

## Poor Periodontal Health as a Risk Indicator for Low Birth Weight of the Infants

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### Abstract

**Background:** Pre-term birth and low birth weight are the leading perinatal problems worldwide and have evident public health. There is convincing evidence to suggest that infections affecting the mother during pregnancy could result in pre-term birth and low birth weight. The aim of this study was to determine the association between periodontal inflammation and the incidence of preterm birth and low birth weight.

**Materials and methods:** Seven hundred and seventy patients were enrolled. Periodontal data, pregnancy outcome variables and information on other factors that may influence adverse pregnancy outcomes were collected. Data were analyzed using logistic regression analysis.

**Results:** The age of mother (p value= 0.148), literacy (p value = 0.375), Hb% (p value =0.952), obstetric history (p value = 1.000) habits (p value = 0.347) showed no significance with low birth weight (LBW). Gestational age revealed statistical significance with low birth weight (p= 0.00) and gestational age and periodontal status of mother (p=0.033) showed significance.

**Conclusion:** The oral health parameters were no different in women who experienced preterm birth compared to full term. But the risk of LBW was associated with gestational age. The risk of low birth weight reduced with healthy periodontal status compared to severity of periodontal disease.

**Key words:** Periodontal diseases, gestational age, low birth weight.

### Introduction

The birth weight of an infant is the single most important determinant of its chances of survival and healthy growth and development. Because birth weight is conditioned by the health and nutritional status of the mother, the proportion of infants born with low birth weights closely reflects the health status of the communities into which they are born.

At the Thirty-fourth World Health Assembly, the Member States of the World Health Organization (WHO) adopted, as part of the global strategy for "Health for all by the year 2000", the proportion of infants born with LBW as one of the global indicators with which progress could be monitored. Associated with the use of this indicator, however, are a number of practical problems. In developing countries, accurate and complete population data and medical records usually do not exist. Usually only those who are born in institutions and hospitals are weighed. These infants constitute only the privileged group of population. A recent survey has shown that only about one-third of births in the developing world take place in institutions; in some countries, the proportion is even lower than one-fifth. Even when records of birth weights exist at the institutional level, they are rarely collated at the national level. The variations in the religious practices such as local burial customs discourage the registry of infants.<sup>1</sup>

The WHO Expert Committee, 1961 recommends that birth registration should be as complete as possible and that, as soon as it is practicable, birth weight should be added to the official birth certificate used in each country. Hospitals, domiciliary services etc. if have any interest in the statistical aspects of this subject, can collect and study the birth weights in different weight groups. Such statistics will

allow meaningful comparisons to be made and inevitably lead to an increased interest in the survival rates of infants of all weights, thus filling in the gaps of knowledge.

It is clear from the many causes that there is no single solution to LBW. Interventions have to be cause-specific. Prenatal care, nutrition programs, health education on the needs of pregnant women, family planning, and measures aimed at improving the health and nutrition of young girls are factors which require solution. The analysis of the bulletin of WHO has demonstrated that preterm is a significant perinatal health problem across the globe, not only in terms of the associated mortality but also with regard to short and long term morbidity and financial implications for health care systems.<sup>2</sup>

Since the last two decades, several studies have reported poor periodontal status of pregnant women in association with low birth weight of the infant. Periodontal disease is one of the most common chronic infectious disorders in human, with prevalence of 10-60%.<sup>3</sup>

The aim of this study is to determine the association between poor periodontal status of pregnant women using Community Periodontal Index by controlling other confounding factors like age, literacy, gestation period, antenatal care among patients reporting between the period of September 2007 and December 2009.

### Objectives of the study

1. To determine the prevalence of low birth weight of infants delivered in the free labour ward, KLE Hospital, Belgaum.
2. To assess the prevalence of periodontal disease among primiparous mothers delivering during the study period and to estimate the association between

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periodontal disease and low birth weight among the mothers.

3. To quantify associations between other risk factors and low birth weight among these mothers.
4. To deduce risk scores for LBW among mothers with or without periodontal disease.

### Material and methods

The study population was drawn from the women between the ages of 18-35 years who gave birth in the free labour ward of KLE Hospital, Belgaum, Karnataka between September 2007 and December 2009. After obtaining the institutional and hospital approval to carry out the study and with the consent of the subjects, the subjects were screened for their periodontal condition and the data was also recorded from the hospital birth register within 48 hours. The hospital was visited on a 3-day per week regular basis. Inclusion criteria included mothers with a single-term gestation.

Exclusion criteria included systemic conditions like severe anaemia, diabetes, cardiovascular disorders, high blood pressure associated with premature birth or intra-uterine growth delay. Women with a medically terminated preterm delivery that followed pregnancies complicated with maternal obstetric disorders (pre-eclampsia or eclampsia and gestational diabetes) were excluded from the study.

Information regarding age, Hb%, obstetric history, height of the mother, gestational age, sex and birth weight of the newborn was collected from the hospital birth register. The level of education, habits, socio-economic status and past dental history was obtained by a structured questionnaire survey.

Details regarding the ante natal care and the mother's height were recorded from the records provided to the patient from the primary health care centres visited by them, at regular intervals, for the same.

Oral examinations were performed by a single investigator using the World Health Organisation criteria. The periodontal status of the mother was recorded using Community Periodontal Index.

The analysis of healthy sextants and bleeding sextants and sextants with calculus, shallow or deep pockets was counted for each subject. Examination was done on 6 index teeth and the highest score was recorded for the patient.

The scoring was as follows:

- 0 Healthy
- 1 Bleeding on probing present
- 2 Presence of calculus
- 3 Presence of periodontal pockets < 5mm deep
- 4 Presence of periodontal pockets > 5mm deep

### Statistical analysis

The data was analyzed using Chi square test to find the association between LBW and socio-demographic and other variables. Univariate and multivariate logistic regression analysis was performed for those variables which were significantly associated with prevalence of LBW. SPSS (Version10) statistical software was used to analyze the data.

### Results

In relation to age of mothers, Table 1a shows the distribu-

tion of LBW where  $\chi^2 = 5.353$  and  $DF = 3$  with p value 0.148. There was no association between age of mothers and LBW. On the basis of CPI scores, the periodontal disease was more among the age group between 20-24 years followed by the age group 25-29 years, where both the groups constituted majority of the samples.

The study sample had literacy among majority of the mothers in the groups, with almost similar distribution in both the groups (Table 1b). In the present study, only 10.3% of the mothers were illiterate. There was no significant difference in prevalence rate of LBW in different literacy categories ( $p = 0.347$ ).

The mothers did not show any significant association between adverse oral habits with LBW (Table 1c) ( $\chi^2 = 0.885$ ,  $DF = 1$ ,  $p = 0.347$ ).

The obstetric antecedents of the mothers showed that amongst mothers with history of abortion, prevalence rate of LBW was 28.5% and in mothers without a history of abortion, it was 25%, which did not have any significance with LBW with p value 0.394 (Table 1d).

The hemoglobin is considered as one of the risk factors for preterm and low birth weight. In the study, only 3 mothers among 770 had less than 7 mg % of hemoglobin. (Table 1e) these parameters did not show any significant difference ( $\chi^2 = 0.099$ ,  $DF = 2$ ; p value = 0.952).

The previous dental visits for treatment showed no significant association with low birth weight (Table 1f) (p value = 0.798)

Among the total sample, antenatal care was taken by 763 mothers (99%). Only 7 (1%) did not seek ANC (Table 1g) ANC was not associated with low birth weight ( $\chi^2 = 0.066$  and p value = 0.800).

Among 770 mothers, 105 mothers showed healthy periodontium while the remaining mothers had clinical signs of periodontal disease (Table 1h). The study showed statistical significance with  $\chi^2 = 10.503$  and p value = 0.033 with the low birth weight.

The incidence of low birth weight infants is 17.3% in term gestation and 45.5% in preterm gestations. (p value = 0.000) (Table 1i).

The univariate logistic regression analysis is identical (Table 2). Gestational Age and Periodontal health status as risk factors with unadjusted Odds ratio of 1.365 and 0.562 respectively, with multivariate logistic analysis, (Table 3) the same findings are confirmed with adjusted odds ratio of 1.38 for gestational age and 0.57 for periodontal status. The risk of LBW is associated with gestational age. The prevalence of low birth weight is significantly more in preterm compared to normal delivery and the risk of LBW reduces with healthy periodontal status compared to severity of periodontal disease.

In this study, at least 259 mothers (35%) showed a CPI score of 4 indicating at least half of the study population has at least one deep pocket in any one sextant.

Sex of the child did not show any significance with the low and normal birth weight in our study. (Table 1j) ( $\chi^2 = 0.001$  and p value = 0.974).

Thus, in this study, only gestation period and periodontal disease emerged as risk factors.

With multivariate logistic analysis, the same findings are confirmed with adjusted odds ratio of 1.38 for gestational age and 0.57 for periodontal status. So, periodontal status

FACTOR	LBW	NBW	TOTAL	$\chi^2$	DF	P VALUE
<b>1a) Age</b>				5.353	3	0.148
15-19	22 (23.7%)	71 (76.3%)	93			
20-24	137 (26.8%)	375 (73.2%)	512			
25-29	31 (20.7%)	119 (79.3%)	150			
30-34	4	6	10			
35-39	2	1	3			
<b>1b) Literacy</b>				4.238	4	0.375
Illiterate	25 (31.6%)	54 (68.4%)	79			
< 10th std	66 (24.8%)	200 (75.2%)	266			
10-PUC	75 (25.2%)	223 (74.8%)	298			
PUC-degree	15 (18.8%)	65 (81.2%)	80			
Degree	11 (28.2%)	28 (71.8%)	39			
PG	2	1	3			
<b>1c) Habit</b>				0.885	1	0.347
Yes	40 (22.9%)	135 (77.1%)	175			
No	157 (26.4%)	438 (73.6%)	595			
<b>1d) Obstetric history</b>				0.727	0.394	1
Abortion	39 (28.5%)	98 (71.5)	137			
No abortions	158 (25%)	475 (75%)	633			
<b>1e) Hb (gm%)</b>				0.099	2	0.952
< 7	1	2	3			
7-10	54 (25%)	162 (75%)	216			
10-11	67 (26.3%)	188 (73.7%)	255			
>11	75 (25.3%)	221 (74.7%)	296			
<b>1f) Previous dental visits</b>				0.066	1	0.798
Yes	62	186	248			
No	135	387	522			
<b>1g) ANC</b>				0.064 (with Yate's correlation)	1	0.800
Not taken	1 (14.3%)	6 (85.7%)	7			
Taken	196 (25.7%)	567 (74.3%)	763			
<b>1h) Periodontal status</b>				10.503	4	0.033
Healthy	18 (17.1%)	87 (82.9%)	105			
Bleeding	21 (20%)	84 (80%)	105			
Calculus	76 (25.3%)	224 (74.7%)	300			
PPD <5mm	61 (31.6%)	132 (68.4%)	193			
PPD >5mm	21 (31.3%)	46 (68.7%)	67			
<b>1i) Gestational age</b>				76.743	1	0.000
Pre term	99 (48.5%)	105 (51.5%)	204			
Term	98 (17.3%)	468 (82.7%)	566			
<b>1j) Sex of the child</b>				0.001	1	0.974
Male	Male	280 (74.5%)	376			
Female	Female	293 (74.4%)	394			

Table 1 (a-j) : Association between birth weight and other factors

LBW=Low Birth Weight; NBW=Normal Birth Weight; CDF=Degree of Freedom; OR=Odds Ratio

	Unadjusted OR	P	95% CI
Gestational age	1.365	0.000	1.28 1.49
Periodontal status	0.562	0.035	0.33 0.96

Table 2 : Logistic regression univariate analysis

	Adjusted OR	P	95% CI
Gestational age	1.384	0.000	1.28 1.49
Periodontal status	0.569	0.054	0.321 1.01

Table 3 : Logistic regression multivariate analysis

and gestational age emerged as risk factors for LBW.

### Discussion

The hypothesis that poor periodontal health of the pregnant women is associated with LBW of the infant was tested by an observational study. The data was analyzed evaluating the risk factor components for LBW. Each of the risk factor components was studied individually to determine its effect on LBW of infants.

The average age of the mother at the first child birth was early to mid 20s in most of the other studies. In our study, the majority of mothers were between the age groups of 20-29 years. Kristenson J et al., 1995 showed in their study that low maternal age < 20 years was a risk factor for pre-term delivery with the explanation that younger women are not completely developed anatomically to conceive a child. This (Table 1a) was not statistically significant, and age had no relation with prevalence of low birth weight. The age above 30 years is thought to have high prevalence of low birth weight.<sup>4</sup> Since in our study, the sample size had less subjects in this group (Table 1a), it cannot be established as a risk factor in our study.

The data for literacy has shown that mothers who are illiterate have higher chances of delivering PTB and LBW infants since this group is not much aware of the antenatal care. In our study, the prevalence of low birth weight among illiterate women was 31.6% as compared to 68.4% in the literate women. Out of 770 mothers, only 79 were illiterate. Among the literate mothers, the percentage of mothers with the normal weight infants was higher as compared to LBW infants (Table 1b) but education of mothers did not show any significance with the birth weight.<sup>5</sup>

Only 7 among 770 subjects had not received antenatal care. The reason for the awareness could be easy access to the primary health care centres at their talukas. Inadequate antenatal care is cited as a risk factor for poor pregnancy outcome. Several studies have shown antenatal care is associated with improved birth weights. In India, the establishment of primary health care centres in the various talukas enabled mothers to have easy and free access to these centres and also increase their awareness for receiving antenatal care (Table 1g). So we did not find any association between low birth weight and antenatal care.

Adverse oral habits like tobacco, paan chewing, etc., maybe the aggravating factors for severe periodontal

disease in pregnant mothers. Periodontal disease plays a role in PTB and LBW. In our study, only 595 mothers out of the total 770 subjects presented with no adverse habits and hence the habits did not exhibit any relation with LBW.

Only 32% of the women had visited dentists during or earlier to pregnancy, either for restoration of their carious teeth or for extractions. Only 2% visited for cleaning of teeth. Reduced awareness of oral hygiene and decreased availability of dental treatment in rural areas in developing countries reflects in this study. This did not show any significance with low birth weight. However, it can be stated that since periodontal disease is a risk factor for LBW, dental neglect could increase the severity of periodontal diseases and thus indirectly affect the birth weight of infants.

In previous studies, women in their first pregnancies/primaries have a higher incidence of PTB and LBW. Other studies reported that cross-sectional analysis showed a higher rate of parity in women.<sup>6</sup> However, Bakketeig and Hoffman showed that this is an artifact and identified a progressively lower risk with each successive birth. This work has been confirmed by Hall et al. It is not known whether this pattern applies to parities above 4 previous deliveries, since parity and maternal age are interrelated.<sup>7</sup> In this study, sample consisted of only primiparous patients where their previous history (with and without abortion) were taken into consideration and this did not show significance ( $p=0.001$ ) with PTB and LBW.

The hemoglobin carries nutrition for the mother and the fetus, which acts as an important factor for the development of the fetus. Thus, low hemoglobin values can act as risk factors for PTB and LBW. Prevalence of PTB or LBW is seen in severe anemia < 7 mg%.<sup>8</sup> Women with severe anemia were only 3 out of 770. Hence no association was found with hemoglobin and LBW.

The National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units Network had analyzed the causes of delivery before 37 weeks. One of the main reasons for preterm birth was the individual's lifestyle. Tobacco chewing, inadequate maternal weight gain during pregnancy were found to play important roles in both incidence and the outcome of low birth weight neonates. Other maternal factors implicated included young or advanced maternal age, poverty, short stature, vitamin C deficiency and occupational factors such as prolonged walking or standing, strenuous working

conditions and long weekly work hours. The recurrent, familial and racial nature of preterm birth led to the suggestion that genetics may play a causal role. Another possible explanation of some cases of ruptured membranes and preterm labour is infection of the membranes and amniotic fluid caused by a variety of microorganisms and viral products. Oral bacteria, especially, *F. nucleatum* and *Capnocytophaga spp.* have been associated with upper genital tract infection in pregnant women. Offenbacher et al., found that women with periodontitis have a 7-fold risk of preterm birth compared with that of controls. It is generally true to say that the majority of preterm births are also low birth weight.<sup>9</sup> Our study showed an average gestational period of  $38.09 \pm 2.58$  weeks. 48.5% and 17.3% infants had LBW in preterm and term deliveries respectively, thus showing LBW significantly increases with preterm deliveries as compared to term deliveries.

The reasons for sex differences in gestation and delivery are not known. Hall et al. in his study reported the preponderance of male infants being delivered preterm and female infants being delivered low birth weight.<sup>7</sup> The reason for sex difference and gestational age in delivery are not known. Since it occurs along the complete range of gestational age, it could be considered that normal gestational age length in males is shorter than in females or this difference might be mediated by hormonal factors. But the present study (Table 1j) showed sex of the infant had no significance with low birth weight.<sup>6</sup>

On oral examination to assess periodontal status, 26.8% and 20.7% among 20-24 and 25-29 year women, respectively, were found to have bleeding gums and periodontal pockets 5mm deep. These women gave birth to infants with LBW (Table 1h). This may be due to large sample size in the above group. Thus, the study shows a significant relationship between periodontal status and low birth weight (p value = 0.033) (Table 1h).

Alternatively association between clinical periodontal disease and pre term delivery may be present in some susceptible population because of the presence of environmental or genetic risk factors. Also the difference in the distribution and virulence of specific periodontal pathogens may contribute to heterogeneity of studies. Periodontal pathogens are thought to gain access to fetoplacental tissues via blood borne pathways and are thought to elicit inflammatory and prostaglandin cascades that precipitate pre term low birth. This view was supported by Offenbacher's hypothesis that gram negative anaerobic pathogens from the periodontium and associated endotoxins and maternal inflammatory mediators could have a possible effect on the developing fetus. Researchers have however noticed that a consistent and reproducible feature of PTLBW cases is an increased level of PGE<sub>2</sub> and TNF- $\gamma$ , even in the absence of clinical or subclinical infections of the genitourinary tract.<sup>9</sup> This has led these researchers to conclude that most PTLBW cases are probably caused by infections of unknown origin. During the infection process, the levels of biologically active molecules such as PGE<sub>2</sub> and TNF- $\alpha$ , which are normally involved in parturition, are raised to artificially high levels in the infection process. The periodontium can serve as a renewing reservoir for some mediators such as TNF- $\alpha$ , IL1, as well as PGE<sub>2</sub>, because they can reach high concentra-

tions in tissues with periodontitis and result in PTB.<sup>10</sup> The present study showed positive correlation between the periodontitis and PTB which relates inflammation of the periodontium also can result in PTB.<sup>10</sup>

The study data recorded for the LBW relating to the periodontal inflammation correlates with the study conducted by Collins et al., who demonstrated in pregnant hamsters that non-disseminating, local infections with oral anaerobe, *Porphyromonas gingivalis*, created by injecting low numbers into subcutaneously-implanted chambers, can lead to adverse pregnancy outcomes including decreased fetal weight and an increase in embryo lethal and fetal malformations.<sup>11</sup> The data of the study provided evidence that periodontal infection can provide a microbial challenge to induce fetal growth retardation.

### Conclusion

In conclusion, in our study, periodontal status and gestational age emerged as risk factors for LBW. Thus, treatment of the periodontal disease during pregnancy is safe and control of oral diseases improves a woman's quality of life and has the potential to reduce the transmission of oral bacteria from mothers to children.<sup>12</sup> Hence, large multicentre trials are necessary to provide oral hygiene care and prevent development of disease in the early pregnancy for the reduction of pre term and low birth weight of infants.

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