Review Article

Association of pregnant women periodontal status to preterm and low-birth weight babies: A systematic and evidence-based review

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ABSTRACT

The mouth serves as a mirror to general health and also as a portal for disease to the rest of the body. 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. In the past decade, there has been mounting scientific evidence suggesting that periodontal disease may play an important role as a risk factor for adverse pregnancy outcomes. Considering all the above stated factors this systematic review is aimed to focus on the association of periodontal diseases to preterm and low-birth weight (LBW) babies. In view of the large body of literature the review is limited to studies identified by computer searching. Hand searching of journals and gathering of unpublished reports and conference proceedings was outside the scope of the review. The PubMed database was searched using the search terms: periodontitis, preterm, LBW. The titles, authors, and abstracts from all studies identified by the electronic search were printed and reviewed independently on the basis of keywords, title and abstract, to determine whether these met the inclusion criteria. The electronic search identified 68 papers. After review of the study title, keywords and abstracts, 62 papers were identified potentially meeting inclusion criteria. Generally, all the studies reviewed in the paper suggest that periodontal disease may be a potential risk factor for preterm LBW babies.

Key Words: Low birth weight, periodontitis, preterm birth, systematic review

INTRODUCTION

The mouth serves as a mirror to general health and also as a portal for disease to the rest of the body.[1] 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.[2] It is well known that hormonal changes during pregnancy are associated with oral mucosal changes most of which are reversible clinically.[3,4] The reasons for these changes are not well established. However, they can complicate pregnancy.[5] Of all the changes, the ones most well written about is pregnancy gingivitis and pregnancy epulis (alternate names – pregnancy tumour, epulis gravidarum, pregnancy granuloma).[6] Periodontitis can be considered a continuous pathogenic and inflammatory challenge at a systemic level, due to the large epithelium surface that could be ulcerated in the periodontal pockets. This fact allows bacteria and their products to reach other parts of the organism, creating lesions at different levels. Some bacterial species, like Porphyromona gingivalis and Aggregatibacter actinomycetemcomitans (previously named Actinobacillus actinomycetemcomitans) can directly invade cells and tissues. This exposition to Gram-negative bacteria and their products can generate an immuno-inflammatory response with potential damage to different organs and systems. Thus, in the last decade, periodontal infections have been associated with different systemic diseases, e.g., preterm low birth weight (LBW).[7]
Pre-term (PT) birth is a major cause of infant mortality and morbidity that has considerable societal, medical, and economic repercussions. The rate of PT birth appears to be increasing worldwide and efforts to prevent or reduce its prevalence have been largely unsuccessful. If periodontal disease is associated with higher risk of adverse pregnancy outcome in these specific populations, large multicenter randomized-controlled trials will be needed to determine if prevention or treatment of periodontal disease, perhaps combined with other interventions, has an effect on adverse pregnancy outcome in these women.\(^8\)

LBW, which is defined by WHO\(^9\) as a birth weight of less than 2500 gms is a well documented risk factor for neonatal and infant morbidity as well as mortality. The theory that periodontal infection may contribute to LBW was first tested by Collins et al. (Collins, 1994) who demonstrated significant mechanisms that involve bacterially induced activation of cell-mediated immunity, which leads to production of cytokines (such as interleukins [IL-1 and IL-6] and tumor necrosis factor alpha [TNF-α]) and the ensuing synthesis and release of prostaglandins (especially prostaglandin E2 [PGE2]). In the past decade, there has been mounting scientific evidence suggesting that periodontal disease may play an important role as a risk factor for adverse pregnancy outcomes. Considering all the above stated factors this systematic review is aimed to focus on the association of periodontal diseases to preterm and LBW babies.

**PROPOSED HYPOTHETICAL MODEL OF PERIODONTITIS CAUSING PRETERM LOW-BIRTH WEIGHT BABIES (PLBW)**

Proposed hypothetical model cited in the article of Yeo et al.\(^{10}\) 2005 is illustrated in a modified version in Figure 1.

Periodontitis is a multifactorial disease. Although the primary etiology of periodontal diseases is bacterial, host and environmental factors modulate the severity of the disease. Host and environmental factors include genetics, chronic disease, tobacco use, socioeconomic level, educational level, frequency of dental visits, and both local and systemic nutrition and host response and its impact on periodontal disease. Dental professionals need to routinely assess the optimal functioning of the immune system in combating infection and to promote optimal periodontal health.\(^{11}\)

**EVIDENCE OF PERIODONTAL PATHOLOGIES AS A POTENTIAL RISK FACTOR FOR PLBW**

Chronic periodontitis has been proposed as a risk factor for preterm birth.\(^{12}\) Multiple factors coupled with periodontitis have been associated with LBW along with the summarization of few supporting articles are charted out in Table 1.

![Figure 1: Proposed hypothetical model cited in the article of Yeo et al. 2005 is illustrated in a modified version](image)

**Table 1: Risk factors for preterm birth**

| Risk factor                              | Modifiable |
|-----------------------------------------|------------|
| Smoking\(^{13-15}\) (Jeffcoat 2001, Goldenberg 2003, Marakoglu 2008) | Yes        |
| Alcohol\(^{13-15}\) (Jeffcoat 2001, Goldenberg 2003, Marakoglu 2008) | Yes        |
| Weight\(^{13,15}\) (Jeffcoat 2001, Marakoglu 2008) | Yes        |
| Multifetal Pregnancies\(^{13,15,16}\) (Jeffcoat 2001, Marakoglu 2008, Offenbacher 2004) | No         |
| Mothers medical problems\(^{13,15,16}\) (Jeffcoat 2001, Marakoglu 2008, Offenbacher 2004) | Variable   |
| Abnormal placenta uterus or cervix\(^{13,15}\) (Jeffcoat 2001, Marakoglu 2008) | No         |
| Previous preterm birth\(^{13-15}\) (Jeffcoat 2001, Marakoglu 2008) | No         |
| Periodontal disease\(^{13-17}\) (Jeffcoat 2001, Goldenberg 2003, Marakoglu 2008, Offenbacher 2004, Lopez 2002) | Unknown    |
| Maternal Age\(^{15,16}\) (Marakoglu 2008, Offenbacher 2004) | No         |
| Low socioeconomic status\(^{15,16}\) (Marakoglu 2008, Offenbacher 2004) | No         |
In an attempt to identify modifiable risk factors for LBW, Dasanayake et al.\textsuperscript{[18]} in 2001 have reported that a pregnant woman’s poor periodontal health may be an independent risk factor for LBW. The periodontal diseases share many common risk factors with PLBW. Few risk factors and the corresponding reference articles supporting this are enumerated in Table 2.

**ROLE OF INFECTION IN PLBW**

Infection is now considered one of the major causes of PLBW deliveries, responsible for somewhere between 30% and 50% of all cases. Bacterial infection of the chorioamnion, or extraplacental membrane, may lead to chorioamnionitis, a condition strongly associated with premature membrane rupture and preterm delivery.\textsuperscript{[21]}

**REVIEW OF EPIDEMIOLOGICAL STUDIES ON PERIODONTITIS AND PLBW**

Offenbacher et al.\textsuperscript{[26]} conducted a case-control study of 124 pregnant or postpartum women in 1996. Multivariate logistic regression models, controlling for other risk factors and covariates, indicated that periodontal disease is a significant risk factor, with impressively high odds ratios of 7.9 for mothers of preterm LBW babies and 7.5 for mothers giving birth for the first time.

Offenbacher et al. in 1998\textsuperscript{[27]} a study of 48 women between cases and controls, found that the case group, i.e., mothers of preterm had worse periodontal disease than control group, finding them in higher levels of PGE2 and IL - lb, as well as periodontal pathogens. In that sense, these biochemical and microbiological tests, more accurately diagnosed with periodontal status.

Hill. (1998)\textsuperscript{[28]} suggested the potential of periodontal bacteria to produce infection in the upper genital tract in pregnant women, leading to preterm delivery. Found species of *Fusobacterium nucleatum* and *Capnocytophaga* in the amniotic fluid cultures in women with preterm labor. He indicated that at least a portion of the bacteria responsible for genital infection cannot occur in the vagina, but in the patient’s mouth.

More recently, Offenbacher’s group in 1999\textsuperscript{[29]} analyzed blood samples from fetal cords for the presence of immunoglobulin M (IgM) antibody against various periodontal pathogens. Of the PLBW samples, 33.3% tested positive for IgM against the test bacteria, whereas only 17.9% of the normal birth weight samples tested positive. Of the 13 periodontal pathogens included in the analysis, IgM antibodies against *Campylobacter rectus*, *P. gingivalis* and *F. nucleatum* were most often encountered. Although both preterm and normal birth weight infants had foetal cord IgM directed against specific bacteria, these fetal immune responses indicate that maternal periodontal infections can provide a systemic challenge to the foetus in uteri. Collectively, these animal and clinical studies clearly indicate an association between periodontal infection and adverse pregnancy outcomes.

Engebretson et al. in 2000\textsuperscript{[30]} determined from a study of 164 women, mothers of preterm had significantly higher levels of periodontal pathogens. Furthermore, they suggested that periodontal treatment in pregnant women may substantially reduce the risk of having premature babies with LBW.

Recent review by Xiong et al. in 2006\textsuperscript{[31]} suggest periodontal disease, as a source of sub clinical and persistent infection, may induce systemic inflammatory responses that increase the risk of adverse pregnancy outcomes. Periodontal disease may be associated with an increased risk of adverse pregnancy outcomes. However, more methodically rigorous studies are needed for confirmation.

To examine the existing evidence on the relationship between periodontal disease and adverse pregnancy outcomes, Xiong et al.\textsuperscript{[32]} conducted a systematic review of studies published up to December 2006. Studies published in full text were identified by searching computerized databases (e.g., Medline,
Embase). A meta-analysis was performed to pool the effect size of the clinical trials. Forty-four studies were identified (26 case-control studies, 13 cohort studies, and 5 controlled trials). The studies focused on preterm LBW, preterm birth, and birth weight by gestational age, miscarriage or pregnancy loss, preeclampsia, and gestational diabetes mellitus. Of the chosen studies, 29 suggested an association between periodontal disease and increased risk of adverse pregnancy outcome (odds ratios [ORs] ranging from 1.10 to 20.0) and 15 found no evidence of an association (ORs ranging from 0.78 to 2.54). A meta-analysis of the clinical trials suggested that oral prophylaxis and periodontal treatment may reduce the rate of preterm LBW (pooled risk ratio (RR): 0.53, 95% confidence interval [CI]: 0.30-0.95, \( P < 0.05 \)), but did not significantly reduce the rates of preterm birth (pooled RR: 0.79, 95% CI: 0.55-1.11, \( P > 0.05 \)) or LBW (pooled RR: 0.86, 95% CI: 0.58% 1.29, \( P > 0.05 \)). The authors conclude that periodontal disease may be associated with increased risk of adverse pregnancy outcomes.

**TRANSLOCATION OF PERIODONTAL PATHOGENS TO THE FETOPLACENTAL UNIT**

No bacterial organisms are identified in 18% to 49% of histologically inflamed chorioamnionic membranes.\(^{33,34}\) As a result, it is generally maintained that the role of periodontal infection as a possible risk factor for PLBW more likely involves translocation of bacterial products (specifically LPS) or inflammatory mediators (specifically IL-1, IL-6, TNF-\( \alpha \), and PGE2) rather than bacteremic spread and translocation of the bacteria themselves.\(^{35}\) Most bacteria associated with progressive periodontitis are anaerobes, which find aerobic settings so inimical that they would rarely survive to enter the bloodstream,\(^{36}\) let alone establishing an infection in the foeto-placental unit. According to Qureshi et al. in 2005\(^{37}\) histologically confirmed that chorioamnionitis is not associated with active infection in genito-urinary tract and results of the culture are negative.

**INTERVENTION STUDIES ON THE EFFECT OF PERIODONTAL TREATMENT IN THE INCIDENCE OF PRETERM BIRTHS OR LOW BIRTH WEIGHT**

Lopez et al. in 2002\(^{38}\) had conducted a randomized controlled trial (RCT) in which it was concluded that periodontal treatment reduces significantly the incidence of PB or LBW in women with periodontitis.

Michalowicz et al.,\(^{39}\) has done a RCT where no statistically significant differences were found and periodontal treatment did not significantly alter rates of PB.

Offenbacher et al. in 2006\(^{40}\) did a RCT wherein significant differences were found and they concluded that periodontal treatment reduces the incidence of PB.

**RESULTS OF THE SYSTEMATIC REVIEW**

**Sources of data**

In view of the large body of literature on periodontitis, preterm and LBW babies the review is limited to studies identified by computer searching. The inclusion criteria of the review was randomized controlled trials, cohort studies, case-control studies, and all types of reviews with an implicit or an explicit mention of the hypothesis that periodontitis and preterm low birth babies have some association. The PubMed being a relevant computerized data base was used. We searched the Pubmed database for eligible studies from their earliest date to January 30, 2010. PubMed was searched using the keywords: periodontitis, preterm, LBW.

The titles, authors, and abstracts from all studies identified by the electronic search were reviewed independently on the basis of keywords, title and abstract, to determine whether these met the inclusion criteria. Systematically all the studies that were an output of the search which included both that showed an association and that did not show an association of the study variables were included in the review.

**Results of the review**

The electronic search identified 68 papers. After review of the study title, keywords, and abstracts, 62 papers were identified potentially meeting inclusion criteria. Also, the references of the above mentioned studies were also checked for [Tables 3 and 4].

**LIMITATIONS OF THE REVIEW**

The review’s discussions, conclusions are limited to the articles searched by the authors through the computerized database. The inclusion criteria of the review are randomized controlled trials, cohort studies, case-control studies, and all types of
Table 3: Articles showing periodontitis is associated with Preterm, Low birth weight, Preterm lowbirth weight TLBW

| Authors/Year               | Study design | Sample size | Results                                                                 | Study conclusion                                                                 |
|----------------------------|--------------|-------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Guimaraes et al. 2010[41] | Descriptive study | 1207 women | Periodontal disease was associated with fewer weeks of gestation by linear regression | Periodontal disease is associated with a premature or extremely premature birth |
| Rakoto-Alson et al. 2010[42] | Cohort study | 204 pregnant women | The rates of periodontitis were considerably higher in PB (78.6%), LBW (77.3%), and PLBW (77.8%) groups than in the full-term (8.6%), normal weight (16.5%), and normal birth (2.7%) groups. | There is a strong association among Periodontitis, PB, and LBW |
| Lin et al. 2009[43] | Case-control study | 60 women (30 PLBW and 30 healthy women) | The PLBW cases had a poorer oral conditions and the presence of P. gingivalis was found in a higher proportion in the PLBW than the healthy pregnant | There may be a possible link between periodontal diseases and PLBW |
| Africa et al. 2009[44] | Descriptive study | 66 women | Perioscan results showed an association with the indices used to diagnose periodontal disease | Periodontal disease could be associated with preterm delivery of low birth-weight infants |
| Sha et al. 2009[45] | Review | Review | Review | oral health instruction and periodontal treatment may decrease the infection of periodontal pathogens and reduce the risk of PLBW |
| Khader et al. 2009[46] | Case-control study | 148 woman who gave preterm birth/low birth weight birth and 438 women with uncomplicated full term vaginal delivery | The average of probing pocket depth (PPD) and average of clinical attachment level (CAL) were significantly higher among women who gave PLBW babies | The extent and severity of periodontal diseases appeared to be associated with increased odds of PLBW delivery |
| Radnai et al. 2008[47] | Intervention study | 80 pregnant women who received professional oral hygiene treatment including plaque and calculus removal, root planing, motivation and instruction (treatment group); only the periodontal status was recorded in 79 cases (control group) | The delivery occurred later in the treatment group (37.0 week), than among the control group (36.4 week), although the difference was not significant (P = 0.059) | Periodontal treatment completed before the 35th week appeared to have a beneficial effect on birth weight and time of delivery. |
| Zanata et al. 2008[48] | Questionnaire study on knowledge | Seventy-nine obstetricians and 37 dentists responded the questionnaires | Forty-three percent of dentists and 34% of obstetricians did not know the potential contribution of periodontal infection as a risk factor for preterm low birth-weight babies | Dental management during pregnancy still presents some deviations from scientific literature recommendations |
| Águeda et al. 2008[49] | Review | Review | Review | There is a possible association between periodontitis and adverse pregnancy outcomes have been suggested |
| Betleja-Gromada et al. 2008[50] | Case-control study | 120 postpartum mothers | The microbial investigation for anaerobic bacteria of deepest periodontal pockets was performed in 35 cases of periodontitis | A significantly higher incidence of preterm low birth weight cases in patients with periodontitis |
| Sacco et al. 2008[51] | Review | Review | Review | There is an emerging evidence of a possible relationship between maternal periodontal diseases as a potential risk factor of adverse pregnancy outcomes, like preterm low birth weight |
| Silk et al. 2008[52] | Review | Review | Review | Appropriate dental care and prevention during pregnancy may reduce poor prenatal outcomes and decrease infant caries |

Contd...
### Table 3: Contd...

| Authors/Year          | Study design           | Sample size | Results                                                                                                                                                                                                 | Study conclusion                                                                                   |
|-----------------------|------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Marakoglu et al. 2008 | Cross sectional study  | 48 mothers, 20 of who had a preterm low birth weight delivery | The study results indicated that periodontitis together with bacterial vaginosis were independent risk factors of a preterm low birth weight                                                                 | Poor periodontal health status of the mother may be a potential risk factor for a preterm low birth weight |
| Mealey et al. 2008    | Review                 | Review      |                                                                                                                                           | Periodontal inflammation is associated with an elevated systemic inflammatory state and an increased risk |
| Vettore et al. 2008   | Case-control study     | 542 post partum women | Periodontal disease levels were higher in control individuals than in cases                                                                                                                                | The extent of periodontal disease did not increase risk of preterm low birthweight                |
| Agueda et al. 2008    | Prospective cohort study | 1096 women | The incidence of PLBW was 3.3%. Preterm Birth(PB) was related to mother's age, systemic diseases, onset of prenatal care, previous PBs, complications of pregnancy, type of delivery, the presence of untreated caries and the presence of periodontitis | There is a modest association between periodontitis and PB                                         |
| Wilder et al. 2007    | Questionnaire study on knowledge | One hundred ninety four practicing obstetricians, 55 responded | Most (84%) considered periodontal disease to be as important a risk factor to adverse pregnancy events as those currently known in obstetrics practice | The authors have concluded that there is knowledge of periodontal disease and its potential role as a pregnancy risk factor |
| Siqueira et al. 2007  | Case-control study     | 1,305 Brazilian women | After adjusting for variables of interest, maternal periodontitis was retained in the final model for PTB                                                                                               | Maternal periodontitis is associated with an increased risk for PTB, LBW                            |
| Seymour et al. 2007   | Review                 | Review      | Review                                                                                                                                                                                                 | Oral infection may represent a significant risk-factor for systemic diseases                      |
| Tarannum et al. 2007  | Interventional study   | 200 pregnant women | A multiple regression model showed a significant effect of periodontal treatment on birth outcomes                                                                                                     | Non-surgical periodontal therapy can reduce the risk for preterm births in mothers who are affected by periodontitis |
| Toygar et al. 2007    | Cross sectional study  | 3,576 Turkish women | The overall PTB rate was 12.5% (N = 447), and the LBW rate was 7.5% (N = 269). The mean birth weight and weeks of gestation decreased as the CPITN level increased (P < 0.001 for both) | Maternal periodontal disease may be a risk factor for an adverse pregnancy outcome                   |
| Sharma et al. 2007    | Cross sectional study  | 670 multiethnic pregnant women | More than 50% of this group displayed moderate to severe periodontitis compared with 13% of women who had a normal delivery                                                                                                    | There is a highly significant association between pre-term birth and moderate to severe periodontal disease |
| Sanchez et al. 2007   | Cross sectional study  | 113 pregnant patients | The prevalence of periodontitis and gingivitis in this population was 23.9% and 54%, while the prevalence of PT/LBW infants was 19%, 7%, and 13% among the patients with periodontitis, gingivitis, and healthy periodontium, respectively | Infant birth weight showed moderate relationships with maternal periodontal conditions in subjects with periodontal diseases |
| Michalowicz et al. 2006 | Interventional study | 413 patients in the treatment group or after delivery 410 patients in the control group | There were no significant differences between the treatment and control groups in birth weight or in the rate of delivery of infants that were small for gestational age                                                                 | Treatment of periodontitis in pregnant women improves periodontal disease and is safe but does not significantly alter rates of preterm birth, low birth weight, or fetal growth restriction |
| Radnai et al. 2006    | Case-control study     | Into the PB (case) group, 77 women were allocated, while 84 were included in the control group | A significant association was found between PB and initial chronic localized periodontitis                                                          | Initial chronic localized periodontitis of pregnant women could lead to PB, and birth-weight reduction. |

Contd...
| Authors/Year | Study design | Sample size | Results | Study conclusion |
|-------------|-------------|-------------|---------|-----------------|
| Urban et al. 2006 | Case-control study | Was not available | Was not available | Provides microbial evidence that maternal periodontal disease and the presence of key pathogens are significant contributors to the obstetric risk of preterm delivery. |
| Sadatmansouri et al. 2006 | Case-control study | 30 pregnant women, 15 controls and 15 cases | In the control group, the observed rate of PLBW was 26.7% whereas among periodontally treated group, phase I, PLBW infant was not observed (P < 0.05) | Periodontal therapy, phase I, results in a reduction in PLBW incidence rate |
| Lopez et al. 2005 | Randomized Control Trial | 870 pregnant women, 36 women (27 in the treatment group and nine in the control group) were excluded | Multivariate logistic regression analysis showed that, after adjusting for several known risk factors for PT/LBW, women with gingivitis were at a higher risk of PT/LBW than women who received periodontal treatment | Periodontal treatment significantly reduced the PT/LBW rate in this population of women with pregnancy-associated gingivitis. |
| Felice et al. 2005 | Review | | Review | There is growing evidence that periodontal disease represents a risk factor for preterm delivery and premature membrane rupture. |
| Pizzo et al. 2005 | Review | | Review | Randomized controlled studies published indicated that periodontal treatment significantly reduces the risk of PTD and LBW infants |
| Kazmierczak et al. 2004 | Review | | Review | Periodontitis should be regarded as a systemic disorder capable of affecting a pregnancy so prevention procedures should be introduced as soon as the problem is recognized |
| Marin et al. 2005 | Cross sectional study | 152 Caucasian pregnant women, healthy group (HG) (n = 38), gingivitis group (GG) (n = 71) and periodontitis group (PG) (n = 43). At delivery, birth weight was recorded. | The total incidence of preterm birth and LBW infants was 5.3% and 4.6%, respectively. Bleeding on probing was significantly greater in women with <2500 g infants compared with 2500-3499 g and > or = 3500 g | Periodontal disease in normal Caucasian pregnant women, older than 25 years, is statistically associated with a reduction in the infant birth weight |
| Rajapakse et al. 2005 | Prospective study | 227 women | After adjustment for the independent variables, the OR for preterm low birthweight in relation to “exposure” was 1.9 (95% CI = 0.7-5.4) | This study is suggestive of an association between periodontal disease and preterm low birthweight, perhaps indicating that previously reported associations may have been subjected to residual confounding due to tobacco, alcohol, and drug use. |
| Jarjoura et al. 2005 | Case-control study | compared women with a singleton gestation giving birth before the 37th week (cases, n = 83) with term delivery controls (n = 120) | Cases showed greater mean attachment loss and higher prevalence of periodontitis | The data support the notion that periodontitis is independently associated with PTB and LBW |
| Konopka T 2004 | Review | | Review | It’s possible that treatment of periodontitis may reduce the risk of preterm birth |
| Konopka T 2004 | Case-control study | 88 postpartum women, The case group consisted of 52 women with PLBW and the control group consisted of 36 women giving birth in time. | The levels of IL-1beta and PGE2 in gingival fluid were significantly higher in all PLBW mothers (also PLBW primiparous) than in the control group. | There were no significant differences between women with PLBW. R : Such findings suggest that inflammatory mediator synthesis is mainly result of specific cells exposition to bacterial products. Therefore it seems that more frequent occurrence of the phenotype of hyperactive cells that synthesize these mediators is not responsible for PLBW |

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The evidence linking periodontitis to early localized periodontal disease presents a significant risk for preterm low birth weight (PLBW) deliveries. In a study by Offenbacher et al. (2004), the adjusted prevalence rates among mothers with periodontal disease were significantly different from those without (n=566) and moderate-severe disease (n=45) by pair-wise comparisons to the periodontally healthy reference group (n=201) at P=0.017 and P < 0.0001, respectively. For those with low weight controls (n=41) and to the periodontally healthy reference group (n=44), the risk for PLBW decreased with increasing pocket depth. Early localized periodontal disease appears to be an independent risk factor for PLBW. Periodontal therapy significantly reduces the rates of low birth weight deliveries. Several aspects of this relationship remain to be elucidated. The mechanisms associated with the potential passage of periodontal bacteria across the placental barrier are needed to prevent and treat periodontal disease as a means of improving pregnancy outcomes. Providing evidence that maternal periodontal problems typical of pregnancy and the occurrence of complications such as preterm low birth weight, periodontal infection, serving as a reservoir for bacterial products (such as LPS) or various inflammatory mediators (or both), may play an important role in the development of PLBW. Chronic periodontal infection, with an increased risk for PLBW is limited. The data confirm that there is a possible correlation between periodontal problems typical of pregnancy and the occurrence of complications such as preterm low birth weight.

### Table 3: Contd...

| Authors/Year               | Study design        | Sample size | Results                                                                 | Study conclusion                                                                 |
|----------------------------|---------------------|-------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Sanchez et al. 2004[22]   | Review              | Review      | Review                                                                  | Review                                                                           |
| Radnai et al. 2004[24]    | Case-control study  | case (41) and to the control (44) | The average weight of the newborns in the periodontitis group was less than in the control group, the difference is significant (P = 0.047) | Early localized periodontitis of the patient during pregnancy can be regarded as an important risk factor for PB |
| Carta et al. 2004[23]     | Case-control study  | Unable to retrieve | Results indicate that gingival crevicular fluid (GCF)-PGE2 and GCF-IL-1beta levels are significantly higher in preterm low birth weight (PLBW) mothers as compared with normal birth weight controls | The data confirm that there is a possible correlation between periodontal problems typical of pregnancy and the occurrence of complications such as preterm low birth weight |
| Konopka et al. 2003[19]  | Case-control study  | The study group consisted of 84 women with PLBW, controls were 44 women who gave birth to normal weight babies | In case of the severe and generalized periodontitis presence there is 3.9 times higher possibility of PLBW compared to women with healthy periodontium | In all women with PLBW there is a significantly higher PGE2 and IL-1 beta concentration in GCF, and in primiparous also PGE2 level in blood serum, compared to controls |
| Madianos et al. 2002[27] | Review              | Review      | Review                                                                  | The evidence linking periodontitis with an increased risk for PLBW is limited     |
| Paquette DW 2002[29]      | Review              | Review      | Review                                                                  | Early data indicate that periodontal therapy administered to pregnant mothers with periodontitis can reduce the incidence of preterm low birth weight deliveries |
| Champagne et al. 2000[19] | Review              | Review      | Review                                                                  | Several aspects of this relationship remain to be elucidated                     |
| Lopez et al. 2002[17]     | Randomized control trial | 639 women studied, 406 had gingivitis and received treatment before 28 weeks' gestation, and 233 had PD and were treated after delivery | The incidence of PLBW was 2.5% in periodontally healthy women, and 8.5% in women with PD (P = 0.0004) | Periodontal disease appears to be an independent risk factor for PLBW. Periodontal therapy significantly reduces the rates of PLBW in this population of women with periodontal disease |
| Davenport et al. 2002[28] | Case-control study  | 236 cases (infants < 37 wks and weighing < 2499 g) and a daily random sample of 507 controls | The risk for PLBW decreased with increasing pocket depth | Our results do not support a specific drive to improve periodontal health of pregnant women as a means of improving pregnancy outcomes |
| Charlene et al. 2002[11]  | Review              | Review      | Review                                                                  | The literature suggests that more sex-specific research is essential to determine the strategies needed to prevent and treat adverse pregnancy outcomes through hormone modification and periodontitis control |
| McGaw 2002[21]            | Review              | Review      | Review                                                                  | Chronic periodontal infection, may play an important role in the development of PLBW |
| Offenbacher et al. 2001[20] | Prospective study | In the 5 year study the first 814 deliveries demonstrate that maternal periodontal disease at antepartum and incidence/progression of periodontal disease are significantly associated with a higher prevalence rate of preterm births | The adjusted prevalence rates among GA outcomes were significantly different for mothers with mild periodontal disease (n = 566) and moderate-severe disease (n = 45) by pair-wise comparisons to the periodontally healthy reference group (n = 201) at P = 0.017 and P < 0.0001, respectively | Provides evidence that maternal periodontal disease and incident progression are significant contributors to obstetric risk for preterm delivery, low birth weight and low weight for gestational age |
Table 3: Contd...

| Authors/Year            | Study design | Sample size       | Results                                                                 | Study conclusion                                                                 |
|-------------------------|--------------|-------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Sembene et al. 2000[83] | Cross sectional | 113 pregnant women | In spite of percentage of preterm low birth weight, we registered 33.9% babies of normal birth weight with mother’s CPITN under 1 | Studies to date have only shown an association between the two conditions, and this does not indicate a causal relationship. Since the inflammatory mediators that occur in the periodontal diseases, also play an important part in the initiation of labor, there are plausible biological mechanisms that could link the two conditions |
| Williams et al. 2000[19] | Review       | Review            | Review                                                                  | Review                                                                            |
| Fowler et al. 2001[84]  | Review       | Review            | Review                                                                  | Review                                                                            |
| Engebretson et al. 1999[27] | Case-control study | Review            | Review                                                                  | Review                                                                            |
| Offenbacher et al. 1998[27] | Case-control study | Review            | Review                                                                  | Review                                                                            |

reviews with an implicit or an explicit mention of the hypothesis that periodontitis and PLBW babies have some association. The limitations mentioned in the individual articles are also the limitations of the systematic review.

COMMUNITY PERSPECTIVE

In both developed and developing countries, PLBW has a tremendous impact on both the health care system and the individual families’ affected.[91] Periodontitis and its causal factors are the important risk factors for PTLW. At the community level there is a need for prevention of Periodontitis or at least early detection through dental visits. The community health centres’ need to provide dental camps at village/district levels so that women in general and pregnant women in particular have opportunities to rule out Periodontitis. Dental plaque is considered to be the main cause of Periodontitis. So organizing health promotion programs through dental camps and educating the rural public on various steps to be taken to prevent formation and accumulation of plaque is essential.

Oral health condition has to be investigated at rural level especially for all pregnant women and plaque formation/periodontitis has to be ruled out, so that even in case periodontitis is present, it can be cured in the initial stages. There should be an increase in the programs for pregnant women on the importance of oral health maintenance. By addressing the cause, health promotion regarding periodontitis can be done for pregnant women at a community level.

Promotion of oral health can be done through:
1. Health education programs at all the Maternal and Child Health Centres for the pregnant women should include dental care also.
2. Professional education through dental professionals and also the auxiliary personnel on the oral hygiene practices.
3. Marketing high quality products at affordable prices.
4. Reaching the unreached through NGOs or Government programs.
5. Organizing treatment camps on scaling throughout the reached dental centres.
6. Through health education programs emphasis on the various health problems that can occur in a
PTLB baby.
7. Incorporation of skills of oral hygiene into training of health education and social care professionals.

Preventive care services should be provided during early stages of pregnancy. Preliminary evidence to date suggests that periodontal intervention may reduce adverse pregnancy outcomes. However, women should be encouraged to achieve a high level of oral hygiene prior to becoming pregnant and throughout their pregnancies. Many factors associated with dental care use during pregnancy are not amenable to intervention; however, provision of counselling on oral health care by maternity care providers is a simple, low-cost intervention. Clinicians and public health care providers need latest practical information concerning dental care. This will facilitate development and implementation of oral health counselling, screening, and referral strategies. A diagrammatic presentation of a need for health promotion is enumerated in Figure 2.

Table 4: Articles showing periodontitis is not associated with PTLBW

| Authors/Year          | Study design      | Sample size | Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Study conclusion                                                                                                                                                                                                 |
|-----------------------|-------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ebersole et al. 2009  | Prospective study | Serum samples, obtained from pregnant women at baseline (13 to 16 weeks; 6 days of gestation) and 29 to 32 weeks, were analyzed by enzyme-linked immunosorbent assay | At baseline, women who delivered preterm infants had significantly lower total serum levels of IgG antibody to the panel of periodontal pathogens (P = 0.0018), to P. gingivalis (P = 0.0013), and to F. nucleatum (P = 0.0200) than women who delivered at term. These differences were not significant at 29 to 32 weeks | Changes in IgG antibody during pregnancy are not associated with birth outcomes                                                                                                                                                                                                |
| López R 2007          | Randomized control trial | 407 in treatment group and 405 in the control group | Preterm birth (before 37 weeks of gestation) occurred in 49 out of 407 women (12.0%) in the treatment group (resulting in 44 live births) and in 52 out of 405 women (12.8%) in the control group (resulting in 38 live births) | Treatment of periodontitis in pregnant women improves periodontal disease and is safe but does not significantly alter rates of preterm birth, low birth weight or foetal growth restriction                                                                                                                                                     |
| Bobetsis et al. 2006  | Review            | Review      | Review                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | There is insufficient evidence at this time for health care policy recommendations to provide maternal periodontal treatments for the purpose of reducing the risk of adverse pregnancy outcomes                                                                                                                                                   |
| Kurnatowska et al. 2006 | Case-control study | 80 pregnant women, 40 with pathologic pregnancy and 40 with normal pregnancy | In the searching group gingivitis gravidum haemorrhagica diffusa and hyperplastica generalisata were dominating. In the control group gingivitis gravidatum simplex and hyperplastica localisata were observed | Study did not prove correlation between amount of bacterial dental plaque in pregnant women and risk of preterm low birth weight                                                                                                                                                                                   |
| Meurman et al. 2006   | Retrospective cohort study | 207 women | In 72%, the delivery was uncomplicated and the CPI values did not differ between the groups | This study failed to show an association between poor dental health and pregnancy or delivery complications                                                                                                                                                                                                                           |
| Noack et al. 2005     | Case-control study | 59 cases and 42 controls | The mean percentage of sites showing moderate to advanced attachment loss (> or = 3 mm) was low in all study groups (group 1: 9.9 ± 11.2%; group 2: 10.6 ± 14.1%, respectively). No significant differences between the groups in any aspects of the studied periodontitis parameters could be detected | Periodontitis was not a detectable risk factor for preterm low birth weight in pregnant women                                                                                                                                                                                                                                  |
| Moore et al. 2004     | Prospective study | 3,738 subjects | Regression analysis indicated that there were no significant relationships between the severity of periodontal disease and either preterm birth (PTB) or low birth weight (LBW). In contrast, there did appear to be a correlation between poorer periodontal health and those that experienced a late miscarriage | There was no association between either preterm birth or low birth weight and periodontal disease in this population. There is evidence of a correlation between markers of poorer periodontal health and late miscarriage                                                                                                    |
CONCLUSION

Generally, all the studies reviewed in the paper suggest that periodontal disease may be a potential risk factor for preterm LBW babies. The increase in the infant mortality rates due to PLBW has been on the rise. Since periodontitis and its causes may be associated risk factors for preterm LBW babies, it is suggested to include the oral health condition of a pregnant woman along with other risk factors such as BP, blood sugar etc., especially in the rural areas. In cases of necessity, case has to be referred to a dentist for the needful. Health promotion at a community level is essential to prevent periodontitis to prove the old wives’ tale of “the loss of a tooth for every pregnancy,” wrong.

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