Low birth weight and the delay on the eruption of deciduous teething in children

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Abstract

Objectives: To analyze the association between low birth weight (LBW) and the occurrence of the delay on the eruption of deciduous teething (DEDT) in children from 04 to 30 months, living in Salvador, Bahia.

Methods: A cross-sectional study involved 520 children at four to thirty months of age, from public, private and philanthropic daycares from two districts in Salvador. A descriptive analysis and unconditional logistic regression were done to estimate the odds ratios (ORs), using the Confidence Interval of 95% as a criterion for accepting associations. Poisson regression was used as an analytical strategy to obtain the prevalence ratio.

Results: the prevalence of the delay on the eruption was 10.29%. There was a positive association between LBW and occurrence of DEDT among children with less than 24 months, both in the unadjusted model (PR=2.07, 95%CI= 0.96 4.44) as in the adjusted (adjusted PR=2, 27, 95%CI= 1.02 5.07).

Conclusions: the variables of development and nutritional at birth and during the early life may be important predictors of the chronology of eruption. Further investigations should be carried out towards the adequate evaluation of the LBW role in the occurrence of the delay on the eruption.

Key words *Tooth eruption, Deciduous tooth, low birth weight newborn, Epidemiology*

http://dx.doi.org/10.1590/1806-93042019000300012

Introduction

Dental eruption understands all the movement of the tooth in the occlusal direction during the formation until it reaches its occlusal functional position with its antagonist. It constitutes the part of the physiological movements of the teeth relating to the maintenance of its position in the growing jaws and compensates by chewing decay and it is a useful assessment on the children's physiological and chronological age.[1-9] The knowledge on the normal timing of tooth eruption ranges from the intrauterine life up to 30 months, it has clinical relevance to diagnose various locations and systemic conditions that may affect this process.[1-2,4,6,9-17]

The variation in the chronological dental eruption is dependent of multiple genetic and environmental factors and none of them acts individually, there is an inter-relation among themselves during the development of deciduous teething, such as race, gender, systemic conditions, environmental conditions, socioeconomic level, maternal breastfeeding, infant nutritional status and physical development.[1,18]

Nutritional factors influence the odontogenesis and the eruption of the teeth.[16,17,19] During teeth development, the lack of nutrients such as calcium deficiency,[8] can affect not only the cellular architecture of the organic matrix, such as calcification and amelogenesis maturation process but also morphology and teeth eruption pattern.[18,20] Other conditions as intrauterine growth restriction, inadequate size according to gestational age, exclusive parenteral nutrition for a long time can also potentially delay the eruption of deciduous teething.[8] In situations where prematurity and low birth weight (LBW) coexist in the delay of making it even greater, especially those who are at a critical stage of development at the moment of a systemic disorder and they are still unclassified at the moment of birth.[8,21,22]

There are evidence of a positive association between children with LBW and late teeth eruption related to an overall development delay.[5,12,23] However, there are some controversies regarding the association between birth weight and time of the first tooth eruption.[13] In some studies, when age is corrected for prematurity, there is no delay in the eruption.[12,22,24]

Thus, it is important to carry out studies on the chronology of the rupture of the first deciduous teething to analyze some factors that influence the delay of dental eruption. This study aims to analyze the association between LBW and the occurrence to delay the eruption of deciduous teething in children aged 04 to 30 months living in Salvador - BA.

Methods

A cross-sectional study was developed and the information used in this study were obtained from a pre-existing database. A detailed description of the area and population of this study, the methods to select participants, procedures used in the data collection, the strategy and the criteria test, as well as the details on the ethical issues involved are presented in another publication.[25]

This study tried to involve in the analysis all the participant children of the original research that adopted the census perspective (n=556). The group was composed of children four to thirty months of age attending public, private and philanthropic daycares in two districts in Salvador city (Barra-Rio Vermelho and Cabula – Beirú). On the opportunity, the exclusion criteria was considered finding congenital anomalies or systemic alterations that prevented the examination to be performed.

Delayed eruption was considered as a dependent variable. The chronology of the dental eruption was verified by registering the month of the first deciduous teething eruption. In this study, to define the delay of the eruption, Aktoren *et al.*[26] proposal was used to define delayed dental eruption. According to these authors, the children presented delayed eruption when his/her first tooth erupted after 40 weeks on the chronological age.

The main independent variable was low birth weight, considering if the child weighed less than 2500g at birth, regardless of gestational age.

Among the socioeconomic and demographic covariates, the following were considered: the child's age in months; sex; skin color; family income; maternal schooling; maternal age, and the mother's marital status. Regarding to the variables, related to lifestyle, were considered as: breastfeeding pattern; time for maternal breastfeeding; the use of medication in the first months of the infant's life. Information regarding prenatal history was included in the analysis: pregnancy without complications, hypertension and urinary tract infection during pregnancy; alcohol, tobacco and drug consumption during pregancy and the performance of prenatal care. The variables related to childbirth were: gestational age; difficulty of suction; the use of catheter and the necessity of being intubated.

Initially, the descriptive analysis of the variables was performed, obtaining the simple frequencies for the categorical variables and the measures for the

central tendency and dispersion for the continuous ones. The prevalence of effect was observed according to the covariates by analyzing the differences between the categories by using Pearson's Chi-square test.

Afterwards, the stratified analysis was performed to evaluate potential associations. In this phase, the crude associations between low birth weight and the delay in the chronology eruption were estimated, as well as for the covariates selected through the Prevalence Ratio and 95% Confidence Intervals obtained by Mantel-Haenszel's Method. The modifying effect of the potential covariates were identified by verifying the difference in the prevalence ratio for each of its categories at a statistical significant level (alpha=0.05). In the confounding covariates were observed whether they were simultaneously associated to the exposure among the non-cases and the outcomes among the non-exposed individuals, considering a relative difference between the adjusted measures of each covariate and the crude association measurement greater than 10% for the confounding identification. Along the elements of theoretical model and literature, this statistical procedure contributed to select covariates used in the modeling.

In multivariate analysis, the method used was unconditional logistic regression. For statistical inference the 95% Confidence Interval was used. The product terms were created to potentially modify the variables effect. The interaction analysis was performed through a backward modeling procedure, from the definition of the saturated or complete model and the reduced model for each potential modifier effect, observing the difference in the deviations between the saturated and the reduced models, and adopting an alpha=0.20 from the Maximum Likelihood- Ratio Test (MLRT) to verify statistical significance. The backward procedure in the confounding analysis was used, comparing the measurements of the association and its respective confidence intervals estimated for the saturated and reduced models.

The modeling procedures allowed the construction for the final model to estimate the *odd ratios* between low weight and the dependent variable controlled by the interaction variables and adjusted by the confounding variables. The Poisson Regression was used as an analytical strategy to obtain the Prevalence Ratio. The goodness of adjusting the model was verified by Hosmer and Lemeshow's Chi-square test.[27] The data were analyzed in the STATA7.0 program.[28]

Results

Considering the original population of 556 children, it was observed that there was information regarding the eruption of the first tooth of 554 participants. On the other hand, proper birth weight registeration was available for 520 children. Thus, the population in this study was composed of 520 children ranging from four to thirty months of life and the mean age was 21.8 months, SD=6.82. The prevalence of delayed eruption was 10.29%, therefore, 89.71% of the children's eruption of their first tooth occurred before 40 weeks of the chronological age. The characteristics in the study population in relation to sociodemographic variables are according to the exposure shown in Table 1. Among the children with LBW, 14.71% had their first tooth erupted after 10 months. The prevalence among the same children were female, black/mixed ethnicity, family income of up to 01 minimum wage. For sociodemographic variables, the differences in proportion was according to birth weight that was not statistically significant.

In Table 2 the characteristics of maternal health and habits during pregnancy according to birth weight were observed. Statistically significant differences were observed for the occurrence of urinary tract infection during pregnancy (p<0.001), smoking (p=0.016), the use of drugs during pregnancy (p=0.009) and uneventful pregnancy (0.017).

In regards to the covariables relating to childbirth and behavior, so this was verified, as expected, the statistical significant difference in the occurrence of prematurity according LBW (p<0.001). Similarly, other variables intrinsically related to premature birth had higher ocorrence among low weight children as compared to others - born less than 50cm long (p<0.001), and have presented the necessity of hospitalization (p=0.018), intubation (p<0.001) and medications (p<0.001) (Table 3).

Bivariate analysis revealed a positive association, but without statistical significance between LBW and the delay of eruption (PR=1.51; 95% CI=0.79-2.86). Among the covariates selected for this analysis, only maternal schooling had a positive and statistically significant association to the outcome of this study, with higher occurrence of delayed eruption among children whose mothers had low schooling level (PR=1.91; 95%CI=1.14-3.18) (Table 4).

The covariates did not behave as modifying or confounding effect in the stratified analysis. In the modeling, using the logistic regression method, the same result was observed. However, based on the

Table 1

Sociodemographic characteristics of the study population according to the presence of low birth weight, Salvador-BA, 2014 (n=520).

Covariables	Low Birth Weight				*p*[1]
	LBW absent (n=452)		LBW present (n=68)		
	n	%	n	%	
Delay in the eruption					0.210
Absent	408	90.17	58	85.29	
Present	44	9.73	10	14.71	
Age					0.357
>24 months	186	41.15	32	47.06	
≤24 months	266	58.85	36	52.64	
Sex					0.116
Female	213	47.12	39	57.35	
Male	239	52.88	29	42.65	
Ethnicity					0.105
White	66	14.60	5	7.35	
Black / Mixed	386	85.40	63	92.65	
Maternal schooling*					0.939
High school or higher	246	54.91	37	54.41	
Up to elementary level	202	45.09	31	45.59	
Family income					0.269
More than 1 MW	143	31.64	17	25	
Up to 1 MW	309	68.36	51	75	
Maternal age *					0.684
21 to 39	330	73.83	47	69.12	
≤20	108	24.16	19	27.94	
≥40	9	2.01	2	2.94	
Maternal marital status					0.826
Married / Lives with a partner	292	64.60	43	63.24	
Single / separated / widow	160	35.40	25	36.76	

*Missing data, [1]= Mantel Haenszel's Chi-Square Test *p* value, MW= Minimum Wage, LBW=Low Birth Weight.

Table 2

Maternal health characteristics and gestational habits according to low birth weight, Salvador-BA, 2014 (n=520).

Covariables*	Low Birth Weight				*p*[1]
	LBW absent (n=452)		LBW present (n=68)		
	n	%	n	%	
Hypertension during pregnancy					0.272
Absent	413	92.19	60	88.24	
Present	35	7.81	8	11.76	
Urinary tract infection during pregnancy					0.001
Absent	416	92.86	55	80.88	
Present	32	7.14	13	19.12	
Smoking during pregnancy					0.016
Absent	414	92.62	57	83.82	
Present	33	7.38	11	16.18	
Alcohol consumption uring pregnancy					0.155
No	426	95.30	62	91.18	
Yes	21	4.70	6	8.82	
Use of drug during pregnancy					0.009
No	403	90.16	54	79.41	
Yes	44	9.84	14	20.59	
Uneventful pregnancy					0.017
Yes	338	75.45	42	61.76	
No	110	24.55	26	38.24	
Prenatal care					0.861
Yes	404	90.38	61	89.71	
No	43	9.62	7	10.29	

[1]Mantel Haenszel's Chi-Square Test *p*-value, *There were missing data in all the variables, LBW=Low Birth Weight.

Table 3

Birth and behavioral characteristics of the study population according to the presence of low birth weight, Salvador-BA, 2014 (n=520).

Covariables	Low Birth Weight				*p*[1]
	LBW absent (n=452)		LBW present (n=68)		
	n	%	n	%	
Prematurity					<0.00 1
Absent	431	95.35	39	57.35	
Present	21	4.65	29	42.5	
Height at birth *					<0.00 1
≥50 cm	154	45.56	3	5.88	
≤50 cm	184	54.44	48	94.12	
Need of hospitalization at childbirth					0.018
No	389	86.06	51	75.00	
Yes	63	13.94	17	25.00	
Use of Probe					<0.00 1
No	447	98.89	61	89.71	
Yes	5	1.11	7	1.29	
Need to be intubated					0 860
No	444	98.23	67	98.53	
Yes	8	1.77	1	1.47	
Breastfeeding					0.304
Yes	393	86.95	56	82.35	
No	59	13.05	12	17.65	
Breastfeeding duration (months)					0.835
More than or equal to 6	152	33.63	22	32.35	
Less than 6	300	66.37	46	67.65	
Artificial feeding					0.822
No	127	28.10	20	29.41	
Yes	325	71.90	48	70.59	
Use of medication					<0.00 1
No	418	92.48	53	77.94	
Yes	34	7.52	15	22.06	

*Missing data,[1]= Mantel Haenszel's Chi-Square Test *p*- value, LBW=Low Birth Weight.

Table 4

Prevalence and Prevalence Ratios and Confidence Intervals at 95% of the crude association between the analyzed covariates and the delayed eruption, Salvador-BA, 2014 (n=520).

Variables	N	%	RP[1]	CI95%[2]	*p*[3]
Low birth weight				0.79-2.86	0.21
No	44	9.73	1.00		
Yes	10	14.71	1.51		
Age				0.61-1.67	0.96
24 months or more	24	1.21	1.00		
Less than 24 months	33	10.34	1.01		
Skin color				0.65-3.82	0.29
White	5	6.86	1.00		
Black / Mixed	52	1.81	1.58		
Sex				0.83-2.24	0.22
Male	25	8.74	1.00		
Female	32	11.94	1.37		
Maternal schooling*				1.14-3.18	0.01
High school or higher	21	7.27	1.00		
Elementary level or less	36	13.85	1.90		
Uneventful Pregnancy *				0.45-1.48	0.51
Yes	44	10.92	1.00		
No	13	8.97	0.82		
Gestational age				0.6 2-2.71	0.49
At term	50	10.02	1.00		
Premature	7	12.96	1.29		
Exclusive breastfeeding				0.65-2.36	0.51
Yes	47	9.94	1.00		
No	10	12.35	1.24		
Breastfeeding duration				0.68-2.01	0.57
6 months or more	17	9.24	1.00		
Less than 6 months	40	10.81	1.17		

*Missing data, [1]= Prevalence Ratio, 2 95% Confidence Interval, [3]= Mantel Haenszel's Chi-Square Test *p*-value.

Table 5

Estimates of crude and adjusted PR and the respective 95% Confidence Intervals for the association between low birth weight and the delayed eruption according to age obtained by the logistic regression, Salvador-BA, 2014 (n=520).

Delay in eruption	Child's age			
	More than 24 months (n=218)		Up to 24 months (n=302)	
	RP[1]	CI95%[2]	RP[1]	CI95%[2]
Model 1 (delayed eruption)				
Present	0,92	0,29-2,93	2,07	0,96-4,44
Model 2 (delayed, adjusted for uneventful pregnancy and breastfeeding)				
Present	0,89	0,28-2,82	2,27	1,02-5,07

[1]= Prevalence Ratio, [2]= 95% Confidence Interval.

literature, the final model was controlled by the covariate of the child's age and to measure the crude and adjusted association to the exclusive breastfeeding and pregnancy without complications were generated. Thus, there was a positive association between LBW and the delayed eruption in children younger than 24 months (PR adjusted=2.27, 95% CI=1.02-5.07) (Table 5).

The diagnoses performed for the logistic models adjusted in Strata (age=0 and age=1), respectively, using the Hosmer and Lemeshow's Chi-square test (p=0,842 and p=0,067), the area under the ROC curve, 0.59 and 0.55, which showed acceptable discrimination between the delays (1) and non-delays (0) in relation to LBW (exposure), in addition to the model agreement, 89.8% and 89.3, high specificity, 100% and 100%, and the influential covariate patterns indicated that the models would adjust to the data.

Discussion

The results suggest that in the studied population, there is an association between LBW and the occurrence of delayed eruption in children under 24 months of age. After adjusting for the independent variables which were exclusive breastfeeding and uneventful pregnancy, there was an increase in the strength of this association that became statistically significant.

Considering the measures of occurrence of late dental eruption (LDE) observed in this study, it can be mentioned that the overall prevalence (10.29%), and the prevalence found among children with LBW (14.71%) are less when comparing to the results of other studies involving the same age group. Aktoren *et al*.[26], for example, verified that 21.95% of the premature children studied had their first tooth erupted after 10 months of age.

This study reinforces the hypothesis that biological and nutritional factors present in the "early" life influence dental eruption patterns later in life. Specifically, the effects of intrauterine growth and nutritional status may be seen on deciduous teething. It was observed that children with LBW had higher occurrence of LDE, which this agrees with Rezende *et al*.[16] study that children who were born with low weight had a late dental eruption compared to children who had birth weight greater than 2,500g. According to Andrade *et al*.[23], dental eruption is a sign of development most affected by the variables that were most often described as acting on the child's integral evolution. Thus, among underweight, premature, malnourished children who are not breastfeeding or were not breastfed at any time in their lives, children of teenage mothers whose schooling did not pass the fourth grade in the elementary level showed a significant risk of delayed teething compared to children who did not have any of these conditions.

Ramos *et al*.[12] also found a positive statistically significant association between birth weight and the timing of the first tooth eruption by using the chronological age, as this study did.

According to these authors, children whose birth weight was less than 1,500g had their first tooth erupted later when compared to those whose birth weight was between 1,500 and 2,499g and those whose birth weight was 2,500g or more. However, when the corrected age was used, there was no statistically significant difference in the three birth weight groups.

In Sjjadian *et al*.[13] work on linear regression analysis, identified a negative linear correlation between birth weight and the first deciduous teething eruption. This result suggests that nutritional and developmental variables at birth and through *early life* may be important predictors of the chronological eruption of the first deciduous teething.

Al-Sayagh *et al*.[21] observed delayed eruption of deciduous teething in children with LBW in relation to children in the control group in all age groups except for the 4 to 6 months group. When comparing the mean age of the eruption between normal-weight and low-weight infants, Um *et al*.[4] had checked that the same occurred significantly earlier in children born with normal weight, with an exception of the maxillary first molar and the upper and lower canine teeth.

This presente study highlights the approach of the variables potentially associated with prematurity and uneventful pregnancy (tobacco use, urinary tract infection and others). Thus, it reinforces the hypothesis that children presenting malnutrition before childbirth, during which the teeth are still being formed, they suffer a nutritional problem in which can cause damage in the development of deciduous teething.[1] As LBW may be due to intrauterine growth restriction, which is a condition related to inadequate nutrition, it may alter the magnitude of the delayed eruption of the deciduous teething.[24,29]

Unlike the present study, Um *et al.*[4] did not find any statistically significant correlation between the timing of eruption of the deciduous teething and birth weight. The results point to the fact that the baby, even those born prematurely or underweight, may present at any age, as many erupted teeth as full-term and normal weight babies as long as their

growth has reached a an accelerated pace to the point where his/her height and age appropriate represents a higher percentile than those with normal anthropometric measurements at birth.

Alnemer *et al.*[10] results showed a distinct relation between birth weight and the number of erupted teeth. According to the authors, LDE is common in premature babies regarding to deciduous teething, but the catch-up development occurs after early childhood and regularizes the chronological eruption.

Delayed dental development in premature children has also been researched by Zaidi *et al.*[24] who identified this as a LDE cause. This study observed that prematurity was an important adjusted variable in the modeling, because in some studies showed a delay in the dental eruption among premature children, but when the corrected age was considered, no delay was found in the chronological eruption.[8,10,29] The corrected age is the postnatal age subtracted of the number of days, weeks or months to complete 40 weeks at the time of the child's birth.[29]

Alnemer *et al.*[10] could demonstrate the lower the birth weight, the longer the delay in the dental eruption. However, they stated that when the corrected age was considered, there was no difference between the groups, implying that the delayed eruption among low birth weight children was simply attributed to their premature birth. Thus, LBW may lead to a delayed dental eruption due to prematurity rather than the delayed dental development.[29]

In this study, the confounding and interaction analysis did not reveal the necessity to adjust or control the researched covariates. However, it is known that children with LBW typically tend to regain growth velocity between 2 and 3 years of age, during the recovering growth phase or the catch-up phase. This phase is characterized by a rapid increase on the weight, length and head circumference with an accelerated growth rate, surpassing children found in the general population of full-term and normal birth weight. The catch-up weight growth is the compensatory weight gain and above normal standards for specific age between birth and 24 months. Considering the catch up and the delay in the dental eruption in children with low birth weight is even more evident until 24 months of age,[11,29] opting to control the child's covariate age, even if the child did not behave as a modifier effect in the analysis. Higher magnitude of positive associations were found among children aged up to 24 months.

As the delays in the eruption of the deciduous teething are common in children who were not breastfed by mothers1 and considering that the existence of uneventful pregnancy is an important predictor in a child's health and adjusted models were generated for uneventful pregnancy and for exclusive breastfeeding.

Birth weight results from prenatal growth and dental eruption is cumulatively influenced by both prenatal and postnatal growth, as well as the genetic, maternal and gestational factors.[4] The presence of uneventful pregnancy, such as maternal diseases, the use of medication, smoking, alcohol and other drugs can influence the time of the dental eruption, either through the occurrence of premature birth, inadequate birth weight or both, this has been analyzed in this manuscript. As LBW may be related to lower gestational age, lower weight and systemic problems, children who are born under this condition tend to have a delayed eruption of their first deciduous teething.[24,29]

Some methodological aspects need to be discussed. It should be noted that epidemiological approaches of confirmatory character and that consider the multiple factors involved in a determined investigated effect are rare in the epidemiology field of alterated eruptions, where most studies employ bivariate or descriptive analyzes. However, it should be considered that the cross-sectional study design and its limits for the causal hypothesis test were in exposure and the effects are investigated at the same moment. Although, in this study, the exposure (LBW) is necessarily prior to teething eruption, thus, there may have been a memory bias in relation to this variable.

In spite of the limitations, this study suggests that the development and nutritional variables at birth and during early life may be important predictors for the children's first deciduous teething eruption time in their early childhood.

Authors' Contributions:

Castro CRS, Vianna MIP, Cabral MBBS e Mota ELA - elaboration of the article, analysis and interpretation of the data, writing the draft manuscript, critical revision of the content and elaboration of the final version of the manuscript. Cangussu MCT - writing the draft manuscript, critical review of the content and preparation of the final version of the manuscript. All authors approved the final version of the manuscript.

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Received on January 22, 2018

Final version presented on September 21, 2018

Approved on July 25, 2019