



# Prevalence and Relationship Between Maternal Periodontal Disease and Preterm Low Birth Weight Baby

Prabha Kumari<sup>1</sup> · Sumanlata Mendiratta<sup>1</sup> · Subodh Sharma<sup>1</sup> · Sangeeta Popli<sup>1</sup>

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**Abstract** The objective of this study was to examine the prevalence and relationship between maternal periodontal disease and preterm low birth weight (LBW) babies among women delivering at Hindu Rao Hospital, Delhi, India. A case control study was performed on 150 women fulfilling the selection criteria over a period of one year. The study consisted of 50 cases, (women delivering preterm babies weighing  $\leq 2.5$  kg, Group I) and 100 controls (women delivering babies at  $\geq 37$  weeks and weighing  $> 2.5$  kg, Group II). Associated risk factors for preterm low birth weight (PT-LBW) were ascertained by means of a structured questionnaire and maternal notes. Women having any of the possible risk factors for preterm LBW were either excluded or confounded in the study. The prevalence of periodontal disease was assessed by the community periodontal index of treatment needs (CPITN) scoring method, with scores ranging from 0 to 4. Data were analyzed using Graphpad Prism-5 software. *P* value and odds ratio (OR) with 95 % confidence interval were calculated as and when required for statistical analysis. Prevalence of periodontal disease was 84.66 % ( $n = 150$ ) in the study population. Prevalence of periodontal disease was high, at least in some form or other, in cases (100 %) as compared to controls (77 %). The prevalence of severe periodontal disease (CPITN score-4) was 8 % in cases and 3 % in controls. Periodontal disease is an avoidable risk factor for LBW as almost all of the known risk factors for LBW were either excluded or confounded during the study. Hence,

routine periodontal examination and advice on good oral hygiene should be included as part of preconceptional care and antenatal checkups during pregnancy. Any dysfunction should be thoroughly investigated and treated for the sake of health of both mother and baby.

**Keywords** Periodontal disease · Pregnancy · Preterm birth · Low birth weight · CPITN scoring

## Introduction

Periodontal diseases are a group of infectious diseases caused predominantly by gram-negative, anaerobic and microaerophilic bacteria that colonize the subgingival area resulting in inflammation of gingival and periodontal tissues and progressive loss of alveolar bone.

Low birth weight (birth weight  $< 2.5$  kg) is a major determinant of neonatal morbidity and mortality [1]. Preterm low birth weight (PT-LBW) is recognized as a major cause of neonatal mortality and of nearly one-half of all serious long term neurological morbidity [2].

Various factors have been associated with the delivery of PT-LBW babies. One of the major factors among these is infection, either sub-clinical or clinical. An association with maternal lower genitourinary tract infection, urinary tract infection, and cervical colonization with microbes etc. has been demonstrated by a number of studies [3, 4]. Studies [5–7] show that periodontitis may be a potential independent risk factor for preterm labor and/or LBW infants when all other known obstetric risk factors are not dominant and the pathogenic mechanism is postulated to be the same as with other maternal infection. Inflamed periodontal tissues produce significant amount of pro-inflammatory cytokines, mainly interleukin-1 beta (IL-1 $\beta$ ),

✉ Sumanlata Mendiratta  
sumanmendi@yahoo.co.in

<sup>1</sup> Department of Obstetrics and Gynecology, North DMC Medical College and Hindu Rao Hospital, A-3/224 Janak Puri, New Delhi 110058, India

interleukin-6 (IL-6), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), and prostaglandin-E2 (PG-E2). It is known that prostaglandins and certain cytokines (IL-1 $\beta$ , IL-6, TNF- $\alpha$ ) in appropriate quantities stimulate labor and these may be responsible for delivery of PT-LBW babies in women with periodontal disease [8]. These inflammatory cytokines may also cause placental tissue damage contributing to fetal growth restriction and LBW [9].

The present study is undertaken to determine the prevalence and relationship between periodontal disease in pregnant women and PT-LBW babies.

## Materials and Methods

A retrospective case control study was conducted in the Department of Obstetrics and Gynecology, Hindu Rao Hospital, Delhi in association with its Dental Department.

### Inclusion Criteria

One hundred and fifty women of age between 20 and 35 years with singleton pregnancy in cephalic presentation and spontaneous onset of labor were included in the study. For statistical analysis all selected subjects were categorized into two groups:

Cases—Group I (PT-LBW) included women delivering babies weighing  $\leq 2.5$  kg before 37 completed weeks of gestation ( $n = 50$ ).

Controls—Group II [Term normal birth weight (T-NBW) group] included women with babies of birth weight 2.5 kg or more who delivered at term ( $n = 100$ ).

### Exclusion Criteria

Women aged less than 20 years or more than 35 years, having multiple pregnancies, malpresentation, stillborn infant, and induced labor were excluded from the study, as were women with history of previous preterm delivery and history of hypertension—gestational/essential, diabetes mellitus, antepartum hemorrhage, and smoking/alcohol/antibiotics intake in current pregnancy. The potential confounders that may affect the study outcome such as congenital heart disease, bronchial asthma, chronic renal disease, genitourinary infection, threatened abortion, and medication such as current use of systemic corticosteroid were adjusted.

The subjects were selected by inspection of Hindu Rao Hospital's birth records each weekday. They were examined within 24 h of delivery as this indicates that the maternal periodontal disease was present during or prior to the present pregnancy. It also ensures that mothers were recruited prior to their discharge from the hospital.

Detailed history was taken and complete examination was done. The risk factors for LBW were established by examination of the hospital records and by a structured questionnaire. Pregnancy outcomes were measured in terms of preterm or term delivery. Estimation of gestational age was based on the last menstrual period, antenatal ultrasound examination reports, sequential antenatal physical examination, and postnatal examination of babies. All selected subjects were informed and consent was taken for participation in the study.

### Measurement of Periodontal Status

The dental examination was carried out in the dental department and the examiner was blinded to the pregnancy outcome. Probing depth (PD), bleeding on probing (BOP), presence or absence of calculus, and CPITN scoring were determined. A specially designed 11.5 mm long, color-coded (black color in 3.5–5.5 mm of the probe) periodontal probe (WHO CPITN probe) with 0.5 mm ball tip was used to evaluate the PD of the dental sulcus, i.e., the distance from gingival crest to the base of the dental pocket. Any bleeding after gentle probing was noted on sites at which PD was determined and deemed positive, if it occurred within 15 s after probing. The teeth were examined for supragingival or subgingival calculus. The worst finding in each sextant was coded according to the table below (Table 1).

Prevalence of periodontal disease was defined based on the CPITN score of all subjects. In the present study, score 0 denoted healthy periodontium i.e., no periodontal disease; score 1–2 denoted mild periodontal diseases; score 3 denoted moderate periodontal diseases; and score 4 denoted severe periodontal diseases. The prevalence of periodontal disease in the two groups was calculated and the possibility of relationship between periodontal disease and PT-LBW babies was explored. Statistical analysis was conducted using Graphpad Prism-5 software. Analysis of variance (ANOVA) and Chi square tests were used. *P* value and odds ratio (OR) with 95 % confidence interval were calculated for statistical comparisons. A *P* value of less than 0.05 was regarded as statistically significant.

## Results

The mean age of women in both the groups was comparable;  $24.00 \pm 2.703$  and  $23.18 \pm 2.706$  years in Group I (PT-LBW) and Group II (T-NBW), respectively (Table 2).

The subjects were from lower to lower middle class family and mostly housewife by occupation. There was no major difference in the educational level of both the study groups.

**Table 1** Community periodontal index of treatment needs scoring

| Findings  | Maximum score | Treatment recommendation  |
|---|---------------|---|
| No signs of periodontal disease   | 0             | Healthy periodontium  |
| Gingival bleeding after gentle probing  | 1             | Need to improve personal oral hygiene   |
| Supragingival or subgingival calculus; entire black area of the probe visible       | 2             | Need for professional cleaning of teeth, and improvement in personal oral hygiene |
| Pathologic pockets 4–5 mm deep; gingival margin situated on black area of the probe | 3             | Need for professional cleaning of teeth, and improvement in personal oral hygiene |
| Pathologic pockets ≥6 mm deep; black area of the probe not visible                  | 4             | Need for more complex treatment to remove infected tissue                         |

**Table 2** Comparison of two groups

|                                       | Group I (Cases = 50) | Group II (Controls = 100) | <i>P</i> value |
|---------------------------------------|----------------------|---------------------------|----------------|
| Age (mean ± SD)                       | 24.00 ± 2.703        | 23.48 ± 2.706             | 0.5385         |
| Educational level                     |                      |                           |                |
| Illiterate                            | 19 (38 %)            | 25 (25 %)                 |                |
| Primary                               | 13 (26 %)            | 29 (29 %)                 |                |
| Secondary                             | 09 (18 %)            | 30 (30 %)                 |                |
| Higher secondary                      | 05 (10 %)            | 10 (10 %)                 |                |
| Graduate                              | 04 (08 %)            | 06 (06 %)                 |                |
| Antenatal booking                     |                      |                           |                |
| Unbooked                              | 5 (10 %)             | 5 (5 %)                   |                |
| Booked                                |                      |                           |                |
| First trimester                       | 15 (30 %)            | 58 (58 %)                 |                |
| Second trimester                      | 24 (48 %)            | 33 (33 %)                 |                |
| Third trimester                       | 06 (12 %)            | 04 (4 %)                  |                |
| Mean gestational age ± SD at delivery | 33.16 ± 2.113        | 38.78 ± 1.001             |                |
| Mean birth weight ± SD at delivery    | 1.775 ± 0.3332       | 3.118 ± 0.2862            |                |

Most women (93.33 %, *n* = 150) were booked patients of Hindu Rao Hospital, i.e., they had minimum three visits to the hospital. Only 5 (10 %) women in both the groups were unbooked (Table 2). The mean gestational age at the time of delivery was 33.16 ± 2.113 weeks in Group I (PT-LBW), and 38.78 ± 1.001 weeks in Group II (T-NBW), respectively (Table 2). The mean birth weight in Group I (PT-LBW) and in Group II (T-NBW) was 1.775 ± 0.3332 kg and 3.118 ± 0.2862 kg, respectively. The means were significantly different with *P* value <0.0001 (Table 2). Table 3 shows the values of dental parameters like bleeding on probing (BOP), supra or subgingival calculus, probing depth (PD), and CPITN scoring.

Bleeding on probing was present in 42 (84 %) subjects in Group I and in 63 (63 %) subjects in Group II. Odds ratio with 95 % CI was significant 3.08 (1.31–7.27). Calculus was present in 43 (86 %) and 58 (58 %) in Group I and II, respectively [OR value 4.45 (1.82–10.85)]. Mean PD was 3.440 ± 1.264 mm in case Group I and 2.660 ± 1.327 mm in control Group II. The *P* value

0.0014 was significant. Mean CPITN score was 2.440 ± 0.8609 in Group I and 1.710 ± 1.149 in Group II with significant *P* value of 0.0003.

Periodontal disease was present in 127 women, at least in some form or other (CPITN scores ranging from 0 to 4), in the study population. Thus, prevalence of periodontal disease was 84.66 % (*n* = 150) (Table 4).

In the present study, score 0 denotes healthy periodontium, score 1–2 denote mild periodontal disease, score 3 denotes moderate periodontal disease, and score 4 denotes severe periodontal disease. In Group I, no woman had healthy periodontium, i.e., CPITN score 0, 48 % had mild periodontal disease, 44 % had moderate, and 8 % had severe periodontal disease. In Group II, 23 % women had healthy periodontium, 49 % had mild periodontal disease, 25 % had moderate, and 3 % had severe periodontal disease. Table 5 shows the relationship between birth weight and maternal periodontal disease in the two groups.

In group I (PT-LBW), 24 % of women had babies of birth weight between 1.01 and 1.49 kg. Among these, 6 %

**Table 3** Measurement of periodontal status of mothers in different groups

| Parameters  | Group I<br>Cases (n = 50) | Group II<br>Controls (n = 100) |
|---|---------------------------|--------------------------------|
| <b>Bleeding on probing</b>                                  |                           |                                |
| Positive  | 42 (84 %)                 | 63 (63 %)                      |
| Negative  | 08 (16 %)                 | 37 (37 %)                      |
| Odds ratio (95 % CI)  | 3.08 (1.31–7.27)          |                                |
| <b>Calculus</b>   |                           |                                |
| Present   | 43 (86 %)                 | 58 (58 %)                      |
| Absent  | 07 (14 %)                 | 42 (42 %)                      |
| Odds ratio (95 % CI)  | 4.45 (1.82–10.85)         |                                |
| <b>Probing depth (mm)</b>                                   |                           |                                |
| Mean ± SD   | 3.440 ± 1.264             | 2.660 ± 1.327                  |
| P value   | 0.0014                    |                                |
| <b>Community periodontal index of treatment needs score</b> |                           |                                |
| Mean CPITN ± SD   | 2.440 ± 0.8609            | 1.710 ± 1.149                  |
| P value   | 0.0003                    |                                |

**Table 4** Prevalence and severity of periodontal disease in different groups

| Periodontal disease | CPTIN score | Cases<br>(n = 50)<br>Group I | Controls (n = 100)<br>Group II |
|---------------------|-------------|------------------------------|--------------------------------|
| Healthy             | 0           | 00 (00 %)                    | 23 (23 %)                      |
| Mild                | 1–2         | 24 (48 %)                    | 49 (49 %)                      |
| Moderate            | 3           | 22 (44 %)                    | 25 (25 %)                      |
| Severe              | 4           | 04 (08 %)                    | 03 (03 %)                      |
| Total               |             | 50 (100 %)                   | 100 (100 %)                    |

**Table 5** Relationship between birth weight and maternal periodontal disease in the two groups

| Birth weight (in kg)                                 | Community periodontal index of treatment needs score |           |           |           |         | Total       |
|--|--|-----------|-----------|-----------|---------|-------------|
|  | 0  | 1         | 2         | 3         | 4       |             |
| <b>Group I [Preterm low birth weight] (n = 50)</b>   |  |           |           |           |         |             |
| 1.01–1.49  | 0 (0 %)  | 2 (4 %)   | 3 (6 %)   | 4 (8 %)   | 3 (6 %) | 12 (24 %)   |
| 1.50–1.99  | 0 (0 %)  | 1 (2 %)   | 5 (10 %)  | 8 (16 %)  | 1 (2 %) | 15 (30 %)   |
| 2.00–2.49  | 0 (0 %)  | 5 (10 %)  | 8 (16 %)  | 10 (20 %) | 0 (0 %) | 23 (46 %)   |
| Total  | 0 (0 %)  | 8 (16 %)  | 16 (32 %) | 22 (44 %) | 4 (8 %) | 50 (100 %)  |
| Odds ratio   | 2.811  |           |           |           |         |             |
| <b>Group II [Term normal birth weight] (n = 100)</b> |  |           |           |           |         |             |
| 2.50–2.99  | 6 (6 %)  | 1 (1 %)   | 9 (9 %)   | 6 (6 %)   | 2 (2 %) | 24 (24 %)   |
| 3.00–3.49  | 11 (11 %)  | 16 (16 %) | 18 (18 %) | 15 (15 %) | 1 (1 %) | 61 (61 %)   |
| 3.50–3.99  | 6 (6 %)  | 0 (0 %)   | 5 (5 %)   | 4 (4 %)   | 0 (0 %) | 15 (15 %)   |
| Total  | 23 (23 %)  | 17 (17 %) | 32 (32 %) | 25 (25 %) | 3 (3 %) | 100 (100 %) |

of women had CPITN score 4 indicating severe periodontal disease; 30 % of women had babies of birth weight between 1.50 and 1.99 kg, and among these, 2 % had CPTIN score 4; 46 % of women had babies of birth weight between 2.00 and 2.49 kg, and among these, no women had CPTIN score 4.

Thus, women with LBW had higher CPITN score of 4 in Group I.

Women with severe periodontal disease had 2.811 (OR 2.811) times higher risk of having preterm low-birth-weight baby.

In Group II (T-NBW), 24% of women had babies of birth weight between 2.50 and 2.99 kg, and among these, 2 % of women had CPTIN score 4; 61 % of women had babies of birth weight between 3.00 and 3.49 kg, and among these, only 1 % of women had CPTIN score 4. Among 15 % of women having birth weight between 3.50 and 3.99 kg, no one had CPTIN score 4.

Table 6 shows the relationship between gestational age at the time of delivery and maternal periodontal disease. In Group I (PT-LBW), 20 % of women delivered at the gestational period between 28 and 30 weeks and these women had CPITN score 4 (severe periodontal disease) in 4 % of cases. 22 % of women in this group delivered at the gestational period between 31 and 33 weeks, and 2 % of women among these had CPITN score 4; 58 % of women delivered at the gestational period between 34 and 36 weeks, and 2 % of women among these had CPITN score 4 in this group. Thus, total 8 % of women had CPITN score 4 in this group. Rest of the women had CPITN score ranging from 0 to 3.

Thus, women having severe periodontal disease, i.e. CPITN score 4, delivered at the lower gestational period in Group I(PT-LBW).

**Table 6** Relationship between gestational age at the time of delivery and maternal periodontal disease

| Gestational age (in weeks)                    | Community periodontal index of treatment needs score |           |           |           |         | Total       |
|---|--|-----------|-----------|-----------|---------|-------------|
|   | 0  | 1         | 2         | 3         | 4       |             |
| Group I [Preterm low birth weight] (n = 50)   |  |           |           |           |         |             |
| 28–30   | 0 (0 %)  | 2 (4 %)   | 1 (2 %)   | 5 (10 %)  | 2 (4 %) | 10 (20 %)   |
| 31–33   | 0 (0 %)  | 3 (6 %)   | 6 (12 %)  | 1 (2 %)   | 1 (2 %) | 11 (22 %)   |
| 34–36   | 0 (0 %)  | 3 (6 %)   | 9 (18 %)  | 16 (32 %) | 1 (2 %) | 29 (58 %)   |
| Total   | 0 (0 %)  | 8 (16 %)  | 16 (32 %) | 22 (44 %) | 4 (8 %) | 50 (100 %)  |
| Group II [Term normal birth weight] (n = 100) |  |           |           |           |         |             |
| 37–39   | 19 (19 %)  | 13 (13 %) | 23 (23 %) | 15 (15 %) | 3 (3 %) | 73 (73 %)   |
| 40–42   | 4 (4 %)  | 4 (4 %)   | 9 (9 %)   | 10 (10 %) | 0 (0 %) | 27 (27 %)   |
| Total   | 23 (23 %)  | 17 (17 %) | 32 (32 %) | 25 (25 %) | 3 (3 %) | 100 (100 %) |

In Group II (T-NBW), 73 % of women delivered at the gestational period between 37 and 39 weeks, and among these, 3 % of women had CPITN score 4. In women delivering at 40–42 weeks, no one had CPITN score 4.

## Discussion

Among the various factors associated with the delivery of preterm and/or LBW baby, infection is the leading cause. The hypothesis that infections remote from fetoplacental unit may cause preterm or term LBW, has led to an increased awareness of the potential role of chronic bacterial infections elsewhere in the body. Offenbacher et al. in 1996 [10], performed the pivotal study to identify the association between periodontal disease and pregnancy outcomes. The present study was also an effort to determine maternal periodontal disease as a possible risk factor for preterm LBW babies.

The prevalence of periodontal disease was high (84.66 %, n = 150) in the study population. The high prevalence of periodontal disease in the study population might be due to the lack of awareness about oral hygiene practices and utilization of dental care facilities. Subjects in our study in both the groups were relatively homogenous in relation to demographic and social factors. This may be because of the fact that Hindu Rao Hospital is a Government hospital which provides free outdoor and indoor services. This leads to heavy rush in the hospital all the time and the facilities are usually availed by the people of lower to lower middle class socioeconomic status. Education has overall impact on the utilization of health services both antenatal care services and dental services. Inadequate antenatal care is often cited as a risk factor for poor pregnancy outcomes in low socioeconomic status and poorly educated women [11]. Several studies have shown

that adequate utilization of antenatal care is associated with improved birth weights and lower risk of preterm birth [12].

To study the severity of periodontal disease clinically, there are a lot of potential measures available. CPITN scoring system was used in this study because it is a quick screening system which can be easily done in the ward also [13]. This is an epidemiologic tool developed by the World Health Organization (WHO) in the year 1977 after an extensive field study by WHO and Federation Dentire Internationale (FDI) working group for the evaluation of periodontal disease and treatment recommendation in population surveys. The current study is able to show that most individuals examined needed some level of periodontal care. Oral hygiene instruction and scaling and root planning are the most needed procedures based on the distribution of CPITN scores, i.e., CPITN score between 1 and 3. Women having CPITN score 4 require complex treatment.

The present study suggests that severe periodontal disease (CPITN-4) was more prevalent in women with preterm LBW babies. This can be explained by the fact that periodontal disease might have influenced the pregnancy outcomes by direct and or indirect effect of periodontal pathogens on the developing fetus [14]. Two recent meta-analyses of the association between maternal periodontal disease and preterm birth have been published [15, 16]. While there are data suggesting a relationship between maternal periodontal infection and preterm birth and LBW, several studies have failed to demonstrate such an association. Noack et al. [17] found that periodontitis was not a detectable risk factor for PT-LBW in Germany. Mitchell-Lewis et al. [18] found no evidence to connect periodontitis and PTB, in agreement with a 2002 study of 236 patient cases and 507 control individuals in a mixed-race population by Davenport et al. [19]. Studies by Buduneli et al.

[20] and Lunardelli and Peres [21] could not establish a significant association between periodontitis and LBW. A study by Wang et al. [22] revealed no significant relationship between periodontal disease and PTB, but the association with LBW was significant. Despite the controversy regarding the association between maternal periodontal infection and adverse pregnancy outcomes, several investigators have reported that periodontal treatment during pregnancy leads to a reduction in preterm birth risk [23].

In the event of a positive association of periodontal infection with PLBW, this would have potential applications to include preventive oral health programs as an integral component of antenatal care for pregnant mothers. Indeed, as healthcare professionals working as a team, an understanding of the role of periodontal-systemic relationship and its implications will further enhance the quality of medical and dental care being provided to our patients in the community. All health care providers should advise women that maintaining good oral health during pregnancy is not only safe but necessary to reduce the risk of infection to the mother and possibly the fetus.

One limitation to the future of oral health care is the lack of knowledge regarding oral care in the medical community. More education is needed within the medical community to help achieve better oral health care. Another limitation of the study is that the present study is a retrospective study with small sample size. Larger well-designed prospective studies will be able to prove the association between maternal periodontal disease and PLBW in a better way. Also other more precise methods for dental evaluation may be used in the future studies.

## Conclusions

Therefore, the conclusions drawn from this study are that most periodontal diseases are both preventable and treatable and would be of significant public health interest in pregnancy if a cause-effect relationship with preterm birth and LBW can be demonstrated. Maintaining good oral hygiene before and during pregnancy is crucial for preventing adverse effects on the fetus due to periodontitis. Hence, routine periodontal examination and advice on good oral hygiene should be included as part of pre-conceptional care and antenatal checkups during pregnancy. Any dysfunction should be thoroughly investigated and treated for the sake of health of both mother and baby.

## Compliance with Ethical Standards

**Conflict of interest** None.

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