

A Prospective Cohort Study to Assess and Correlate the Maternal Periodontal Status with Their Pregnancy Outcome

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Abstract

Background There is an overwhelming body of evidence strongly suggesting that periodontal infection may have a significant negative impact on pregnancy outcome in some women. The aim of this study was to determine the association between periodontal disease and preterm low birth weight of babies.

Materials and Methods A total of 300 pregnant women, between 20 and 24 weeks of gestation i.e., second trimester, were considered for the study. The periodontal status was recorded using the following parameters: probing pocket depth, clinical attachment level, oral hygiene index and plaque index. After initial examination in the second trimester, the pregnant women were followed till delivery of the baby. Postpartum data i.e., weight of baby, gestational age of pregnancy and type of delivery, were recorded.

Results Out of 300 pregnant women, 248 women had full-term delivery (12 low birth weight and 236 normal birth weight) while 52 had preterm delivery (6 normal birth weight and 46 low birth weight). There was significant association between body mass index and level of periodontal disease severity of pregnant women with birth weight of babies, gestational age of pregnant women and mode of delivery, respectively. As the level of periodontal disease severity increased, the proportion of delivering preterm and low birth weight babies also increased.

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Conclusion The conclusions obtained revealed that Periodontal disease is a potential risk factor for preterm low birth weight babies of pregnant women.

Keywords Preterm · Lowbirth weight · Periodontal disease · Pregnancy outcome

Introduction

Every pregnant women who is carrying a live baby in her womb wishes to deliver a healthy baby. There are numerous genetic, pathological and environmental factors that can affect the growth and development of baby in the womb. Medical science aims at reducing the risk factors involved in the growth and development of baby in the womb.

Periodontal disease is a multifactorial disease affecting the tooth-supporting structure causing bone loss, tooth mobility and even tooth loss. Periodontal disease per se causes little clinical features and goes unnoticed until late in disease status. The tissue destruction is characterized by the formation of periodontal pocket that acts as reservoirs for bacterial colonization in the dentogingival environment [1, 2].

There is tremendous progress in identification of periodontal pathogens, as well as elucidation of potential systemic mechanisms of action of bacterial products and inflammatory cytokines on systemic health. These have opened a new way to study the effect of systemic disease on periodontal health and viceversa. Systemic health that could get affected by the periodontal inflammation and infection has an array ranging from the cardiovascular changes, glycemic control and chronic obstructive pulmonary diseases to the preterm and/or low birth weight deliveries (PTLW) [3, 4].

World Health Organization (WHO) in 1995 defined low birth weight (LBW) as any live birth of <2500 gms and very low birth weight to be <1500 gms. WHO defines preterm birth (PB) as any live birth at <37 weeks of gestation period [5, 6]. More than 33 % of the infant mortality is attributed to the preterm low birth weight (PTLW), and surviving infants also have increased morbidity to congenital, neurological disabilities and various developmental defects [7].

Multiple factors have been associated with PB and/or LBW such as smoking, drug use, high or low maternal age, low socioeconomic strata, inadequate prenatal care, low maternal body mass index (BMI), hypertension, genitourinary tract infections, cervical incompetence, diabetes, low nutritional status, stress and multiple pregnancies. However, more than 50 % of the cases do not show the presence of these risk factors and are still affected by PB and/or LBW [8]. The search continues for other causes including the presence of the chronic infectious diseases like periodontal infection.

The hypothesis that infection remote from the fetal-placental unit may influence PLBW has led to an increased awareness of the potential role of chronic bacterial infections elsewhere in the body. Periodontal disease is associated with a ‘chronic gram-negative infection’ of the periodontal tissues which results in long-term local elevation of pro-inflammatory prostaglandins and cytokines [9] and an increase in the systemic levels of some of these inflammatory mediators [10]. Hence, periodontal disease has a potential to influence PLBW through an indirect mechanism, involving inflammatory mediators or a direct bacterial assault on the amnion.

In extant medical literature, the available data is based on retrospective studies and very few prospective studies are available highlighting role of periodontal disease in PLBW. Hence, the present prospective study was designed to correlate periodontal disease and preterm low birth weight in pregnant women of selected population of western Maharashtra.

The aim of this prospective study was to assess severity of periodontal status in pregnant women and correlate with their variable pregnancy outcome, to provide basis for recommending oral health care as a part of routine prenatal care.

Materials and Methods

The present study was undertaken at the Department of Obstetrics and Gynecology, Krishna Institute of Medical Sciences, Karad, after due approval from the Ethical Committee of Krishna Institute of Medical Sciences Deemed University (KIMSDU) [Ref no. KIMSDU/IEC/2013, dated 06/12/2013]. The study was conducted during the period from March 2014 to June 2015.

A total of 333 pregnant women, between 20 and 24 weeks of gestation i.e., second trimester, were considered for the study after obtaining an informed consent. Pregnant women who were willing to participate in the study were included. Pregnant women with positive history of HIV, AIDS, systemic disorder affecting pregnancy outcome, bacterial vaginosis, intrauterine growth restriction, tobacco users and alcohol and drug abuse were excluded from the study.

After considering the inclusion and exclusion criteria, only 300 women out of 333 were considered and 33 women were excluded as they did not fulfill the requirements.

A predesigned structured proforma was used to enter the periodontal and gynecological records. The periodontal status was recorded using the following parameters: probing pocket depth (PPD), clinical attachment level (CAL), oral hygiene index (OHI) and plaque index (PI).

Periodontal Examination

A single calibrated examiner (ML) performed all the measurements under the guidance of a senior periodontist (GS). The clinical parameters such as plaque index (PI), probing pocket depth (PPD) and clinical attachment loss (CAL) were recorded. A disclosing agent (Alphaplac, DPI, Wallace Street, Mumbai) was used to disclose the plaque during the examination. Plaque index was measured using Turskey-Gilmore-Glickman Modification of the Quigley Hein Plaque Index, 1970. Plaque index for entire mouth was determined by dividing the total score by the number of surfaces examined; score 0 or 1 was considered as low, and score 2 or more was considered high [8].

The level of periodontitis was assessed using parameters PPD and CAL, with a periodontal probe (UNC-15, Hu-friedy, Chicago, IL). The periodontal probe was inserted parallel to the vertical axis of the tooth and walked circumferentially around each tooth with standardized constant probing force. The measurements were taken on four sites per tooth (mesiobuccal, distobuccal, midbuccal and midlingual) of all the teeth except third molars. Probing pocket depth was measured from gingival margin to the base of gingival sulcus. Clinical attachment loss was measured from cemento-enamel junction (CEJ) to base of gingival sulcus.

Participants were grouped to be suffering from gingivitis or periodontitis based on the clinical findings. The participants were classified as having chronic periodontitis based on 1999 consensus classification of periodontal disease [9]. Based on the average CAL, all chronic periodontitis subjects were categorized into three categories: slight (1–2 mm CAL), moderate (3–4 mm) and severe (≥ 5 mm CAL) [10].

The body mass index of pregnant women was calculated by dividing the weight by height in square meters, and they were categorized as underweight, normal, overweight and obese [11].

After initial examination in the second trimester, the pregnant women were followed till delivery of the baby. Postpartum data i.e., weight of baby, gestational age of pregnancy and type of delivery, were recorded. The obtained data were correlated with the periodontal status, to find association between periodontitis and preterm low birth weight of the babies.

Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Science software (SPSS Inc. released 2007, SPSS for Windows, Version 16.0, Chicago). The mean, median and the standard deviation were calculated for the periodontal index score for the cohort group. The ‘Mann–

Whitney *U* test’ was carried out to find out the association between the qualitative periodontal status with the pregnancy outcome. The Univariate analysis was performed using the Chi-square test to find out the association between the dependant variables (pregnancy outcome) with the other independent variables rather than the periodontal score. Logistic regression analysis was performed to check for the association between the various variables with the pregnancy outcome, and association was said to be significant if $P \leq 0.05$.

Results

Frequency of Study Subjects and Study Variables

Table 1 denotes demographic data for all subjects including age, educational status and financial income status. The mean age of study population was 24.80 ± 12.70 years. In terms of education and financial income status, the majority of population belonged to secondary level of education group [$n = 147$ (49 %)] and had income $<10,000$ [$n = 204$ (68 %)] (Table 1).

Level of Periodontal Disease Severity in Pregnant Women

Table 2 shows periodontal data among the study subjects out of which 242 (80.7 %) had gingivitis and 58 (19.3 %) had periodontitis. In the periodontitis subjects, 11 (3.7 %) had slight periodontitis, 39 (13 %) had moderate periodontitis and 8 (2.7 %) had severe periodontitis (Table 2).

Table 1 Sociodemographic table of the study population

	Subjects (<i>n</i>)	Percentage (%)
Age group (years)	24.80 ± 12.70	100 %
Education		
Illiterate	7	2.3
Primary level	25	8.3
Secondary level	147	49.0
Higher secondary level	66	22.0
Graduate level	46	15.3
Postgraduate level	9	3.0
Financial income		
No income	3	1.0
$\leq 10,000$	204	68.0
10,001–20,000	66	22.0
20,001–30,000	20	6.7
30,001–40,000	5	1.7
40,001–50,000	2	0.7

Distribution of Birth Weight Babies of Pregnant Women and Gestational Age

In the present study, 248 women had full-term delivery (12 low birth weight and 236 normal birth weight) while 52 had preterm delivery (6 normal birth weight and 46 low birth weight) (Table 3).

Association Between Body Mass Index (BMI) of Pregnant Women and Birth Weight of Babies

Among 58 women who delivered low birth weight babies, 15 were underweight.

Similarly, among 52 women who had preterm delivery, 13 were underweight.

There was significant association between body mass index of pregnant women with birth weight of babies and gestational age, denoting that low body mass index was associated with low birth weight of babies and preterm delivery (Table 4).

Table 2 Periodontal disease severity

Periodontal disease severity	Number of patients	Percentage (%)
Gingivitis	242	80.7
Slight periodontitis	11	3.7
Moderate periodontitis	39	13.0
Severe periodontitis	8	2.7
Total	300	100.0

Table 3 Distribution of birth weight and gestational age

Birth weight	Low birth weight	Normal birth weight	Total
Preterm	46	6	52
Full term	12	236	248
Total	58	242	300

Table 4 Association between body mass index (BMI) and birth weight of babies

BMI	Normal	Obese	Overweight	Underweight	Total	P value
Birth weight						
Normal birth weight	139	11	53	39	242	0.001*
Low birth weight	40	1	2	15	58	
Gestational age						
Preterm	35	1	3	13	52	0.001*
Full term	144	11	52	41	248	

* Statistically significant (Fisher's exact test)

Association of Level of Periodontal Disease Severity with Birth Weight of Babies, Gestational Age and Mode of Delivery

In the present study, 58 subjects had low birth weight of babies, out of which 27 (46.55 %) had moderate periodontitis and seven (12.06 %) had severe periodontitis.

Out of 300 pregnant women, 52 had preterm delivery. Among these 58 women, 29 (74.35 %) had moderate periodontitis and 7 (87.50 %) had severe periodontitis.

In the current study, 56 (%) pregnant women underwent lower segment cesarean section, out of which 29 (%) had moderate periodontitis and seven (%) had severe periodontitis.

There was significant association between level of periodontal disease severity with birth weight of babies, gestational age of pregnant women and mode of delivery, denoting that as the level of periodontal disease severity increased, the proportion of delivering low birth weight babies, preterm delivery and patients requiring LSCS also increased (Table 5).

Discussion

Preterm low birth weight is considered to be the foremost problem in obstetrical medicine and remains the leading cause of morbidity and mortality among neonates. Preterm low birth weight infants are at higher risk of a number of acute and chronic disorders, including respiratory distress syndrome, cerebral palsy, pathologic heart conditions and epilepsy [7]. Most of the neonatal deaths are associated with preterm delivery and birth weight of lower than 1500 g. Thus, birth weight is considered to be important determinant of the chances of an infant to survive, grow and mature [12].

Multiple factors have been associated with the delivery of preterm and low birth weight infants [12]. The evidence suggests that an infectious etiology is main cause for a

Table 5 Association of level of periodontal disease severity with birth weight of babies, gestational age and mode of delivery

Disease severity	Gingivitis	Slight	Moderate	Severe	Total	P value
Birth weight						
Normal birth weight	222	7	12	1	242	<0.001*
Low birth weight	20	4	27	7	58	
Gestational age						
Preterm	12	4	29	7	52	<0.001*
Full term	230	7	10	1	248	
Mode of delivery						
Normal	226	7	10	1	244	<0.001*
LSCS	16	4	29	7	56	

* Statistically significant

large percentage of cases for preterm birth. Genitourinary tract infections, such as bacterial vaginosis, and inflammatory mediators resulting from such infections have been considered a biologically plausible pathway for preterm labor and premature rupture of the membranes. Alternatively, it was hypothesized that preterm low birth weight may be indirectly mediated through distant infections resulting in translocation of bacterial vesicles and lipopolysaccharide (LPS) in the systemic circulation. However, the exact mechanisms for the proposed relationship remain unclear [7].

The periodontal infection is initiated by predominantly gram-negative, anaerobic and microaerophilic bacteria that colonize the subgingival area. Host defense mechanisms play integral role in the pathogenesis of periodontal disease. It has been postulated that the association between periodontal disease and preterm low birth weight (PLBW) may have similar pathogenic mechanisms as other maternal infections [13]. Inflamed periodontal tissues produce significant amounts of pro-inflammatory cytokines, mainly interleukin 1 (IL-1 β), IL-6, prostaglandin E2, and tumor necrosis factor alpha (TNF- α), which may have systemic effects on the host, leading to premature rupture of membrane. Hence, periodontal disease has the potential to influence preterm low birth weight through an indirect mechanism involving inflammatory mediators or a direct bacterial assault on the amnion [14].

The study by Offenbacher et al. [8] suggested that maternal periodontal disease could lead to a sevenfold increased risk of delivery of a preterm low birth weight infant. Human case–control studies have demonstrated that women who have low birth weight infants as a consequence of either preterm labor or premature rupture of membranes tend to have more severe periodontal disease than mothers with normal birth weight infants [2].

Based on the evidence from the above review of information, this prospective study was conducted to determine

whether maternal periodontal disease could be associated with preterm low birth weight infants.

In the current study, we did not find any correlation between level of education with preterm and low birth weight infant. These finding were contradictory to the studies done by Radnai et al. [15] and Davenport et al. [16] who reported that both maternal and paternal education have impact on the birth weight of babies; increasing levels of education was associated with decrease in risk of PLBW. The contradictory results seen in our study may be due to smaller sample size.

Socioeconomic status and preterm low birth weight did not show any significant association in present study. Similar findings were reported by Secher et al. [17] in Malaysian case–control population who reported that lower socioeconomic income was not a risk factor for low birth weight. The results are contradictory to the study conducted by Kramer [18] and Kaunas [19] who found that poor socioeconomic conditions, low level of education and occupation are important risk factors for LBW.

In current study, the relationship of BMI to preterm low birth weight was statistically significant. The results are similar to the findings reported by Buduneli et al. [20] who showed that mothers who delivered preterm low birth weight infants gained significantly less weight during the pregnancy than did the mothers who delivered full-term normal weight infants. The above results are contradictory to those reported by Romero et al. [21] who stated that body mass index, BMI (19.8–26.0 kg/m²), covered a wide range and found no significant difference when BMI was compared to periodontal condition.

When periodontal index score was compared, a statistically significant association was found between periodontitis and preterm low birth weight. These results are in accordance with study conducted by Mokeem [22] who concluded that periodontal disease was more prevalent in mothers who delivered preterm low birth weight infants than in mothers who delivered full-term normal weight

infants. This can be explained by the fact that periodontal disease may influence pregnancy outcome by direct or indirect effect of periodontal pathogens and inflammatory mediators on the developing fetus.

In the present study, out of 244 women who had normal delivery, only 18 (7.3 %) suffered from periodontitis, while out of 56 pregnant women who underwent LSCS, 40 (71.4 %) suffered from periodontitis. These results are in accordance with study conducted by Genco et al. [23] who postulated that gram-negative anaerobic pathogens from the periodontium and associated endotoxins and maternal inflammatory mediators could have a possible adverse effect on the mode of delivery.

Bobetsis et al. [24] showed that periodontal infection can lead to placental–fetal exposure and, when coupled with a fetal inflammatory response, lead to preterm delivery. He established that infection with *Campylobacter rectus* induced hypermethylation in the promoter region of the insulin-like growth factor (Igf2) gene in a murine placenta. The authors concluded that epigenetic alterations could be induced in the placenta by oral bacteria which could lead to alteration of the placental phenotype that influences the development of the fetus.

The conclusions drawn from present study were that low body mass index and severity of periodontal disease progression are significantly associated with preterm low birth weight, thus, highlighting role of periodontal disease as a potential risk factor for preterm low birth weight babies.

Caution must be taken in interpreting the applicability of the current data until these findings can be confirmed by larger, prospective multicenter investigations from different hospitals in different parts of India.

Considering possible correlation between periodontal disease and PLBW, it is recommended that pregnant women should be advised to undergo oral prophylaxis as a part of prenatal care.

Compliance with Ethical Standard

Conflict of Interest All the authors hereby declare that there is no conflict of interest.

Ethical Approval All procedures performed in these studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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