Evaluation of Association between Maternal Periodontal Disease and Infant Preterm Low Birth Weight: A Case Control Study

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Abstract

Primiparous women, aged 18-35 years were selected randomly from different medical college hospitals in Bangalore city, India to find out association if any between maternal periodontal disease and infant preterm low birth weight (PLBW*)*. Case were defined as those mothers who delivered an infant weighing under 2500 g and born before 37 weeks gestation and control mothers as those who delivered an infant weighing equal to or more than 2500 g and born after 37 weeks gestation. The clinical examination included recording of pocket depth and loss of attachment. Appropriate statistical tests such as Chi-square, Fisher Exact test, Student's t test were used to analyze the data. The control group had statistically more number of healthy sextants [Community Periodontal Index Score 0 was 0.63 ± 1.25] when compared to the PLBW group [0.01 ± 0.11]. The mean numbers of sextants with periodontal pocket depth of 4-5 mm and 6 mm or more were significantly higher in the PLBW mothers [1.87 ± 1.38], [1.32 ± 1.53] when compared to the control group [0.81 ± 1.06], [0.25 ± 1.74]. Multiple logistic regression analysis after considering the variables simultaneously, the risk factors for preterm low birth weight were body mass index (p<0.001, odds ratio 0.83), lack of prenatal care prior to 20 weeks of gestational age (p=0.013,odds ratio 0.14), loss of attachment scores of 6-8 mm and 9 mm or more (p=0.004, 0.003 and odds ratio of 10.21 and 44.25 respectively). Present study suggests that maternal periodontal disease is a potential independent risk factor for PLBW.

Key Words*: Periodontal diseases, Preterm low birth weight, Case-control, CPI index, Risk factors*

Introduction

The theme of World Health Day 2005 was healthy mothers and children [1]. It is essential that women are able to go through pregnancy and child birth safely, that the outcome of pregnancies is successful in terms of maternal and infant survival and well being. However, despite the advances in obstetrical prevention, diagnostics, and therapy innumerable challenges persist. Preterm low birth weight (PLBW) is still considered to be the greatest problem in obstetrical medicine and remains the leading cause of morbidity and mortality among the newly born children. Preterm birth (PTB), which refers to the delivery of a new born child before the 37th week of pregnancy and low birth weight (LBW), which refers to the birth of a newborn child with a weight less than 2500 gms are grouped under the term of PLBW [2]. PLBW children seem to have a higher risk for a strain of acute and chronic disorders that impair systemic health throughout their life [3].

The prevalence of LBW in the United States is about 7.3%. In the United Kingdom 6% of all live births are classified as LBW and 6.7% as PLBW. In Africa the average LBW is around 12% and around 15% in Asia. Globally, about 16% of the infants born in the world are LBW infants [4]. Incidence of preterm labor is 23.3% and of preterm delivery 10-69% in India. The national neonatology forum data for the year 1995 yielded a LBW prevalence of 32.8%, and 33% of the LBW infants were preterm [5].

Established risk factors for PLBW include high (>34 years) and low (<17 years) maternal age, low maternal weight gain, low socioeconomic status, ethnicity, poor nutritional status, and stress, inadequate prenatal care, low pregravid weight, multiple gestations, gestational diabetes, hypertension, diabetes, generalized infections, genito-urinary tract infections, drug abuse, cigarette smoking, and excessive alcohol consumption, while previous PTB is a strong predictive marker of future pre-term labor [4,6,7]. Despite the considerable progress in describing the risk factors involved in PLBW, a high proportion of PLBW, in over 50% of clinical cases have unexplained etiology [8].

Since the old wives' tale of "the loss of a tooth for every pregnancy," oral health during pregnancy has long been a focus of interest [9]. The link between pregnancy and periodontal inflammation has been known for many years. In 1778, Vermeeren discussed "toothpains" in pregnancy. Galloway was the first to suggest in 1931, that infection of the periodontium by Gram-negative anaerobic bacteria may ''provide sufficient infectious microbial challenge'' to have ''potentially harmful effects on the pregnant patient and developing fetus" [10].

In recent years, the hypothesis that periodontal disease, representing a chronic Gram-negative infection, may have consequences beyond the periodontal tissues themselves has regained considerable attention. Evidence has been reported suggesting significant associations between periodontal disease and other non-oral conditions including pregnancy complications [11]. Since the 1990s, several studies have found a relationship between PTB and periodontal disease, with many publications showing that the severe, generalised infection of the periodontium is a possible risk factor for PLBW [6]. However risk estimates derived from a number of these studies vary greatly. In attempting to account for this wide variance in risk estimates, one theory that arises is that the observed association is linked to the confounding effects of risk factors other than periodontal infection [12]. Hence this present case control study was undertaken with the objective to find out if there is any association between periodontal disease and infant PLBW, after adjusting for the confounding factors.

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Materials and Methods

A case control study consisting of 300 primiparous women, aged 18-35 years was conducted to evaluate the association between maternal periodontal disease and infant preterm low birth weight. The study was systematically scheduled to spread over a period of 5 months from May 2008- September 2008. A multicentre study was planned in general maternity wards of various medical college hospitals in Bangalore city. From 13 medical college hospitals having maternity wards in the city, 3 college hospitals (St. Martha's Hospital, K.C. General Hospital, Dr. B. R. Ambedkar Medical College Hospital) were selected randomly. Each hospital was surveyed for a period of two weeks on a rotation basis till the required sample size of 300 was obtained. Sample size was estimated on the basis of following assumptions: i) confidence level of 99%, ii) statistical power kept at 80% and the minimum odds ratio was assumed to be 1.5. The sample size was further increased by 20% to accommodate multivariate modelling, losses and refusals. Hence the final sample size was estimated to be 300.

Inclusion criteria

1. Primiparous women with single gestation.
2. Minimum of 20 teeth present

Exclusion criteria

1. Multiple gestation, high risk gestation, placenta previa, preeclampsia, eclampsia.
2. Mothers with induced labour, mothers whose infants were stillborn.
3. Severe anaemia, malnutrition.
4. Infections of genital or urinary system (including bacterial vaginosis).
5. Gestational diabetes, Asthma, Heart diseases, Glomerulonephritis, Hypertension, Hyperthyroidism, Renal diseases, systemic diseases & disorders.
6. Positive history of **human immunodeficiency virus** (**HIV**) infection, **acquired immune deficiency syndrome (**AIDS), autoimmune disease.
7. Any medical condition requiring antibiotic prophylaxis, current use of corticosteroids.
8. Mothers who had undergone profession oral prophylaxis during the last one year.
9. Mothers requiring antibiotic prophylaxis for periodontal examinations.

A pretested proforma, which included questions regarding personal data, socio-demographic profile, personal history, oral hygiene practices, antenatal, intranatal history was prepared. Modified B.J. Prasad's classification [13] was used for assessment of per capita income. Visual Analogue Scale (VAS) was used to assess stress level of the mother [14].

Ethical clearance was obtained from the ethical committee of the Oxford Dental College, Hospital and Research Centre, Bangalore, India. The medical college authorities were approached, the purpose of the study explained and their approval obtained. Voluntary informed written permission (script presented both in English and Kannada, local language) was obtained from the mothers, after explanation of the nature of the study.

The clinical examination of every mother was comprehensively carried out by the investigator herself. Before the start of the survey, the investigator was calibrated at the Department of Preventive and Community Dentistry, The Oxford Dental College and Hospital. The Kappa co-efficient value ($\varkappa$) for intra-examiner reliability with respect to the Community Periodontal Index was 0.84. These values reflected high degree of conformity in observations.

A pilot study was undertaken on 10% of the study population (30 mothers). The proforma was tested for reproducibility by test-retest. Reliability was assessed by split half reliability coefficient test (ρ=0.842). It took about 6-10 minutes for each examination.

Mothers were examined within 2 days of delivery. The hospital birth registers were scrutinized each day by the study team support members (staff nurses) to identify and select all case (defined as those mothers who delivered an infant weighing under 2500 g and born before 37 weeks gestation) and control mothers (those who delivered an infant weighing equal to or more than 2500 g and born after 37 weeks gestation). The investigator performed the clinical examinations blinded to the case status. The Clinical examination included recording of pocket depth and loss of attachment according to the Community Periodontal Index (CPI index- World Health Organisation, 1997) [15]. A specially designed lightweight CPI probe with a 0.5 mm ball tip, with a black band between 3.5 mm and 5.5 mm, and rings at 8.5 and 11.5 mm from the ball tip was used(IN-111002, WHO periometer, Equinox Medical technologies, Netherlands). All teeth in a sextant were examined and the highest score was recorded as the sextant score. Sextants were defined by tooth position, with molars and premolars making up four posterior sextants, and canines and incisors making up two anterior sextants (18-14, 13-23, 24-28, 38-34, 33-43 and 44-48). A sextant is examined only if there are two or more teeth present which are not indicated for extraction. All teeth in a sextant were examined and the most severe periodontal condition observed was recorded as the sextant score [15].

The codes are [15]:– Healthy.

0- Bleeding observed, directly or by using a mouth mirror, after probing.

1- Calculus detected during probing, but all of the black band on the probe visible.

2- Pocket 4-5 mm (gingival margin within the black band on the probe).

4 – Pocket 6 mm or more (black band on the probe not visible).

X – Excluded sextant (less than two teeth present).

9 – Not recorded.

Loss of Attachment [15]

The extent of loss of attachment was recorded using the following codes:

0 – Loss of attachment 0-3 mm (CEJ not visible and CPI score 0-3)

If the CEJ is not visible and the CPI score is 4, or if the CEJ is visible:

1 – Loss of attachment 4-5 mm (CEJ within the black band).

2 – Loss of attachment 6-8 mm (CEJ between the upper limit of the black band and the 8.5 mm ring).

3 – Loss of attachment 9-11 mm (CEJ between the 8.5 mm and the 11.5 mm rings).

Examinations were carried out in the maternity ward with

the subject lying supine, flat on her bed, which would not strain the mother and facilitate a reproducible examination position for the investigator. After the clinical examination the weight and delivery date of infant were obtained from the hospital records and the mothers were grouped according to pregnancy outcomes into the case or control group. Any oral observations requiring treatment were informed to the mothers and they were advised to seek treatment for the same.

Significance was assessed at 5% level of significance. Student's t test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups (Inter group analysis). Chi-square test and Fisher Exact test, has been used to find the significance of study characteristics on continuous scale.

Results

Both the cases and the controls were similar with respect to the major risk factors for PLBW such as socioeconomic status, and maternal age *(Table 1)*. No statistically significant difference was observed between the two groups. Thus, the present results may be considered as free of selection bias. Also both cases and control mothers had no relevant past medical history or personal history. None of the mothers reported using tobacco or alcohol either before or during pregnancy.

The oral hygiene practices of the study participants in terms of method of cleaning, material used, frequency, were found to be non-confounding factors with respect to the case/ PLBW or control status. Other factors such as weight and height of the mother were not confounding. The mean stress level in the case (21.32 ± 18.67) and control (17.58 ± 19.50) groups was not significantly different (P=0.09, Student's t test, df=298, standard error of difference=2.204, 95% confidence interval: -0.60 to 8.08). However there were significantly more mothers with BMI ≥ 30.0 in the control group than the case group.

When compared for mean loss of attachment scores, the case group showed significantly worst scores when compared to the controls. The cases had significantly more mean number of sextants with loss of attachment of 4-5 mm (0.58 ± 0.95), 6-8 mm (0.79 ± 1.07), 9-11 mm (0.21 ± 0.63), 12 mm or more (0.01 ± 0.12) when compared to (0.23 ± 0.62), (0.12 ± 0.48), (0.02 ± 0.25) and 0.0 respectively in the controls. The controls had significantly better periodontal status, with more number of 0-3 mm scored sextants (5.63 ± 0.82) when compared to the cases (4.40 ± 1.72) *(Tables 2,3)*.

Table 1. *Characteristics of the study groups according to case and control status.*

Maternal characteristics	Cases No. %		Controls No. %	
Maternal age, years				
18-23	30	20	33	22
24-29	120	80	114	76
30-35	0	0	3	2
Socioeconomic status				
Upper class	24	16.0	27	18.0
Upper middle	39	26.0	34	22.7
Lower middle	53	35.3	57	38.0
Upper lower	31	20.7	31	20.7
Lower class	3	2.0	1	0.6
Weight of the mothers				
<45 kg	3	2.0	4	2.7
45-50 kg	14	9.3	11	7.3
>50 kg	133	88.7	135	90.0
Height of the mothers				
<1.55 m	66	44.0	64	42.7
1.56-1.59m	55	36.7	50	33.3
≥1.60m	29	19.3	36	24.0
Body mass Index (kg/m²)				
<18.5	2	1.3	2	1.3
18.5-24.9	76	50.7	62	41.3
25.0-29.9	67	44.7	54	36.0
≥30.0	5	3.3	32	21.3
Onset of prenatal care				
Beginning routine care prior to 20 weeks of gestational age	32	21.3	60	40.0
Between 20-25 weeks of gestational age	109	72.7	85	56.7
After 25 weeks of gestational age	8	5.3	5	3.3
No routine prenatal care	1	0.7	0	0.0
Adequacy of prenatal care				
No prenatal care	1	0.7	0	0.0
<6 visits	90	60.0	65	43.3
>6 visits	59	39.3	85	56.7

Discussion

300 primiparous women, aged 18-35 years were selected randomly from different medical college hospitals in Bangalore city. The selection of the study population from hospitals was based on the fact it provides a large accessible community of child bearing women from diverse groups. The periodontal examinations were carried out within 2 days post delivery coinciding with a study conducted by Bosnjak et al. [3]. This allows for a clear comparison of the influence of periodontal status on outcome and insures that the mothers were recruited prior to their discharge from the hospital [3,4,16].

A case-control design was chosen to insure that the controls are representative (by avoiding selection bias) and that all potential confounding factors are measured. Misclassification

Table 2. *Comparison of CPI and loss of attachment (LOA) between the cases and controls.*

	Cases No. %		***Controls No. %***		***Total No. %***		***p value***	***OR***
CPI								
Healthy	0	-	3	2.0	3	1.0	0.247	-
Bleeding	1	0.6	10	6.6	11	3.7	0.006	0.09
Calculus	16	10.7	67	44.7	83	27.7	<0.001**	0.15
Pocket (4-5 mm)	52	34.7	48	32.0	100	33.3	0.624	1.13
Pocket (6mm or more)	81	54.0	22	14.7	103	34.3	<0.001**	6.83
Loss of attachment								
0-3 mm	61	40.7	117	78.0	178	59.3	<0.001**	0.19
4-5 mm	13	8.7	22	14.7	35	11.7	0.106	0.55
6-8 mm	55	36.7	10	6.7	65	21.7	<0.001**	8.15
9-11 mm	19	12.7	1	0.6	20	6.7	<0.001**	21.6
12 mm or more	2	1.3	0	-	2	0.6	0.498	-

** Strongly significant $p \leq 0.01$

Table 3. *Comparison of Mean CPI and loss of attachment (LOA) Scores between the cases and controls.*

	Cases No. %		***Controls No. %***		***Total No. %***		***p value***	***OR***
CPI								
Healthy	0	-	3	2.0	3	1.0	0.247	-
Bleeding	1	0.6	10	6.6	11	3.7	0.006	0.09
Calculus	16	10.7	67	44.7	83	27.7	<0.001**	0.15
Pocket (4-5 mm)	52	34.7	48	32.0	100	33.3	0.624	1.13
Pocket (6mm or more)	81	54.0	22	14.7	103	34.3	<0.001**	6.83
Loss of attachment								
0-3 mm	61	40.7	117	78.0	178	59.3	<0.001**	0.19
4-5 mm	13	8.7	22	14.7	35	11.7	0.106	0.55
6-8 mm	55	36.7	10	6.7	65	21.7	<0.001**	8.15
9-11 mm	19	12.7	1	0.6	20	6.7	<0.001**	21.6
12 mm or more	2	1.3	0	-	2	0.6	0.498	-

** Strongly significant $p \leq 0.01$

of the case status (PLBW) was minimum since case status was based on the hospital records. In the present study, controls were selected at random from eligible mothers who were present on the ward each day, and the clinician remained blinded to the selection process. The exposure to established risk factors for PLBW was established by examination of the hospital records and by questionnaire. Several well known risk factors for PLBW were confirmed, including, age, height, weight, socio-economic status, tobacco and alcohol use, prenatal care, stress and physical violence.

Women with maternal age under 18 and over 35 years were excluded, since age outside this range is known as a risk factor for PLBW [17]. This pattern of age group was similar to the study conducted by Offenbatch et al. [6] (18-34 years) and Shahrzad et al. [18] (18-35 years).

One of the criteria for inclusion in the study was that women should have at least 20 teeth. It was conceivable that women with more severe disease who may have lost teeth due to periodontal disease and had less than 20 teeth were excluded from the study. However, at interview, no women reported advanced tooth loss because of increased tooth mobility due to periodontitis. No person had to be excluded because of less than 20 teeth. Also only primiparous women with single gestation were included, hence the mothers were free of previous pregnancy-related risk factors [19]. Multiple gestation has a significant relationship with PLBW [4]. For this reason, women who had a multiple birth (i.e. twins or triplets) were not included in the study.

Subjects with the following medical history were excluded: Multiple gestation, high risk gestation, placenta previa, preeclampsia, eclampsia, induced labor, stillborn infants, severe anemia, malnutrition, Infections of genital or urinary system (including bacterial vaginosis), Gestational diabetes, Asthma, Heart diseases, Glomerulonephritis, Hypertension, Hyperthyroidism, Renal diseases, other systemic diseases and disorders, Positive history of HIV infection, AIDS, autoimmune disease, any medical condition requiring antibiotic prophylaxis, current use of corticosteroids. Mothers who had undergone profession oral prophylaxis during the last one year and mothers requiring antibiotic prophylaxis for periodontal examinations were also excluded.

Gestational diabetes is associated with complications in the second half of pregnancy. Preeclampsia occurs more frequently in diabetic mothers and is a major cause of preterm delivery. Large for gestational age and macrosomic newborns are most common perinatal complications of pregestational and gestational diabetes. Diabetic patients were excluded from the study because of the metabolic and local effects of all types of diabetes. One of the most important factors implicated in preterm birth is genitourinary tract infection [20]. Genito-urinary infections have been implicated as a main risk factor in 15 to 25% of preterm deliveries. Despite genito-urinary infections generally responding to treatment with metronidazole, erythromycin, and or clindamycin this has not always resulted in a reduction in preterm birth rate, except for women with a previous history of preterm birth [21]. Exclusion of women with chronic hypertension avoided bias of confounding, since anti-hypertensive medications are strongly related to periodontal status. Any medical condition requiring antibiotic prophylaxis, current use of corticosteroids was excluded because of effects of these drugs on periodontal tissues.

Recently domestic violence, especially injury due to physical abuse was found to be significantly associated with both preterm birth and low birth weight [22]. None of the mothers in the study reported being subjected to any kind of physical violence.

In studying periodontal disease there are a lot of potential measures of the disease severity available.

The main obstacle in the comparison of our results and other studies is highlighted by the variety of protocols and lack of consistency in the use of periodontal indices. Comparison with previous studies was not possible because, in previous studies CPI index has not been used. Earlier reports did not use clinical attachment loss as a measure of periodontal destruction, but considered probing pocket depth as a relevant and objective sign of periodontal disease. However, the pocket depth gives no information on the extent and severity of the periodontitis, but simply registers the current situation, and as such cannot be considered representative information on the disease history and extent [3].

On comparison of the CPI scores, case mothers had significantly fewer healthy sextants. This was similar to the observations of Dasanayake [23] using Community Periodontal Index of Treatment Needs (CPITN) index. The mean number of sextants with periodontal pocket depth of 4-5 mm and 6 mm or more were significantly higher in the PLBW mothers when compared to the control group. The control group had significantly more mean number of bleeding and calculus sextants when compared to the PLBW group, substantiating the severity of periodontal disease in the case mothers. This may be due to the highest score recorded for each sextant according to CPI index.

Mokeem et al. [4] in a case-control study using CPITN index, observed that the prevalence of periodontal pockets of 4-5mm was 42.22% in the study population (present study-33.3%). The mean CPITN was higher in the case mothers than in controls (OR 4.21, 95% CI 1.99 -8.93).

When compared for mean loss of attachment scores, the

case group showed significantly worst scores when compared to the controls. The cases had significantly more number of sextants with loss of attachment of 4-5 mm (0.58 ± 0.95), 6-8 mm (0.79 ± 1.07), 9-11 mm (0.21 ± 0.63), 12 mm or more (0.01 ± 0.12) when compared to (0.23 ± 0.62), (0.12 ± 0.48), (0.02 ± 0.25) and 0.0 respectively in the controls. The controls had significantly better periodontal status, with more number of 0-3 mm scored sextants (5.63 ± 0.82) when compared to the cases (4.40 ± 1.72).

Offenbacher et al. [6] using extent and severity index observed that mean clinical attachment levels for primiparous cases were significantly more; 2.98 ± 0.84 mm/site vrs 2.56 ± 0.54 mm/site for primi controls. The primiparous cases had significantly more severe periodontal disease, p=0.03.

The results of final conditional multiple regression model show that the risk factors for PLBW were BMI with $p<0.001$, odds ratio 0.83, mothers who did not receive prenatal care prior to 20 weeks of gestational age with a p value of 0.013 and odds ratio of 0.14, loss of attachment scores of 6-8 mm and 9 mm or more with a p value of 0.004 and 0.003 and odds ratio of 10.21 and 44.25 respectively *(Table 4)*.

After multiple logistic regression, Dasanayake observed that mothers with more healthy sextants in the mouth and those who were taller had a lower risk of giving birth to an LBW infant, while mothers who did not receive prenatal care had a higher risk of giving birth to a LBW infant [23].

Table 4. *Multivariate logistic regression analysis of risk factors for predicting PLBW.*

Factors	*Logit*	*SE*	*p value*	*Adj. OR*	*95% CI*	
					Lower	*Upper*
Age in years	0.13	0.08	0.095+	1.14	0.98	1.32
Upper middle	1.01	0.49	0.541	1.19	0.88	1.58
Lower middle	0.83	0.47	0.074+	2.30	0.92	5.72
Upper lower+ Lower class	0.64	0.53	0.228	1.89	0.67	5.31
Past dental history	-0.79	0.51	0.120	0.45	0.17	1.23
BMI (kg/m^2)	-0.19	0.05	<0.001**	0.83	0.75	0.91
Stress	0.01	0.01	0.126	1.01	1.00	1.03
Beginning routine care prior to 20 weeks of gestational age	-1.95	0.79	0.013*	0.14	0.03	0.66
Between 20-25 weeks of gestational age	-1.23	0.75	0.098+	0.29	0.07	1.26
Adequacy of prenatal care <6 visits	-0.05	0.32	0.874	0.95	0.50	1.79
CPI-Bleeding	2.87	12.60	0.820	17.70	-	-
CPI-Calculus	4.28	12.56	0.733	72.50	-	-
CPI-pocket (4-5 mm)	5.84	12.56	0.642	343.08	-	-
CPI pocket (6mm ore more)	5.17	12.57	0.681	175.14	-	-
LOA-4-5 mm	-0.29	0.54	0.591	0.75	0.26	2.17
LOA- 6-8 mm	2.32	0.81	0.004**	10.21	2.11	49.46
LOA(9 or more mm)	3.79	1.26	0.003**	44.25	3.74	522.95

* Moderately significant $0.01<p\leq 0.05$, ** Strongly significant $p\leq 0.01$

Obstetricians recognize that intra-uterine infections act as a risk factor for prematurity and LBW. In this case, bacterial lipopolysaccharides (LPS) and inflammatory chemical intermediates [prostaglandin E_2 (PGE2), Interleukin -1 beta (IL-1 β) and tumor necrosis factor-alpha (TNF-α)] can speed up the physiological process of normal birth [25]. Maternal genitourinary tract infection has been associated with pregnancy outcomes [26,27]. These infections do not necessarily involve infection of the fetal – placental unit. Hence, infections remote from the developing fetus have potential to influence gestation [28]. Periodontal infections have much in common with genitourinary infections. In both these situations, the infection may be caused by Gram-negative micro-organisms which release LPS. The patient's defence system reacts to these antigens in a way that the blood levels of inflammatory cytokines such as PGE2, IL-1 β and TNF-α increase significantly. High concentrations of these cytokines, in pregnant women, are responsible for the rupture of the uterine membranes causing premature birth and growth retardation [25].

A number of studies have examined the relationship between infection and low-birth-weight, preterm labor or premature rupture of membranes. Offenbacher et al. [6] hypothesized that Gram-negative anaerobic pathogens from the periodontium and associated endotoxins, maternal inflammatory mediators could have a possible adverse effect on the developing fetus. The view is further supported by the results obtained from animal models, where subcutaneous infection with a periodontal pathogen and experimental periodontal disease in pregnant hamsters resulted in decreased fetal growth as well as increased inflammatory mediator levels [24].

Nevertheless, contradictory to the present study, Davenport et al. [21] in a case-control study using CPITN index, did not find any evidence for an association between PLBW and periodontal disease after adjusting for confounding variables such as maternal age, education, ethnicity, smoking, alcohol consumption, infections and hypertension during pregnancy. This difference between studies was attributed to the possible presence of other specific genetic and environmental factors and failure to control adequately for potential confounding factors. Bassani et al. [12] suggested that the disparity of the results observed in the literature, may also be a result of publication bias, as negative-result studies may not be favoured for publication.

A possible criticism of the present study may be that the periodontal disease levels were measured at a time when the disease levels are significantly influenced by pregnancy. Several studies have established a relationship between pregnancy and periodontal conditions. Laine suggested that pregnancy does not cause periodontal disease but may exacerbate a pre-existing periodontal condition. Many experts agree that periodontal health declines during pregnancy [20]. The CPI scores may have been significantly influenced by pregnancy. In a study of 121 pregnant women, Loe and Silness observed that all showed signs of gingival inflammation. This is confirmed in the present study in which only 3

(1%) individuals had score of 0 [4]. Furthermore, the high prevalence of CPI scores 3 and 4 may also reflect elevations in gingival inflammation leading to enlarged gingiva and hence an increase in probing depths. Changes in gingival inflammation associated with pregnancy are thought to be reversed post partum [28]. However, in the present study, all subjects were examined clinically within 2 days of delivery, at which stage there was liable to be little resolution of this condition.

Moreover, the radiographic alveolar bone level was not assessed, in interest of patient's safety and due to limitation of the facilities. In relation to the association of periodontal infection with preterm birth, the size of the surface area of the pocket, through which bacterial products can invade the periodontal tissues, was found to be more important than bone levels per se [29].

Additionally case-control studies can present a problem in that both a patient's willingness to participate in a study and her postpartum health behaviors can be biased by the outcome being studied [16].

Findings from the present study suggest that maternal periodontal disease is a potential independent risk factor for PLBW. The potential impact of these associations could be significant from a public health standpoint, given that periodontal disease affects significant percentage of the general population and it is both preventable and treatable.

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