

Periodontal Infection During Pregnancy and its Association with the Delivery of Pre-Term Low Birth Weight Babies

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ABSTRACT: *Objectives:* This study was conducted to investigate any association between periodontal disease during pregnancy and delivery of pre-term low birth weight (PLBW) babies in a population of Pakistani women during pregnancy (age=18-35 years) who are nutritionally healthy, socio-economically sound and not under influence of any medical disease. *Study Design:* Cross-sectional study conducted at Department of Gynaecology and Obstetrics, Shaikh Zayed Hospital, Lahore. *Patients And Methods:* Study selected (calculated sample size=325) mothers after excluding known confounders for PLBW. Periodontal status of mothers and their delivery outcome recorded on a specially designed proforma. Sample divided into two groups according to delivery outcomes. SPSS 11.0 was used for data analysis. Percentage frequencies were calculated for periodontal and delivery outcome variables. Fisher's exact chi-square test with 5% level of significance was applied to analyze statistical association and Odd's ratio was also calculated. *Results:* Out of total 325, 21.2% (n=69) women delivered PLBW babies, out of which 15 had healthy periodontal status and 43.4% (n=30) had periodontal pockets depth of >4 mm, remaining had bleeding gums and calculus. Women delivering normal birth weight babies (n=256), 42 had healthy periodontal status, 35.9% (n=92) had periodontal pockets. No significant difference was observed in periodontal status of two groups ($p>0.05$). Odd's Ratio calculated for the periodontal pocket depth between both the groups was 0.72 (CI=95%; $\chi^2=0.58$). *Conclusion:* Study failed to show any association between periodontal disease (indicated by pocket depth) and the delivery of low birth weight. However, periodontal disease level was high in both the groups.

Keywords: Periodontal disease, Pregnancy, Pre-Term Low Birth Weight (PLBW) Babies, Infection, Risk factors

INTRODUCTION

In Pakistan, 19% babies are classified as pre-term low birth weight (PLBW), which is a significant menace for developing enduring health problems¹. Thus, the determination of risk factors for PLBW represents a major public health priority in Pakistan.

Various factors have been identified to risk pregnancy outcome²⁻⁷. However, 25-50% of the causes of PLBW still remain idiopathic⁸. The role of infection, may it be local or distant, is receiving increasing attention; indicative of the remaining 50% that may be responsible for such adverse pregnancy outcome⁹.

Research into systemic sequelae of periodontal disease has been a particular area of interest. Just a decade ago researchers started suggesting that periodontal infection during pregnancy may have a causal relationship with adverse pregnancy outcomes, such as delivery of PLBW babies¹⁰⁻¹³. Periodontal infection is a gram negative bacterial infection involving the detachment of periodontal ligaments supporting the tooth structure resulting in periodontal pockets. Clinically its severity can

be assessed by measuring the pocket depth with the help of Community Periodontal Index for Treatment Needs (CPITN) probe¹⁴.

Other studies, however, have contradicted such findings and found no relationship¹⁵⁻¹⁷. Proponents of an association between periodontal disease and adverse pregnancy effect have postulated theories to explain, a cause- effect relationship¹⁰. Galloway (cited by Offenbacher et al.¹⁰ was the first to suggest in 1931, that infection of periodontium by Gram-negative anaerobic bacteria may "...provide sufficient infectious microbial challenge" to have "potentially harmful effects on the pregnant patient and developing fetus".

Periodontal disease is endemic in Pakistan having 22.5% of population of all age groups with bleeding gums, 33.9% with calculus and 16.9% with periodontal pockets¹⁸; women of childbearing age (18-34yrs) being no exception. Although no separate data of periodontal condition of these women is available in Pakistan, they are generally believed to experience poor periodontal health during this important phase of life due to either fluctuating

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hormonal levels,¹⁹ significant increase in the ratio of anaerobic to aerobic bacteria or/ and depression of cell-mediated immunity during pregnancy leading to the same bacterial challenge²⁰. Bacterial assault in turn is responsible for having potential to influence PLBW through an indirect mechanism involving inflammatory mediators or a direct assault in the periodontium on the amnion¹⁰.

More than 50 risk factors have been documented to be responsible for the delivery of PLBW,² including poor maternal nutritional status, systemic diseases, education, very young or advanced maternal age, smoking and poor socio-economic status³⁻⁷. To our knowledge none of the studies carried out up till now has investigated such an influence while excluding all the other confounding factors found responsible for PLBW. Thus, the aim of this study was to investigate the influence periodontal disease during pregnancy on the delivery of PLBW in a population of medically and nutritionally healthy, socio-economically sound, Pakistani women in their child-bearing age. Nonetheless, the high occurrence of periodontal infection and the same higher percent of PLBW babies in our population indicate that it is an area of public health that needs attention.

MATERIALS AND METHODS

This cross-sectional study was carried out in the Department of Gynaecology and Obstetrics, Shaikh Zayed Hospital, Lahore. Sample size of 325 was calculated using 95% confidence interval and a prevalence of 50%. Convenient sampling method was used, where eligible subjects fulfilling all study criteria were examined for their periodontal status on the day of delivery; later their delivery outcome was recorded in the form of baby weight and the gestational weeks.

This study aimed at obtaining more precise information by selecting the subjects carefully and controlling for possible confounders that may influence adverse delivery outcome. Therefore, the study included only those pregnant women who were of the age between 18-35yrs, nutritionally healthy (with BMI at conception of more than 18.5kg/m² or with pregnancy weight gain of at least more than 8kgs), socio-economically sound subjects indicated by a formal education of more than ten years, economic status of at least above poverty line and women with a history of less than five pregnancies.

Women with at least four sextants having at least two teeth in each sextant; and those who had not undergone any periodontal therapy (scaling and root planning) during pregnancy for the past 6 months were included.

Subjects were excluded if they had a history of any medical complications such as anemia, hypertension, diabetes mellitus / gestational diabetes, hemorrhage, pre-eclampsia, urinary-tract infection, chronic liver disease, chronic renal failure, those who were drug abused, having psychiatric illness requiring treatment, those with auto-immune disorders, patients on immune modulating agent (steroids), under any antibiotic treatment for the past six months and those who refused to participate.

Antenatal cards filled on the registration day were used to record the maternal characteristics like height, weight, other demographic variables, history of drug addiction and disease status. All maternal information and record was transferred in a specially designed proforma.

Periodontal examination was performed soon after delivery for standardization purpose, using mouth mirror and the Community Periodontal Index for Treatment Needs probe-35 (CPITN-E) in the presence of sufficient white light. CPITN is an index that has been recommended for epidemiological surveys of the periodontal health. To make the examination unbiased, examiner was not informed about the pregnancy out come and was performed when the babies and their records were in the nursery. Periodontal examination was done by a single trained and calibrated examiner i.e., the first author to avoid inter-examiner bias.

The whole dentition was divided into 6 parts (sextants) for the assessment of periodontal disease. Variables determined and scores assigned were gingival health status (score=0), gingival bleeding (score=1), calculus (score=2), probing/ pocketing depth of 4-5mm (score=3) and probing/pocketing depth of >6mm (score=4).

Baby's weight was measured in kilograms by the nursing staff, whereas gestational age was measured according to the mother's "Lunar Monthly Period" (LMP) in weeks by the gynaecologists. According to the World Health Organization classification newborns with "cut off point" of birth weight less than 2500grams (up to and including 2,499 grams) should be considered to fall in the low birth weight

(LBW) category¹. However, in practice due to the natural tendency to record weights to the nearest “round” number, this change in definition would not make a noticeable difference¹. Thus, in the present study, birth weight of ≤ 2.5 kg was considered as low birth weight (LBW) and > 2.5 kg as a normal birth weight baby (NBW). Gestational age of 37 weeks or less was considered as pre-term delivery and more than 37 weeks as normal gestational age delivery.

Data was entered in SPSS (statistical package for social sciences) version 11.0. Percentage frequency was calculated for the two groups of mothers delivering low birth weight babies and the normal birth weight babies. Similarly mean birth weight and gestational period with standard deviations were calculated. Demographic variables were compared amongst the same and Fisher Exact Chi-Square test was used to evaluate any associations, where level of significance was 0.05 at 95% confidence level.

Height and weight of the mother at her first visit was transferred from the mother’s antenatal record and was computed using the formula $\text{Kg} / (\text{m})^2$ to attain the BMI of the women at conception and her pregnancy weight gain according to the gestational period. Pre-pregnancy BMI was coded according to IOTF (International Obesity Task Force) classification²¹ as 0=underweight, 1= normal, 2= class I over weight, 3= class II obesity, 4= class II a obesity, 5 class III obesity, where underweight are considered to have BMI <18.5 kg/m². Normal weight gain during pregnancy was considered to be 7–11.5 kg.

Percentage frequencies and mean sextants involvement of individual CPITN scores were calculated. Further analysis was performed using Fisher’s Exact Chi-Square test for any association between the periodontal status of the subjects and

the delivery outcome and a linear regression was plotted for both groups. Odd’s Ratio was calculated between healthy periodontal variable and diseased periodontal status indicated by periodontal pocket of >6 mm (CPITN Score=4) in the two groups.

Additional analysis was performed to observe any association, if any, between maternal nutritional variables and delivery outcomes. For this the pre-conception BMI was combined with pregnancy weight gain of the mother as 1= normal pre-conception BMI with normal mean pregnancy weight gain and 2= obese/overweight pre-conception weight with normal mean pregnancy weight gain.

RESULTS

A total of 1966 deliveries were carried out during the study period and of these a sample of 325 mothers fulfilling the study criteria were selected. According to the study criteria, none of these subjects was found of suffering from any local, systemic or gynecological infections and/ or diseases. None of the subjects were identified as involved in smoking and drinking habits due to the cultural and ethnic reasons. All recruited subjects were found to have a better nutritional status in this study as evident by normal pre-pregnancy BMI or normal pregnancy weight gain; and socio-economically sound.

Subjects’ age ranged from 18-35 years, where majority of subjects were of age 25 years (13%). These subjects had a minimal ten years and a maximum 16 years of formal education. Majority of mothers (36%) had a formal education of intermediate level (12 years). Socio-economic status of the total study sample was observed to be middle with an average earning of Rs.12, 000/ month for approximately 6 family members.

Table 1: Maternal characteristics and delivery outcome

Variables	PLBW (N= 69) Mean $\pm$ SD	NBW (N= 256) Mean $\pm$ SD	p-value
Maternal age (yrs)	26.52 $\pm$ 3.47	26.60 $\pm$ 3.96	0.8
Maternal education (yrs)	13.07 $\pm$ 2.01	13.12 $\pm$ 2.04	0.9
Pre-pregnancy BMI (kg/m ²)	24.99 $\pm$ 4.62	26.87 $\pm$ 5.39	0.008
Pregnancy weight gain (kg)	7.74 $\pm$ 1.19	7.91 $\pm$ 1.41	0.3
Monthly income (Rs.)	12188.41 $\pm$ 12433.38	12528.63 $\pm$ 14156.527	0.8
Family members (n)	6.5 $\pm$ 3.81	6.23 $\pm$ 3.34	0.5
Total pregnancies (n)	2.3 $\pm$ 1.35	2.3 $\pm$ 1.36	0.8
Total deliveries (n)	0.87 $\pm$ 1.15	1.10 $\pm$ 1.14	0.1

PLBW: Pre-term low birth weight, NBW: Normal birth weight

Table 2: Percentage frequencies with periodontal status in relation to the delivery outcome

Periodontal variables	PLBW (N=69)	NBW (N=256)	p-value
	%	%	
Healthy (Score=0)	18.8	16.7	0.45
Bleeding (Score=1)	17.3	19.1	0.36
Calculus (Score=2)	20.2	28.1	0.42
Pocket 4-5mm (Score=3)	18.8	19.5	0.38
Pocket >6mm (Score=4)	24.6	16.4	0.41

For comparative analysis ([Table 1] study population was divided into two groups. The groups were classified into: The case group, including mothers delivering low birth weight babies. As the majority of the low birth weight babies were delivered pre-term and very few were full term, therefore, both the pre-term and full-term low birth weight babies, being SGA (small for gestation) and IUGR (intra-uterine growth retardation) were designated as PLBW case group. The control group was subjects delivering normal birth weight (NBW) babies, including a minority of pre-term and a majority of full-term babies with normal birth weight. This classification/groupings were done in order to achieve the level of comparability between the two groups, that is, at least 1:4 (case: control). This grouping was also acceptable mainly because the final results were not affected by the presence of the minority full-term low birth weight babies and a minority pre-term normal birth weight babies.

According to the neonatal records checked after recording maternal periodontal status, the mean weight and the gestational term of PLBW neonates were 2.19 kg and 252.5 days (36 weeks) respectively. The smallest live baby delivered was recorded to have a birth weight of 1.1kg on the 32nd week of gestation. On the other hand, 256 neonates (approximately 79%) out of the total deliveries (325) were found having normal birth weight (NBW) with a mean of 3.1 kg and mean gestational term of 272.1 days (39 weeks). Maximum birth weight recorded was 4.7kg on the 42nd gestational week.

It may be observed in Table 1 that the maternal characteristics of both the groups are similar but the difference was observed in the mean BMI at conception of the mothers delivering PLBW which was 24.99 ± 4.62 kg/m² and those delivering NBW was 26.87 ± 5.39 kg/m² ($p < 0.05$). However, they were in a range of normal BMI.

Frequency of periodontal characteristics in mothers according to the delivery outcome is shown in Table 2. Only 15 out of the total women delivering PLBW babies were observed to have healthy periodontal status. Similarly only 42 women had healthy periodontal status out of the total 256 women delivering NBW babies. On the other hand approximately 43.3% women were identified having periodontal pockets of >4mm in case group and almost 36% with similar periodontal condition in the non-case group. However, this difference was not statistically significant. Therefore, in the absence of any other risk factors for PLBW, no association at all is observed ($p > 0.05$) in the delivery outcome of the mothers with periodontal disease. Odd's ratio calculated between healthy periodontal status and diseased condition as indicated by periodontal pockets of >6mm for both the groups was found to be 0.72.

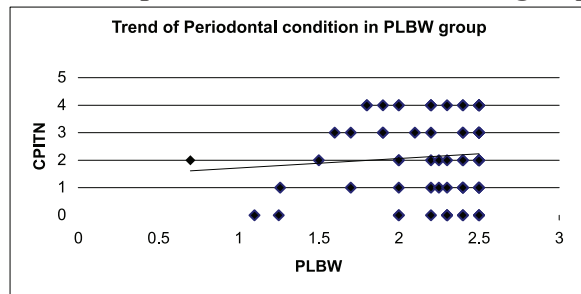
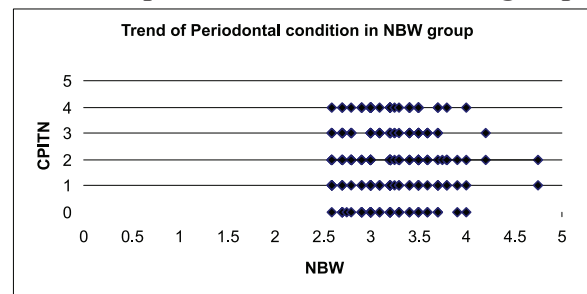
Table 3 shows the mean number of sextants with healthy and diseased periodontal condition amongst the two groups. It may be observed that even though the number of women with healthy periodontal status in both the groups were less [Table 2], the number of sextants with healthy status is still higher than sextants with diseased status [Table 3]. Almost three sextants are observed to have healthy periodontal status in PLBW group and only half of one sextant is found diseased with a periodontal pocket of > 4 mm. This result is insignificant ($p > 0.5$) as the same level of periodontal status is observed in the NBW group.

Graph 1a and 1b shows the similarity in the trends of delivery outcome in relation to the periodontal status in both the groups. It is obvious that with the increase and advancement in the poor periodontal condition, no change is observed on the birth weight and the gestational period of the baby at the time of delivery. The trend remains unchanged.

Although not part of the study design, it was found

Table 3: Mean sextants with periodontal status in relation to the delivery outcome

Periodontal Variables	PLBW (N=69) (Mean $\pm$ SD)	NBW (N=256) (Mean $\pm$ SD)	p-value
Healthy	2.94 $\pm$ 2.44	2.89 $\pm$ 2.35	0.87
Bleeding	1.02 $\pm$ 1.46	1.08 $\pm$ 1.43	0.79
Calculus	1.10 $\pm$ 1.29	1.28 $\pm$ 1.38	0.34
Pocket 4-5mm	0.67 $\pm$ 1.13	0.59 $\pm$ 1.03	0.57
Pocket >6mm	0.22 $\pm$ 0.80	0.10 $\pm$ 0.31	0.59

Graph 1a: Trend of delivery outcome in relation to maternal periodontal status in PLBW group.**Graph 1b: Trend of delivery outcome in relation to maternal periodontal status in NBW group.**

that pre-pregnancy BMI along with the pregnancy weight gain was associated with the pregnancy outcome. During analysis it was observed that alone pre-pregnancy BMI was not associated with adverse delivery outcome; similarly alone pregnancy weight gain was also not found to be associated with adverse delivery outcome. However, when both the variable, that is, pre-pregnancy BMI with a pregnancy weight gain were combined it was observed [Table 4] that risk of delivering PLBW by the normal pre-pregnancy BMI mothers with less or normal pregnancy weight gain is slightly more than (n=33) those who are obese or over weight at the time of conception and with normal weight gain during pregnancy (n=30). This finding is observed to be statistically significant at borderline (p=0.05), suggesting an association between BMI and the delivery outcome.

DISCUSSION

It has been reported that periodontal infection during pregnancy may have a causal relationship with the pre-term delivery of low birth weight babies (PLBW)¹⁰⁻¹³. However, it is suggested that if some types of periodontal disease merely constitute an oral component of a systemic disorder or have etiological features in common with systemic diseases, periodontal and systemic diseases might

frequently occur together without having a cause-effect relationship²². Similarly, it may simply be suggestive of the role of shared risk factors involved with the susceptibility of adverse delivery outcome²³.

The present study attempted to exclude all together the key confounding and risk factors such as low socioeconomic, low education, younger and advanced maternal age and diseased status found to be associated with PLBW and investigate whether periodontal condition has any etiological effects on PLBW. Moreover, there was need to evaluate such a relationship amongst Pakistani population, where there is a high prevalence (19%) of PLBW babies¹.

In the presence of rigorous selection criteria, the present study contemplated that the subjects recruited may have a better periodontal condition that may not be appropriate to analyze the study results. This was anticipated because most of the confounding factors responsible for having a risk for PLBW also risk the periodontal health status (such as education, socio-economic status, age and a number of systemic diseases). However, during pilot study it was found that even after excluding these key-confounding factors, only approximately 17% of the study population had healthy periodontal status. These findings were different when compared with the results of our national oral health survey of the same age and socio-economic group with same

Table 4: Association of maternal nutritional status with delivery outcome

Pre-pregnancy BMI with pregnancy weight gain (N=325)	PLBW (N=63)	NBW (N=247)	p-value
Normal pre-pregnancy weight with less and normal mean pregnancy weight gain	33	94	0.050
Over weight and Obese pre-pregnancy weight with normal mean pregnancy weight gain	30	153	OR=1.72

OR= odd's ratio

periodontal measurement criteria,¹⁸ where healthy status was reported as 24% and disease status 11.5%. This change probably suggests that periodontal diseased status is increased during pregnancy. However, this increase in the diseased status did not show any association with an adverse delivery outcome like PLBW, unlike reported by others¹⁰⁻¹³.

Although the evidence of associating periodontal infection during pregnancy with the adverse pregnancy outcome is biologically plausible,¹⁰ however a study suggested that the association may be due to a chance occurrence or the clinical findings may be exaggerated¹². Although clinically, Jarjura et al's¹² finding was consistent with the pioneer study,¹¹ but according to the results it still contradicts the biological plausibility of host susceptibility to adverse pregnancy outcome, which is explained by the presence of same sub-gingival bio-films acting as reservoir of gram-negative bacteria in subjects delivering PLBW and NBW.

The present study sample were identified as belonging to a nutritionally healthy population; however, during data analysis it was observed that mothers who had a normal BMI at the time of conception, gaining low pregnancy weight gain had more risk of delivering PLBW babies than those having over weight than normal and gaining normal pregnancy weight giving birth to normal weight babies.

This finding, although not part of the study design, suggested that the cause for PLBW might be the weight of the women at conception and during pregnancy. Other studies also suggest this association. [6] However, in present study this association was statistically significant at borderline ($p=0.05$) and was true for only half (52%) of mothers delivering PLBW in the present study. The cause for PLBW still remains unknown for the rest half delivering PLBW.

Life style factors related to maternal stress, maternal employment, use of micro- nutrient or diet and infections of unknown origin might be other risk factors,^{24,25} which may be contributing to PLBW. Further studies are required to look into these hidden

or unrevealed factors.

Whatever the cause may be the study infers that even in the absence of key confounding roles for PLBW the poor periodontal status was similar in both the group although it did not have any effects on the delivery outcome. This is in contrast with the findings of other studies which found such an association. This difference could be due to different selection criteria and methodology in these studies, as there is a great variation found in the definition of periodontal disease and the pre-term low birth weight.

It is suggested that studies be designed such that not only clinical, but microbiological and bio-chemical investigations be performed so as to corroborate the inflammatory effects of periodontal infection on the pregnancy outcome. Moreover, it is known that hypothesis, which persistently are proven by a larger number of studies, become known facts. By and large, very trifling work been done to investigate this plausible association through out world, which still impede this plausibility as a known fact especially in our population. Thus still there is a need to carry out studies in the field that may help perform a valid meta-analysis and suggest a definitive relationship between periodontal disease during pregnancy and the adverse pregnancy outcome.

CONCLUSION

The present study did not find any difference in the periodontal condition of the mother in relation to their subsequent delivery outcome; within the group of mothers delivering PLBW it was however, noticed that periodontal disease as indicated by periodontal pocket depth was still high (43.4%) in mothers.

Hence, it is suggested that the role of oral infections must not be over looked in such a population. No matter if the association is statistically not validated, women having poor periodontal status must be encouraged to keep their oral hygiene and in severe cases they may be targeted towards appropriate treatment. After all children's oral health status

and practices reflect those of their mothers' and if the mothers are healthy, their children will also be healthy.

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