Maternal gingivitis as a factor associated with low birth weight – a pilot study

Simone Seixas da Cruz[1]
Isaac Suzart Gomes-Filho[2]
Maria da Conceição Nascimento Costa[3]
Johelle de Santana Passos[4]
Eliesita Costa Pereira[5]
Graziella Figueiredo Machado[6]

Abstract
This study evaluated the existence of an association between gingivitis and low birth weight in the municipality of Feira de Santana. A case-control design was used, with a total of 185 women: 53 mothers of live births of low weight (case group) and 132 mothers of live births with normal gestational weight (control group). The existence of an association between gingivitis and low birth weight was evaluated by means of a multivariate logistic regression model that took into consideration other risk factors. The two groups of mothers were comparable with regard to age, height, pregestational weight, smoking, alcohol use, previous diseases, marital status, socioeconomic situation, frequency of tooth brushing, use of dental floss, number of meals per day and visits to the dentist. Logistic regression analysis showed that, among the puerperal women with gingivitis, the chance of having a child with low birth weight was 37% greater than for those without this disease, after adjusting for schooling level, thus indicating the existence of a positive association, albeit without statistical significance. It was concluded that gingivitis is a possible factor associated with low birth weight.

Keywords: Gingivitis, maternal – Newborn – Low birth weight.

INTRODUCTION

Today, low birth weight and prematurity have come to an important position in the statistics on deaths among children under one year of age, particularly in developing countries. This transformation has resulted from relative growth in neonatal mortality following a significant reduction in infant mortality, especially with regard to post-neonatal mortality.

Various biological or social factors that cause the occurrence of prematurity and low birth weight have already been established[1,2]. This knowledge has contributed towards guiding programs aimed at their prevention and consequently at reducing infant mortality.

[1] PhD in Collective Health – Department of Health – Feira de Santana State University.
[2] PhD in Periodontics – Department of Health – Feira de Santana State University.
[3] PhD in Collective Health – Department of Health – Federal University of Bahia.
[4] MSc in Collective Health – Department of Health – Feira de Santana State University.
[5] Undergraduate Student – Department of Health – Feira de Santana State University.
[6] Graduate in Dentistry – Department of Health – Feira de Santana State University.

Correspondência para / *Correspondence to*:
Simone Seixas da Cruz.
Avenida Getúlio Vargas, 379 – Centro.
CEP: 44.025-010 Feira de Santana – Bahia – Brazil.
Tel./fax: 55 75 3623-0661.
E-mail: simone.seixas1@gmail.com

The importance of occurrences of infectious diseases during pregnancy as causes of prematurity and low birth weight can be highlighted here[3,4]. Molecular, microbiological and observational studies, clinical trials and even studies on animal models have been undertaken since the 1990s taking the hypothesis that a state of maternal infection and inflammation may favor rupture of the uterine membrane, thus leading to prematurity, or even disturbance of maternal-fetal homeostasis, thus causing difficulties in intrauterine growth and impairing the birth weight[5,6].

Within this perspective and starting at that time, some researchers began to consider that periodontal disease, which is a bacterial inflammatory process in the periodontal tissue, might also perform an important role in causing prematurity and low birth weight. It has been suggested that its presence could be an explanation for a significant proportion of the occurrences of these gestational outcomes[6-8].

The biological plausibility of this hypothesis is supported by the knowledge that certain opportunistic periodontal pathogens and/or their toxins may promote an inflammatory response in mothers. They may act as activators of the mechanism for inducing delivery, coordinate changes in the uterine cervix and in contractions, and threaten the integrity of the placental membrane[6,9]. Another plausible reason is the fact that the microorganisms involved in periodontal disease may produce chronic reservoirs of substances (lipopolysaccharides) that promote the production of specific inflammatory mediators (interleukin beta 1 and prostaglandin E2), with the placental membrane as the target, through the bloodstream[6,10]. Moreover, it is believed that these pathogens may enter the bloodstream in numbers that are thus sufficient to have an influence on general health and on the susceptibility to certain illnesses. This reinforces the need for interdisciplinary attention to pregnant women's health[11].

Although a possible association between gingivitis/periodontitis and prematurity/low birth weight is biologically plausible, the scientific findings relating to this topic are still controversial. Most studies have demonstrated the existence of a positive association between periodontal disease (periodontitis) and prematurity/low birth weight[7,12-

[15]. On the other hand, some others[16-18] did not detect this association. Hence, so far there is insufficient evidence to allow this hypothesis to be refuted or accepted.

Within this context, the importance of analyzing the severity of the periodontal infection is emphasized. Some studies have reinforced the hypothesis that severe maternal periodontitis is more strongly associated with prematurity and low birth weight than is mild periodontitis[7,13,19]. Also, recently, López et al. [20] found a moderate association between gingivitis and prematurity/low birth weight.

Thus, in view of the incipient and controversial evidence regarding this topic, as well as its relevance for the field of public health, it was sought to evaluate the existence of an association between maternal periodontal disease (defined in this study as gingivitis) and low birth weight.

MATERIAL AND METHODS

This was a pilot study of case-control type that was developed among 185 mothers whose deliveries took place at the Women's Hospital in the city of Feira de Santana, between February and July 2003. The design of this study was submitted for consideration by and was approved by the Research Ethics Committee of Feira de Santana State University (Protocol No. 020/2002).

The case group was formed by 53 puerperal women who were the mothers of newborns from normal deliveries with birth weight less than 2500 gram. The control group was formed by 132 mothers of newborns from normal deliveries at the same hospital with birth weight greater than or equal to 2,500 grams, who were selected randomly. Puerperal women who presented cardiopathy or diabetes during their pregnancies, or other systemic abnormalities that required antibiotic prophylaxis, were excluded. Women who were only identified more than seven days after delivery were also excluded. All the participants received information about the research and then filled out a form through which they gave their informed consent.

Data on the newborns' weights were collected from the newborns' file cards or the live birth certificates. The volunteer participants (cases and

controls) were invited to answer a questionnaire that was administered by means of an interview, containing the following sections: identification, sociodemographic data, gestational history, lifestyle and health-related matters.

Following the interview, a single dentist who was unaware of the newborn's weight and who was chosen because of his great previous experience of periodontics carried out a full periodontal examination of each participant's oral cavity, at the dental clinic of the Women's Hospital (all 185 women were examined). Intra-examiner calibration was performed before starting the study. In this examination, the probing depth in the sulcus/pocket, gingival recession and loss of clinical attachment were measured. These observations were made at six different locations (distovestibular, mediovestibular, mesiovestibular, distolingual, mediolingual and mesiolingual) for each tooth, as suggested by Pihlstrom, Ortiz-Campos and McHugh [21], and were logged in an appropriate file. All these measurements were made with the aid of a Williams-type probe, graduated in millimeters (Trinity, São Paulo, Brazil).

The puerperal women who presented bleeding on probing in at least 25% of the sites were considered to present gingivitis. The women who presented at least four teeth with a loss of attachment of 3 mm or more and a probing depth greater than or equal to 4 mm at the same site were classified as presenting periodontitis and were excluded from the sample, considering that the interest in this study was to investigate the contribution of gingivitis alone during pregnancy, with regard to causing prematurity and low birth weight.

To describe the study population, the distribution of the main independent variable (gingivitis) and all the covariables considered was investigated. Stratified analysis was used to investigate the existence of potential confounding factors and effect modifiers among the following covariables: number of prenatal consultations, occupation before and during the pregnancy, pregestational weight, location of the home, number of children, number of people living in the home, existence of gestational urinary infection, hypertension, cardiopathy and diabetes, use of medications, smoking habit, alcohol use, age,

schooling level, family income, marital status, frequency of tooth brushing, use of dental floss, number of meals per day and number of visits to the dentist. The backward strategy was used in logistic regression analysis of nonconditional type, taking 95% confidence intervals for evaluating the statistical significance. The possibility of effect modification was evaluated by means of the maximum likelihood ratio test. Potential confounding variables were selected on both a theoretical and an empirical basis, and variables were considered to be confounders if they produced a change of at least 20% in the association measurement. To process and analyze the data, the Stata software, version 8.0, was used.

RESULTS

Sociodemographic and lifestyle characteristics of the women involved in this study are presented in Table 1. In a general manner, the results indicate that the case and control groups were comparable with each other. Although the puerperal women in the case group (58.49%) were slightly younger than the women in the control group (46.97%), there was only a statistically significant difference in relation to schooling (cases: 92.45%; controls: 78.03%; p=0.021).

Among the women in the case group, 30.19% presented gingivitis, while among those in the control group, 25.76% had gingivitis. However, this difference was not statistically significant (Table 2).

Analysis of the unadjusted association showed that, among the women with gingivitis, the chance of having a child with low birth weight was 25% greater than among those without gingivitis. However, this difference was not statistically significant (unadjusted OR = 1.25; 95% CI: 0.62 2.52). Stratified analysis did not identify any variables that might be effect modifiers, but indicated that schooling level was a possible confounder. These findings were also confirmed after modeling (Table 3).

In the final model, after adjusting for schooling level, it was seen that among the puerperal women with gingivitis, the chance of having a child with low birth weight was 37% higher than among those

Table 1 – Some sociodemographic and lifestyle characteristics (number and percentage) of the cases and controls included in the study on maternal gingivitis and low birth weight. Women's Hospital, Feira de Santana, Bahia, 2003.

Variables	Cases *		Controls †		P-Value ‡
	N	%	N	%	
Age (in years)					
13 to 20	31	58.49	62	46.97	0.156
21 to 35	22	41.51	70	53.03	
Family income					
(in minimum monthly salaries)					
≤1	33	62.26	69	52.27	0.217
>1	20	37.74	63	47.73	
Schooling					
0 – 4	49	92.45	103	78.03	0.021
> 4	4	7.55	29	21.97	
Number of children					
1	0	0	1	0.76	0.525
>1	53	100	135	99.24	
Smoking					
Yes	3	5.66	9	6.82	0.773
No	50	94.34	123	93.18	
Urinary infection					
Yes	15	28.3	38	28.79	0.947
No	38	71.7	94	71.21	
Number of prenatal consultations					
0 - 3	17	32.08	34	25.76	0.385
4 - 7	36	67.92	98	74.24	
Marital status					
Single	12	22.64	27	20.45	0.742
Married/living together	41	77.36	105	79.55	
Use of dental floss					
Yes	13	24.53	30	23.26	0.854
No	40	75.47	99	76.74	

Notes: n = 185; * = mothers of newborns with birth weight less than 2500 gram; † = mothers of newborns with birth weight greater than or equal to 2500 grams;‡ Statistical significance: $P \leq 0.05$.

Table 2 – Distribution of gingivitis (number and percentage) among cases and controls. Women's Hospital, Feira de Santana, Bahia, 2003.

Periodontal disease	Cases		Controls	
	N	%	N	%
Yes	16	30.19	34	25.76
No	37	69.81	98	74.24

OR $_{unadjusted}$ = 1.25   95% CI: [0.62 2.52]

Note: n = 185.

Table 3 – Odds ratios (OR) and confidence intervals (CI) obtained from the logistic regression parameters for the association between maternal periodontal disease and low birth weight, with and without adjustment for the mother's schooling level. (n = 185).

Models	OR	95% CI
Unadjusted	1.25	[0.62 - 2.52]
Adjusted	1.37	[0.67 - 2.83]

Note: n = 185.

without gingivitis. This indicated the existence of a positive association, albeit without statistical significance (Table 3).

DISCUSSION

The greater frequency of low birth weight among the children whose mothers presented gingivitis during pregnancy that was observed in the present investigation is consistent with the findings of López et al.[20] in a study on the same topic. Nonetheless, contrary to what was demonstrated by those authors, the association found in the present study was not significant.

One of the possible explanations for this result may come from the fact that, despite the biological plausibility of an association between gingivitis during pregnancy and prematurity/low birth weight, there are some doubts regarding the quantity of cytokines produced by periodontal disease that would be sufficient to affect the placenta to a degree that might trigger early delivery labor and limit the nutrient supply to the fetus[22]. Furthermore, the specific literature on this topic indicates that the severity of the periodontal disease is important with regard to causing prematurity and low birth weight[19]. Therefore, it is possible that in reality no such association between these outcomes exists.

However, at the same time, the hypothesis of an association between gingivitis during pregnancy and prematurity/low birth weight still cannot be refuted, considering that the present study has some limitations. First of all, the hypothesis that the results found from this pilot investigation were chance occurrences, possibly resulting from insufficient sample size, cannot be dismissed.

In turn, the retrospective design of this study for evaluating gingivitis must be highlighted. The limitation from this study design lies in the fact that there is no guarantee that the gingival inflammation was present throughout the pregnancy. Investigations aimed at evaluating the existence of associations with periodontal disease (represented by the clinical entity of periodontitis) have always excluded gingivitis under the allegation, even if this is not always

explicit, that gingival inflammation may go into remission within a few days, in response, for example, to more rigorous oral hygiene implemented at home. In other words, over the course of the pregnancy, the protective periodontium may alternately present states of inflammation or remission, without professional intervention[23]. This would make it difficult to accept the hypothesis that, once maternal gingivitis has been detected, it would be present throughout the remainder of the pregnancy.

It is known that, in addition to the physiological and sexual hormone alterations that are natural during pregnancy, lifestyle transformations such as eating and oral hygiene habits often occur among pregnant women. The increased frequency of eating during the day and the typical nausea experienced by pregnant women also causes difficulties in correctly cleaning their teeth. This favors predominant bacterial colonization by Prevotella intermedia and rapid clinical emergence of inflammation of the protective periodontium[24]. However, despite the high frequency of gingivitis during pregnancy, ranging from 35% to 100%[25], another limitation of the present study relates to the fact that one week after delivery (the maximum limit established as a criterion for including puerperal women in the study) may also be the minimum time period needed for gingivitis to become established and present clinical manifestations of gingival inflammation[23]. This might have produced selection bias, which would consequently have reduced or even annulled any possible association.

Another limiting factor in the present investigation relates to the definition for the exposure measurement, i.e. the diagnosis of gingivitis. This is a limitation because the criteria commonly used for gingivitis suffer from insufficient precision, in the light of the clinical and histological characteristics of this entity, and because there are still only a few investigations with the same objective.

Nevertheless, even recognizing that the internal validity of the present study suffers from the limitations mentioned, its importance is that it may provide the motivation for carrying out new studies in which the exposure and outcome

would be gingivitis and prematurity/low birth weight, respectively. Such studies might have different methodological strategies, including evaluation of the possible dose-response effect, given that it is plausible that only gingivitis in its most severe form might be clearly associated with the study outcome. Strategies like these may reinforce the body of evidence around the hypothesis of an association, such that this hypothesis can be accepted or refuted more conclusively.

CONCLUSION

In accordance with the findings, it can be concluded that there are indications that gingivitis is a possible factor associated with low birth weight. However, other methodological strategies for reinforcing the body of evidence around the hypothesis of an association are required, such that this hypothesis can be accepted or refuted more conclusively.

Gengivite materna como fator associado ao baixo peso ao nascimento – um estudo piloto

Resumo
O objetivo deste estudo foi avaliar a existência de associação entre gengivite e o baixo peso ao nascer no Município de Feira de Santana. Empregou-se o desenho de caso-controle com 185 mulheres, 53 mães de nascidos vivos de baixo peso (grupo caso) e 132 mães de nascidos vivos com peso gestacional normal (grupo de controle). A existência de associação entre gengivite e baixo peso ao nascer foi avaliada mediante modelo multivariado de regressão logística, considerando-se outros fatores de risco. Ambos os grupos de mães eram comparáveis no que se refere à idade, altura, peso pré-gestacional, tabagismo, alcoolismo, doenças prévias, estado civil, situação socioeconômica, número de escovações e uso de fio dental, número de refeições diárias e de visitas ao dentista. A análise de regressão logística mostrou que, entre as puérperas com gengivite, a chance de ter filho de baixo peso ao nascer é elevada em 37%, quando comparada à daquelas sem a doença; ao ajustar-se por nível de escolaridade, constatou-se a existência de associação positiva, embora sem significância estatística. Conclui-se que há indícios de que a gengivite é um possível fator associado ao baixo peso ao nascer.

Palavras-chave: Gengivite materna – Recém nascido – Baixo peso.

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