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ASSOCIATION BETWEEN MATERNAL GINGIVITIS, LOW BIRTH WEIGHT AND PRETERM DELIVERY

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ABSTRACT
Objective: To determine the association between maternal gingivitis and pregnancy outcome, including low birth weight (LBW) and preterm delivery.
This prospective study was conducted among 300 randomly selected pregnant women aged 20-34 years attending the antenatal clinic, University of Benin Teaching Hospital, Benin-City, Edo state. Data were collected by means of interviewer-administrated questionnaires, clinical examination using Gingival Bleeding Index and respondents' hospital records. The prevalence of gingival bleeding using Gingival Bleeding Index among the test group at 12 weeks was 91(63.2%) while control group was 66 (43.1%) which was significant. Prevalence of score 1 increased from 36.8% at 12weeks to 70.8% at 28 week; while score 2 decreased from 54.9% at 12weeks to 27.1% at 28weeks. Similarly, score 3 decreased from 8.3% at 12weeks to 2.1% at 28weeks which indicates a reduction in the number of women with spontaneous bleeding. The prevalence of gingival bleeding improved significantly from 91(63.2%) at 12weeks to 42(29.2%) at 28weeks.
Test group with reduced gingival bleeding did not have low birth weight deliveries. The 18 low birth weight deliveries in the study were from the untreated mothers. However the same test group had 27 (79.4%) out of the 34 preterm deliveries recorded in the study. This was not statistically significant ($p > 0.05$). There is some association between maternal gingivitis and pregnancy outcome. Further studies are necessary in the areas of microbiology, biochemistry of the subgingival flora and dietary analysis.

INTRODUCTION

Gingivitis is the inflammation of the various tissue components of the gingiva without destruction of the tooth supporting tissues. This is in response to the irritation of the gingival tissues by bacterial plaque. Good oral health is important across a person's life span. Pregnancy is a particularly important time to promote oral health and healthy behavior, including education about the prevention of gingivitis and other dental problems[1]. During pregnancy, many changes take place in both systemic and local environments leading to a significant increase in the severity of gingivitis. It may remain contained (limited to the gingiva) and largely reversible on removal of the plaque[2]. On the other hand, an established gingivitis lesion may spread into the deeper tissues to become a destructive chronic periodontitis[2]. Gingivitis is said to be more severe and exaggerated in pregnancy[3].

KEYWORD: Maternal gingival status and low birth weight, Preterm Delivery

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Where the mouth is clean gingivitis does not occur, but low-grade plaque can elicit severe inflammatory response during pregnancy[4]. Anaerobic bacteria colonize the depth of the gingival sulcus/pockets surrounding the teeth, leading to reversible damage to the gingival soft tissues or to irreversible damage to the underlying supporting tissues of the teeth in chronic periodontitis. The incidence of gingivitis in pregnancy has been reported to be between 30 and 100% [4, 5]. A multi-centre study in Thai reported an average of 98.4% prevalence of gingivitis among the pregnant women[5]. It is believed that increasing levels of progesterone produce an increase in vascularity with alterations in the walls of the gingival vessels which make them more permeable. A marked increase in the numbers of Gram-negative anaerobes in the subgingiva have also been ascribed to pregnancy hormones with resultant dissemination of microorganisms, or chemical mediators via the blood that alter or trigger physiological processes such as the duration of gestation[6].

Pregnancy is not a risk factor for gingivitis[7]. However, the microbial composition of subgingival plaque changes during pregnancy, so the ratio of Gram-negative bacterial species to aerobic species increases during the 2nd trimester. The changes usually start about the third month of gestation and the severity of the inflammation gradually increases during pregnancy, with partial or complete resolution after parturition[9,10,11]. Gingivitis has also been reported to peak at 6 months' of gestation and then resolves slightly in the third trimester[10]. These changes occur regardless of whether the outcome is a full term normal infant or not. The gingivae may become bright red, swollen, sensitive and bleed spontaneously. There is also an increase in gingival exudates and tooth mobility.

Low birth weight (LBW), defined as birth weight less than 2.5kg continues to be a significant public health issue in both developed and developing countries[11]. It can result from either preterm birth (delivery before 37 weeks of gestation) or intrauterine growth restriction or both. Birth weight is considered to be one of the most relevant biological determinants of new born survival in both developed and developing countries.[11] The importance of birth weight not only comes from its capacity to predict increased risk of death among infants born with LBW and or preterm births. It also reflects the mother's exposure to other risks factors such as unfavourable socioeconomic conditions, malnutrition and other systemic diseases, including oral diseases.[12] Periodontal diseases have come under serious scrutiny of recent in the research community and various studies conducted have also come out with myriads of results with some suggesting association between periodontal diseases and pregnancy outcomes[11] and others claiming otherwise[12] A study reported 81.5% to 83.6% incidence of gingivitis in pregnant women [13], while a similar study carried out at the University of Alabama, Birmingham, United States of America[14] reported that gingivitis was the most common form of periodontitis in pregnant women. There are however very scanty data on such study in Nigeria. Most international and local studies have concentrated on the effect of periodontal disease on pregnancy outcome. Another study carried out in India among women attending Mumbai government hospital found high prevalence of gingivitis which increased with age and decreased with socio-economic income.[15], they however did not look into the pregnancy outcome of

their participants. A Chilean study found that periodontal therapy reduced preterm birth and low birth weight rates by 68%, and so concluded there was an association between maternal periodontal disease and preterm delivery.[16]

Though there are many literature and on-going studies on the effect of maternal periodontitis on pregnancy out-come such as preterm delivery and low birth weight; no published work yet in Nigeria. Also, most studies are on the effect of maternal periodontitis and not gingivitis and plaque-induced gingivitis which is the most common form of periodontal disease in pregnant women. This study may be an effective approach towards improving oral health of pregnant women with the potential to reduce adverse pregnancy outcomes.

The objective of the study was to determine the association between maternal gingivitis and pregnancy outcome, including low birth weight (LBW) and preterm delivery.

MATERIALS AND METHODS

The study was conducted at the ante-natal clinic of the Department of Obstetrics and Gynaecology, as well as at the Periodontics' clinic of the University of Benin Teaching Hospital (UBTH), Benin-City, Edo State. University of Benin Teaching Hospital is the largest tertiary health centre in the state with 575 bed spaces. The hospital serves as a referral centre for Edo, Delta, Ondo and Kogi States with an estimated population of 14 million. The study comprised of pregnant women within the age of 20 to 34 years attending the antenatal clinic, for the duration of nine months from June 2010 to February 2011. This was a longitudinal study, using systematic random selection to choose participants for the study. The first subject (x) was randomly selected from the sampling frame and every k^{th} subject was selected. Therefore, if the first subject selected was x, next subjects were x + k; x + 2k; x + 3k until the desired sample size of 300 was attained. The selected population was further divided into two equal groups (test and control groups). The test group had scaling and polishing done immediately they were recruited into the study while the control group had scaling and polishing after delivery. To determine which participant went into either of the group, alternate k^{th} was chosen to arrive at a ratio of 1: 1. Inclusion criteria included; pregnant women within the 1^{st} trimester registering for antenatal care at the hospital, pregnant women in apparent good health without systemic conditions likely to affect intra-uterine growth, pregnant women between the ages of 20 to 34 years, primigavid women, women with spontaneous vaginal delivery which was ascertained from labour ward delivery records, women with singleton delivery (which was also known from participants' case records of ultrasound report if any or from manual palpation) and all those who agreed to sign the consent form were selected. Any participant who did not have spontaneous vaginal delivery or had undetected multiple pregnancy deliveries were dropped from the study. Data were from closed ended structured interviewer administered questionnaires, patient records and clinical examination. The questionnaires consisted of a series of questions which were asked to obtain data on demographics, socio-economic status, social life styles, past and present dental history, past and present medical history. Relevant Obstetric and Gynaecological status of respondents' data collection were from their case records and the antenatal clinic register. Prior to respondents' assessment, intra and inter calibration of the chosen index was done using Intra-class Correlation Coefficient and Kappa

test of agreement respectively. Ninety-five percent agreement on the index was obtained for inter-examiners' reliability from the three investigators and ninety-eight percent for intra-examiner's reliability. The gingival status of respondents was assessed using the Gingival Bleeding Index[13] to assess the presence and degree of gingival inflammation. Statistical significance was set at $p < 0.05$.

RESULTS

Out of the 300 women recruited, 288 (96%) subjects completed the study based on the set criteria and were thus analysed. Twelve of the subjects did not satisfy the inclusion criteria, amongst whom 6 were lost to follow up.

The age distribution of participants ranged from 20 to 34 years with the majority (48.3%) of the participants within the age bracket of 25 to 29 years, with 29.5 ± 3.57 years being the mean age for the study group. There was no observed statistical significance difference in their age distribution ($p > 0.05$) (Table1). The social habits revealed minimal (10.4%) use of alcohol among the participants with an observed statistical significance ($p < 0.05$). No smokers were recorded in the study, however 1(0.4%) participant did not respond to the question and therefore assumed to be a smoker. ($p > 0.05$) was not significant for smoking of cigarette among participants. (Table 2)

The prevalence of gingival bleeding among the participants at 12 weeks was 91(63.2%) among the test group while control group was 66(43.1%), (scores 2 and 3 were added to arrive at these figures). The predominant score among the test group was 2 (bleeding on slight probing) while that of the control group 1(no bleeding on slight probing). There was statistical significant relationship ($p < 0.05$) between the groups.

Table 3

The table shows that following treatment, the predominant score improved from score 2 at 12 weeks to score 1 at 28 weeks. Frequency of score 1 increased from 36.8% at 12weeks to 70.8% at 28 weeks while score 2 decreased from 54.9% at 12 weeks to 27.1% at 28 week. Similarly, score 3 decreased from 8.3% at 12 weeks to 2.1% at 28 weeks which indicates a reduction in the number of women with spontaneous bleeding. The prevalence of gingival bleeding improved significantly from 91 (63.2%) at 12weeks to 42(29.2%) at 28weeks, (scores 2 and 3 were added because gingival bleeding was recorded). There was an observed statistical significance ($P < 0.05$).Table 4

Relating gingival bleeding of participants to the prevalence of the 34 preterm deliveries of the study showed that majority 27 (79.4%) of the preterm deliveries were from mothers in the test group and 17(50%) of them were mothers who recorded score 1. The control group followed a similar pattern in that mothers with better gingival bleeding index score1 had higher numbers 5 (14.7%) of preterm deliveries out of the 7(20.6%) preterm deliveries recorded in this group. Mothers with score 3 did not record any preterm deliveries ($p > 0.05$). Table 5

Relating the prevalence of gingival bleeding among participants to their pregnancy outcome, the control group had all the 18 LBW deliveries. Eleven (61.1%) of these babies were from mothers with score 1 (mild gingival inflammation). However, the mothers with worse score 3 (spontaneous bleeding) delivered only 3(16.7%) of the LBW babies.

TABLE 1: AGE DISTRIBUTION OF PARTICIPANTS

Age (years)	Test group n (%)	Control group n (%)	Total n (%)
20-24	12 (8.3)	11(7.6)	23 (8.0)
25-29	72 (50.0)	67 (46.3)	139 (48.3)
30-34	60 (41.7)	66(46.1)	126 (43.7)
Total	144(100.0)	144(100.0)	288 (100.0)

X_2 = 0.509, df =2, P=0.775

TABLE 2: SOCIAL HABITS OF PARTICIPANTS

Alcohol	Test group n (%)	Control group n (%)	Total n (%)
Yes	21 (14.6)	9 (6.3)	30 (10.4)
No	123 (85.4)	135 (93.7)	258 (89.6)
Total	144(100.0)	144(100.0)	288(100.0)

X_2=5.358, df =1, P=0.021

Smoking	Test group n (%)	Control group n (%)	Total n (%)
Yes	0 (0.0)	1 (0.7)	1 (0.4)
No	144(100.0)	143 (99.3)	287 (99.6)
Total	144(100.0)	144(100.0)	288(100.0)

X^2=1.003, df=1, P=0.316

Table 3: Pre-treatment assessment of gingival bleeding of participants using Gingival Bleeding Index (GBI)

Gingival bleeding at Baseline 12 weeks of gestation

GBI	Test group n (%)	Control group n (%)	Total n (%)
1	53 (36.8)	82 (57.0)	135 (46.9)
2	79 (54.9)	51 (35.4)	130 (45.1)
3	12 (8.3)	11 (7.6)	23 (8.0)
Total	144 (100.0)	144 (100.0)	288(100.0)

X^2=12.304, df=2, P = 0.002

KEY

Score 1 – Glazing and swelling, no bleeding on slight probing.

Score 2 – Bleeding on slight probing

Score 3 – Spontaneous bleeding

TABLE 4: COMPARISON OF PRE-TREATMENT AND POST-TREATMENT GINGIVAL BLEEDING ASSESSMENT OF TEST GROUP USING GINGIVAL BLEEDING INDEX (GBI)

GBI Score	At 12 weeks n (%)	At 28 weeks n (%)	Total n (%)
1	53 (36.8)	102 (70.8)	155 (53.8)
2	79 (54.9)	39 (27.1)	118 (41.3)
3	12 (8.3)	3 (2.1)	15 (5.2)
Total	144 (100.0)	144 (100.0)	288 (100.0)

X^2=35.37, df=2, P=0.000

TABLE 5: GINGIVAL BLEEDING AND PREVALENCE OF PRETERM DELIVERIES

GBI Score	**Test group n (%)**	**Control group n (%)**	**Total n (%)**
1	17 (50.0)	5 (14.7)	22(64.7)
2	10 (29.4)	2 (5.8)	12 (35.3)
Total	27 (79.4)	7 (20.6)	34 (100.0)

X^2= 0.174, df=1, P=0.676

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DISCUSSION

Many foetal and maternal factors have been implicated in the complications of pregnancy, child birth and neonatal survival. These include maternal demographic characteristics, social habits, access to antenatal services, nutritional status, systemic conditions and oral health with special emphasis on periodontal health[15].

The result of this study showed that the age of the participants ranged from 20 to 34 years, with the mean age being 29.5 ± 3.5 years. Majority (48.3%) were within the age bracket of 25 to 29 years. While this age range has been advocated to be the most favourable for child birth[18], however, some literatures have associated this age in primigravdae with poor pregnancy outcome[19]. The age range was comparable to the study by Lopez et al[16] whose study group age range was from 18 to 35 years.

Social history showed that 30 (10.4%) of the participants consumed alcohol. This low alcohol consumption was similar to the Tanzanian study in which the women reported 15% of alcohol use[20]. The low alcohol use in this study can probably be accounted for by their cultural and religious back ground. This also eliminated this social habit a risk factor from this study group. Majority (99.6%) of the participants had no history of smoking, however a participant did not respond to the question and was therefore assumed to be a smoker. Smoking which is said to be a risk factor for poor pregnancy outcome will not affect this result since no participant reported smoking in the questionnaire

The participants in this study demonstrated various degrees of gingival inflammation, because there was no zero score based on Gingival Bleeding Index (GBI). This was similar to the study reported by Mokeem et al[21] and Loe and Silness[5]. A high proportion of the subjects recorded gingival bleeding which is a sign of gingivitis. This was similar to other studies that claim that gingivitis is the most common form of periodontitis among pregnant women [14,15,23.] There was also a remarkable decrease in the prevalence of gingival bleeding in the pre-treatment and post-treatment periods among the test group, similar to some studies that reported improved oral health following periodontal therapy[22,23]. The prevalence of gingival bleeding of 29.1% found in the test group in this study was lower than that reported by Lopez[16]and Lunardelli[6,] but was however higher than that reported by Vettore et al[24.] The differences in the gingival bleeding could be due to the level of oral hygiene of the subjects in their studies. The plaque score in this study was 61.5% while that of Lopez et al[16] was 83.8%. High plaque score is expected to result in gingival inflammation. The presence of gingival inflammation is highly associated with bleeding, more so in pregnancy where there is an exaggerated tissue reaction to plaque due to the hormones in circulation[10.] The prevalence rate of 12.3% for low birth weight recorded in this study was among the control group. This rate was inconsistent and lower than the prevalence rate of 16.5% reported by WHO[25] for developing countries, and Asia; but within the prevalence rate of 5.8% to 28.3% for Nigeria. The test group that had periodontal therapy did not have low birth weight babies. This was similar to the Chilean study which reported 68% reduction rate of low birth weight following periodontal therapy[16]. The prevalence of preterm deliveries for the entire study participants was 11.8%, with the test group having a higher prevalence than the control group. This prevalence

was higher than the finding of Lopez et al[16] but similar to that of Mokeem et al[21]. This similarity could be adduced to the fact that both studies were conducted in University Teaching Hospitals. Studies carried out on Chilean women by Lopez et al[16] and that conducted by Lundardelli et al[6] on southern Brazilian women reported preterm prevalence rates of 4.7% and 7.1% respectively which were lower than that of this study. The gingival bleeding index assessment for maternal gingival bleeding showed that majority of the mothers with preterm deliveries recorded score 1(which is an indication of gingival inflammation without bleeding), while the poorer score 2 (an indication of bleeding on slight probing) the mothers had fewer preterm babies.

Relating the gingival status of the participants to pregnancy outcome (low birth weight and preterm deliveries) has not demonstrated consistent relationship. The fact that the test group recorded a higher number of preterm deliveries may imply that the risk of having preterm birth is not only due to the possible presence of microbial plaque, but could be due to other factors such as immune protection factors, genetic factors, helminthiasis, nutritional status, and subclinical conditions. Some degree of immunosuppression occurs during pregnancy which minimizes the risk of foetal rejection[26], this will also affect the systemic infection control. The reduced effect of periodontal treatment on the prevalence of preterm birth rate among the test group is in conformity with the findings of Stamilo et al[27]. They noted that the causation and treatment efficacy can be interrelated or they can function independently. Yet another explanation for the inconsistent findings is that periodontal treatment provided after the systemic inflammation is established may have come too late to reduce the risk of experiencing adverse birth outcome[28]. A meta- analysis by Polyzos et al[29] concluded that the best effect of periodontal treatment was when preventive treatment is done rather than the treatment of an established or severe periodontal disease.

In this study, post treatment periodontal assessment of the test group showed improved periodontal health but did not translate to a reduction in preterm deliveries. This is similar to the findings of Michalowicz et al[30], that periodontal treatment improved periodontal health, but did not significantly alter the risk of preterm delivery. This can be explained in line with the findings of Boggess et al[31] that the treatment of periodontal disease has not always been successful because total elimination of bacterial plaque is usually not possible and pregnancy itself poses an additional risk for periodontal disease onset and progression. Periodontal therapy consisting of twice scaling, polishing and oral hygiene instruction from base line to delivery proved ineffective in completely resolving gingival inflammation and preventing disease progression in these treated pregnant women. The greatest benefits from periodontal treatment is said to be when it is carried out among pregnant women with less periodontal disease at base line and no previous preterm deliveries. Prevention, which includes preconception and intraconception intervention is more efficacious than treatment of severe disease during pregnancy. This manifested in this study, where 29.1% of the treated group demonstrated disease progression shown by gingival bleeding, which is a marker of potential systemic infectious exposure and disease activity. The fact that disease activity might still have been present in the treated group could have contributed to the high prevalence of preterm births in this

group.

CONCLUSION

This study demonstrated a relationship between maternal gingivitis and pregnancy outcome, with the test group that was treated not recording any low birth weight deliveries. That the preterm deliveries were more among the treated mothers seems to contradict any link, but several studies have shown that scaling does not eliminate completely the presence of microbial agents which could have affected the results. Further studies will be required to ascertain the correct association in the areas of subgingival microbiology, gingival crevicular fluid biochemistry and genetics. The study has also demonstrated that it is safe to treat pregnant women since none of the women treat developed complications following treatment.

Recommendation

We recommend the incorporation of routine dental care into all ante-natal care so as to reduce systemic effect of bacterial plaque and its attendant adverse pregnancy out-come.

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REFERENCES

1 Cawsons RA. Essentials of Dental Surgery and Pathology. 5th ed. Churchill Livingstone 1993; 64: 432-444.

2 Hugoson A, Rylander H. Longitudinal study of periodontal status in individuals aged 15 years in 1973 and 29 years in 1978 in Jonkoping, Sweden. Community Dent Oral Epidemiol 1982; 10:37-42

3 Adam D, Carney JS, Dick DA. Pregnancy gingivitis: A survey of 100 antenatal patients. J Dent 1973; 2: 106-10

4 Loe H. Periodontal disease in pregnancy. Prevalence and severity. Acta Odontol Scand 1965; 21: 533-51

5 Rakchnok N, Amporn D, Yoshida Y, Harun-OR-Rashid, Sakamoto J. Dental caries and Gingivitis among pregnant and non-pregnant women in Chiang Mai, Thailand. Nagoya J Med Sci 2010; 72:43-50

6 Lunardelli AN, Perez MA. Is there an association between periodontal disease, prematurity and low birth weight? A population-based study. J Clin Periodontol 2005; 32: 938- 946.

7 Korman KS, Loesche WJ. The subgingival microflora during pregnancy. J Periodontol Res 1980; 15: 111-122.

8 Jensen J, Liljemark W, Bloomquisti C. The effect of female sex hormones on subgingival plaque. J Periodontol 1981; 52: 599-602.

9 Lunundgren D, Magnussen B, Lindhe J. Connective tissue alterations in the gingival of rats treated with oestrogens and progesterone. Odonol Revy 1973; 24; 49-58.

10 Laine MA. The effect of pregnancy on periodontal and dental health. Acta Odontol Scand 2000; 60 (5): 257-64.

11 McGaw T. Periodontal disease and preterm delivery of low-birth-weight infants. J Can Dent Assoc 2002; 68(3):165-9.

12 Shapiro S, McCormick MC, Starfield BH. Relevance of correlation of infant deaths for significant morbidity at 1 year of age. Am J Obstet Gynaecol 1980; 136(3): 363-73.

13 Tarannum F, Faizuddin M. Effect of periodontal therapy on pregnancy outcome in women affected by periodontitis. Journal of

Periodontology 2007; 78 (11): 2095-103.

14 Reddy MS. A study to evaluate association between gingivitis and pregnancy outcome 2010; NCT00641901.

15 Rathod V. Periodontal condition of pregnant women and its co-relation with clinical variables and socioeconomic status. JIDA 2010; 4: 12

16 Lopez NJ, Smith PC, Guteierrez J. Periodontal therapy may reduce the risk of preterm low birth weight in women with periodontal disease; a randomized controlled trial. J Periodontol 2002; 73 (8): 911-24.

17 Loe H. The gingival index. The plque index and the retention index systems. J Periodontol 1967; 38: 610 (part 11)

18 Milner M, Barr-Kinsella C, Unwin A, Harrison RF. The impact of maternal age on pregnancy and its outcomes. Int J Gynecol Obstet 1992; 38 (4): 281-286.

19 Hugoson A. Gingivitis in pregnant woman, a longitudinal clinical study. Odontol Revy 1971; 22: 65-84.

20 Mumghamba EGS, Markkenen HA, Honkala E. Initial risk factors for periodontal diseases in Ilala, Tanzania. J Clin Periodontol 1995; 22: 343-5.

21 Mokeem SA, Molla GN, Al-Jewair TS. The prevalence and relationship between periodontal disease and preterm low birth weight infants at King Khalid University Hospital. Riyadh, Saudi Arabia. J Contemporary Dent Pract 2004; 2(5) 040-056.

22 Offenbacher S, Beck J, Jared H, Mauriello SM, Mendoza LC, Couper DJ, Stewart DD, et al. Effect of periodontal therapy on the rate of preterm delivery: A randomized controlled trial. Obstetric Gynecol 2009; 114(3): 551-559.

23 Lopez NJ, Da Silva I, Ipinza J, Guitierrez J. Preiodontal therapy reduces the rate of preterm low birth weight in women with pregnancy associated gingivitis. J. Periodontol 2005; 76(11 suppl) :2144-53.

24 Vettore MV, Leal M, Doc, Leao AT, Monteiro da Silva AM, Lamarca GA, Sheiman A. The relationship between periodontitis preterm low birth weight. J Dent Res 2008; 87(1): 73-78.

25 Mortality statistics. Perinatal and infant: social and factors. England and Wales. OPCS. London: HMSO, 1995: Series DH3, No26.

26 Hansen PJ. Regulation of uterine immune function by progesterone--lessons from the sheep. J Reprod Immunol 1998; 40(1):63-79.

27 Stamilio DM, Chang JJ, Macones GA. Periodontal disease and preterm birth: do the data have enough teeth to recommend screening and preventive treatment? Am J Obstet Gynecol 2007; 196(2):93-4.

28 Goldenberg RL, Culhane JF. Preterm birth and periodontal disease. N Engl Med 2006; 355(9180): 1925-1927.

29 Polyzos NP, Polyzos IP, Mauri D, Tzioras S, Tsappi M, Cortinovis I, et al. Effects of periodontal disease treatment during pregnancy on preterm birth incidence: a meta-analysis of randomized trials. Am J Obstet Gynecol 2009; 200: 225-32.

30 Michalowicz BS, Hodges JS, DiAng3lis AJ, Lupo VR, Novak MJ, Ferguson JE, et al. Treatment of periodontal disease and risk of preterm birth. N Engl J Med 2006;355: 1885-94

31 Boggess KA, Beck JD, Murtha AP, Moss K, Offenbacher S. Maternal periodontal disease in early pregnancy and risk for a small- for-gestational- age infant. Am J Obstet Gynecol 2006; 194:1316-22.