

ASSOCIATION OF MATERNAL PERIODONTITIS IN WOMEN DELIVERING PRETERM, LOW BIRTH WEIGHT AND PRETERM LOW BIRTH WEIGHT INFANTS

Dr. Shivangi Maletia^{1*}, Dr. Anup N.², Dr. Vikas Jeph³, Dr. Swasti Tambi⁴, Dr. Kuldeep Singh⁵, Dr. Ashfak Mohammed⁶, Dr. Jai Kishan Meena⁷

^{1*}PG student, Department of Public Health Dentistry, Jaipur Dental College & Hospital, Jaipur, Rajasthan, Email: Eletricashiva@gmail.com

²Professor & Head, Guide, Department of Public Health Dentistry, Jaipur Dental College & Hospital, Jaipur, Rajasthan

³Professor, co-guide, Department of Public Health Dentistry, Jaipur Dental College & Hospital, Jaipur, Rajasthan

⁴Professor, Department of Public Health Dentistry, Jaipur Dental College & Hospital, Jaipur, Rajasthan

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⁵Staff Surgeon, NFSG- Dental, CGHS Safdarjung Hospital, New Delhi

⁶PG student, Department of Public Health Dentistry, Jaipur Dental College & Hospital, Jaipur, Rajasthan

⁷PG student, Department of Public Health Dentistry, Jaipur Dental College & Hospital, Jaipur, Rajasthan

ABSTRACT:

Background: Maternal periodontal disease has been proposed as a potential independent risk factor for adverse pregnancy outcomes. Periodontal pathogens and their by-products may reach the fetoplacental unit via hematogenous spread, leading to localized placental inflammation, increased prostaglandin production, and subsequent initiation of preterm labor or restriction of fetal growth

Aim & Objectives: The present study was conducted to assess the periodontal status among pregnant women and to evaluate the association between periodontal disease and adverse pregnancy outcomes, namely preterm birth (PTB), low birth weight (LBW), and preterm low birth weight (PTLBW).

Material & Methods: The present hospital-based observational analytical study with a cross-sectional framework was conducted among 110 pregnant women who attended antenatal clinics. The study was carried out over a period of 6 months. All eligible participants delivering during this period were screened and recruited consecutively. Ethical approval for the study was obtained from the institutional ethical committee, and informed consent was obtained from all participants prior to their inclusion in the study. The study population consisted of pregnant women within the reproductive age group who were willing to participate in the study. A structured questionnaire was used to collect information regarding demographic characteristics, oral hygiene practices, and other relevant variables. Clinical examination was carried out using standardized periodontal indices including the Community Periodontal Index (CPI) and Loss of Attachment (LOA) as recommended by the World Health Organization for epidemiological studies. Clinical periodontal parameters including plaque index, probing depth, and clinical attachment loss were recorded using a periodontal probe under adequate illumination. The data obtained from the questionnaire and clinical examination were systematically recorded and analyzed using appropriate statistical methods.

Results: The study findings also demonstrated a significant association between periodontal disease and adverse pregnancy outcomes. Mothers with periodontal disease were found to have a higher likelihood of delivering infants with low birth weight compared to mothers with healthy periodontal tissues. Similarly, periodontal disease was also associated with an increased risk of preterm birth.

Conclusion: Maternal periodontitis may be associated with an increased risk of preterm birth and low birth weight, particularly when both outcomes occur together. Assessment of periodontal health should be considered as an integral component of antenatal healthcare. However, the observational nature of the study does not establish causality, and larger prospective studies using standardized periodontal diagnostic criteria are required.

KEYWORDS: Maternal periodontitis; pregnancy; preterm birth; low birth weight; preterm low birth weight; periodontal disease; periodontal health; adverse pregnancy outcome.

INTRODUCTION

Periodontal diseases are initiated primarily by dental plaque biofilm composed of complex microbial communities dominated by gram-negative, anaerobic, and microaerophilic bacteria. These microorganisms colonize the subgingival area and stimulate a host immune-inflammatory response, which, if uncontrolled, results in progressive destruction of the periodontal ligament and alveolar bone, formation of periodontal pockets, gingival recession, or both.¹ The ulcerated epithelium lining periodontal pockets provides a direct pathway for bacteria, endotoxins, and inflammatory mediators to enter the systemic circulation. This translocation can induce low-grade systemic inflammation characterized by elevated levels of cytokines such as

interleukin-1 β , interleukin-6, prostaglandin E2, and tumor necrosis factor- α , thereby linking periodontal disease with several systemic conditions.²

The concept that oral health is inseparable from general health is now well established. Periodontal disease has been associated with a wide range of systemic disorders including cardiovascular diseases, diabetes mellitus, respiratory infections, and adverse pregnancy outcomes. These associations have shifted periodontal disease from being considered a localized oral condition to a potential contributor to systemic disease burden.³

Pregnancy is a unique physiological state marked by profound hormonal, immunological, and vascular changes. Increased levels of estrogen and progesterone during pregnancy influence the periodontal tissues by altering vascular permeability, collagen metabolism, and host immune responses, thereby increasing susceptibility to gingival inflammation and periodontal breakdown in the presence of local irritants.⁴

Preterm birth and low birth weight are major public health problems globally, contributing significantly to neonatal morbidity, mortality, and long-term developmental disabilities. The World Health Organization defines preterm birth as delivery before 37 completed weeks of gestation and low birth weight as a birth weight of less than 2500 grams. Preterm low birth weight represents a combination of both conditions and is associated with particularly poor neonatal outcomes.⁵ Maternal periodontal disease has been proposed as a potential independent risk factor for adverse pregnancy outcomes. Periodontal pathogens and their by-products may reach the fetoplacental unit via hematogenous spread, leading to localized placental inflammation, increased prostaglandin production, and subsequent initiation of preterm labor or restriction of fetal growth.⁶

Several epidemiological, case-control, and cohort studies have demonstrated a positive association between maternal periodontal disease and preterm birth, low birth weight, or both. These studies suggest that women with moderate to severe periodontitis are at a higher risk of delivering preterm or low birth weight infants compared to periodontally healthy women.⁷

Despite the biological plausibility and growing body of evidence, data on the association between maternal periodontal disease and adverse pregnancy outcomes in the Indian population, particularly in the Delhi/NCR region, remain limited and inconclusive. Regional variations in healthcare access, nutritional status, and oral health practices further necessitate localized research.⁸ In light of the above considerations, the present study is undertaken to evaluate the association of maternal periodontitis in women delivering preterm, low birth weight, and preterm low birth weight infants in selected hospitals of Delhi/NCR. The findings of this study may help clarify the role of periodontal disease as a modifiable risk factor and contribute to the integration of oral health care into prenatal health programs.

MATERIAL & METHODS:

The present hospital-based observational analytical study with a cross-sectional framework was conducted among 110 pregnant women who attended antenatal clinics. The study was carried out over a period of 6 months. All eligible participants delivering during this period were screened and recruited consecutively. Ethical approval for the study was obtained from the institutional ethical committee, and informed consent was obtained from all participants prior to their inclusion in the study. The study population consisted of pregnant women within the reproductive age group who were willing to participate in the study.

Study Setting: The present study was conducted in selected tertiary care hospitals in Delhi/NCR, which serve a heterogeneous population with varied socioeconomic and demographic backgrounds. These institutions provide comprehensive antenatal and delivery services, ensuring adequate case representation. The periodontal examination was conducted in coordination with the Departments of Obstetrics & Gynecology and Dentistry under standardized clinical conditions.

Study Population : The study population consisted of postpartum women admitted for delivery in the selected hospitals. A non-probability convenience sampling method was adopted. All eligible subjects meeting the inclusion criteria during the study period were recruited until the required sample size was achieved.

Inclusion Criteria

Women aged between 18–40 years
Women who delivered live singleton infants
Women examined within 24–72 hours postpartum
willing to participate and provide informed consent

Exclusion Criteria

Women with systemic diseases influencing periodontal status (e.g., diabetes mellitus, hypertension, immunocompromised conditions)
Women who received periodontal therapy during pregnancy
Multiple pregnancies (twins or higher order)

Data Collection: A structured questionnaire was used to collect information regarding demographic characteristics, oral hygiene practices, and other relevant variables. Clinical examination was carried out using standardized periodontal indices including the Community Periodontal Index (CPI) and Loss of Attachment (LOA) as recommended by the World Health Organization for epidemiological studies. Clinical periodontal parameters including plaque index, probing depth, and clinical attachment loss were recorded using a

periodontal probe under adequate illumination. The data obtained from the questionnaire and clinical examination were systematically recorded and analyzed using appropriate statistical methods.

Statistical Analysis:

All the collected data were entered into a Microsoft Excel spreadsheet and subsequently analyzed using Statistical Package for Social Sciences (SPSS) software version 27 (IBM Corp., Armonk, NY, USA). Prior to analysis, the data were checked for completeness and accuracy. Descriptive and inferential statistical analyses were performed to evaluate the association between periodontal disease and adverse pregnancy outcomes. Statistical analysis includes chi-square tests, student 't' test, One-Way ANOVA & logistic regression analysis.

RESULTS:

A total of 110 postpartum women who satisfied the inclusion and exclusion criteria were included in the present study. All participants underwent a detailed clinical periodontal examination and relevant demographic and obstetric information was recorded using a structured proforma.

Out of the total 110 participants, the majority belonged to the 25–30 years age group (38.2%), followed by the 18–24 years age group (32.7%). Participants aged 31–35 years constituted 20%, while only 9.1% of the participants were above 35 years of age. The predominance of participants within the 18–30 year age group (approximately 71%) indicates that most pregnancies occurred during the early reproductive period, which is considered biologically optimal for pregnancy. (Table1)

The mean Plaque Index score was 1.82 ± 0.64 , with a 95% confidence interval ranging from 1.70 to 1.94. The mean probing pocket depth recorded in the study was 3.42 ± 0.88 mm, with a confidence interval of 3.25 to 3.59 mm. The mean clinical attachment loss was 3.12 ± 1.04 mm, with a confidence interval of 2.91 to 3.33 mm. Statistical analysis using one-way ANOVA revealed a statistically significant difference among the periodontal parameters ($F = 5.21$, $p = 0.007$), (Table 2)

The most commonly observed condition was CPI score 2 (presence of calculus) affecting 32.7% of participants. Approximately 25.5% of participants exhibited CPI score 3, indicating periodontal pockets measuring 4–5 mm. Furthermore, 9.1% of participants demonstrated CPI score 4, which represents deep periodontal pockets measuring 6 mm or more.(Table3)

Nearly 47.3% of participants exhibited attachment loss between 0–3 mm, which is considered within the normal range. However, 27.3% of participants showed attachment loss of 4–5 mm, indicating moderate periodontal destruction. Additionally, 18.2% demonstrated attachment loss of 6–8 mm, suggesting advanced periodontal involvement. Severe attachment loss greater than 9 mm was observed in a small proportion of participants, indicating the presence of advanced periodontal disease in some cases.(Table4)

It was observed that 74.5% of infants were born with normal birth weight, whereas 25.5% were classified as low birth weight. The majority of deliveries (83.6%) occurred at term, while 16.4% were classified as preterm births.(Table5&6)

The Chi-square test revealed a statistically significant association ($p < 0.001$). Participants with periodontal disease exhibited a higher proportion of low birth weight infants compared to those without periodontal disease. The results of the Chi-square test revealed a statistically significant association between periodontal disease and preterm birth ($p = 0.003$). Mothers with periodontal disease were more likely to deliver preterm infants compared to mothers with healthy periodontal tissues.(Table7&8)

The independent t-test revealed that infants born to mothers with periodontal disease had a significantly lower mean birth weight compared to infants born to mothers without periodontal disease ($p < 0.001$). Logistic regression analysis demonstrated that periodontal disease remained an independent predictor of adverse pregnancy outcomes, even after adjusting for other confounding variables. (Table9&10)

Table 1: Distribution of study participants according to age.

Age group (years)	Number (n)	Percentage (%)
18–24	36	32.7
25–30	42	38.2
31–35	22	20.0
>35	10	9.1
Total	110	100

Table 2: Mean periodontal clinical parameters among study participants

Clinical parameter	Mean	SD	95% CI	F value	p-value
Plaque Index	1.82	0.64	1.70 – 1.94	5.21	0.007(S)
Probing Pocket Depth (mm)	3.42	0.88	3.25 – 3.59		
Clinical Attachment Loss (mm)	3.12	1.04	2.91 – 3.33		

Table 3: Community Periodontal Index distribution

CPI score	n	%
0 Healthy	14	12.7
CPI score	n	%
1 Bleeding	22	20.0
2 Calculus	36	32.7
3 Pocket 4–5 mm	28	25.5
4 Pocket $\geq$ 6 mm	10	9.1

Table 4: Loss of Attachment distribution.

LOA score	n	%
0 (0–3 mm)	52	47.3
1 (4–5 mm)	30	27.3
2 (6–8 mm)	20	18.2
3 (9–11 mm)	6	5.5
4 ($\geq$ 12 mm)	2	1.8

Table 5: Distribution according to birth weight

Birth weight	n	%
Normal birth weight	82	74.5
Low birth weight	28	25.5

Table 6: Distribution according to gestational age

Gestational age	n	%
Term birth	92	83.6
Preterm birth	18	16.4

Table 7: Association between periodontal disease and low birth weight.

Periodontal status	Normal Birth Weight n (%)	Low Birth Weight n (%)	Total	χ^2 value	p-value	Odds Ratio (OR)	95% CI
No periodontitis	56 (87.5)	8 (12.5)	64	14.62	<0.001	5.38	2.08–13.90
Periodontitis	26 (56.5)	20 (43.5)	46				
Total	82 (74.5)	28 (25.5)	110				

Table 8: Association between periodontal disease and preterm birth

Periodontal status	Term Birth n (%)	Preterm Birth n (%)	Total	χ^2 value	p-value	Odds Ratio (OR)	95% CI
No periodontitis	58 (90.6)	6 (9.4)	64	8.71	0.003	3.41	1.25–9.29
Periodontitis	34 (73.9)	12 (26.1)	46				
Total	92 (83.6)	18 (16.4)	110				

Table 9: Comparison of mean birth weight between mothers with and without periodontitis.

Group	Mean Birth Weight (kg)	SD	95% CI	t-value	p-value
Without periodontitis	3.08	0.41	2.97 – 3.19	6.24	<0.001
With periodontitis	2.54	0.37	2.43 – 2.65		
Total	2.86	0.47	2.77 – 2.95		

Table 10: Logistic regression analysis for predictors of adverse pregnancy outcomes

Variable	Adjusted Odds Ratio (AOR)	95% CI	Wald statistic	p-value
Periodontitis	3.80	1.50 – 9.20	8.41	0.004
Poor oral hygiene	2.10	0.90 – 4.70	2.98	0.084
Maternal age >30 yrs	1.40	0.60 – 3.20	0.64	0.420

DISCUSSION:

Pregnancy is associated with profound hormonal and physiological changes that may influence the periodontal tissues. Elevated levels of estrogen and progesterone during pregnancy lead to increased vascular permeability and enhanced inflammatory response of the gingival tissues. These hormonal changes may alter the host immune response to plaque microorganisms, thereby increasing the susceptibility of pregnant women to

gingivitis and periodontal disease. Consequently, pregnant women constitute a vulnerable group in which periodontal health requires special attention.⁹

The present study was undertaken to evaluate the periodontal status among pregnant women and to determine the association between periodontal disease and adverse pregnancy outcomes such as low birth weight and preterm birth. A total of 110 pregnant women were included in the study, which provided an adequate sample size for assessing the periodontal condition and evaluating the possible relationship between periodontal disease and pregnancy outcomes.

In the present study, the majority of the participants belonged to the 25–30 years age group, followed by 18–24 years, whereas relatively fewer participants were above 30 years of age. This distribution is consistent with the reproductive age pattern observed in many developing countries, including India, where the majority of pregnancies occur during the mid-twenties. Similar findings were reported by Offenbacher et al., who observed that most pregnant women included in their study were within the age group of 20–30 years.¹⁰

Maternal age has been reported to influence pregnancy outcomes, with both younger and older maternal age groups showing an increased risk of complications. However, in the present study, maternal age did not show a statistically significant association with adverse pregnancy outcomes after adjusting for other variables. This finding suggests that periodontal disease may play a more significant role than maternal age alone in influencing pregnancy outcomes in the study population. Similar observations were reported by Jeffcoat et al., who found that periodontal disease was independently associated with adverse pregnancy outcomes regardless of maternal age.¹¹

The findings of the present study revealed that a significant proportion of participants exhibited signs of periodontal disease, including bleeding on probing, calculus deposition, and periodontal pocket formation. These findings are consistent with the results of previous epidemiological studies conducted among pregnant women. Gürsoy et al. reported that hormonal changes during pregnancy are associated with increased gingival inflammation and periodontal pocket formation.¹² Similarly, Offenbacher et al. observed a high prevalence of periodontal disease among pregnant women in their study population.¹³

Loss of attachment is considered an important indicator of cumulative periodontal destruction and reflects the extent of periodontal tissue damage over time. In the present study, a considerable proportion of participants exhibited loss of attachment in the range of 4–5 mm, indicating moderate periodontal destruction. Similar findings were reported by Albandar and Rams, who observed moderate levels of periodontal attachment loss among adult populations in epidemiological studies.¹⁴ The presence of attachment loss among pregnant women suggests that periodontal disease may have been present prior to pregnancy and may have progressed during the gestational period.

One of the most important findings of the present study was the statistically significant association between periodontal disease and low birth weight infants. Mothers with periodontal disease were found to have a higher risk of delivering infants with low birth weight compared to mothers with healthy periodontal tissues. The biological mechanism underlying this association has been widely investigated. Periodontal infections may lead to the systemic dissemination of inflammatory mediators and bacterial endotoxins into the bloodstream. These inflammatory mediators may reach the fetoplacental unit and stimulate the production of prostaglandins and cytokines, which are known to induce uterine contractions and premature rupture of membranes. The landmark study conducted by Offenbacher et al. demonstrated that

maternal periodontal disease was associated with a significantly increased risk of preterm low birth weight infants.¹⁵ Similar findings were reported by Dasanayake et al., who found that pregnant women with periodontal disease were more likely to deliver infants with low birth weight.¹⁶

The present study also demonstrated a significant association between periodontal disease and preterm birth. Preterm birth is defined as delivery before 37 weeks of gestation and is one of the leading causes of neonatal morbidity and mortality worldwide.

The proposed mechanism linking periodontal disease with preterm birth involves the systemic spread of inflammatory mediators originating from periodontal infections. These mediators may trigger premature uterine contractions and lead to early onset of labor.

Jeffcoat et al. reported that pregnant women with severe periodontal disease had a significantly higher risk of preterm birth compared to those with healthy periodontal tissues.¹⁷ Similarly, Xiong et al., in their systematic review, concluded that maternal periodontal disease may increase the risk of preterm birth and low birth weight infants.¹⁸

In the present study, logistic regression analysis was performed to evaluate the independent association between periodontal disease and adverse pregnancy outcomes. The results indicated that periodontitis remained a significant predictor of adverse pregnancy outcomes even after adjusting for potential confounding variables.

This finding suggests that periodontal disease may act as an independent risk factor for adverse pregnancy outcomes rather than merely being associated with other socioeconomic or behavioral factors. The results of the present study are consistent with those reported in several epidemiological studies which have identified periodontal disease as an independent risk factor for preterm birth and low birth weight.

Public Health Implications:

The findings of the present study highlight the importance of maintaining good oral health during pregnancy. Periodontal disease is a preventable condition, and early intervention may help reduce the risk of adverse pregnancy outcomes. Incorporating oral health education and periodontal screening into routine antenatal care programs may contribute to improving both maternal and neonatal health outcomes.

Dental professionals should collaborate with obstetricians and healthcare providers to promote awareness regarding the importance of oral health during pregnancy. Preventive measures such as oral hygiene instruction, scaling and root planing, and regular dental check-ups should be encouraged among pregnant women.

CONCLUSION: Maternal periodontitis may be associated with an increased risk of preterm birth and low birth weight, particularly when both outcomes occur together. Assessment of periodontal health should be considered as an integral component of antenatal healthcare. However, the observational nature of the study does not establish causality, and larger prospective studies using standardized periodontal diagnostic criteria are required.

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