition of VLBW and ELBW infants to morphological alterations in the oral structures, the aim of this study was to determine the prevalence and the determinant factors of these alterations in 2- to 4-year-old children born prematurely with VLBW and ELBW. The morphological alterations comprised cavity/decay and enamel defects (hypoplasia, demarcated opacity, and diffuse opacity) in primary teeth, cleft anomalies and palatal groove, oral trauma, and skeletal bone deformity due to parafunctional habits (pacifier and finger-sucking, bruxism, onicophagy). Also evaluated were feeding habits—such as natural and artificial breast-feeding and nocturnal bottle feeding—cariogenic diet, nutritional state, oral hygiene, and socioeconomic status, which could be factors of influence in those alterations.

METHODS

The present research was approved by the Medical Science Research Ethics Committee of the State University of Campinas, Campinas, São Paulo, Brazil, under protocol no. 649/2003.

Initially, 114 VLBW and ELBW children were selected from the files of the Neonatology Center Service of the Center of Woman Health (CAISM). All children were born between May, 2001 and November, 2002 and were, therefore, 2 to 4 years old at the time of the exams. The exclusion criteria were: (1) living in another state; (2) children with special needs; and (3) being impossible to contact by telephone or letter. The final sample consisted of 52 children (26 girls and 26 boys), with a mean age of 34.98±6.87 months and a mean birth weight of 1147.69±229.29 g, whose parents/guardians agreed to participate in the research (V/ELBW group).

Observing the files, all selected children had experienced some respiratory, cardiovascular, metabolic, renal, gastrointestinal, hematological, and immunological disorders that are known to cause generalized and localized defects, the latter of which are most likely caused by laryngoscopy and orotracheal intubation.[12]

A control group was selected at day care centers at the Medical Science School, State University of Campinas, and consisted of 52 children born full-term with normal birth weight (NBW; 28 girls and 24 boys), with a mean age of 36.15±6.20 months and a mean birth weight of 3117.60±428.70 g (NBW group). All parents and guardians responsible for the children were properly informed of the purpose of the research and agreed to participate.

Written and verbal consent was obtained from each child's parents or guardians. In accordance with World Health Organization (WHO) criteria,[13] an oral clinical exam was performed for each child under natural light using a dental mirror and explorer and after drying the surfaces with gauze. Each child's mother sat on a chair in front of the examiner. During the exam, each child stayed in his or her mother's lap. The exam was performed at the CAISM clinic and in an appropriate room at the respective day care centers. All primary maxillary and mandibular teeth were examined.

The variables considered and the evaluation parameters are described in Table 1. To complement the information obtained from the files, interviews were held with the parents/guardians to obtain detailed reports of the pregnancy, breast-feeding conditions, current feeding habits, presence of nutritious suction, parafunctional habits,[14] oral hygiene, nutritional state,[15] and socioeconomic level.[16]

STATISTICAL ANALYSIS

The data were analyzed by the descriptive statistics for the continuous variables. The Mann-Whitney test was used to compare between groups. The chi-square and Fisher exact tests were used to verify the association between the groups

Table 1. Description of the Analyzed Variables Evaluated During Clinical Examination, From Child's Hospital Files and Anamneses

Variable	Clinical characteristics	Categories	
Cavity/decay*	• Lesion in a pit or fissure or on a smooth tooth surface with an unmistakable cavity, undermined enamel, or a detectably softened floor or wall • A tooth with a temporary filling or sealed but also decayed • Caries not present	Yes	No
Hypoplasia*	• Quantitative alteration with located reduction in the thickness of the ename: Pits, grooves, or larger areas of missing enamel	Yes	No
Demarcated opacity*	• Quantitative alteration in the translucency of the enamel of variable degree • Enamel of normal thickness and intact surface with demarcation starting from the normal adjacent enamel with clear limits • White, cream, yellow, or brown coloring	Yes	No
Diffuse opacity*	• Alteration of variable degree in the translucency of the enamel • Without defined limit among the adjacent normal enamel areas • In lines, in patchy or confluent distribution • White coloring	Yes	No
Cleft anomalies and palatal groove†	Platine cleft or groove	Yes	No
Other defects†	• Oral trauma (crows with fractures, avulsion, intrusion, displacement of anterior primary teeth, alteration of tooth brownish color) • Skeletal bone deformity (observed clinically, complementing the anamneses peformed with the parents, and observing the child's hospital file about oral intubation at birth	Yes	No
Feeding habits	Natural breast feedign in months	Yes: >30 days or it is still in use	No: Never breastfed or only up to 30 days
	Artificial breast-feeding: Bottle-feeding in months, frequency, content, and type of milk	Yes	No
	Nocturnal bottle-feeding (at least 1x/night)	Yes	No
Cariogenic diet	Presence of carbohydrates and/or sugar in the diet-based meals: A written description of the child's food consumed over 3 days was requested	Yes: Consumption of ≥5 carbohydrate- and/or sucrose-based meals	No: Consumption of <5 carbohydrate- and/or sucrose-based meals
Parafunctional habits [14]	Pacifier-sucking during day and/or at night	Yes	No
	Finger-sucking during day and/or at night	Yes	No
	Bruxism: Grinding teeth. Parents were asked to determine the presence and frequency of bruxism (more than 1x/wk was considered positive); the presence of bruxofacets in the primary teeth (several showing wear in dentin) was used only to confirm that reported	Yes	No
	Onicophagy: The nail-biting habit, visual examination and parent's information	Yes	No

Table 1. Continuation

Variable	Clinical characteristics	Categories			
Neonatal variables	Gestational age: The number of complete wks from the date of the last period to the day of the child's birth (checked in child's hospital files)	≤37 wks		>37 wks	
	Birth weight: The weight informed by the mother and confirmed in child's hospital file	VLBW: 1,00-1,500g ELBW: <1,000 g	V/ELBW group	>2,500 g	NBW group
	Reflux in the neonatal period: Observed in the child's hospital file	Yes		No	
Nutritional state [15]	Means of the birth weight and the current weight at the moment of the exam, given by the growth curve [15]	Malnutrition: <fifth percentile		Eutrophic: >fifth percentile	
Oral hygiene	Habit of tooth-brushing: It must be performed by parent(s)/ guardian(s) due to children ages	Absent: Sometimes or it doesn't brush		Present: Brushing teeth ≥ 1x/day	
Socioeconomic status [16‡]	ABIPEME scale (Brazilian Association of Institutes of Marketing Research), classifying the family according to social class, where class A is of larger purchasing power and the people of class E is the more poor	Social Class			
		A	B	C	D	E
		High	High average	Medium	Low	Very low

** Examination in accordance with World Health Organization [13] criteria–visual examination after drying the surfaces with gauze.*

† Visual examination after drying the oral cavity with gauze.

‡ The ABIPEME scale considers the education years of the chief earner of the household and a durable index based on the ownership of cars, TV sets and VCRs, refrigerators and freezers, washing machines, vacuum cleaners, and the number of bathrooms and domestic employees.

and the categorical variables, when indicated. Unvaried logistic regression was performed to test the influence of gender, dental caries, and enamel defects, adjusting the model for the group variable (V/ELBW group vs NBW group). Then, multiple logistic regression analysis, using the stepwise procedure, was performed to identify the risk indicators for groups, controlling the confounding variables (feeding, trauma, and oral habits). All statistical tests were performed using the SAS system v. 8.02 for Windows (SAS Institute Inc, 1999-2001, Cary, NC) at a 5% significance level.

RESULTS

The sample consisted of 52 children born preterm with VLBW and ELBW and 52 children born full-term. The demographic variables are demonstrated in Table 2, showing no age, gender, economical class, and nutritional state differences between groups.

In Table 3, the following results can be observed: Maternal breast-feeding was more prevalent in the full-term group, while the bottle-feeding was shown to be more frequently used in the V/ELBW group, with a significant association. The diet itself was cariogenic in both groups, without significant association. The most prevalent habits were pacifier use and tooth grinding in the V/ELBW and NBW groups, respectively. The frequency of poor oral hygiene was more prevalent in the V/ELBW group, with statistical significance. It was observed that demarcated opacity and hypoplasia were significantly associated with prematurity and with VLBW and ELBW. Dental decay and diffuse opacity did not present an association with the respective groups. The children who had suffered trauma only presented with dental alterations, as shown by the brownish coloring or fracturing of the affected teeth—presenting a higher significant statistical proportion in the V/ELBW group. Palate distortions and cleft palate and lip were joined due to the low prevalence and presented no different proportions between groups.

Systemic disorders at birth did not show significant associations with oral variables, but in the V/ELBW group, the lower values in weight, gestational age, and the presence of reflux were significant determinants of hypoplasia (Table 4). Moreover, 6 VLBW children had received orotracheal intubation and showed maxillary asymmetry.

There was a significant association between the numbers of teeth with anomalies in the V/ELBW group that presented with significantly higher proportions compared to the NBW group—except for the second primary molar, which was the least affected tooth (Table 5).

Table 2. Mean Values and Standard Deviation of Children's Age at Examination, Natal Variables and Distribution in Relation to Gender, Nutritional State, and Economical Class

	GROUPS*		
Variable	**V/ELBW**	**NBW**	***P*-value**
Age (mos)±(SD)	34.98±6.87	36.15±6.20	.36
Birth weight (g) mean±(SD)	1,147.69±229.29	3,117.60±428.70	<.0001
Birth weight (g) range	715-1,500	2,500-4,100	–
ELBW (g) range	715-995 (N=15)	–	–
VLBW (g) range	1,015-1,500 (N=37)	–	–
Gestational (wks)±(SD)	30.39±2.59	39.00±1.00	<.001
Gender (male)	26	24	.84
Nutritional state (malnutrition)	18	12	.19
Economical class (low and very low)	28	31	.71

** V/ELBW=very/extremely low birth weight; NBW=normal birth weight.*

Table 3. Distribution and Frequency of Feeding and Oral Habits, and Oral Variables for Both Groups

		GROUPS *				
		V/ELBW		**NBW**		
		N	%	N	%	***P*-value**
Feeding habits	Cariogenic diet	45	87	46	88	.77
	Breast-feeding	32	62	47	90	<.001
	Nocturnal bottle-feeding	45	87	35	67	.02
Oral habits	Pacifier	29	56	17	33	.02
	Finger	2	4	4	8	.68
	Bruxism	2	4	10	19	.01
	Onicophagy	2	4	4	8	.68
	Oral hygiene	46	92	39	75	.02
Oral variables	Cavity/decay	6	12	5	10	.75
	Demarcated opacity	26	50	4	8	<.001
	Diffuse opacity	10	19	6	12	.28
	Hypoplasia	12	23	2	4	.004
	Trauma	11	21	3	6	.02
	Palatal distortions or cleft palate and/or lip	2	4	1	2	.50

** V/ELBW=very/extremely low birth weight; NBW=normal birth weight.*

VLBW and ELBW children have a 12.5 times greater risk of presenting demarcated opacity, while for hypoplasia the chance is 6.6 times greater than full-term children (Table 6). Moreover, the risk of presenting nocturnal bottle-feeding, poor oral hygiene, and enamel defects was significantlyhigher for the V/ELBW group (Table 7).

DISCUSSION

At the time of birth, a series of physiological adaptations take place. For a short period, growth stops, producing a physical effect on the skeletal tissues in formation, and the regular sequence of mineralization can be disturbed. Under normal circumstances, children have a soft neonatal line that can be seen if the dental surface is enlarged. If the prenatal period is disturbed, however, the result can be a prominent area of spotted, distorted, or poorly mineralized enamel.[17] Therefore, prematurity[3,7,18] and low birth weight[19] can be considered a risk factor for the occurrence of dental enamel alterations, as observed in the present study's results, which are similar to those of Seow.[7,12]

If alterations occur during the organic matrix formation or secretory stage, the possible clinical expression is enamel hypoplasia, which is characterized by points, furrows, or enamel absence. In the event that alteration occurs later on, during the maturation period or enamel calcification, the result can be a hypocalcification, manifested by opaque or decalcified areas, surrounded by enamel of normal appearance.[19] Consequently, this explains why V/ELBW group children with hypoplasia present a significantly lower gestational age and birth weight than those without the presence of this anomaly. The demarcated opacity was the most prevalent anomaly, demonstrating that at the time of the birth the affected teeth were in the maturation process. The results of unvaried regression analysis confirmed that the V/ELBW group had a greater chance to have enamel defects, such as demarcated opacity and hypoplasia (Table 6).

Among the teeth with structural alterations, the most affected were the first molars (Table 5), since the formation process happens earlier in relation to the second primary molar. This agrees with findings by Lai et al,[20] but differs from Fearne et al,[21] who found a larger prevalence for the anterior teeth.

A similar proportion of children affected by decay was observed in both groups (Table 3), agreeing with others.[20,22] Alterations in the enamel structure can predispose teeth to cariogenic bacteria colonization, increasing susceptibility to decay.[7,22] The similar proportion found, however, could be explained by decay being a behavioral disease of multifactorial etiology.[23] Despite the fact that most of the children in the present study belonged to less-favored social classes that could contribute to the high risk of decay,[24] few of them presented with caries. This could be attributed to the studied age group and educational and preventive methods that have been applied to the population in general. On the other hand, the diet was considered cariogenic in both groups, but hygiene habits were more frequent in the V/ELBW group, justifying the same proportion of children with decay in both groups (Table 3). The proportion of V/ELBW group children with demarcated and diffuse opacity and hypoplasia was significantly higher than for NBW group children (Table 3). Therefore, V/ELBW group could be considered at risk for disease development in the long-term, depending on other etiological factors.

The association among the structural defects and the neonatal variables that could interfere in these alterations was not significant, despite the fact that many of the systemic illnesses experienced by VLBW and ELBW children have been known to cause enamel hypoplasia in other children.[25] Any one of the systemic conditions can cause enamel hypoplasia individually, however, since a central mechanism plays a role related to mineral loss or osteopenia. This central pathway suggests that mineral stores become depleted in a preterm infant and the entry of calcium and phosphorus into the developing tooth germs may be altered sufficiently to affect enamel formation.[7] It was verified, however, that the children with a lower gestational age and birth weight presented with more significant hypoplasia.

The feeding process involves the oral motor mechanism and areas of behavior related to the state of consciousness/awareness, cognition, motor and neurological development, physiologic maturation,[26] and mother-child interaction.[27] Thus, maternal breast-feeding does not always happen in lower birth weight children, as observed in 39% of the children in the V/ELBW group, a value that was significantly higher in relation to the NBW group (Table 3 shows the presence of breast-feeding in both groups). The lack of natural breast-feeding can favor the emergence of nutritious and non-nutritious oral habits; if they are perpetuated, they can cause morphologic alterations in the dental arches. In this study, the highest percentage of V/ELBW group children with nocturnal bottle-feeding habits and pacifier-sucking (Table 3) evidences this finding. On the other hand, more consistent studies must be performed including diet (breast milk vs formula), mode of feeding (bottle- vs breast- vs orogastric vs nasogastric feeding), positioning, biometric data, and the influence of the mandible.[5]

Traumatism was present in a significantly higher proportion in the V/ELBW group, which could be attributed to significantly higher pacifier using (Table 3). Non-nutritious sucking habits can cause changes in tooth inclination, predisposing the incisors to traumatism, due to lack of protection by the soft tissues. In cases of tooth discoloration due to traumatism, differential diagnosis must be considered, since some antibiotics, such as ciprofloxacin, can cause dental color alteration.[28]

All 6 children who had been intubated showed maxillary asymmetry. These findings evidence the attention required in cases of oral habits and intubation techniques, to prevent early malocclusion. On the other hand, none of the raised confounding factors for developmental disturbances may be excluded until evident results are presented, such as the non-nutritious habits; consequently, early orthodontic and logopedic control of formerly premature infants is recommended up to the late mixed dentition stage.[5] From the orthodontic point of view, nasal intubation should be favored.[29]

Table 4. Association Between Natal and Neonatal Variables and Hypoplasia

Variable	Without hypoplasia	With hypoplasia	*P*-value
Birth weight±(SD)	1190.63±209.73 (N=40)	1004.58±242.38 (N=12)	.02
Gestational age±(SD)	31±2.32	28.42±2.50 (N=12)	.008
Reflux	5 (N=38)	5 (N=12)	.04

Table 5. Distribution and Frequency of the Affected Teeth

	GROUPS *				
	V/ELBW		NBW		
Teeth	No. of teeth	%	No. of teeth	%	*P*-value
Primary central incisors	19	37	5	10	.001
Primary lateral incisors	17	33	3	6	<.001
Primary canines	19	37	6	12	.003
Primary first molar	21	40	8	15	.005
Primary second molar	7	13	3	6	.18

** V/ELBW=very/extremely low birth weight; NBW=normal birth weight.*

Table 6. Unvaried Logistic Regression for the Variable Group (N=102)

Variable	Odds ratio	95% confidence interval	*P*-value
Gender	.0712	0.272-1.862	.49
Dental caries	2.426	0.465-12.655	.29
Demarcated opacity	12.482	3.124-49.872	<.001
Diffuse opacity	2.218	0.578-8.501	.25
Hypoplasia	6.699	1.223-36.707	.03

Table 7. Distribution and Frequency of Feeding and Oral Habits, and Oral Variables for Both Groups

Variables	Odds ratio	95% confidence interval	*P*-value
Breast-feeding	3.476	0.782-15.463	.012
Trauma	5.247	0.871-31.599	.070
Pacifier	1.406	0.389-5.081	.603
Bruxism	2.533	0.368-17.430	.345
Oral hygiene	11.043	1.438-84.799	.021
Nocturnal bottle-feeding	4.966	1.181-20.874	.029
Demarcated opacity	19.600	4.300-89.331	<.001
Diffuse opacity	7.797	1.566-38.825	.012
Hypoplasia	11.078	1.408-87.175	.022

The habit of teeth grinding or bruxism was more prevalent in the NBW group, inferring that factors of influence are not dependent on the gestational age and birth weight. This habit can appear early in childhood and can either persist during the individual's lifetime or not. Its etiology is considered multifactorial, such as a combination of local factors (premature occlusal contacts) and/or psychological (stress) factors, malocclusion or occlusal disharmony, traumatism, dental filling excess, and increased muscular tension.[14]

The change of presenting with nocturnal bottle-feeding, oral hygiene, and enamel defects was significantly higher for the V/ELBW group (Table 7). Thus, to promote good dietary and oral hygiene habits and, as observed by Davenport et al,[18] improve the quality of life for preterm and low birth weight children, it is necessary to create educational programs for pregnant women, recommend maternal breast-feeding, and encourage family support for children's oral care. Promoting good oral health is an important aspect of promoting good overall health. Good dental care should be emphasized to parents of all preterm infants.[4]

The obtained outcomes infer that a greater number of VLBW and ELBW children presented with hypoplasia and demarcated opacity. Non-nutritious sucking habits (such as bottle-feeding and pacifier use) were present to a greater extent in the V/ELBW group, which could determine malocclusion, just as an excessive overjet predisposes an increased chance of dental traumas due to lack of protection by the soft tissues. Maternal breast-feeding and bruxism were more prevalent in the NBW group. On the other hand, the higher risks of presenting enamel defects and nocturnal bottle-feeding by VLBW and ELBW children (Tables 3 and 7) emphasize their needs for special dental care early.

CONCLUSIONS

In this study, very low birth weight and extremely low birth weight were indicators of enamel defects and contributed to an increase in non-nutritive suction habits. Considering the precarious conditions and the risks that these children are subjected to in their growth process, development, and adaptation to extrauterine life, it is necessary to bring very low and extremely low birth weight concerns to the attention of health professionals, who can offer full attention to promote better quality of life.

ACKNOWLEDGEMENTS

The authors are grateful to the Neonatology Center Service of the Center of Woman Health (CAISM)—State University of Campinas—UNICAMP and to the day care centers at the Medical Science School, UNICAMP, for the assistance given in all phases of this research.

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