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ORIGINAL ARTICLE

Periodontal disease in pregnancy and low birth weight

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Abstract

Objective: recently, it has been suggested that periodontal disease during pregnancy could have a causal relationship with low weight at birth. Our objective was to evaluate the influence of periodontal disease during pregnancy on the birth weight of newborn infants.

Methods: mothers who gave birth to low-birth-weight infants were randomly selected (Group 1 - G1; n=13). Immediately after inclusion of each mother in group 1, the mother of the next term newborn with birth weight of > 2,500 g (Group 2 - G2; n=13) was included as control. Mothers were examined by a periodontist who was not informed of the group the child belonged to. A probe was used to measure attachment loss of the alveolar bone. The extension index (EI) and severity index (SI) of the periodontal disease were determined.

Results: both groups of mothers were similar in terms of maternal age, parity, color of skin, height, nutrition, smoking, drinking, socioeconomic status, prenatal examinations, premature rupture of membranes, chorioamnionitis, bacteriuria, placenta previa, abruptio placentae, previous hypertensive disease, preeclampsia, and heart disease. The characteristics of the newborns were: birth weight - G1 = 1,804 ± 675 g x G2 = 3,030 ± 516 g; gestational age - G1 = 33 ± 5 weeks x G2 = 39 ± 2 weeks; length of stay in the neonatal intensive care unit (NICU) - G1 = 128 days x G2 = 0 days. Average EI: G1 = 89.788 ± 18.355 x G2 = 72.420 ± 20.717; p=0.033. Average SI: G1 = 1.377 ± 0.626 x G2 = 0.754 ± 0.413 (OR=18.3; CI95%: 2.5-133.3; p = 0.006). After adjustment for risk factors for low birth weight, such as smoking, maternal height, bacteriuria, and previous hypertension, the odds ratio for SI dropped to 7.2 (CI95% = 0.4-125.4; P = 0.176).

Conclusion: the multivariate analysis indicated a marked association between periodontal disease measured by SI score and low birth weight. Our data suggested that periodontal disease during pregnancy may be a risk factor for low weight at birth.

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Introduction

In odontology, it is widely known that chronic infection of the teeth and periodontium, even if it does not cause discomfort for the patient, may result in distant insidious lesions that may be fatal. In this sense, it has been described that the oral condition of patients should not be considered as separate problems, but rather in relation to the human body as a whole.[1]

In the beginning of the 20th century (1910), William Hunter, at a conference at the McGill University Faculty of Medicine, stated that he had treated several patients with obscure complaints that disappeared after he requested the removal of their dental prothesis.[2]

Recently, in the United States, there has been an increasing attention towards studies regarding the relationship of periodontal infection and cardiovascular diseases. In 1993, DeStefano, after an average 14-year follow-up study with 20,000 patients, observed that "dental disease is associated with an increased risk of coronary heart disease".[3]

In 1994, Collins et al. in a study on the effects of *Escherichia coli* and *Porphyromonas gingivalis*

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lipopolysaccharide on pregnancy outcome in hamsters, suggested that maternal exposure to *P. gingivalis* LPS prior to and during pregnancy can induce deleterious effects on the developing fetus.[4] The same authors also studied inflammatory mediator response and pregnancy outcome in hamsters infected with *Porphyromonas gingivalis*. Results in that study indicated statistically significant increasing levels of both PGE2 and TNF-alpha, and fetal growth retardation of 24%.[5] More recently, Offenbacher et al. suggested that periodontal infection in pregnant women is a risk factor for preterm, low weight births.[6]

Our study was designed to evaluate the influence of periodontal disease during pregnancy on birth weight.

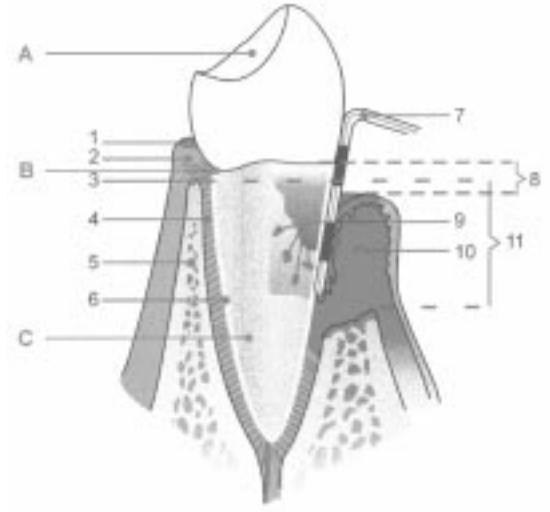
Periodontal disease

Periodontal disease is a general term for a series of pathological alterations of the periodontium (Figure 1). Periodontium, in this sense, is the tissue surrounding and supporting a tooth; more importantly, the gum, alveolar bone, tooth cement, and periodontal ligament (connective tissue joining the alveolar bone and the cement). Although there are numerous periodontal diseases, they can be classified into two large groups: gingivitis and periodontitis. In gingivitis, only the soft gingival tissue are altered. In periodontitis, in addition to the soft tissue the hard tissue (bone, periodontal ligament, and cement) is affected. When microorganisms are allowed to attach to the teeth, near the gum, usually what follows is inflammation of the gum (gingivitis). In this case, the small space between the gum and the teeth, named groove (normal), increases and, consequently, turns into a pocket (pathological). If the microbial flora of gingivitis is eliminated, the inflammation will recede and the gum will return to its normal status. It is possible that, if not properly treated, the pathological process of gingivitis may reach the hard tissue and, slowly or abruptly, cause alterations and result in periodontitis. In periodontitis, the most important alterations are resorption of the alveolar bone and destruction of the connective tissue between the bone and teeth (periodontal ligament), which result in attachment loss (AL). AL is the most important measurement assessed in our study. There is a marked difference between the microbial flora that attaches to the teeth before gingivitis and that related to established periodontitis. In gingivitis, the microbial flora is predominantly formed of gram-positive, aerobic, saccharolytic, and immobile bacteria; whereas in periodontitis, the microbial flora is predominantly formed of gram-negative, anaerobic or microaerophilic, proteolytic, and mobile bacteria. In the relation between invading bacteria and invaded system, there are various reactions that result in site-specific alterations and, also, in distant alterations.

Patients and methods

Mothers who gave birth to babies weighing less than 2,500 grams were selected from August 1997 to July 1998 at the São Lucas Teaching Hospital of the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). Group 1 is a convenience sample including mothers of low-birth-weight newborns and who were still at the Hospital during the specific day of the week set for dental examinations. For group 2, or control group, immediately after inclusion of each mother into group 1, the mother of the next term newborn with birth weight of 2,500 grams or more, at Hospital São Lucas, was included. After being selected for possible inclusion in the study, all mothers were given information regarding our research and signed an informed consent form.

General and perinatal information were collected from perinatal medical charts by a neonatologist in our team. Additional information were collected using a questionnaire



A. Crown cowered with enamel
B. Cement / enamel junction
C. Root covered with enamel

1. Groove
2. Gum
3. Normal height of a normal alveolar bone (approximately 1 mm below the cement/enamel junction)
4. Periodontal ligament
5. Normal alveolar bone
6. Cement
7. Millimeter probe inside the pocket (location where thousands of microorganisms proliferate)
8. Gingival retraction in mm. If present, should be added to "11" for total attachment loss
9. Calculus deposited on the root
10. Gum tissue with inflammation
11. Bone attachment loss

Figure 1 - Schematic representation of a process of periodontitis explored using a probe for determining bone attachment loss

designed with the objective of confirming data obtained from medical charts.

Data related to clinical condition of the gum of mothers were always collected by the same periodontist. Consequently, the probability of error, if any, was constant. The periodontist was not given information as to the group of the patient being examined. All mothers (100%) received periodontal examination within a maximum three days after the delivery. Dental examination checked for missing and decayed teeth; for presence of gingival retraction; for depth of groove at mesial, distal, and mid- palatal and vestibular areas of the teeth; and for AL. In order to measure gingival retraction, depth of groove, and AL we employed a high-precision, millimeter probe (UNC-15).

The extension and severity index of periodontal diseases were determined according to Carlos et al.[7] These indexes are used as a simple method for epidemiological studies of periodontal disease and, according to the authors, can be applied to various epidemiological data providing high comparability and low loss of information. The extension of the disease is determined by the number of teeth with periodontal problems (following an arbitrary and conservative standard that a site is considered affected when AL exceeds 1 mm). The extension index is calculated simply by the percentage of areas examined that were affected. The severity index of the disease indicates the average AL of over 1 mm, that is, the areas in a tooth in which AL exceeded 1 mm.

Our study was approved by the Scientific Committee and the Ethics and Research Committee of the Hospital São Lucas at PUCRS.

Results

Table 1 presents the characteristics of mothers in groups 1 and 2. Both groups were similar in relation to possible risk factors for low birth weight with no statistically significant differences between the groups. Group 2 presented a higher number of primiparas and a smaller number of abortions and low-birth-weight newborns in previous pregnancies;

Table 1 - Characteristics of mothers of low-birth-weight newborns (Group 1) compared to those of mothers of controls (Group 2) - differences were not statistically significant

Characteristics	Group I (n=13)	Group II (n = 13)
Age (years)*	22 (14-36)	20 (15-34)
Low family income	8	6
Primiparous	4	7
Insufficient prenatal care**	4	3
Previous abortion	4	1
No prenatal care	2	1
Previous LBWN †	3	1
Premature rupture of membrane >24 h	1	0
White skin	8	10
Chorioamnionitis	1	0
Height (cm) ‡	160±6	162±7
Bacteriuria	0	2
Weight (kg) ‡	65±13	66±13
Placenta previa	0	0
Malnutrition§	1	0
PDP ‖	0	0
Obesity ¶	2	0
Diabetes	0	0
Smoking	4	4
Previous hypertension	2	0
Drinking	0	1#
Preeclampsia	1	1
Not admitted to private room	11	12
Cardiopathy	0	0

* Average + variation; ** 1 to 4 prenatal appointments; † low-birth-weight newborn; ‡ average + standard deviation; § weight < 10th percentile; ‖ premature detachment of placenta; ¶ weight > 90th percentile; # with moderation (2 glasses of beer or wine per week).

these differences were not statistically significant. Both groups were very similar for color of skin, anthropometric measures, and incidence of nutritional alterations. Four mothers in each group reported being smokers and only one mother in group 2 reported drinking alcohol, but with moderation. The social profile of both groups was also very similar. Both groups presented similar data regarding mothers who had had no prenatal exams or insufficient prenatal exams. In group 1 there was 1 case of premature rupture of membrane and 1 case of chorioamnionitis. In group 2 there were 2 cases of bacteriuria. Moreover, in group 1 there were 2 cases of previous hypertension and in both groups there was 1 case of preeclampsia; in group 2, however, there were no cases of previous hypertension.

Weight and gestational age of newborns and duration of hospital stay are presented in Table 2. Out of the 13 low-birth-weight newborns, 11 babies presented normal weight for gestational age, 1 baby was small-for-gestational age and another was large-for-gestational age. All newborns were premature. Most newborns in group1 were admitted to the Neonatal ICU for presenting low weight at birth. Newborns in group 1 remained 128 days at the ICU, whereas no babies in group 2 required admission to the ICU. The total duration of hospital stay was 5-fold higher for group 1 than for group 2.

Table 3 presents the extension and severity indexes of gingival diseases in both groups. Both indexes were higher for group 1 but differences were not statistically significant.

Multivariate analysis of the population indicated a marked association between periodontal disease, indicated by the severity index, and low birth weight (Odds Ratio = 18.3; CI 95%: 2.5 to 133.3; p = 0.006). After the adjustment for factors of smoking, maternal height, bacteriuria, and previous hypertension, the OR for severity index dropped to 7.2 (0.4 to 125.4; p = 0.176). Likewise, there was a statistically significant association between the extension index for periodontal disease and low birth weight (p = 0.033).

Discussion

None of the obstetrical risk variables examined for this population presented a statistically significant association with low weight at birth of newborns. Conversely, however, in the comparison between group 1 (low-birth-weight) and 2 (control), differences between indicators of periodontal disease were statistically significant. These differences suggest the possibility of a causal relation between maternal periodontal disease and low weight at birth. However, we were not able to draw a definite conclusion due to the reduced number of patients in each group. Our data presented the same trend found by Offembacher et al.[6]

Currently, it is understood that the onset and continuation of periodontal disease is caused by a small group of bacteria, which is predominantly gram-negative, anaerobic or microaerophilic, and that colonizes the sub-gingival area.[8] In a recent workshop on clinical periodontics, it was concluded that most cases of human periodontitis are caused by *Porphyromonas gingivalis*, *Bacteroides forsythus*, and *Actinobacillus actinomycetemcomitans.*[9] Infections caused by the referred microorganisms can turn into chronic reserves of lipopolysaccharide and stimulate the production of prostaglandin E2 (PGE2) and interleukin-1 beta, thus affecting the placental membrane through blood circulation.

Recently, Offembacher et al.[10] have found significantly higher levels of prostaglandin E (PGE) on gingival crevicular fluid of mothers of premature, low-birth-weight newborns. In addition, they also found a significant inverse association between weight at birth and levels of PGE.

Table 2 - Characteristics of low-birth-weight newborns (Group I) and controls (Group II)

Characteristics of newborns	Group I (n = 13)	Group II (n = 13)
Weight at birth (g)	1804±675	3030±516
Gestational age according to DLMP* (weeks)	33±5	39±2
Gestational age according to NB** (weeks)	34±4	39±1
Duration of stay at Neonatal ICU (days)†	128	0
Total duration of hospital stay)†	135	28

* DLMP = date of last menstrual period; ** NB = New Ballard score;
† Total amount of days of hospital stay of all patients

Table 3 - Average and standard deviation of extension and severity indexes of periodontal diseases in mothers of low-birth-weight newborns (Group I) and of mothers of controls (Group II) - Analysis of Variance (ANOVA) for differences in index averages

	Group I		Group II		Anova	
	Average	SD*	Average	SD*	F-ratio	P**
Extension index	89.788	18.355	72.420	20.717	5.119	0.033
Severity index	1.377	0.626	0.754	0.413	8.963	0.006

* SD = Standard Deviation; ** P= statistical significance

It is possible that the results of Offembacher et al. present an explanation for the association between periodontal disease and low weight at birth: the levels of PGE2 and TNF would increase progressively during gestation until a critical threshold is reached and labor is induced. In this sense, the molecules produced in the periodontium can reach the circulation, cross the placenta, and increase levels of PGE and TNF in the amniotic fluid.

Cytokines can also participate in the process of rupture of membranes. It is understood that the TNF and Interleukin-1 can induce the liberation of protease (collagenase, elastase, and others) from macrophages that, in turn, digest the fetal membrane, leading to its rupture.

It is also possible that a set of underlying genetic and/or environmental factors act together towards putting the patient at risk for having both periodontal disease and premature, low-birth-weight newborns. Slots,[11] while analyzing the theories on focal infection and many diseases that have been related to periodontal pathological processes, emphasizes that periodontal and other clinical diseases can frequently occur at the same time without any relation of cause and effect.

The implications of a possible causal relation between periodontal disease and low weight at birth cannot, however, be ignored. Low birth weight significantly increases risk for death, for neurological sequelae, and for unsatisfactory neurological development. It also increases healthcare costs since a large percentage of low-birth-weight newborns require intensive or intermediate care. If periodontal diseases increase the incidence of low weight at birth, it seems clear that public health policies should also be directed towards periodontal healthcare of pregnant women. Consequently, perinatologists and prenatal healthcare professionals should be aware of the importance of dental healthcare of pregnant women for both the health of the mother and, possibly, of the baby.

The data regarding association between periodontal disease, alterations, and premature, low-birth-weight newborns indicate the necessity for broader, randomized studies comparing the pregnancy outcome of mothers with and without periodontal diseases and, moreover, comparing the results obtained with and without treatment of periodontal disease during pregnancy.

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