

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 Hand searching of journals and gathering of unpublished reports and conference proceedings was outside the scope of the review.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

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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 gra-vidarum, 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]

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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.

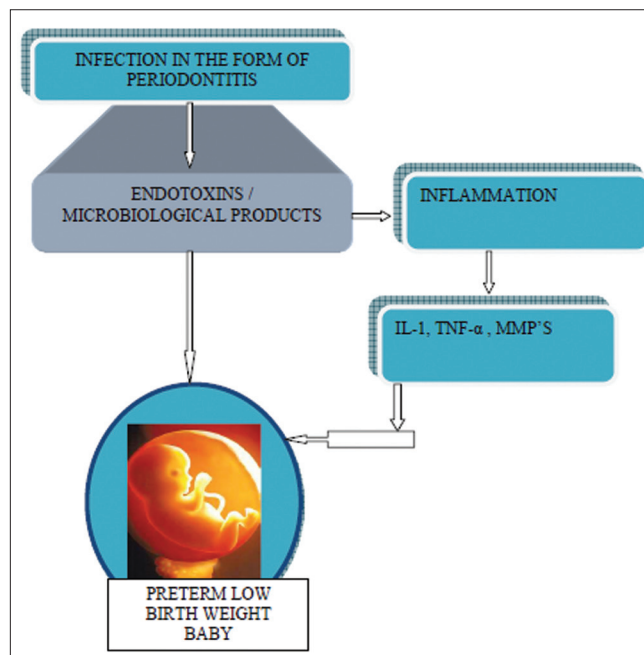


Figure 1: Proposed hypothetical model cited in the article of Yeo *et al.* 2005 is illustrated in a modified version

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.*^[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.^[21]

REVIEW OF EPIDEMIOLOGICAL STUDIES ON PERIODONTITIS AND PLBW

Offenbacher *et al.*^[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^[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 - 1b, as well as periodontal pathogens. In that sense, these biochemical and microbiological tests, more accurately diagnosed with periodontal status.

Hill. (1998)^[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^[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^[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^[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.*^[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,

Table 2: Risk factors for low birth weight babies

Risk factor	Modifiable
Smoking ^[19-21] (Williams 2000, National Academy Press: 1985, McGaw, 2002)	Yes
Alcohol ^[20,21] (National Academy Press: 1985, McGaw, 2002)	Yes
Socioeconomic status ^[19-21] (Williams 2000, National Academy Press: 1985, McGaw, 2002)	No
Infections in the foetus ^[21] (McGaw, 2002)	No
Chronic infections in the mother ^[21-25] (McGaw, 2002, Sanchez 2004, Offenbacher 1998, Romero 1988, Mc Donald 1991)	Variable
Age (Williams 2000, McGaw, 2002) ^[19,21]	No
Multiple Pregnancies ^[20,21] (National Academy Press: 1985, McGaw, 2002)	No
Periodontal disease ^[17,19,20-25] (Williams 2000, National Academy Press: 1985, McGaw, 2002, Sanchez 2004, Offenbacher 1998, Romero 1988, Mc Donald 1991, Lopez 2002)	Unknown

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 chorioamniotic 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- α , 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 printed and 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 <i>et al.</i> 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 <i>et al.</i> 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 <i>et al.</i> 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 <i>P. gingivalis</i> 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 <i>et al.</i> 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 <i>et al.</i> 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 <i>et al.</i> 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 <i>et al.</i> 2008 ^[47]	Intervention study	80 pregnant women 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 35 th week appeared to have a beneficial effect on birth weight and time of delivery.
Zanata <i>et al.</i> 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 <i>et al.</i> 2008 ^[49]	Review	Review	Review	There is a possible association between periodontitis and adverse pregnancy outcomes have been suggested
Bettleja-Gromada <i>et al.</i> 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 <i>et al.</i> 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 <i>et al.</i> 2008 ^[52]	Review	Review	Review	Appropriate dental care and prevention during pregnancy may reduce poor prenatal outcomes and decrease infant caries

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Table 3: Contd...

Authors/Year	Study design	Sample size	Results	Study conclusion
Marakoglu <i>et al.</i> 2008 ^[55]	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 <i>et al.</i> 2008 ^[53]	Review	Review	Review	Periodontal inflammation is associated with an elevated systemic inflammatory state and an increased risk
Vettore <i>et al.</i> 2008 ^[54]	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 <i>et al.</i> 2008 ^[7]	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 <i>et al.</i> 2007 ^[55]	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 <i>et al.</i> 2007 ^[56]	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 <i>et al.</i> 2007 ^[57]	Review	Review	Review	Oral infection may represent a significant risk-factor for systemic diseases
Tarannum <i>et al.</i> 2007 ^[58]	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 <i>et al.</i> 2007 ^[59]	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 <i>et al.</i> 2007 ^[60]	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 <i>et al.</i> 2007 ^[61]	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 <i>et al.</i> 2006 ^[39]	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 <i>et al.</i> 2006 ^[62]	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.

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Table 3: Contd...

Authors/Year	Study design	Sample size	Results	Study conclusion
Urban <i>et al.</i> 2006 ^[63]	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 <i>et al.</i> 2006 ^[64]	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 <i>et al.</i> 2005 ^[65]	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 <i>et al.</i> 2005 ^[66]	Review	Review	Review	There is growing evidence that periodontal disease represents a risk factor for preterm delivery and premature membrane rupture.
Pizzo <i>et al.</i> 2005 ^[67]	Review	Review	Review	Randomized controlled studies published indicated that periodontal treatment significantly reduces the risk of PTD and LBW infants
Kazmierczak <i>et al.</i> 2004 ^[68]	Review	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 <i>et al.</i> 2005 ^[69]	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 ≥ 3500 g	Periodontal disease in normal Caucasian pregnant women, older than 25 years, is statistically associated with a reduction in the infant birth weight
Rajakpaxse <i>et al.</i> 2005 ^[70]	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 <i>et al.</i> 2005 ^[71]	Case-control study	compared women with a singleton gestation giving birth before the 37 th 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 ^[72]	Review	Review	Review	It's possible that treatment of periodontitis may reduce the risk of preterm birth
Konopka T 2004 ^[73]	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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Table 3: Contd...

Authors/Year	Study design	Sample size	Results	Study conclusion
Sanchez <i>et al.</i> 2004 ^[22]	Review	Review	Review	The mechanisms associated with the potential passage of periodontal bacteria across the placental barrier
Radnai <i>et al.</i> 2004 ^[74]	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 <i>et al.</i> 2004 ^[75]	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 <i>et al.</i> 2003 ^[76]	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 <i>et al.</i> 2002 ^[77]	Review	Review	Review	The evidence linking periodontitis with an increased risk for PLBW is limited
Paquette DW 2002 ^[78]	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 <i>et al.</i> 2000 ^[79]	Review	Review	Review	Several aspects of this relationship remain to be elucidated
Lopez <i>et al.</i> 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 8.6% 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 <i>et al.</i> 2002 ^[80]	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 <i>et al.</i> 2002 ^[81]	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, 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
Offenbacher <i>et al.</i> 2001 ^[82]	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

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Table 3: Contd...

Authors/Year	Study design	Sample size	Results	Study conclusion
Sembene <i>et al.</i> 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	Not clear
Williams <i>et al.</i> 2000 ^[19]	Review	Review	Review	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
Fowler <i>et al.</i> 2001 ^[84]	Review	Review	Review	Early reports indicate the potential association between systemic and oral health. Additionally, these studies support the central hypothesis that periodontal disease involves both a local and a systemic host inflammatory response
Engebretson <i>et al.</i> 1999 ^[30]	Review	Review	Review	Reviews proposed mechanisms for such associations and outlines studies currently underway aimed at clarifying this issue
Offenbacher <i>et al.</i> 1998 ^[27]	Case-control study			These data suggest that biochemical measures of maternal periodontal status and oral microbial burden are associated with current PLBW

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

Table 4: Articles showing periodontitis is not associated with PTLBW

Authors/Year	Study design	Sample size	Results	Study conclusion
Ebersole <i>et al.</i> 2009 ^[85]	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 live preterm infants had significantly lower total serum levels of IgG antibody to the panel of periodontal pathogens ($P = 0.0018$), to <i>P. gingivalis</i> ($P = 0.0013$), and to <i>F. nucleatum</i> ($P = 0.0200$) 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 ^[86]	Randomized control trial	407 in treatment group and 405 in the control	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 <i>et al.</i> 2006 ^[87]	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 <i>et al.</i> 2006 ^[88]	Case-control study	80 pregnant women, 40 with pathologic pregnancy and 40 with normal pregnancy	In the searching group gingivitis gravidarum 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 <i>et al.</i> 2006 ^[89]	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 <i>et al.</i> 2005 ^[90]	Case-control study	59 cases and 42 controls	The mean percentage of sites showing moderate to advanced attachment loss ($> \text{ or } = 3 \text{ mm}$) was low in all study groups (group 1: $9.9 \pm 11.2\%$; group 2: $10.6 \pm 14.1\%$, 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 <i>et al.</i> 2004 ^[91]	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

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.^[92] 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.^[93] 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.^[94] A diagrammatic presentation of a need for health promotion is enumerated in Figure 2.

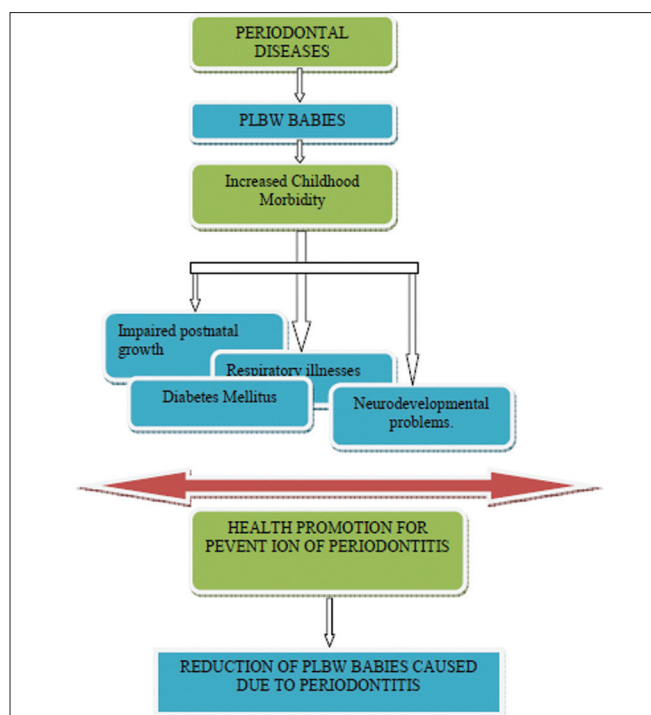


Figure 2: A diagrammatic presentation of a need for health promotion

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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