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Correlation between infant birth weight and mother's periodontal status

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Abstract

Objectives: Recent studies have suggested that periodontal disease is a risk factor for low birth weight (LBW) with other multiple factors. A cross-sectional study was undertaken to help further evaluate the proposed association between periodontal disease and infant birth weight.

Material and Methods: Caucasian pregnant women ($n = 152$), aged 14–39 years, were enrolled while receiving prenatal care. Dental plaque, probing depth, bleeding on probing and clinical attachment level were recorded and three groups were made: healthy group (HG) ($n = 38$), gingivitis group (GG) ($n = 71$) and periodontitis group (PG) ($n = 43$). At delivery, birth weight was recorded.

Results: Infant mean weight at delivery was 3293.9 ± 508.1 g. The total incidence of preterm birth and LBW infants was 5.3% and 4.6%, respectively. The incidence of LBW infants was 3.5% in term gestations and 25% in preterm gestations. Mothers height correlated with infant birth weight ($p = 0.03$). Significant difference in birth weight existed between mothers with <1.55 m (3229.23 ± 462.57) and those with $\geqslant 1.65$ m (3475.55 ± 505.07). In the group of women >25 years old infant mean weight in HG was 3588.33 ± 531.83, being lower in GG (3466.75 ± 334.45) and even lower (3092.60 ± 592.94) in PG ($p = 0.0198$). Bleeding on probing was significantly greater in women with <2500 g infants (40.2 ± 21.8%) compared with 2500–3499 g (18.6 ± 15.1%) and $\geqslant 3500$ g (17.1 ± 16.1%) ($p = 0.009$).

Conclusions: Periodontal disease in normal Caucasian pregnant women, older than 25 years, is statistically associated with a reduction in the infant birth weight. These data provide new evidence on the relationship between periodontal disease and birth weight.

Key words: low birth weight; periodontal disease/adverse effects; pregnancy; preterm birth; risk factors

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Term infants weigh an average of 3200 g (range: 2500–3900 g). Weights outside this range are considered abnormal and could be associated with neonatal pathology (McCormick 1985). Low birth weight (LBW), defined as birth weight less than 2500 g, continues to be a major public health problem. Preterm deliveries (less than 36 completed weeks of gestation) and associated low birth weight (PLBW) represent the major causes of neonatal mortality and, among survivors, a major contributor to long-term disability, including neurodevelopmental problems, respiratory problems, congenital anomalies and behavioural problems (Yu 2000). An LBW or a premature infant is at a higher risk of death and also more likely to incur physical or mental disabilities.

Multiple factors have been associated with PLBW and some authors have emphasized the heterogeneity of the causes of PLBW (Moore et al. 1994). Results of three case–control studies (Offenbacher et al. 1996, Dasanayake 1998, Romero et al. 2002) and a concurrent cohort study (Lopez et al. 2002a) showed that periodontal disease may be a potential independent risk factor for PLBW after adjusting for several known risk factors. Moreover, two prospective studies have shown an association between preterm birth and periodontal infection (Jeffcoat et al. 2001a, Mitchell-Lewis et al. 2001). Recently, a randomized controlled trial (López et al. 2002b) has concluded that periodontal disease appears to be an independent risk factor for PLBW and that periodontal therapy significantly reduces the rates of PLBW in the population of women with periodontal disease.

However, the case–control study conducted by Davenport et al. (2002) concluded that there is no evidence for

an association between PLBW and periodontal disease. Moreover, Madianos et al. (2002), analysing the evidence available, concluded that there is limited evidence that periodontitis is associated with an increased risk of PLBW. Most of those studies were carried out on predominantly African American, low income level and younger group of women. These are variables that are related with LBW and PLBW. Moreover, these studies analyse infant birth weight as a dichotomized variable (LBW *versus* normal birth weight), without taking into account that this variable is a continuous variable.

So this association must be further explored in observational and intervention studies to establish whether it is causal in nature or incidental and to determine the possible benefits of intervention and the potential to generalize the findings in diverse populations. A cross-sectional study was undertaken to determine the relationship between maternal periodontal status and birth weight in a group of pregnant women.

Materials and Methods

Patient population

The study population consisted of Caucasian pregnant women who received uniform pre-natal care between March 1999 and June 2000, in the public health clinic of Bucarein (Joinville, state of Santa Catarina, Brazil).

Selection of subjects

Criteria for inclusion were: women aged 14–39 years, with singleton gestation, any weeks' gestation. Exclusion criteria were: multiple gestation, high-risk gestation, hypertension, gestational diabetes, any systemic disease, placenta previa and less than 20 natural teeth. The midwives who attended the prenatal care clinics identified potential participants. A total of 162 volunteer mothers were entered in the study after giving written consent. The Institutional Review Board for Bio-Ethics of the University of Vale do Itajaí (Brazil) approved this study.

Recording of maternal characteristics

In the first visit, detailed data about previous pregnancies and the outcome of the current pregnancy from the patient's prenatal record and history from current and previous pregnancies were gathered. The following variables were recorded for each woman: age, height, educational level, number of prenatal visits, previous pregnancy history – number carried to full term, number of previous pregnancies aborted, tobacco consumption, alcohol consumption, use of illicit drugs, domestic violence, gestational age and dental treatment.

After delivery, in the second visit, the following variables were recorded: gestational age, birth weight and total maternal weight gain during pregnancy. The primary outcome measured was birth weight. Women were grouped according to birth weight and gestational age. If they delivered a baby with a birth weight under 2500 g they were classified as ''LBW group''. If they delivered before 36 weeks of gestation they were classified as ''preterm birth'' group. ''Normal women'' grouped women who delivered an infant with a birth weight superior to 2500 g and after 36 completed weeks' gestation.

Clinical examination and procedures

The dental clinician who had been calibrated prior to the commencement of the study carried out all clinical periodontal examinations in the dental office at the public health clinic of Bucarein. Periodontal examination was made with a PSP12 probe (Hu-Friedy, Chicago, IL, USA).

The periodontal examination consisted of assessments at vestibular, lingual, mesial and distal sites of all present teeth of the following parameters: (1) Plaque index: the presence of dental plaque was recorded according to the O'Leary (1972) plaque index with 0 = absent and 1 = presence of bacterial plaque, and the percentage of dental plaque was calculated; (2) Bleeding on probing: presence (1) or absence (2) was evaluated to the most apical penetration of the probe, using the index proposed by van der Velden (1979); (3) Probing depth*:* measured from the gingival margin to the most apical penetration of the probe; and (4) Clinical attachment level: measured from the cemento-enamel junction to the most apical penetration of the probe.

The criteria to determine the presence of periodontal disease were those previously established by Machtei et al. (1992). Women showing less than 5% gingival bleeding, without clinical attachment loss higher than 6 mm in two or more sites and without one or more sites with probing depth $\geqslant 5$ mm were grouped as healthy periodontal women. Women showing more than 5% gingival bleeding, but without clinical attachment loss higher than 6 mm in two or more sites and without one or more sites with probing depth $\geqslant 5$ mm, were diagnosed as having gingivitis. Finally, for the clinical definition of patients who positively and unequivocally exhibited periodontal disease, women showing more than 5% gingival bleeding, with clinical attachment loss higher than 6 mm in two or more sites and with one or more sites with probing depth $\geqslant 5$ mm were diagnosed as having periodontitis.

Statistical analysis

For plaque index, bleeding on probing, probing depth and clinical attachment level, the data were subject based. Analysis included descriptive statistics (mean and standard deviation of all variables). Quantitative variables were analysed with Student's *t*-test and the Kolmogorov–Smirnov test to assess their normal distribution. ANOVA, with Bonferroni's correction, or the Kruskal–Wallis test was used depending upon the normality. ANCOVA was carried out using maternal age and height as covariates. Logistic regression analysis was used for statistical evaluation of dichotomized pregnancy outcomes. The χ^2 test was used to analyse qualitative variables. Statistical significance was defined as $p < 0.05$.

Results

Of the 162 women enrolled in the study, 10 (6.2%) were excluded for spontaneous abortion or multiple gestations. Table 1 summarized the characteristics of the sample. The mean age of the women was 23.3 ± 5.7 years, with the majority of the study population in the 19–25 years old category (67.8%). The mean height was 1.60 ± 0.06 m. Only 33 women (21.7%) had secondary or higher education. More than 50% of the women had not received dental treatment during the last year.

Obstetric antecedents of the women (Table 2) showed that 74 (49.3%) had previous live births and 26 (17.1%) had previous aborts. Only 10 (6.6%) women had an antecedent of previous PLBW.

Table 1. Characteristics of the study population ($n = 152$)

Variable	Number	Percentage
Age (years)		
<18	34	22.4
19–25	69	67.8
>25	49	32.2
Mean ± SD	23.3 ± 5.7	
Height (m)		
$\leqslant 1.55$	34	22.4
1.56–1.59	39	25.7
1.60–1.64	43	28.3
$\geqslant 1.65$m	36	23.7
Mean ± SD	1.60 ± 2.1	
Educational level		
None	53	34.9
Primary	66	43.4
Secondary or higher	33	21.7
Previous dental treatment		
During last year	72	47.4
2–3 years before	61	40.1
$\geqslant 4$ years before	16	10.5
Never	3	2.0

Table 2. Obstetric antecedents

Variable	Number	Percentage
Previous live births		
None	78	50.7
One	57	27.6
Two or more	17	21.7
Previous aborts		
None	126	82.9
One	22	14.5
Two or more	4	2.6
Previous preterm low birth weight		
None	142	93.4
One or more	10	6.6

Table 3. Clinical variables related to pregnancy ($n = 152$)

Variable	Number	Percentage
Gestational age in the first examination		
First trimester	50	32.9
Second trimester	84	55.3
Third trimester	18	11.8
Number of prenatal visits		
1–3	6	3.9
4–6	74	48.7
$\geqslant 7$	72	47.4
Maternal gain in weight (kg)		
$\leqslant 5$	4	2.6
6–10	119	78.3
16–20	20	13.2
>20	9	5.9
Infant Birth weight (g)		
<2500	7	4.6
2500–3499	98	64.5
>3500	47	39.9
Mean ± SD	3293.9 ± 508.1	
Gestational age at delivery		
Term	144	94.7
Preterm	8	5.3
Infections during pregnancy		
None	73	48.0
One or more	79	52.0
Use of antibiotics during pregnancy		
None	75	49.3
One or more	77	50.7
Tobacco consumption during pregnancy		
No smoking	137	90.1
Smoking 1–5 cigarettes/day	11	7.2
Smoking $\geqslant 6$ cigarettes/day	4	2.6
Alcohol consumption during pregnancy		
None	152	100
Illicit drugs consumption during pregnancy		
None	152	100
Domestic violence during pregnancy		
None	152	100

Table 4. Infant birth weight in relation to gestational age ($n = 152$)

	Term (>36 weeks)	Preterm ($\leqslant 36$ weeks)
Number	144	8
Infant weight (g) (mean ± SD)	3319.5 ± 497.4	2833.1 ± 506.9*
<2500	5 (3.5%)	2 (25.0%)
2500–3499	93 (64.6%)	5 (62.5%)
$\geqslant 3500$	46 (31.9%)	1 (12.5%)

χ^2 test: $p = 0.0138510$. *Student's t-test: $p = 0.008$.

Most of the patients (55.3%) were enrolled in the study during the second trimester (Table 3). There was no association between the timing of the examination and the periodontal status ($p > 0.05$). The majority (96.1%) had more than three prenatal visits. Maternal gain in weight during pregnancy was in the range 6–10 kg in 78.3% of the patients. Although 9.8% were smokers, no woman declared alcohol or illicit drugs consumption during pregnancy. Domestic violence was also not reported.

Infant mean weight at delivery was 3293.9 ± 508.1 g. The total incidence of preterm birth was 5.3% (8/152). There were seven women (4.6%) with LBW (<2500 g), with a mean age and SD of 23.3 ± 5.9 years. The incidence of LBW infants was 3.5% (5/144) in term gestations and 25% (2/8) in preterm gestations (Table 4). Infant mean weight at delivery was significantly lower in preterm gestations (2833.12 ± 506.9 g) than in term gestations (3319.5 ± 497.4 g) ($p = 0.014$). Mother's height correlated with infant birth weight ($p = 0.03$) (Fig. 1). Bonferroni's test showed that significant difference existed between mothers with <1.55 m and those with $\geqslant 1.65$ m. However, after adjustment for the mother's height as a covariate in the logistic regression model constructed, there were statistically significant differences (ANCOVA; $p = 0.01$) in the infant mean weight between periodontally healthy women and women with periodontal disease.

Indicators of periodontal disease in women are summarized in Table 5. Plaque index, bleeding on probing, probing depth and clinical attachment loss were significantly greater in women with periodontal disease. The group with periodontitis had a significantly higher mean age ($p < 0.01$), mean number of children ($p < 0.01$) and a higher ratio of previous abortion ($p = 0.011$) (Table 6). Moreover, women with periodontitis had double the frequency of previous abortion than healthy women (odds ratio = 1.92; 95% CI =

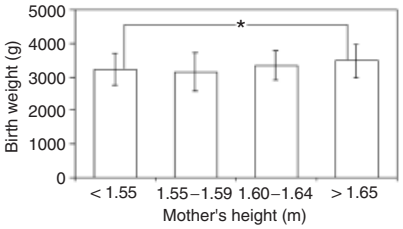

Fig. 1. Infant birth weight in relation to mother's height. *Bonferroni's test: $p = 0.03$.

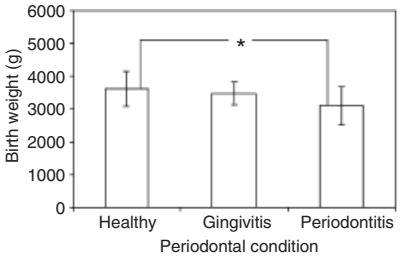

Fig. 2. Infant birth weight in relation to mother's periodontal condition in the group of women >25 years old. *$p = 0.02$.

Table 5. Indicators of periodontal disease

Characteristic	Healthy	Gingivitis	Periodontitis
Number	38 (25%)	71 (47%)	43 (28%)
Plaque index (%)	9.5 ± 8.8	25.9 ± 16.1	35.8 ± 22.1
Bleeding on probing (%)	5.9 ± 7.1	17.7 ± 13.2	33.2 ± 16.1
Percentage of sites with			
Probing depth ⩾5 mm	0	0	4.6 ± 5.4
Attachment loss >5 mm	0.03 ± 0.2	0	1.1 ± 1.7

Table 6. Characteristics of women related to periodontal condition

Characteristic	Healthy	Gingivitis	Periodontitis	p
Number	38 (25%)	71 (47%)	43 (28%)	
Mean age	22.3 ± 6.0	22.0 ± 4.9	26.5 ± 5.7	<0.01
Parity	1.5 ± 0.8	1.6 ± 1.1	2.2 ± 1.3	<0.01
Previous abort	18.4%	8.4%	30.2%	<0.01
Infant birth weight (g)				
<2500	0	4	3	
2500–3499	27	41	31	
>3500	11	26	10	
Infant mean weight	3386.3 ± 477.2	3304.6 ± 498.2	3195.9 ± 543.9	0.23
Infant mean weight (women >25-year old)	3588.3 ± 531.8	3466.8 ± 334.5	3092.6 ± 592.9	0.02
Gestational age at delivery				
Term	36	68	40	
Preterm	2	3	3	

Table 7. Mother's height and clinical variables related to pregnancy in women in relation to their age: ⩽25 ($n = 103$) or >25 years ($n = 49$)

Variable	⩽25	>25	*p*
Height (m)			>0.05
⩽1.55	24	10	
1.56–1.59	22	17	
1.60–1.64	33	10	
⩾1.65m	24	12	
Mean ± SD	1.61 ± 2.8	1.60 ± 1.5	>0.05
Infant birth weight (g)			>0.05
<2500	4	3	
2500–3499	68	30	
>3500	31	16	
Mean ± SD	3288.3 ± 482.9	3305.6 ± 562.5	>0.05
Gestational age at delivery			>0.05
Term	97	47	
Preterm	6	2	

0.7–5.5; $p > 0.05$). The average birth weight decreased with increasing periodontal disease status, but not significantly ($p > 0.05$) (Table 6). Infant mean weight in periodontally healthy women was 3386.3 ± 477.2, being lower in women with gingivitis (3304.6 ± 498.2) and even more (3195.9 ± 543.9) in women with periodontitis ($p = 0.23$). Women with periodontitis had approximately double the frequency of LBW than women with gingivitis and periodontally healthy women (odds ratio = 1.97; 95% CI = 0.4–9.2; $p > 0.05$). After adjustment for the age of the mother as a covariate in the logistic regression model constructed, in the group of women >25 years old there were statistically significant differences (ANCOVA; $p = 0.02$) in the infant mean weight between periodontally healthy women (3588.3 ± 531.8) and women with periodontal disease (3092.6 ± 592.9) (Fig. 2). In Table 7, mother's height and clinical variables related to pregnancy in women in relation to their age (⩽25 and >25 years) are shown. There were no significant differences between both groups of age in the birth weight or in the gestation period ($p > 0.05$).

Bleeding on probing was significantly greater in women with LBW infants (40.2 ± 21.8%) compared with the others ($p = 0.009$) (Table 8).

Discussion

This study demonstrates that periodontal disease in normal Caucasian pregnant women older than 25 years is statistically associated with a reduction in the infant birth weight ($p < 0.05$), considered as a continuous variable. The relationship between mother's periodontal health status and birth weight infant shown in this research agrees with the positive correlation between periodontal disease and LBW (<2500 g) demonstrated by several authors in different populations (Offenbacher et al. 1996, Dasanayake 1998, Dasanayake et al. 2001, Jeffcoat et al. 2001a, b, Offenbacher et al. 2001, Lopes et al. 2002, Lopez et al. 2002a, Moliterno et al. 2002). Although our results showed that mothers with LBW infants have a significantly higher mean bleeding on probing (40.2 ± 21.8%; $p = 0.009$), the expected low incidence of LBW in our studied population thwarts any conclusion about the association between periodontal status and LBW. However, the aim of this study was not to correlate the mother periodontal status with the incidence of LBW, but to analyse the influence of the mother's periodontal status on the infant birth

Table 8. Infant birth weight in relation to bleeding on probing ($n = 152$)

	No. cases	Mean bleeding on probing (%)	SD
<2500 g	7	40.2	21.8
2500–3499 g	98	18.6	15.1
$\geqslant 3500$ g	47	17.1	16.1

Kruskal–Wallis test: $p = 0.0088$.

weight, considered as a continuous variable. In this respect, the data of the present study showed a consistent relationship between maternal periodontal health status and infant birth weight. The average birth weight decreased as the severity of the mother's periodontal health increased, but the inverse correlation between the severity of the mother's periodontal health and the birth weight only can be statistically stated in the group more than 25 years old. The very low incidence of periodontal disease among women aged 14 and 25 years could explain this result. Moreover, in this study the mean age in PG was, effectively, 26.5 ± 5.7 years, significantly greater ($p < 0.01$) than that of HG (22.3 ± 6.0) and GG (22.0 ± 4.9).

When various studies carried out with different populations and by diverse investigators reach similar conclusions in relation to one possible risk factor, it is probable that we are actually detecting a true causal relation. However, social, racial and demographic factors, together with the different degrees of exposition to other risk factors, produce different distributions of periodontal disease in different populations and could provoke that certain risk factors, such as periodontal disease, are not manifested in all the populations. Consequently, the study sample (pregnant women) must be controlled for the traditional risk factors for LBW. Patients in our study were homogeneous, based on social, racial and demographic factors, and could be considered as representative of the normal Caucasian pregnant women population. Mothers were selected haphazardly without previous consideration of their periodontal condition. However, women with systemic conditions (hypertension, gestational diabetes, systemic disease) associated with LBW were excluded and only patients with a singleton gestation were included because the relationship between multiple gestation and LBW is well established (Berkowitz & Papiernik 1993). We controlled several of the well-known risk factors for LBW, including tobacco and alcohol. Other authors used similar criteria to select the sample study (Davenport et al. 2002, Lopez et al. 2002a, Romero et al. 2002). However, other works (Offenbacher et al. 1996, Dasanayake 1998, Jeffcoat et al. 2001a, Madianos et al. 2001, Mitchell-Lewis et al. 2001, Moliterno et al. 2002) were carried out with samples in which most of the mothers were African Americans, a racial group that presents 2.4 times more risk of LBW (11.4%) than the Caucasian group (4.7%) and three times more risk of very LBW (<1500 g) than the Caucasian group (Berkowitz & Papiernik 1993). In agreement with these data, in our study the incidence of preterm birth was low (5.3%) as was the incidence of LBW (4.6%). On the contrary, the relatively high level of PLBW found by other authors (Offenbacher et al. 1996, Dasanayake 1998, Jeffcoat et al. 2001a) could be explained by the high percentage of African Americans in their samples.

With respect to age, in this study most of the women were aged over 18 and less than 35 years (mean age = 23.3 $\pm$ 5.7 years), a maternal age that has not been found to be a risk factor for LBW (Berkowitz & Papiernik 1993). On the contrary, other investigators have used samples composed of young minority women (Mitchell-Lewis et al. 2001) aged 12–19 years, a maternal age that has been found to be a risk factor for LBW. Moreover, the women included in the study sample did not show most of the risk factors for LBW. Thus, a previous history of LBW is one of the most important risk factors for a subsequent LBW (De Haas et al. 1991, Berkowitz & Papiernik 1993), and low maternal weight gain has also been shown to increase the risk of LBW in several studies (Carmichael & Abrams 1997). However, in our study 93.4% of the women did not show previous PLBW, and only 2.6% showed low maternal weight gain.

In this study, as it can be expected (Berkowitz & Papiernik 1993), mother's height correlated with infant birth weight ($p = 0.03$). However, after adjustment for the mother's height as a covariate in the logistic regression model constructed, there were statistically significant differences (ANCOVA; $p = 0.01$) in the infant mean weight between periodontally healthy women and women with periodontal disease. Dasanayake et al. (2001) did not find statistically significant differences in height between mothers of LBW infant and mothers with normal weight infants, probably because birth weigh is used as a dichotomized variable.

Women in the present study had free access to prenatal care services to control many of the known risk factors for LBW. Free provision of prenatal care is advisable as an effective means of reducing LBW based on the observation that this one is less likely among women who seek prenatal care early or have more prenatal visits. A relationship between the use of prenatal care (Sokol et al. 1980) and birth outcomes has been shown and the beneficial effects of prenatal care are strongest among socially disadvantaged women (Greenberg 1983). Inadequate prenatal cares are risk factors considered to be weakly associated with LBW in retrospective studies (Carmichael & Abrams 1997). Nevertheless, in this study 96.1% of women had four or more prenatal visits.

The mechanisms by which periodontal disease may reduce the birth weight have still not been elucidated, but there is evidence that this association has biologically feasible bases. It has been suggested (Offenbacher et al., 1996) that the effect of periodontal disease on LBW could result from stimulation of foetal membranes on prostaglandin synthesis by cytokines produced by inflamed gingival tissues, or through the effect of endotoxin derived from periodontal infection. Endotoxin can stimulate prostaglandin production by macrophages in human amnion (Romero et al. 1988).

In summary, this research demonstrated that periodontal disease in normal Caucasian pregnant women over than 25 years old is statistically associated with decreased infant birth weight, providing new evidence on the relationship between periodontal disease and birth weight. Nevertheless, the association between periodontal disease and birth weight infant should be further explored in new observational and intervention studies to establish whether it is casual or incidental, and to generalize the findings in diverse populations.

References

Berkowitz, G. S. & Papiernik, E. (1993) Epidemiology of preterm birth. *Epidemiological Review* **15**, 414–443.

Carmichael, S. L. & Abrams, B. (1997) A critical review of the relationship between gestational weight gain and preterm delivery. *Obstetrics and Gynaecology* **89**, 866–873.

Dasanayake, A. P. (1998) Poor periodontal health of the pregnant woman as a risk factor for low birth weight. *Annals of Periodontology* **3**, 206–212.

Dasanayake, A. P., Boyd, D., Madianos, P. N., Offenbacher, S. & Hills, E. (2001) The association between *Porphyromonas gingivalis* – specific maternal serum IgG and low birth weight. *Journal of Periodontology* **72**, 1491–1497.

Davenport, E. S., Williams, C. E. C. S., Sterne, J. A. C., Murad, S., Sivapathasundram, V. & Curtis, M. A. (2002) Maternal periodontal disease and preterm low birthweight: case–control study. *Journal of Dental Research* **81**, 313–318.

Greenberg, R. S. (1983) The impact of prenatal care in different social groups. *American Journal of Obstetrics and Gynaecology* **145**, 797–801.

De Haas, I., Harlow, B. L., Cramer, D. W. & Frigoletto, F. D. Jr. (1991) Spontaneous preterm birth; a case–control study. *American Journal of Obstetrics and Gynaecology* **165**, 1290–1296.

Jeffcoat, M. K., Gerus, N. C., Reddy, M. S., Liver, S. P., Goldenberg, R. L. & Hauth, J. C. (2001a) Periodontal infection and preterm birth. Results of a prospective study. *Journal of the American Dental Association* **132**, 875–880.

Jeffcoat, M. K., Gerus, N. C., Reddy, M. S., Goldenberg, R. & Hauth, J. C. (2001b) Current evidence regarding periodontal disease as a risk factor in preterm birth. *Annals of Periodontology* **6**, 183–188.

Lopes, F, F., Rodríguez, M. C. A., Lima, L. L., Alves, C. M. C., Pereira, A. F. V. & Pereira, A. L. A. (2002) Condição periodontal das puérperas e sua relação com o nascimento de bebês de baixo peso. *Pesquisa Odontologica Brasileira* **16**, 214.

Lopez, N. J., Smith, P. C. & Gutierrez, J. (2002a) Higher risk of preterm birth and low birth weight in women with periodontal disease. *Journal of Dental Research* **81**, 58–63.

Lopez, N. J., Smith, P. C. & Gutierrez, J. (2002b) Periodontal therapy may reduce the risk of preterm low birth weight in women with periodontal disease: a randomised controlled trial. *Journal of Periodontology* **73**, 911–924.

Machtei, E. E., Christersson, L. A., Grossi, S. G., Dunford, R., Zambon, J. J., Genco, R. J. (1992) Clinical criteria for the definition of established periodontitis. *Journal of Periodontology* **63**, 207–215.

Madianos, P. N., Bobetsis, G. A. & Kinane, D. F. (2002) Is periodontitis associated with and increased risk of coronary heart disease and preterm and/or low birth weight births? *Journal of Clinical Periodontology* **29**, 22–36.

Madianos, P. N., Lieff, S., Murtha, A. P., Bogess, K. A., Auten Jr, R. L. & Beck, J. D. (2001) Maternal periodontitis and prematurity. Part II: maternal infection and fetal exposure. *Annals of Periodontology* **6**, 175–182.

McCormick, M. C. (1985) The contribution of low birth weight to infant mortality and childhood morbidity. *New England Journal of Medicine* **312**, 82–90.

Mitchell-Lewis, D., Engebretson, S. P., Chen, J., Lamster, I. B. & Papapanou, P. N. (2001) Periodontal infections and preterm birth: early findings from a cohort of young minority women from New York. *European Journal of Oral Sciences* **109**, 34–39.

Moliterno, L. F., Barros, B. M. & Fiscer, R. G. (2002) Associação entre periodontite e parto prematuro com baixo peso: estudo de caso controle. *Pesquisa Odontologica Brásileira* **16**, 166.

Moore, M. L., Michielutte, R., Meis, P. J., Ernest, J. M., Wells, H. B. & Buescher, P. A. (1994) Etiology of low-birthweight birth: a population-based study. *Preventive Medicine* **23**, 793–799.

Offenbacher, S., Katz, V., Fertik, G., Collins, J., Boyd, D., Maynor, G. & McKaig, R. M. (1996) Periodontal infection as a possible risk factor for preterm low birth weight. *Journal of Periodontology* **67**, 1103–1113.

Offenbacher, S., Lieff, S., Boggess, K. A., Murtha, A. P., Madianos, P. N. & Champagne, C. M. E. (2001) Maternal periodontitis and prematurity. Part I: obstetric outcome of prematurity and growth restriction. *Annals of Periodontology* **6**, 164–174.

O'Leary, T. J., Drake, R. B. & Naylor, J. E. (1972) The plaque control record. *Journal of Periodontology* **43**, 38–41.

Romero, B. C., Chiquito, C. S., Elejalde, L. E. & Bernardoni, C. B. (2002) Relationship between periodontal disease in pregnant women and the nutritional condition of their newborns. *Journal of Periodontology* **73**, 1177–1183.

Romero, B. C., Hobbins, J. C. & Mitchell, M. D. (1988) Endodotoxin stimulates prostaglandin E_2 production by human amnion. *American Journal of Obstetric and Gynaecology* **71**, 227–228.

Sokol, R. J., Wool, R. B. & Rose, M. G. (1980) Risk, antepartum care, and outcome: impact of a maternity and infant care project. *Obstetrics and Gynaecology* **56**, 150–156.

Van der Velden, U. (1979) Probing force and relationship of the probe tip to the periodontal tissues. *Journal of Clinical Periodontology* **6**, 106–114.

Yu, V. Y. (2000) Developmental outcome of extremely preterm infants. *American Journal of Perinatology* **17**, 57–61.

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