

# Association of maternal periodontal health with preterm birth and a low birth weight among newborns: A cross-sectional study

## ABSTRACT

**Background:** Despite numerous advancements in prenatal and natal care, complications arising in pregnancy and related to child-birth are major concerns in public health. Various risk factors responsible for poor outcomes include - life-style, biological, social, infectious, hormonal, and metabolic conditions. Oral diseases have been identified as a risk factor for low birth weight both under preterm and at-term states.

**Aim:** The aim of this study was to find an association of maternal periodontal health with preterm births and low birth weight among newborn infants.

**Materials and Methods:** This was a cross-sectional observational study comprising of 300 pregnant females who had underwent child deliveries within the past 24 h with an age range of 21–30 years. Study participants were selected after interviewing for gestational history and obtaining prior informed consent. Postpartum female subjects following delivery within a time period of 24 h were included in the study. Gingival index (by Loe and Silness) was calculated for the evaluation of bleeding from gingival tooth surfaces. All data tabulations were done by performing statistical analysis into Microsoft Excel Worksheet 2007.

**Results:** Mean age group of study participants was calculated to be 25 years. On analyzing brushing frequency, it was observed that approximately 40% brushed three times daily whereas 35% used to brush twice daily while the remaining, 25% brushed only once daily. No statistical significance was obtained on comparing brushing frequency with gingival health ( $P=0.8$ ). Similarly, no association was found between periodontal health and preterm low weight child births.

**Conclusion:** This study found no association between maternal periodontal health and preterm and low-birth weight births among newborns.

**Keywords:** Birth, low weight, maternal, periodontal health, preterm

## INTRODUCTION

Pregnancy is a physiological state wherein transient and dynamic changes occur within the body which includes the oral cavity. Various oral lesions observed in pregnant females are gingivitis, pyogenic granuloma, and gingival hyperplasia. An elevated estrogen and progesterone levels are abnormally elevated in pregnancy. It has been observed that promotion of oral health, prevention of disease occurrence, early detection of oral lesions and pathological conditions and timely interventional strategies are important for both infant/child and maternal oral health.<sup>[1]</sup>

Oral microorganisms along with their virulent factors possess ability for dissemination along with induction of both local

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as well as systemic inflammatory response in host. This has led to the formulation of the hypothesis that oral diseases may be having clinical and physiological consequences at systemic level as well. This hypothesis was conceptualized by Miller (1891) on publication of his theory on “focal infection.” According to this theory, an oral focus of infection has been considered to play a significant role in a variety of regional and systemic diseases such as pneumonia, tonsillitis, infective endocarditis and most importantly, septicemia.<sup>[2]</sup>

A number of diseases are seen in pregnant females such as dental caries, periodontal diseases, gingivitis, and dental erosion. Pregnant females demonstrate an increased tendency towards dental caries as a result of increased rate of consumption of dietary sugars which result in an acidic environment which may cause tooth decay. If these cariously affected teeth are left untreated, the development of abscesses progressing to cellulitis. Therefore, it is advisable that during pregnancy diet enriched with sugars should be avoided; brushing using fluoridated dentifrices and mouth washes for counteracting demineralization.<sup>[1,3,4]</sup>

The gestation period induces series of hormonal alterations in a pregnant woman's body. These changes in hormone levels can produce wide alterations in oral health systems namely, the periodontal health. Periodontium bears receptors for binding of progesterone and estrogen which triggers an exaggerated inflammatory reaction.<sup>[5]</sup> Investigations have shown *Fusobacterium nucleatum*, a common periodontal pathogen is associated with premature low weight birth.<sup>[6]</sup>

Approximately 30% of pregnant females are reportedly found to suffer from plethora of periodontal diseases. Inflammatory mediators such as interleukins (IL) 6, 8 and prostaglandin E2 (PGE2) have been detected in elevated quantities within amniotic fluid of pregnant women. The presence of these chemical mediators have been linked with premature labor and low infant birth weight in approximately 60% to 70% of child-bearing female subjects.<sup>[3]</sup> This is due to reduced immunological response compounded with fluctuations in progesterone and estrogen hormonal levels and concomitant changes in normal oral microflora.<sup>[7]</sup>

The World Health Organization has defined “low-birth weight” as “weight lesser than 2500 grams or 5.5 pounds.” This factor plays an important role in mortality among neonates, infants, and children.<sup>[8]</sup>

Preterm birth is major reason associated with prenatal morbidity and mortality with an incidence of 5%–13%. Premature birth infants are born prematurely and are at

a greater risk of the development of both short as well as long-term complications related to gastrointestinal, respiratory, and neural developmental abnormalities. Various risk factors include intra-uterine infections which can be propagated via oral route.<sup>[9]</sup> Thus, it is necessarily required that risk factors associated with low-weight premature births are identified as it is a major public health concern.

However, there are barriers in deriving benefit for oral health-care services which may be either due to lack of access to dental treatment or a paucity of awareness toward impact of good oral health during pregnancy.<sup>[10]</sup>

Experimental animal studies have demonstrated that periodontal disease in mothers increase the plasma concentrations of IL-6 and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) allowing pathogenic organisms to reach amniotic fluid and result in complications of pregnancy due to high cellular proliferations, differentiation, and organization. Oral health requires equal amount of care in third trimester as stimulation to capillaries can initiate preterm delivery.<sup>[11]</sup>

Conditions affecting maternal health have been associated with chronic reduction and alterations in placental blood circulation which are related to preeclampsia, hypertension, maternal habit of smoking, etc.<sup>[12]</sup>

Various maternal risk factors that are associated with preterm and low birth weight infant's include socio-economic status, nutritional status, stress, age, height, weight, habit history, etc., The birth weight is an important criterion in determining survival of an infant. Numerous studies have established an association between periodontal health and systemic disease such as cardiovascular diseases such as infective endocarditis along with coronary heart disease, insulin-dependent diabetes mellitus, and various respiratory diseases.<sup>[13]</sup> Of various mechanisms that have been put forth for explaining inter-relationship between periodontal diseases and preterm low birth weight showed that diseased periodontal tissues act as reservoirs of lipopolysaccharides which lead to synthesis of IL-1 $\beta$ , PGE2, and TNF- $\alpha$ . These chemical mediators are associated with preterm birth or parturition and toxic effects on fetuses.<sup>[14,15]</sup>

Thus, aim of this study was to analyze association between maternal periodontal health and preterm and low weight births.

## MATERIALS AND METHODS

This cross-sectional observational study was performed in 300 study participants (pregnant females who had undergone delivery in the past 24 h) with an age range of

21–30 years (mean = 25 years). The study was conducted in compliance with the protocol; ethical approval was obtained from the Ethical Committee of the Patna Dental College, Patna, Bihar (Ethical Approval Number – NM/ETH/2020/066). The subjects participating in the present study provided their informed written consent before taking the survey by signing the consent form. Inclusion criteria were Postpartum female subjects following delivery within a time period of 24 h. Exclusion criteria were (a) pregnant females with diabetes; (b) hypertensive pregnant women; (c) those on antibiotic or anti-inflammatory medications; (d) any other condition including genetic which can affect periodontal health; (e) third molars; and (f) smoking and alcohol consumption habit. Gingival index (Loe and Silness) was calculated for evaluating bleeding from gingival on few tooth surfaces - mesiobuccal, middle, distobuccal, and lingual. Armamentarium employed for clinical examination included- mouth mirrors, tweezers and the Community Periodontal Index (CPI) periodontal probe. The CPI probe is characterized by a bulb measuring 0.5 mm diameter tip with graduated markings at 3.5 mm, 5.5 mm, 8.5 mm, and 11.5 mm.

All data were tabulated for performing statistical analysis into Microsoft Excel Worksheet 2007. The linear regression model analysis was performed to compare following variables gestation, brushing frequency, and gingival index scores. Statistical significance (*P* value) level was set as 5%.

### RESULTS AND OBSERVATION

Mean age group of all study participants was calculated to be 25 years.

#### Analysis of brushing frequency

On analyzing frequency of brushing, it was observed that approximately 40% performed brushing three times daily whereas 35% used to brush twice a day and remaining, 25% of the study population used to brush only once daily.

#### Gingival index score calculation

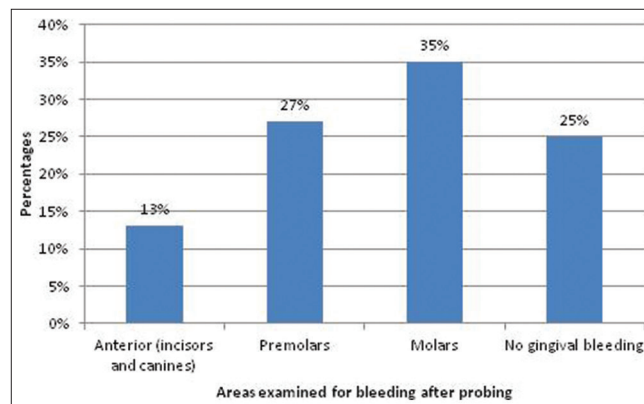
Bleeding on probing was clinically assessed using CPI probe in anterior (incisors and canines), premolars and molars. 13% of anterior, 27% and 35% of premolar and molar gingival tissues, respectively, showed bleeding after probing while no bleeding on probing was seen in 25% cases [Table 1 and Graph 1].

#### Assessment of periodontal health

Periodontal health was evaluated using the community periodontal index of treatment needs index. The dentition was divided into six sextants comprising of one anterior and two posterior regions in each arch [Table 2].

**Table 1: Bleeding after probing**

Areas of gingival bleeding after probing	Percentage
Anterior (incisors and canines)	13
Premolars	27
Molars	35
No gingival bleeding	25



**Graph 1: Bleeding after probing and percentages**

Spearman correlation test was used for quantitative determination of gestation time and brushing frequency and no significant association was found (*P* = 0.8). Similarly, on evaluating periodontal pocket depth, no association was found between periodontal health and preterm low weight child births [Table 3].

### DISCUSSION

Wagle *et al.* in their systematic review evaluated association between preterm birth and dental caries in nine observational studies which comprised of 4826 pregnant female subjects. It was observed that women diagnosed with dental caries did not exhibit high risk of preterm births (*P* = 0.25).<sup>[9]</sup>

Silva *et al.* studied 100 pregnant female subjects between 1<sup>st</sup> and 9<sup>th</sup> month of gestational period in Brazil. 46% of study participants fell in the third trimester. Gingival index demonstrated an average score of 12% while periodontal screening and recording code 2 ranged between 86% and 95% whereas code 4 comprised of mobility, gingival recession ≥ 3 mm and furcation were not observed in any of the subjects. Gingival bleeding was noted in 80% of the study participants.<sup>[5]</sup>

Hedge *et al.* evaluated 200 postpartum female subjects. They categorized subjects into (a) Group I (full-term normal weight births) and (b) Group II which was subdivided into (a) Subgroup A: This category comprised of mothers who gave birth to preterm low weight children; (b) Subgroup B: This group comprised of mothers who gave birth to full-term low birth weight infants; and (c) Subgroup C: This group

comprised of mothers who gave birth to preterm low birth weight children. This study found a statistically significant association between periodontal health of pregnant female subjects and all three categories ( $P < 0.05$ ).<sup>[10]</sup>

Khan *et al.* (2016) in their association study investigated if maternal periodontal health and low weight infant birth is correlated. It was found that mothers afflicted with periodontal disease had 3.173 times increased chance of giving birth to a low-weight child when compared to a normal weight child.<sup>[7]</sup> Similar findings have been reported by Siqueira *et al.*, Jacob and Nath, Shah *et al.* and Lopez.<sup>[16-19]</sup>

Umoh *et al.* conducted a study for determining effects of maternal periodontal status on birth weight of an infant in a longitudinal study wherein 300 pregnant women aged between 20 and 34 years with gestational age ranging between 12 and 16 weeks were recruited and were randomly divided into two study groups (a) The subjects belonging to the test group had received oral prophylaxis treatment while (b) the control group had undergone oral prophylaxis following child birth. Data collection was done using a self-administered questionnaire along with clinical oral and dental examination. Periodontal assessment by using CPI showed that 44.4% cases were in code 2, 22% were code 3 while 16.6% were in code 4. Overall prevalence of low birth weight and normal weight births in this study were 6.3% and

93.8%, respectively while the prevalence of low birth weights in test and control groups were 0.0% and 12.5%, respectively. The highest prevalence of low birth weight delivery was 27.3% among control group was in the study subjects were found to be with CPI score of 4. This finding was observed to have statistical significance ( $P < 0.05$ ). Thus, it was concluded that periodontal status is closely related to low weight birth deliveries.<sup>[20]</sup>

Hashim and Akbar conducted a questionnaire-based survey on knowledge and attitude among gynecologists related to oral health. Their study results demonstrated that 85.2% of gynecologists referred or advised patients for dental consultations. 93.5% practitioners reported gingival bleeding as a major oral health problem while 85.2% expressed requirement of knowledge on an association between periodontal disease and outcome of pregnancy.<sup>[21]</sup> Monteiro *et al.* in their study on 75 pregnant female women observed that 38.6% of subjects presented with bleeding on probing.<sup>[22]</sup>

Mannem and Chava in their investigation observed statistical significant association ( $P < 0.001$ ) between maternal periodontal index scores and premature child birth.<sup>[13]</sup> Mamghumba and Manji performed a retrospective case-control analysis on 373 postpartum subjects of which preterm low birth weight deliveries were noted in 150 mothers while women who gave birth to full-term normal weight deliveries were considered as controls ( $n = 223$ ) using a well-structured questionnaire and complete oral examination for periodontal health. Number of sites with gingival bleeding on probing was found to be higher in mothers with preterm infant births when compared to mothers with full-term normal weight children.<sup>[14]</sup>

Alves and Ribeiro assessed periodontal health of pregnant women and its relationship with low birth weight in preterm babies. Comparison was made between two groups as follows (a) Group I: This group comprised of 19 mothers who had delivered low birth weight babies (weighing <2500 g) and Group II: This group was comprised of 40 females who gave birth to normal weight babies (who weighed more than

**Table 2: Demonstrating CPITN index**

Grade	Observation
Grade 0	Gingival health with no requirement of treatment
Grade 1	Bleeding on probing occurred after gentle probing (mild gingivitis); improvement in oral hygiene methods indicated
Grade 2	Periodontal pockets measuring $\geq 3$ mm; established gingival bleeding and restoration overhangs. Improvement in oral hygiene methods with removal of restorative overhangs indicated
Grade 3	Periodontal pockets measuring 4–5 mm, i.e., mild periodontal involvement. Treatment involves oral prophylaxis and removal of restorative overhangs. Aggressive improvement in oral hygiene methods indicated
Grade 4	Greater than 6 mm deep periodontal pockets. Establishment of periodontitis with complex treatment protocols required

**Table 3: Association between studied clinical parameters and preterm low weight births**

Clinical characteristics	Cases with preterm low weight birth ( $n=150$ ), $n$ (%)	Controls (subjects with term normal weight) ( $n=150$ ), $n$ (%)	Crude OR (95% CI)	$P$
Gingival bleeding on probing				
Yes	55 (36.2)	82 (36)	1.04	0.9
No	95 (62.8)	148 (64)		
Periodontal pocket ( $\geq 4$ mm)				
Yes	44 (28.8)	68 (30.1)	0.94	0.8
No	106 (71.2)	182 (69.9)		

CI: Confidence interval, OR: Odds ratio

2500 g). A high rate of periodontal problems was observed in Group I also, a significant association between periodontal disease and preterm low birth weight delivery ( $P = 0.001$ ) was noted.<sup>[9]</sup> However, Davenport *et al.* excluded any association between low birth weight premature births and maternal periodontal health.<sup>[23]</sup>

However, Lunardelli and Peres observed no association between periodontal health in mothers and infant low birth weights.<sup>[24]</sup> Similarly, Noack *et al.* concluded in his study using the logistic regression model that periodontal health was not a risk factor associated with low weight birth.<sup>[25]</sup>

## CONCLUSION

Historically, it has been widely believed that oral diseases mainly of periodontal origin may cause systemic effects. Recently, scientific evidence has suggested that untreated moderately advanced periodontal diseases may affect an individual at a systemic level contributing to cardio-vascular diseases, onset of diabetes and preterm low-birth weights among infants. Weight at time of birth is influenced by various factors and is a physiological outcome of dynamic and complex multifactorial process. Periodontitis is localized Gram-negative bacterial infection which plays an important role in determining low birth weights. Periodontopathic microorganisms and their by-products produce a wide plethora of side-effects which are mediated through production of cytokines in target host cells. Data combined from numerous animal and human studies support various biological pathways and mechanisms which suggest that poor periodontal health has negative role to play on outcome of pregnancy in few pregnant women.

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## Conflicts of interest

There are no conflicts of interest.

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