

Maternal periodontal disease as a factor associated with low birth weight

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Keywords

Periodontitis. Infant, low birth weight. Pregnant women. Pregnancy, complications.

Abstract

Objective

Recent studies have presented evidence that periodontal disease in pregnant women may be a determining factor for low birth weight. The present investigation was carried out to verify whether or not there is an association between maternal periodontal disease and low birth weight.

Methods

This was a case-control study on 302 women, of whom 102 were the mothers of live newborns of low weight (case group) and 200 were the mothers of live newborns of normal birth weight (control group). The existence of an association between periodontal disease and low birth weight was evaluated by means of a multivariate logistic regression model that considered other risk factors for low weight.

Results

The two groups were comparable with regard to age, height, pre-gestational weight, smoking, alcohol use, previous diseases, marital status, socioeconomic status, frequency of tooth-brushing and use of dental floss, number of meals per day and visits to the dentist. Periodontal disease was diagnosed in 57.8% of the mothers in the case group and 39.0% in the control group. Logistic regression analysis indicated a positive association between periodontal disease and low birth weight (unadjusted OR=2.15; 95% CI: 1.32-3.48), especially among the mothers with schooling of less than or equal to four years (OR_{adjusted}=3.98; 95% CI: 1.58-10.10).

Conclusions

Periodontal disease is a possible risk factor for low birth weight.

INTRODUCTION

Periodontal disease is the second most frequent oral disease in the world. It consists of a bacterial inflammatory process in the periodontal tissue that results from the accumulation of dental plaque on the external surface of the tooth. The occurrence of this condition is associated with low socio-economic levels, difficulty in accessing health services and also health-related behavior such as smoking, alcohol use, carbohydrate-rich diets and inadequate oral hygiene (Mumghamba et al,¹³ 1995).

Some authors have raised the hypothesis that periodontal disease could also trigger serious organic repercussions. Persistent bacterial aggression in the oral cavity together with irregular inflammatory response by the host may have consequences beyond the oral tissues, through co-participation in causing systemic damage. From this perspective, there has been investigation of whether there is any relationship between periodontal disease and diseases of the circulatory system (Davenport et al,⁷ 1998), kidney disease (Naugle et al,¹⁴ 1998) and even gestational complications (Davenport et al,⁷ 1998; Offenbacher et al,¹⁵ 1996).

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The discussion about whether there is a relationship between periodontal alterations during pregnancy and low birth weight is a very recent one. Only since 1996 has any evidence emerged that points in this direction (Offenbacher et al,^{15,16} 1996, 1998; Dasanayake,⁶ 1998; Davenport et al,⁷ 1998; Jeffcoat et al,⁹ 2001). These authors observed that, albeit in an incipient form, the positive association between this oral disease and low birth weight is maintained even when controlled for other factors that could contribute towards this negative outcome.

Pregnancy is a complex human experience involving a social dimension that may be influenced by several external factors. There is also a biological dimension in which a balance is needed between organic conditions, to enable development of the fetus and the mother's immunological system (Barbieri et al,² 2000). With regard to the latter, the mother's inflammatory response towards infection is considered to be a potential activator of the mechanism for intrauterine growth retardation (Offenbacher et al,¹⁵ 1996). However, as yet there is insufficient evidence to state categorically that periodontal infection in pregnant women can indeed be a risk factor for low birth weight (Barros et al,³ 2001).

Low birth weight is considered to be the most relevant biological determinant of newborns' survival, both in developed and in developing countries. The importance of low birth weight not only comes from its capacity to predict increased risk of death among infants born with this condition. It also reflects the mother's exposure to other risk factors such as unfavorable socio-economic conditions, malnutrition and diseases of the mother, among others (Menezes et al,¹² 1998; Castillo-Salgado & Loyola,⁵ 2001). From this perspective, all efforts aimed at identifying other possible risk factors for low birth weight are justifiable. Moreover, one of the targets of the World Health Organization is to reduce the number of births in which the child weighs less than 2,500 g, since this is a probable predictor of childhood morbidity and mortality (Mahan & Escott-Stump,¹¹ 1998).

With the aim of contributing towards increasing the knowledge of such risk factors, the present investigation had the objective of verifying whether there is an association between periodontal disease in the mother and low birth weight.

METHODS

This case-control study initially included 306 mothers whose deliveries took place between February and July 2003, at a public hospital that exclusively pro-

vides care within the National Health System (SUS).

The sample size was calculated by means of the Epi Info software (version 6), and 80% power was accepted with a 95% confidence interval. The following parameters available in the literature were added (Offenbacher et al, 1996): 18% prevalence of periodontal disease among mothers whose newborns had low birth weight and 4.7% prevalence among mothers whose newborns had normal birth weight. The "case" group included all the 102 mothers of children born by normal delivery with birth weight of less than 2,500 g. It was not possible to take into account the gestational age, since this information was not registered in the medical records. The "control" group consisted of 204 mothers of children born by normal delivery, at the same hospital, with birth weight of 2,500 g or more. These mothers were selected randomly by means of a draw, while the "case" group was created. Women with systemic alterations who required antibiotic prophylaxis, and those who underwent periodontal treatment during the pregnancy and whose delivery was more than seven days before the time of identification were excluded. Furthermore, out of the total of 306 mothers initially selected, four women from the control group were not included either because they had bacterial endocarditis or because the birth weight record was illegible. Thus, the final number of women studied was 302. The women selected received the due information about the research and filled out a form to give their informed consent.

Data relating to the weights of the newborn were collected from the registration card or from the declaration of live births. The women who volunteered to participate in the research (cases and controls) were invited to answer a questionnaire during an interview, containing the following sections: identification, socio-demographic data, gestational history, life habits, and health-related characteristics.

After the interview, a single dental surgeon who was not aware of the birth weight of the newborn performed a periodontal examination of each participant's oral cavity, at the dental office of the hospital. During this examination, the sulcus/pouch depth and gum recession were measured by probing them, and values for the clinical insertion level/losses were obtained. These observations were performed and recorded in six different places (distal-vestibular, medial-vestibular, mesiovestibular, distal-lingual, medial-lingual and mesiolingual) for each dental unit, as suggested by Pihlstrom et al¹⁹ (1981). All measurements were performed with the aid of a Williams-type probe with a scale in millimeters.

The mothers who presented at least four teeth with an insertion loss of 4 mm were considered to be affected by periodontal disease (adapted from Lopez et al,¹⁰ 2002; Jeffcoat et al,⁹ 2001, Armitage,¹ 1999). Gingivitis, an inflammation restricted to the protective periodontal area, was not considered to be a disease, since it can generally become active within only a few days depending on how inefficient the oral hygiene is and whether there are any associated factors. Insofar as the diagnosis of periodontal disease is made during the first week after delivery, if gingivitis were considered, there would be no certainty that the disease had really had occurred during pregnancy or at a time very close to its end. The consequence of this procedure is seen in the magnitude of the periodontal disease, which tends to be underestimated. However, its application contributes towards avoiding potential measurement bias.

Upon diagnosis of the disease, the participants were sent for periodontal treatment at a specialized university clinic for periodontal maintenance and therapy, if they so agreed.

To describe the study population, the principal independent variable (periodontal disease) and all the covariables considered were distributed. Stratified analysis was utilized to assess whether there was any potential confounding and effect modification for the following covariables: number of antenatal consultations, occupation prior to the pregnancy, place of residence, number of children, number people living in the home, existence of urinary infection during pregnancy, hypertension, cardiopathy, diabetes, use of medications, smoking, alcohol use, age, height, schooling level, income, marital status, number of tooth brushings, use of dental floss, number of meals

per day and number of visits to the dentist. The existence of an association between periodontal disease and low birth weight was assessed by means of non-conditional logistic regression analysis, using the backwards method. Interactions were identified by means of the maximum likelihood ratio test after defining the saturated and reduced models for each of the variables that were possible effect modifiers. Covariables were considered to be confounders if, when eliminated from the saturated model, a variation of more than 20% in the regression coefficients was induced, in comparison to that of the principal association. The statistical inferences were based on 95% confidence intervals. The data processing and analysis was performed by means of the SAS software, version 8.1.

This research work was approved by the Research Ethics Committee of the Universidade Estadual de Feira de Santana (protocol no. 020/2002).

RESULTS

There were no statistically significant differences between the case and control groups, for any of the characteristics, even though the mothers in the "case" group were relatively younger (49.1% vs 42.5%) and had lower schooling levels (34.3% vs 28.7%). Likewise, there were no significant differences regarding self-reported numbers of tooth brushings and use of dental floss according to schooling level, between cases and controls. It was also observed that both for cases and controls, there was no association between the self-reported numbers of daily tooth brushings and the dental plaque rates found (OR=1.28; 95% CI: 0.92-1.77). Eighty-eight percent of the women who had a dental plaque

Table 1 - Socio-demographic characteristics of the cases and controls and the respective odds ratios and confidence intervals. Feira de Santana, Bahia, 2003.

Variables	Cases (N=102)		Controls (N=200)		OR	95% CI
	N	%	N	%		
Age (years)					1.30	0.81-2.10
13 to 20	50	49.1	85	42.5		
21 to 35	44	43.1	105	52.5		
36 to 48*	8	7.8	10	5.0		
Family income (in minimum wages)					1.25	0.76-2.04
≤1	65	63.7	117	58.5		
>1	37	36.3	83	41.5		
Schooling** (years)					1.30	0.77-2.18
0-4	34	34.3	56	28.7		
+4	65	65.7	139	71.3		
Occupation before pregnancy					0.76	0.46-1.28
Self-employed/agricultural labourer/others	32	31.4	76	30.0		
Domestic employee/student/homemaker	70	68.6	124	70.0		
Occupation during pregnancy					0.81	0.49-1.35
Self-employed/agricultural labourer/others	33	24.5	74	31.5		
Domestic employee/student/homemaker	69	75.5	126	68.5		
Height (cm)**					0.97	0.59-1.58
<160	42	42.0	83	42.78		
≥160	58	58.0	111	57.22		

*Because there were insufficient observations for analyzing associations, this stratum was grouped with the preceding stratum
**Eight observations were lost

Table 2 - Lifestyle and medical-dental characteristics of the cases and controls and the respective odds ratios and confidence intervals. Feira de Santana, Bahia, 2003.

Variables	Cases (N=102)		Controls (N=200)		OR	95% CI
	N	%	N	%		
Urinary infection					0.90	0.53-1.54
Yes	27	26.5	57	28.5		
No	75	73.5	143	71.5		
Number of antenatal consultations					1.19	0.71-2 .01
0-3	33	32.3	57	28.5		
4-9	69	67.7	143	71.5		
Weight before pregnancy (kg)*					1.09	0.55-1.50
≤50	38	37.6	70	35.5		
>50	63	62.4	127	64.5		
Location of the home					1.50	0.89-2.52
Rural	34	33.3	50	25.0		
Urban	68	66.7	150	75.0		
Number of children**					0.87	0.54-1.42
1	50	49.0	104	52.3		
>1	52	51.0	95	47.7		
Number of people living in the home***					1.01	0.62-1.64
0-4	47	48	93	47.7		
>4	51	52	102	52.3		
Smoking					1.39	0.52-3.01
Yes	9	8.8	13	6.5		
No	93	91.2	187	93.5		
Alcohol use****					1.34	0.58-3.10
Yes	10	9.8	15	7.5		
No	90	90.2	185	92.5		
Marital status**					0.88	0.49-1.57
Single	21	20.8	46	23.0		
Married/cohabiting	80	79.2	154	77.0		
Number of tooth brushings*					0.97	0.42-2.25
Once a day	9	8.9	18	9.1		
More than once a day	92	91.1	179	90.9		
Use of dental floss*****					1.18	0.64-2.19
Yes	83	82.2	156	79.6		
No	18	17.8	40	20.4		
Periodontal disease					2.15	1.32-3.48
Yes	59	57.8	78	39.0		
No	43	42.2	122	61.0		

*Four observations were lost

**One observation was lost

***Nine observations were lost

****Two observations were lost

*****Five observations were lost

rate of 65% or more claimed to brush their teeth at least twice a day.

However, 57.8% of cases presented periodontal disease, in comparison with only 39% of controls, which was a statistically significant difference (Table 2). It was also observed that 13.7% of the cases and 7.5% of the controls with periodontal disease presented it in a generalized form, and this was also statistically significant. On the other hand, the localized form of the disease was observed in 86.3% of the cases and 95.5% of the controls.

When analyzing the unadjusted association, it was observed that the mothers with periodontal disease had a twice the chance of having children of low birth weight, in comparison with those without the disease (unadjusted OR=2.15; 95% CI: 1.32-3.48).

In the stratified analysis, only the mother's age was identified as a potential confounder, while schooling level and income were possible effect modifiers. However, the logistic regression analysis showed that only the schooling level was an effect modifier (maximum likelihood ratio =4.68, for one degree of free-

dom). No covariables were identified as confounders, and thus there was no need for adjustments (Table 2).

In the final model (Table 3), the mothers with schooling levels of less than or equal to four years of education who also presented periodontal disease had a four times higher chance of having children with low birth weight, in comparison with those without the disease (OR=3.98; 95% CI: 1.58-10.10). However, among the mothers with more than four years of schooling, even when the OR indicated a positive association between oral infection and the outcome, there was no statistical significance (OR=1.57; 95% CI: 0.87-2.99).

DISCUSSION

Table 3 - Odds ratios and confidence intervals obtained by means of logistic regression, for the association between periodontal disease in the mother and low birth weight, controlled for the mother's schooling level. (N=302)

Covariable of the model	OR	95% CI
Schooling level		
≤Elementary (0-4 years)	3.98	1.58-10.10
>Elementary (+ 4 years)	1.57	0.87-2.90

The results indicate that there is an association between periodontal disease in the mother and low birth weight. This effect is augmented when the mother's schooling level is low.

These findings are consistent to those of other authors who have investigated such associations (Offenbacher et al 1996,¹⁵ 1998; Jeffcoat et al,⁹ 2001; Lopez et al,¹⁰ 2002; Braz et al,⁴ 2000). They differ only from those observed by Davenport et al⁸ (2002), who did not find any evidence of this association. It is possible that this discordant result was related to the latter authors' use of the Community Index for Periodontal Treatment Needs (WHO,¹⁷ 1991) for diagnosing the disease. This index has been heavily criticized because the examination is only partial and does not include important clinical parameters such as the level/loss of clinical insertion. Furthermore, the original objective of this index was to assess treatment needs in large populations and not to diagnose periodontal disease (Papapanou & Lindhe,¹⁸ 1999).

The finding of synergy between low schooling and periodontal disease in the mother can be explained by the high frequency of deficient oral hygiene during pregnancy among the mothers with low schooling levels. Their lack of tooth brushing would activate periodontal disease, thereby making this deficiency even more deleterious for the maternal-fetal balance. It is possible that the lack of statistically significant differences between cases and controls in this study, with regard to oral hygiene procedures, may have been due to limitations on the quality of some of the self-reported information, especially in relation to oral hygiene, given that such information can be manipulated by the interviewee.

Another point suggestive of limitations was the absence of statistically significant differences between the groups, for important risk factors for low birth weight such as smoking during pregnancy and low height of the mother (Solla et al,²⁰ 1997). Widespread knowledge among the population regarding the damaging effects of smoking during pregnancy may have led to the denial of this habit by the preg-

nant or puerperal women. With regard to height, it is probable that, as well as being imprecise, the informed height may refer to some value obtained in the past that has been modified over time.

The results from the present study provide further evidence in favor of the hypothesis that there is an association between periodontal disease and low birth weight. In addition to the care taken in the procedures for diagnosing the disease, the influence of potentially interfering covariables was removed.

Some subjacent environmental and genetic factors may act in conjunction, thus putting the pregnant woman at risk of periodontal disease and low birth weight, without a clear cause-effect relation between such conditions (Slots,²¹ 1998). Moreover, since exposure and effect were assessed retrospectively, the hypothesis of an inverse relationship cannot be discarded, i.e. the biological causes of low birth weight may have contributed towards periodontal disease. This indicates the importance of adequately assessing the direction and timing when testing for a possible causal association. Likewise, it is plausible that other variables that were not investigated may exist, such as infections in other organs, and these could result in periodontal disease and low birth weight. Another point to be considered is the fact that there was no evaluation of whether the effect studied was dependent on the degree of severity of the exposure. The high frequency of the localized form of the disease in both groups and the relatively low frequency of the generalized form among the mothers in the case group suggests that only the more severe cases of periodontal disease are associated with low birth weight.

Therefore, considering the present findings together with those in the literature, new investigations will still be needed, using differing methodological approaches that can bring together further evidence for this association. It is important to investigate other criteria for causal relationships that could contribute towards guiding measures aimed at both improving the health of pregnant women and, ultimately, reducing the incidence of low birth weight.

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