Journal of
PERIODONTAL RESEARCH

J Periodont Res 2011; 46: 542–549

JOURNAL OF PERIODONTAL RESEARCH
doi:10.1111/j.1600-0765.2011.01371.x

Maternal periodontal status and preterm delivery: a hospital based case–control study

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Baskaradoss JK, Geevarghese A, Kutty VR. Maternal periodontal status and preterm delivery: a hospital based case–control study. J Periodont Res 2011; 46: 542–549. © 2011 John Wiley & Sons A/S

Background and Objective: Recent studies have presented evidence that periodontal disease in pregnant women may be a determining factor for preterm delivery. However, this finding has not been consistently observed. The present investigation was carried out to explore the association between maternal periodontal disease and preterm delivery in the state of Kerala, India.

Material and Methods: The case–control study had a sample of 300 (100 cases and 200 controls) postpartum women over 18 years of age. Cases were women who had undergone spontaneous preterm delivery (< 37 wk of gestation) and controls were women who delivered at term (≥ 37 wk of gestation). Standard, clinical and periodontal examinations were performed at the maternity wards, and the existence of an association between periodontal disease and preterm delivery was evaluated by means of a multivariate logistic regression model that also considered other risk factors for preterm delivery.

Results: Periodontitis was diagnosed in 25% of the mothers in the case group and in 14.5% of the mothers in the control group. Logistic regression analysis indicated a risk of nearly threefold for preterm delivery in mothers with periodontitis [adjusted odds ratio (OR^a) = 2.72; 95% confidence interval (CI): 1.68–6.84]. The other factors significantly associated with preterm birth were physical exertion (OR^a = 2.80; 95% CI: 1.18–6.65), a previous history of preterm birth (OR^a = 2.65; 95% CI: 1.20–5.83) and previous abortion/death of infant (OR^a = 4.08; 95% CI: 1.56–10.65).

Conclusion: Periodontal disease is a possible risk factor for preterm delivery in this population.

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Key words: maternal periodontal disease; preterm delivery; pregnancy; risk factors; case–control study

Accepted for publication February 24, 2011

Globally, over 4 million babies die within the first 4 wk of life and almost one-third of these are preterm infants (1). Preterm delivery and low birth weight are considered to be the most relevant biological determinants of survival of a newborn infant, in both developed and developing countries. Preterm delivery is defined as delivery before the end of 37 wk of gestation (< 259 d). The international definition of low birth weight, adopted by the World Health Organization, is a birth weight of < 2500 g (2). The primary cause of low birth weight is preterm delivery or premature rupture of membranes. Preterm infants who are born with a low birth weight are termed preterm low birth weight.

The service provision and utilization with regard to maternity care in hospitals is among the best in the State of Kerala when compared with other Indian States. The National Family Health Survey (NFHS)-I, of 1992–1993, reported that in Kerala, 95% of

mothers received three or more antenatal check-ups and that 89% of the deliveries were institutional (3). The NFHS-II, of 1998–1999, reported that 99% of mothers received at least three antenatal check-ups and that 93% of the deliveries were institutional (4). The NFHS-III, of 2005–2006, reported that 94% of the mothers in Kerala received three or more antenatal check-ups and that 100% of the births took place in a medical facility (5). Based on this report, Kerala and Goa are the only states in India which have 100% institutional deliveries. In spite of the high degree of antenatal care and medical attention for delivery, the proportion of preterm low birth weight deliveries continues to be high, at about 20%. Consequently, the identification of risk factors for preterm delivery that are amenable to intervention would have far-reaching and long-lasting effects. The public health significance of preterm delivery may be ascribed to its association with an increased risk of perinatal and infant mortality and morbidity.

There is evidence of an association between periodontal disease, especially severe periodontitis, and a variety of systemic conditions. Among these are cardiovascular disease, insulin-dependent diabetes mellitus and respiratory disease (6). These findings have potential significance in the assessment of risk for preterm delivery and also for the overall oral health care during pregnancy.

The 1996 study by Offenbacher *et al.* (7) suggested that maternal periodontal disease could lead to a sevenfold increase in the risk of preterm delivery. Furthermore, periodontal pathogens, such as *Porphyromonas gingivalis*, *Aggregatibacter actinomycetemcomitans* and *Treponema denticola*, were significantly associated with preterm delivery/low birth weight (8–10). A study by Khader *et al.* (11), involving 586 women, found that the extent and the severity of periodontal diseases were associated with increased odds of preterm delivery. However, Michalowicz *et al.* (12), found that although periodontal treatment significantly improves the oral health, it does not alter the rates of preterm delivery. A recent study by Lohsoonthorn *et al.* (13) also found no association. The uncertainties of the relationship between periodontal infection and risks for preterm delivery prompted this methodologically robust case–control study.

Material and methods

Study design, setting and participants

This was a hospital based unmatched incident case–control study. In Kerala, 100% of deliveries occur in hospitals and therefore it is possible to obtain a representative sample of the community from a hospital based study. This case–control study of postpartum mothers was performed at two hospitals – Sri Avittom Thirunal (SAT) Hospital and Woman and Child (W&C) Hospital – in the Thiruvananthapuram district of Kerala. SAT and W&C Hospitals are the largest public sector tertiary care centres for maternal and child health care in the district. These hospitals treat referral patients from other hospitals within the district as well as from hospitals in the neighbouring districts. The study population included mothers over 18 years of age, who delivered at SAT Hospital or at W&C Hospital.

The study received ethical clearance from the Institutional Ethics Committee, Sree Chitra Tirunal Institute of Medical Science and Technology, Thiruvananthapuram, Kerala. Ethical clearance was also obtained from the Ethics Committee of Medical College, Thiruvananthapuram, for conducting the study at SAT Hospital. Written consent was obtained from each of the participants before the commencement of the interview and clinical examination.

The sample size was calculated using the STATCALC program (Epi Info version 6.0; Centers for Disease Control and Prevention, Atlanta, GA, USA). A power of 80% with a 95% confidence interval (95% CI) was accepted. The expected prevalence of periodontal disease in the control group was assumed to be 24% and the expected odds ratio (OR) was taken as 2. For a case/control ratio of 1:2, the required sample size was calculated to be 96 cases and 192 controls, which were then rounded up to 100 cases and 200 controls. Hence, the total sample size for the study was fixed at 300 subjects. The working definition for the case group was mothers who gave birth before the end of 37 wk of gestation (< 259 d) at either the SAT Hospital or the W&C Hospital. The control group consisted of mothers who had normal term (> 37 wk of gestation) delivery at the same hospitals. Estimation of gestational age was based on the last menstrual period, as recorded in the patient's medical record.

The investigators referred to the hospital birth register each day and randomly selected the cases and controls by means of a draw. All subjects were examined within the first 48 h after delivery. For every case, two controls, who delivered on the same day, were included in the study. This procedure was followed until the required sample size was achieved (Fig. 1). If the selected subject refused to participate, the next patient selected randomly from the register would be considered.

Inclusion and exclusion criteria

Criteria for inclusion were: any mother > 18 years of age who delivered a live infant at the SAT Hospital or at the W&C Hospital. Mothers who had multiple pregnancies (twins, etc.), complicated labour and/or delivered by Caesarian section were excluded from the study. Severely ill mothers, or those who were receiving antibiotic therapy, were excluded from the study. The study participants who had undergone professional periodontal therapy in the last 3 mo or who had chronic diseases (such as diabetes or hypertension) were also excluded from the study.

The interview schedule and the periodontal examination were carried out at the maternity wards of the Obstetrics and Gynecology Department of the SAT Hospital or the W&C Hospital. A pretested interview schedule, which was translated into the local language, was used. Periodontal assessment was performed using a Williams probe graduated in millimeters.

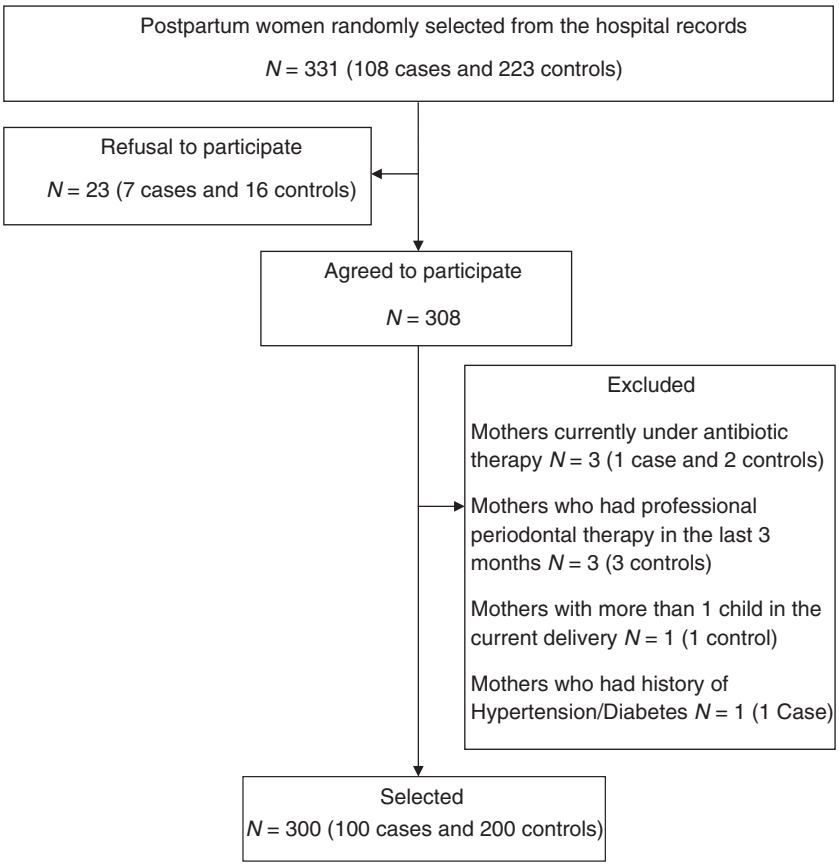

Fig. 1. Flow chart for selection of study participants.

The pregnancy outcome is conditioned by a number of factors, such as biomedical, behavioural, household environment and socio-demographic situation of the mother.

The social and economic factors included religion, educational status of the mother, place of residence, type of family, occupation of the mother, family income, type of cooking fuel used and the assets of the family. Physical stress during pregnancy of the working mother was also included. The household environmental factors included work and rest during pregnancy, any untoward events during pregnancy and also the husbands' smoking and/or use of alcohol.

Behavioural factors included beliefs and practices of diet intake during pregnancy and advice received during pregnancy. Biological factors included the age of the mother, antenatal care, weight and height of the mother. Infections and other medical conditions such as pregnancy-induced hypertension, gestational diabetes mellitus or anaemia were also included. There is definite overlapping of factors and, in reality, the interplay of many of these factors before and during pregnancy determines the pregnancy outcome.

Covariate data, such as anthropometric and socio-demographic characteristics, were collected from medical records or through structured interviews. Pregnancy information, including gestational age, infant's weight at birth, type of delivery, sex of neonate and gestational age, was transcribed from the medical records.

Oral hygiene habits were assessed through the interview schedule, which included questions on the frequency of brushing and the agents used for brushing. The oral health-seeking behaviour was assessed based on the number of visits to the dentist in relation to their dental problems during pregnancy.

Measurement of periodontal status

The periodontal condition was assessed by the principal investigator who examined the bleeding on probing, amount of plaque, probing depth and clinical attachment loss. Periodontal examination was performed on six sites per tooth (buccal-mesial, mid-buccal, buccal-distal, lingual-mesial, mid-lingual and lingual-distal). Dichotomous measures of supragingival plaque accumulation were made by running the periodontal probe across the cervical surface of each tooth. The presence of plaque was deemed positive when a continuous band of plaque was found in contact with the gingival tissue on the cervical portion of the tooth surfaces. Plaque scores were calculated as the percentage of surfaces examined demonstrating plaque. Bleeding on probing was assessed on the same six sites where the probing-depth measurements were taken, and the criterion for bleeding on probing was bleeding within 15 s of probing. Bleeding on probing was expressed as the percentage of sites showing bleeding. Clinical attachment loss and probing depth were recorded to the nearest millimeter, using a calibrated periodontal probe, by a single examiner. The probing depth was recorded as the distance from the gingival margin to the most apical extent of probe penetration. For measuring clinical attachment loss, the cemento–enamel junction was taken as the reference point. Clinical attachment loss is the distance from the cemento–enamel junction to the base of the crevice probed (14). We used the definition of periodontal disease as defined by Lopez *et al.* (15). According to this definition, women who had at least four teeth with one or more sites with a probing depth of ≥ 4 mm and with clinical attachment loss of ≥ 3 mm at the same site were considered to be affected by periodontal disease. The examination was performed with the participant in the supine position on the hospital bed. Throughout the procedure, the principal investigator was assisted by a female chaperone.

Data management and statistical analysis

Data were entered using the Epi Data program, daily, from the interview schedule. All statistical analyses were carried out using spss 17.0 (Statistical Package for the Social Sciences for Windows®; SPSS Inc., Chicago, IL, USA). Reproducibility calculations were presented as 95% CI and the results as ORs; whereas, for continuous variables, the mean values were presented.

Transformation of data

In the study, socio-economic status was calculated based on the Standard of Living Index with some modifications. This index is similar to that used in NFHS-II (4). The Standard of Living Index was calculated on the basis of income, possession of goods, toilet facilities and the type of cooking fuel used by the respondents. Based on this score the socio-economic status was divided into 'high', 'medium' and 'low' categories.

Physical exertion during pregnancy has been reported as an important risk factor for preterm delivery. Physical exertion was analyzed based on the workload, hours of work per day and on whether the work involved carrying a heavy load. The responses were scored as yes or no. Smoking is not common among women in Kerala (5). Exposure to passive smoke was estimated based on the smoking habits of their husbands. Body mass index (BMI) was classified as normal (18.5–24.9), underweight (< 18.5) or overweight (≥ 25.0). Gestational age was classified into five groups: extreme prematurity (< 28 wk); severe prematurity (28–31 wk); moderate prematurity (31–34 wk); near term (34–37 wk); and normal term (> 37 wk).

Bivariate analysis

Preterm delivery proportion was analyzed with respect to age, heavy physical exertion during pregnancy, diet, husband smoking, prenatal care, parity, previous history of preterm delivery/low birth weight, previous history of abortion/death of an infant and any medical problems during pregnancy. Specific oral health conditions, such as the presence of plaque, gingival bleeding (on toothbrushing as well as on gentle probing), periodontal pockets and gingival recession, were also incorporated in the bivariate analysis.

Multivariate logistic regression model

A multivariate logistic regression model was developed to examine the association between maternal oral health status and preterm delivery. This was done with the understanding that preterm delivery is multifactorial in nature involving demographic, genetic, nutritional and obstetric factors as well as antenatal care, oral hygiene, professional dental care, dental plaque, poor oral health, periodontal disease, infection, maternal morbidity and toxic exposure.

The multivariate logistic regression model was built in the following stepwise manner.

Step 1. Socio-demographic variables, such as age, socio-economic status, location of residence (urban/rural), education and occupation, were included in the model.

Step 2. Keeping only the significant variable(s) from the previous step, the behavioural factors were added to the model. This included significant physical exertion during pregnancy, husband smoking and diet.

Step 3. The significant variables in the previous model were added along with the pregnancy-related proximate variables. The covariates included were previous history of preterm delivery/low birth weight, previous history of death/abortion of infant, time of first registration at an antenatal clinic, the type of antenatal care provider, the total number of visits to an antenatal clinic during pregnancy and the medical problems.

Step 4. Finally, along with the significant variables in the previous model, oral health-related risk factors were added.

Results

Of the 331 women randomly selected from the hospital records, 23 (6.9%) refused to participate and eight (2.4%) were excluded for various reasons. The gestational age of the newborn was available in 100% of medical records. There were no significant differences in the demographic characteristics such as social class, location, religion, educational status, occupation, type of family and frequency of vomiting among the groups (Table 1). The household characteristics, such as toilet facility and cooking fuel used, and the economic status, were similar between the groups. The two groups were comparable in terms of maternal age, age at marriage and mean BMI (Table 2). There were no cases of extreme prematurity, 4% had severe prematurity, 12% had moderate prematurity and 17% had near term delivery (Fig. 2).

In the bivariate analysis, it was noticed that physical exertion during pregnancy, previous history of preterm delivery, gestational hypertension and periodontitis were significantly higher among the cases. The utilization of health care facilities was more in the control group. There was no significant difference between the case and control groups in terms of parity. Medical problems, such as gestational diabetes, anaemia, genitourinary infection and asthma, were similar between the cases and the controls. No significant difference in oral health factors, such as dental problems in the last year, visit to a dentist or oral hygiene habits, were noticed between the two groups (Table 3).

The distribution of specific clinical characteristics among cases and controls is shown in Table 4. Mean probing depth, mean clinical attachment loss, and percentage of sites with plaque, bleeding on probing and probing depth ≥ 4 mm were significantly higher among the cases compared with the controls.

Detailed analysis while adjusting for specific risk factors was performed in the logistic regression model. The risk factors were included in a stepwise

Table 1. Demographic details of cases and controls (categorical variables)

	All subjects (n = 300)		Cases (n = 100)		Controls (n = 200)	
Variables	n	%	n	%	n	%
Age						
≤ 25 years	151	50.3	59	59.0	92	46.0
> 25 years	149	49.7	41	41.0	108	54.0
Social class						
Low	184	61.3	64	64.0	120	60.0
Medium	116	38.7	36	36.0	80	40.0
Location						
Urban	124	41.3	41	41.0	83	41.5
Rural	176	58.7	59	59.0	117	58.5
Religion						
Hindu	211	70.3	65	65.0	146	73.0
Christian	57	19.0	23	23.0	34	17.0
Muslim	32	10.7	12	12.0	20	10.0
Education						
Primary	45	15.0	17	17.0	28	14.0
Secondary school	161	53.7	55	55.0	106	53.0
Higher secondary	68	22.7	20	20.0	48	24.0
Graduate	26	8.7	8	8.0	18	9.0
Occupation						
Housewife	278	92.7	94	94.0	184	92.0
Agriculture/daily wage	14	4.7	4	4.0	10	5.0
Private/Government: employee	8	2.7	2	2.0	6	3.0
Number of people in the house						
≤ 4	186	62.0	62	62.0	124	62.0
> 4	114	38.0	38	38.0	76	38.0
Body mass index						
Normal	206	68.7	76	78.4	130	69.1
Underweight	7	2.3	6	6.2	1	0.5
Overweight	72	24	15	15.5	57	30.3
Frequency of vomiting						
Nil	194	64.7	61	61.0	133	66.5
Once a week	29	9.7	10	10.0	19	9.5
1–3 times a week	13	4.3	5	5.0	8	4.0
4–7 times a week	5	1.7	1	1.0	4	2.0
Only in the first 3 mo	59	19.7	23	23.0	36	18.0
Neonate sex						
Male	173	57.7	57	57.0	116	58.0
Size of newborn						
Small for gestational age	11	3.7	11	11.0	–	–

Table 2. Demographic details of cases and controls (continuous variables)

	All subjects (n = 300)		Cases (n = 100)		Controls (n = 200)	
Variables	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD
Maternal age (years)	300	25.51 ± 3.01	100	25.1 ± 3.93	200	25.71 ± 2.41
Age at menarche (years)	300	13.41 ± 1.53	100	13.64 ± 1.40	200	13.29 ± 1.58
Age at marriage (years)	300	21.34 ± 1.90	100	21.87 ± 2.74	200	21.08 ± 1.23
Mean BMI	285	23.0 ± 2.53	97	22.13 ± 2.56	188	23.45 ± 2.38

BMI, body mass index; SD, standard deviation.

manner and in the final step the factors that were entered were: history of previous abortion/death of infant, history of preterm delivery/low birth weight, significant physical exertion, dental problems in the last year, visit to a dentist in the last year, receiving advice from health professionals on oral health, brushing frequency, presence of bleeding while brushing and presence of periodontitis. Among these, factors that were likely to pose an increased risk for preterm delivery were history of previous abortion/death of infant [adjusted OR (OR^a) = 4.08, 95% CI = 1.56–10.65], history of preterm delivery/low birth weight (OR^a = 2.65; 95% CI = 1.20–5.83), significant physical exertion (OR^a = 2.80; 95% CI = 1.18–6.65), age (OR^a = 1.27; 95% CI = 0.60–2.68) and periodontitis (OR^a = 2.72; 95% CI = 1.68–6.84) (Table 5).

Discussion

The study was carried out in an urban setting at the maternity block of the two hospitals. The selection of these two hospitals was based on the availability of a large number of accessible postpartum women.

The majority of the study participants belonged to the low socio-economic group that had very little awareness of oral health care. The distributions of several known risk factors for preterm delivery were similar in both groups. It is well known that approximately 50% of preterm deliveries have no established risk factors (16). In bivariate analysis, the risk factors that showed a significant association with preterm delivery were age, physical exertion during pregnancy, previous history of preterm delivery, number of visits to the antenatal care provider, gestational hypertension and periodontitis. Parity of the mother, which has been shown to be a significant risk factor for preterm delivery in many studies (17,18), was not significant in this study (OR = 1.06; 95% CI = 0.75–1.47).

With regard to the onset of antenatal care received and type of antenatal care provider, there was no significant difference between the case and control groups. However, 96.5% of the controls had visited the antenatal care provider compared with only 90% of the cases, which was statistically significant (OR = 0.35; 95% CI = 0.12–0.89). Among subjects in the case group, 18% had gestational hypertension compared with only 7.5% among controls, which was statistically signif-

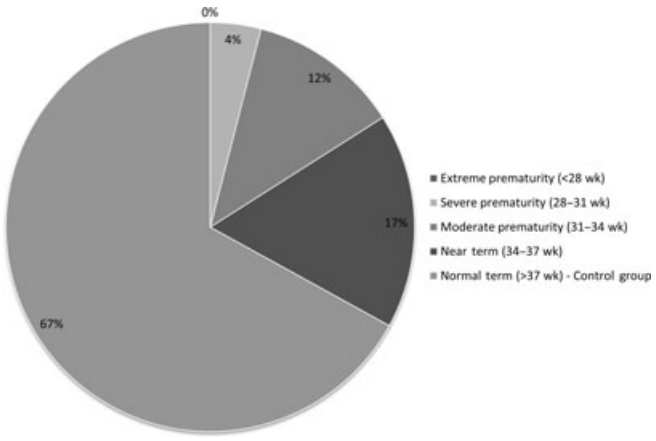

Fig. 2. Distribution of gestational age in the study sample.

Table 3. Factors affecting preterm delivery – bivariate analysis

Variables	All subjects [*n* = 300 (%)]	Cases [*n* = 100 (%)]	Controls [*n* = 200 (%)]	Odds ratio	95% Confidence interval
Significant physical exertion					
Yes	51 (17.0)	25 (25.0)	26 (13.0)	2.23	1.21–4.11
Help with household					
Yes	163 (54.3)	55 (55.0)	108 (54.0)	1.04	0.64–1.69
Husband smoking					
Yes	97 (32.3)	34 (34.0)	63 (31.5)	1.12	0.67–1.87
Diet					
Nonvegetarian	285 (95.0)	96 (96.0)	189 (94.5)	1.4	0.43–4.5
Primiparous					
Yes	87 (29.0)	28 (28.0)	59 (29.5)	1.06	0.75–1.47
Previous PT/LBW					
Yes	45 (23.4)	17 (34.0)	28 (19.7)	2.1	1.03–4.29
Previous abortion/death of infant					
Yes	44 (20.7)	12 (23.1)	32 (19.9)	1.21	0.57–2.57
Number of visits					
> 6 visits	283 (94.3)	90 (90.0)	193 (96.5)	0.35	0.12–0.89
Stress during pregnancy					
Yes	9 (3.0)	4 (4.0)	5 (2.5)	1.63	0.43–6.19
Gestational hypertension					
Yes	33 (11.0)	18 (18.0)	15 (7.5)	2.71	1.30–5.63
Gestational diabetes					
Yes	21 (7.0)	9 (9.0)	12 (6.0)	1.54	0.63–3.81
Anaemia					
Yes	11 (3.7)	4 (4.0)	7 (3.5)	1.15	0.33–4.02
Genitourinary infection					
Yes	20 (6.7)	10 (10.0)	10 (5.0)	2.11	0.85–5.25
Asthma					
Yes	4 (1.3)	1 (1.0)	3 (1.5)	0.66	0.07–6.46
Had dental problems in the last year					
Yes	127 (42.3)	40 (40.0)	87 (43.5)	0.87	0.53–1.41
Had visited a dentist in the last year					
Yes	38 (12.7)	11 (11.0)	27 (13.5)	0.79	0.34–1.67
Had advice from health professionals on oral health					
Yes	97 (32.3)	29 (29.0)	68 (34.0)	0.79	0.47–1.34
Toothbrushing twice a day					
Yes	162 (54)	55 (55.0)	107 (53.5)	1.06	0.66–1.72
Bleeding while brushing					
Yes	153 (51.0)	58 (58.0)	95 (47.5)	1.53	0.94–2.48
Periodontitis					
Yes	54 (18.0)	25 (25.0)	29 (14.5)	1.96	1.08–3.58

LBW, low birth weight; PT, preterm delivery.

icant (OR = 2.71; 95% CI = 1.30–5.63). Other medical problems, such as gestational diabetes, anaemia, genitourinary infection and asthma, were not statistically significant.

Although just over 40% of the subjects had experienced dental problems in the last year, only 12.7% had visited a dentist in the last year. Although the differences between cases and controls were not statistically significant, these data clearly demonstrate the lack of importance given to oral health care. Nevertheless, it appears that the likelihood of an adverse pregnancy outcome increases with the severity of periodontal disease.

According to the operational criteria for periodontal disease diagnosis, the proportion of study participants who had periodontitis was 25% of cases and 14.5% of controls. A study from the neighbouring state of Karnataka reported similar data on the prevalence of periodontitis (32.8%) and it also found that periodontitis is more common in women than in men (19).

When analyzing the unadjusted association, it was observed that the mothers with periodontal disease had almost twice the chance of having a preterm delivery in comparison with those without the disease (OR = 1.96; 95% CI = 1.08–3.58). Stratified analysis involving these covariates was performed to address the issue of confounding and interaction. In order to control potential confounders, women receiving treatment for chronic diseases (such as diabetes mellitus and hypertension) were excluded from the study because antihypertensive medications are strongly related to periodontal status (8,20–22). Women using antibiotics were also excluded because of the effects of antibiotics on periodontal tissues.

Periodontitis was consistently associated with preterm delivery after adjusting for other risk factors and covariates in the multivariate logistic regression model (OR^a = 2.72; 95% CI = 1.68–6.84). The present study supports earlier findings regarding the risk of preterm delivery in mothers with periodontal disease (7,15,18,20,23–30). Also significant were physical exertion during pregnancy, previous abortion/

Table 4. Measurements of periodontal status

Variables	Cases (n = 100) Mean ± SD	Controls (n = 200) Mean ± SD	p-value
Number of teeth	25.39 ± 1.72	25.81 ± 1.45	0.03
Percentage of sites with			
Plaque	63.13 ± 7.02	51.51 ± 8.77	< 0.01
Bleeding on probing	33.15 ± 6.43	21.79 ± 8.01	< 0.01
Probing depth ≥ 4 mm	19.21 ± 3.55	16.1 ± 2.90	< 0.01
Mean probing depth	3.26 ± 0.76	2.95 ± 0.68	< 0.01
Mean clinical attachment loss	2.17 ± 0.69	1.84 ± 0.63	< 0.01

Table 5. Multivariate logistic regression model of risk factors for preterm delivery

Risk factors for PT (dichotomized)	OR[a]	95% CI
Significant physical exertion (yes)	2.80	1.18–6.65
Previous PT/LBW (yes)	2.65	1.20–5.83
Previous abortion/death of infant (yes)	4.08	1.56–10.65
Periodontitis (yes)	2.72	1.68–6.84
Age	1.27	0.60–2.68

CI, confidence interval; LBW, low birth weight; OR[a], adjusted odds ratio; PT, preterm delivery.

death of infant and previous history of preterm delivery. A previous history of preterm delivery was found to be an important risk factor for preterm delivery, which is in accordance with the results of some earlier studies (31,32). It is interesting to note that a previous history of death/abortion, which was not significant in the bivariate analysis, showed a strong association in the multivariate model (OR = 4.08; 95% CI = 1.56–10.65). This could be because of the influence of age and other variables in the bivariate analysis. Also, some of the significant risk factors from bivariate analysis, such as gestational hypertension, number of visits to the antenatal care provider and age (> 25 years) were not significant in the multivariate model.

There is a large body of evidence pointing to infection as a key factor in adverse pregnancy outcomes (33,34). The mechanisms by which periodontal disease may cause preterm delivery is beyond the scope of this study. However, there is evidence of a biologically feasible basis for this association. Chronic periodontal infections can produce local and systemic host responses, leading to transient bacteraemia. Endotoxins are produced as a result of gram-negative bacterial infections, such as periodontal disease. These endotoxins stimulate the production of cytokines and prostaglandins. It is known that prostaglandins and certain cytokines, in appropriate quantities, stimulate labour. The systemic inflammation that is initiated by periodontal disease might contribute to preterm delivery (35,36).

The gestational age was estimated based on the last menstrual period, as recorded in the medical records of the subject. This could be considered as a limitation of the present study because ultrasound estimates of the gestational age were not available.

Conclusion

The results of our study show that periodontal disease is an independent risk factor for preterm delivery, resulting in an increased risk of almost threefold for preterm delivery. The current knowledge of the biological plausibility of this association between periodontal diseases and preterm delivery supports this finding, but the temporal relationship and causality would be difficult to prove. Caution must be taken in interpreting the applicability of the current data until these findings can be confirmed by larger, prospective multicentre investigations.

Acknowledgements

We appreciate cooperation given by the Heads, Department of Pediatrics as well as Obstetrics and Gynecology at Sri Avittom Thirunal (SAT) Hospital and Woman and Child (W&C) Hospital, Kerala. We are very grateful to all mothers who gave consent and participated in this study. We acknowledge the advice of Professor Anil Sukumaran on the technical aspects of this study.

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