Original Article

Periodontitis as a Risk Factor for Preterm Low Birth Weight Infants: A Clinico-Epidemiological Evaluation

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ABSTRACT

Background: There is growing evidence showing that a number of complex human diseases are caused or are at least influenced by periodontal diseases. Such diseases include cardiovascular diseases, respiratory diseases, diabetes mellitus, and osteoporosis. **Aim:** The aim of the present study was to evaluate periodontal diseases as a risk factor for preterm low birth weight infants. **Methods:** A case-control study with a selection ratio of 1:1 was performed using 150 cases and 150 controls, who delivered their babies at Vanivilas Hospital, Bangalore, India, over a 3-months period from January 2012–March 2012. Cases were defined as mothers delivering an infant weighing less than 2,500 gms and born before 37-weeks gestation. Controls were mothers delivering an infant weighing more than 2,500 gms and born after 38-weeks gestation. Patients were evaluated for age, socioeconomic status, obstetric risk, nutritional status, maternal morbidity, infections, toxic exposure, antenatal care, infant characters, through hospital records and personal questionnaire by incharge team members. Oral examination was performed using Extent and severity index, Sulcus Bleeding Index. **Results:** Cases and controls did not reveal any significant difference when compared for age, socioeconomic status, obstetric risk, nutrition, maternal morbidity, and antenatal care. Periodontal disease was more severe and extensive in cases when compared with control and the difference was statistically significant (P<0.001). Bleeding index scores were higher in cases as compared to control and was statistically significant (P<0.001). **Conclusion:** Within the limits of this study, it is concluded that a poor periodontal health status of the mother may be a potential risk factor for a preterm low birth weight.

KEY WORDS: Cytokines, preterm low birth weight, periodontitis, socioeconomic status

INTRODUCTION

Periodontitis is a complex microbial disease affecting the supporting structures of the tooth. It is initiated by oral pathogens and is considered that the severity of periodontal disease is dependent on the response of host to periodontal pathogens.[1]

The concept that periodontal disease might influence systemic health is not new. In 1900, William Hunter[2], a British Physician identified gingivitis and periodontitis as foci of infection. He advocated extraction of teeth with these conditions to eliminate the source of sepsis.

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The focal infection theory fell into disrepute in the 1940s and 1950s when extraction of the entire dentition failed to reduce or eliminate the systemic conditions. However, it was not until the last decade of the twentieth century that dentistry and medicine again began to examine the relationship of oral infection as a risk for systemic disease.

Preterm low birth weight (PLBW) is defined as an adverse pregnancy outcome where the infant weighs less than 2,500 gms and born before 37 weeks of gestational age.[3]

It is a well-recognized fact that, PLBW is associated with increased morbidity, mortality, and societal cost across the world. It is one of the leading causes of death in infants. Respiratory distress[4], cerebral palsy,[5] and learning

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disorders are among of the long-term disabilities of PLBW. Recent epidemiological and microbiological–immunological studies have suggested that periodontal diseases may be an independent risk factor for PLBW.

Abramowicz and Kass[6] in their classic series of articles in 1966 reported a large number of risk factors which are associated with preterm birth. Some reproducible factors associated with PLBW are demographic factors such as, age, race, socio, economic status, marital status, and behavioral factors as smoking, substance abuse, poor nutrition, excessive physical activity are included. Apart from these medical risk factors which includes, predating pregnancy, poor obstetric history, uterine or cervical malformations/myomas, and pregnancy complications such as multiple gestation, abnormalities in amniotic fluid volume, vaginal bleeding, fetal abnormalities, serious infection, and abdominal surgeries constitute and play a role in PLBW.

During pregnancy, maternal hormones and locally acting cytokines play a key role in regulating the onset of labor. But periodontal infection during pregnancy has been demonstrated to perturb this normal cytokine and harmone-regulated gestation, sometimes resulting in preterm labor, preterm rupture of membranes and PLBW.[7-9] Blood samples analyzed from fetal cords of PLBW infants revealed the presence of immunoglobulin M (IgM) antibody[10] against various periodontal pathogens. Chronic periodontal infection can mediate its systemic effect leading to PLBW through one or more of the following mechanisms:

- Translocation of periodontal pathogens to fetoplacental unit[11,12]
- Action of periodontal reservoir of lipopolysaccharides on fetoplacental unit[13,14]
- Action of a periodontal reservoir of inflammatory mediators (IL-1, IL-6, TNF∝, PGE_2) on the fetoplacental unit.

Estimated overall global incidence rate of PLBW in 2010 was 10.6 million births, or 27% of all births worldwide, were PLBW. The prevalence of PLBW babies ranged from 5.3% of live births in East Asia to 41.5% in south Asia. Most PLBW infants were born in India, Pakistan, Nigeria, and Bangladesh.[15] The frequency of PLBW in periodontitis patients is 3.3-5.7%.[16]

Hence, the aim of the present study was to determine whether prevalence of periodontal infection in post-partum mothers could be associated with PLBW babies, and also identify associations between other risk factors such as age, socioeconomic status, obstetric risk, nutritional status, maternal morbidity, infections, toxic exposure, antenatal care and PLBW in this population.

METHODS

This was a case-controlled study of post-partum mothers within the age range of 20-29 years conducted at Vanivilas Hospital, Bangalore over a 3-months period from January 2012-March 2012.

A case-control study with a selection ratio of 1:1 was performed using 150 cases and 150 controls, who delivered their babies at Vanivilas Hospital, Bangalore.

After obtaining the institutional approval and ethical clearance, hospital records pertaining to each delivery occurring during the study period was screened and cases and controls identified. The selection of cases and controls was done by the hospital incharge member based on the hospital records, pertaining to inclusion and exclusion criteria. After screening of hospital records, 150 cases and 150 controls were included in the study. Cases are defined as mothers delivering an infant weighing less than 2,500 gms and born before 37 weeks of gestation. Controls are mothers delivering an infant weighing more than 2,500 gms and born after 38-weeks gestation. A single trained and calibrated clinician who was blind to the selection process carried out the clinical examination. Subjects were screened within 24 hours after delivery. Patients were evaluated for age,[17] socioeconomic status, obstetric risk,[18] nutritional status,[19] maternal morbidity, infections,[20,21] toxic exposure,[22,23] antenatal care,[24] infant characters, through hospital records and personal questionnaire by clinician. Exclusion criteria include mothers with diabetes, asthma, heart disease, glomerulonephritis, hypertension, hyperthyroidism, antibiotic treatment up to 7 days prior to delivery and mothers who have undergone dental treatment (i.e. oral prophylaxis) within 1-year period before delivery. Assessment of socioeconomic status for individual patients was expressed using modified "Kuppuswamy's Socioeconomic Status Scale" (2003).[25]

Oral examination was performed using a disposable periodontal probe (Hu- Friedy PCP-UNC 15, Chicago, IL, USA) to assess clinical attachment loss and bleeding on probing. Following two indices were used for the same:

a) Extent and severity index (Carlos, Wolfe and Kingman, 1986):[26]

This is a simple method for evaluating periodontal disease in epidemiologic studies. The extent and severity index (ESI) of periodontal disease was developed to provide separate estimates of the extent and severity of periodontal disease in individuals and population. Clinical attachment levels were measured at 14 sites in one maxillary quadrant and 14 in the contra-lateral mandibular quadrant. Clinical attachment

levels (CAL) was measured from the cemento-enamel junction (CEJ) to the base of the sulcus/pocket at the midbuccal and mesiobuccal aspects of all teeth (except 3rd molars). Sites were considered diseased only when attachment loss exceeds 1 mm. Thus, the additional vector was generated, where $d_i = 1$ if $x_i > 1$ and $d_i = 0$, otherwise.

Disease extent E, is simply expressed as the percentage of those sites actually examined which exhibit disease (clinical attachment loss).

$E = {}^{n}\Sigma_{i-1}\ d_i \times 100/n$ which corrects for variation in the number of sites at risk when $n < N$.

Disease severity S, is expressed as the mean loss of attachment in excess of 2 or 3 mm for sites where $d_i = 1$.

$S = {}^{n}\Sigma_{i-1}\ [d_i\ (x_1\text{-}1)]/\Sigma\ d_i$

b) Sulcus bleeding index (SBI; Muhlemann and Son, 1971):[27]

The purpose of this index was to locate areas of gingival sulcus bleeding upon gentle probing and thus recognize and record the level of inflammation of the periodontal tissues.

Statistical analysis

In the present study, the data was analyzed using SPSS Statistics for Windows, Version 17.0. Chicago, SPSS Inc. The statistical inference was obtained by applying Z-test and Chi-square test. But when the expected self frequency is <5, Chi-square test cannot be applied. Therefore, Fisher's exact probabilities are computed. The statistical significance level set at $P < 0.05$.

RESULTS

A total of 300 patients were included in the present study. The age-group of mothers ranged from 18-35 years, although cases were slightly older than controls. Old maternal age did not significantly affect PLBW.

In both cases and control groups, most mothers belonged to Group IV (lower) and Group V (upper lower) as per modified Kuppuswamy's classification (Cases: Group IV- 52.66% [79/150]; Group V- 42% [63/150] and Controls: Group IV- 57.33% [86/150]; Group V- 38% [57/150]). Previous records and personal interviewing of the mothers in both the cases and control groups did not show significant co-relationship with obstetric risk factors like, spontaneous abortion, gravida, and parity except for previous history of low birth weight which was positive in six cases and was statistically significant. The nutritional status and maternal illness of the mother's in both cases and controls had no significant difference.

In both the groups, the incidence of smoking and alcohol use, the two traditional risk factors for PLBW was very low. In the present study, since all the patients gave a negative history with respect to toxic exposure, no conclusions could be drawn on the effects of tobacco smoke and PLBW. Similarly, antenatal care also did not show any significant difference [Table 1].

In cases, 84% (126/150) PLBW infants were born during 32-37 weeks while 16% (24/150) were born during 28-32 weeks of their gestational age with the mean weight of 1.91 (0.28) Kgs.

But while comparing for extent and severity index a mean of 53.62 and 30.58 was obtained in cases and controls for extent and the difference between these means was found to be statistically significant ($Z = 6.15$, $P < 0.001$). Similarly, a mean of 1.02 and 0.72 was obtained in cases and controls for severity respectively. Z-value computed was 5.47. Hence, the percentage of distribution between cases and controls for severity was highly significant with $P < 0.001$. Evaluating for bleeding index, a mean of 9.61 and 8.32 bleeding index score were obtained in cases and controls respectively which was found to be statistically significant ($Z = 1.96$, $P < 0.01$) [Table 2].

DISCUSSION

Worldwide, in all population groups, birth weight is the most important determinant of the chances of a newborn infant to survive, grow, and develop healthy. In the hope of improving the outcomes of preterm low birth weight babies, physicians and investigators have shifted their attention from symptomatic care to prevention of

Table 1: Maternal and obstetric variables of post-partum study subjects

Parameter	Case (*n*=150)		Control (*n*=150)		Z-value	*P* value
	Mean (SD)	SE (mean)	Mean (SD)	SE (mean)		
Age (years)	23.26 (3.11)	0.25	23.32 (2.87)	0.23	−0.19	0.84
Nutrition	54.79 (6.03)	0.49	55.63 (6.45)	0.52	−1.16	0.24
Infant weight (kgs)	1.91 (0.28)	0.02	2.95 (0.321)	0.026	−29.79	<0.001
ANC (visits;*n*)	7.12 (2.65)	0.22	7.3 (2.26)	0.18	0.63	0.52
Gravidity (*n*)	1.69 (0.71)	0.06	1.45 (0.612)	0.05	−1.48	0.13
Parity (*n*)	1.45 (0.61)	0.05	1.58 (0.66)	0.05	−1.8	0.07

SD – Standard deviation; SE – Standard error

Table 2: Periodontal variables of post-partum study subjects

Parameter	Case (*n*=150)		Control (*n*=150)		Z-value	*P* value
	Mean (SD)	SE (mean)	Mean (SD)	SE (mean)		
Extent (%)	53.62 (32.31)	2.63	30.58 (32.49)	2.65	6.15	<0.001
Severity (mm)	1.02 (0.4)	0.03	0.72 (0.54)	0.044	5.47	<0.001
Bleeding index score	9.61 (7.94)	0.65	8.321 (1.49)	0.12	1.96	<0.001

SD – Standard deviation; SE – Standard error

underlying causes.[28,29] Present data suggests that more severe periodontal disease was found in PLBW mothers as compared to full-term normal birth weight mothers.[30-33]

Results of present study show that there was no significant difference between cases and control when compared for age, socioeconomic status, obstetric risk, nutrition, maternal morbidity, and antenatal care. Beydoun *et al*.,[34] reported that maternal age at first child birth above 25 years is an independent risk factor for low birth weight, but not for preterm delivery this is in agreement with the current study. Socioeconomic status when compared between the cases and controls showed that most of subjects belonged to Group IV and Group V lower and upper lower category, respectively (Kuppuswamy's classification). Similar results were reported by Hidalgo *et al*.[35]

In the studies published by Kramer *et al.*,[18] and Blondel *et al.*,[36] obstetric factors increased the risk for PLBW. In contrary to this, current study revealed that both the cases and control groups did not show significant co-relationship between PLBW and obstetric risk factors except for previous history of low birth weight which was positive in six cases. The nutritional status and maternal illness of the mother's in both cases and controls had no significant difference. This finding is consistent with the study reported by Christian *et al*.,[37] and Kramer *et al*.,[18] respectively.

In current study, association of antenatal care with PLBW was not significant when compared between both the groups. This finding was supported by Kramer *et al*.[18] In contrary to this, Herbst *et al*.,[24] reported that preterm labor and low birth weight were common in mothers with no prenatal care when compared with mothers with proper prenatal care.

Whereas periodontal disease was more severe and extensive in cases when compared with control with mean clinical attachment for all cases, E = 53.62 and S = 1.02, and for control mothers, E = 30.58 and S = 0.72, the difference was statistically significant ($P < 0.001$ and $P < 0.002$ for extent and severity, respectively). Similar results were reported by several authors.[30,38-41] Bleeding index scores were higher in cases as compared to control. This result was in accordance with studies conducted by Grandi *et al*.,[42] and Satheesh M *et al.*[43] Hence, periodontal disease could be considered as one of the risk factor for PLBW infants.

CONCLUSION

The results obtained in this study, provides additional evidence that periodontal disease in pregnant women may be a significant risk factor for preterm low birth weight. Since periodontal diseases are both preventable and treatable, for this reason, may ultimately provide an opportunity to further decrease the incidence of PLBW in the population.

However, it remains to be seen whether larger prospective studies can confirm this strong link between periodontal diseases and PLBW and also whether periodontal therapy can reduce the risk of PLBW.

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