J Clin Periodontol 2014; 41: 141–148 doi: 10.1111/jcpe.12188

Journal of Clinical Periodontology

Case Report

Oral health education and therapy reduces gingivitis during pregnancy

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Geisinger ML, Geurs NC, Bain JL, Kaur M, Vassilopoulos PJ, Cliver SP, Hauth JC, Reddy MS. Oral health education and therapy reduces gingivitis during pregnancy. J Clin Periodontol 2014; 41: 141–148. doi: 10.1111/jcpe.12188.

Abstract

Background: Pregnant women demonstrate increases in gingivitis despite similar plaque levels to non-pregnant counterparts.

Aim: To evaluate an intensive protocol aimed at reducing gingivitis in pregnant women and provide pilot data for large-scale randomized controlled trials investigating oral hygiene measures to reduce pregnancy gingivitis and alter maternity outcomes.

Materials and Methods: One hundred and twenty participants between 16 and 24 weeks gestation with Gingival Index (GI) scores ≥2 at ≥50% of tooth sites were enrolled. Plaque index (PI), gingival inflammation (GI), probing depth (PD), and clinical attachment levels (CAL) were recorded at baseline and 8 weeks. Dental prophylaxis was performed at baseline and oral hygiene instructions at baseline, 4 and 8 weeks. Pregnancy outcomes were recorded at parturition. Mixed-model analysis of variance was used to compare clinical measurements at baseline and 8 weeks.

Results: Statistically significant reductions in PI, GI, PD, and CAL occurred over the study period. Mean whole mouth PI and GI scores decreased approximately 50% and the percentage of sites with PI and GI ≥2 decreased from 40% to 17% and 53% to 21.8%, respectively. Mean decreases in whole mouth PD and CAL of 0.45 and 0.24 mm, respectively, were seen.

Conclusions: Intensive oral hygiene regimen decreased gingivitis in pregnant patients.

Clinicaltrials.gov: NCT00641901

Key words: behaviour modification; gingivitis; inflammation; oral hygiene; pregnancy; preterm birth

Accepted for publication 20 October 2013

Pregnancy Gingivitis has been extensively described in the literature (Löe & Silness 1963, Mariotti 1994, Raber-Durlacher et al. 1994, Figuero et al. 2013). Previous work demonstrates a progressive increase in gingival inflammation throughout pregnancy independent of bacterial plaque accumulation and a return to baseline levels postpartum. Plaque-induced gingivitis is the most common form of periodontal disease in pregnant women affecting 36–100% of pregnant subjects (Maier & Orban 1949, Löe & Silness 1963, Jansen et al. 1981). Clinical characteristics of pregnancy-associated gingivitis clearly show a tendency towards more severe inflammation with similar levels of etiologic factors (Arafat 1974, Ness & Perkins 1980, Yalcin et al. 2002, Gursoy et al. 2008). The severity of gingival inflammation observed has been correlated with sex steroid hormone levels during pregnancy (Löe & Silness 1963, Zaki et al. 1984, Raber-Durlacher et al. 1993, Figuero et al. 2010). This indicates a possible dose-dependent influence of female sex hormone secretion on inflammation, which increases to high levels from 16 to 40 weeks and then decreases after

Conflict of interest and source of funding statement

Drs. Geisinger, Geurs, Bain, Kaur, Vassilopoulos, Hauth and Reddy and Ms. Cliver declare no financial relationships or conflicts of interest related to any products involved in this study. This research was supported in part by funding and materials from the Procter & Gamble Corporation (Cincinnati, OH, USA).

parturition. Cross-sectional and cohort studies have demonstrated increased prevalence and severity of gingivitis in pregnant women compared to their non-pregnant female controls, despite similar plaque scores (Löe 1965, Cohen et al. 1971). Other reports have demonstrated altered immunoreactivity to putative periodontal pathogens during pregnancy (Lopatin et al. 1980, Kinny et al. 1996). In the absence of oral hygiene measures, all individuals develop gingivitis and in healthy individuals a meticulous regimen of daily plaque removal can prevent the onset of gingivitis and effective oral hygiene can affect a cure (Löe et al. 1965).

While treating gingivitis in pregnant women is of concern for optimal oral health, there is evidence that gingivitis may influence pregnancy outcomes, which makes intervention of interest from a public health standpoint and gives further weight to affecting a cure (Chambrone et al. 2011a,b). Periodontal disease has been identified as a risk factor for adverse pregnancy outcomes (Jeffcoat et al. 2001, Offenbacher et al. 2001), but the efficacy of periodontal treatment on birth outcomes has been inconsistent (Lopez et al. 2005, Michalowicz et al. 2006, Wimmer & Pihlstrom 2008, Kunnen et al. 2010, Chambrone et al. 2011a,b). While this study was not powered to demonstrate differences between maternity outcomes, it may allow pilot data for future large-scale randomized controlled trials evaluating the effectiveness of an intensive home-care regimen on maternity outcomes in women with pregnancy gingivitis.

We hypothesized that gingivitis during pregnancy could be controlled with a minimally invasive approach which used an intensive oral hygiene regimen and behavioural and educational counselling to improve home care in pregnant patients. Due to the widespread prevalence of pregnancy gingivitis the development of a home-care regimen to reduce gingivitis in pregnant women could be a cost-effective mechanism to improve the health of pregnant women. This study evaluated changes in PI, GI, PD, and CAL from baseline to 8-weeks post-intervention to determine if intensive oral hygiene instructions and home-care regimen could improve periodontal clinical parameters in pregnant patients.

Materials and Methods

Sample size calculation

Prior to initiating this study a sample size calculation was completed. Using data from a previous study (Lopez et al. 2005) and assuming at baseline an average of 60% of sites with either BOP or GI = 2, using 80% power the sample size to demonstrate a 33% reduction in whole mouth GI would be 107 subjects.

Enrolment criteria

One hundred and twenty pregnant women between 16 and 24 weeks of gestation from the Center for Women's Reproductive Health (CWRH) at the University of Alabama at Birmingham (UAB) were recruited to participate in this study. All study participants were required to present with generalized, moderate to severe gingival inflammation (GI $\geq$ 2 at $\geq$ 50% of sites) and be free of periodontitis, defined as CAL > 3 mm at 3 or more sites, the definition of periodontitis used in a recent large-scale interventional trial examining periodontitis and preterm birth, Maternal Oral Therapy to Reduce Obstetric Risk (MOTOR) (Offenbacher et al. 2009), as patients for this intervention were recruited in parallel with those with periodontitis enrolled in the aforementioned large-scale interventional trial using the same personnel and facilities. All patients were 16 years or older at enrolment with a minimum of 20 natural teeth present in the mouth. Prior to enrolment, all patients underwent an informed consent process that was approved along with the protocol by the UAB Institutional Review Board. Of the patients recruited, 119 received oral examinations and 117 have pregnancy outcome data. Patients were recruited between April 2007 and October 2008. Final parturition data was obtained in February of 2009. Subjects were excluded if they had the following risk factors for preterm birth: plural gestations, previous spontaneous preterm birth, body mass index <19.8 or bacterial vaginosis as assessed by a gram stain.

Baseline visit

Initial intervention

The participants viewed an educational DVD designed and recorded at UAB at baseline, which explained the potential link between pregnancy gingivitis and prematurity as well as a detailed approach to use of the home-care aids provided. Each participant also received a copy of the DVD for further reference at home.

Clinical evaluation

At baseline and all subsequent study visits, a clinical evaluation of each participant's intra and extra-oral structures was completed by a calibrated examiner. A clinical cancer screening and examination of the head and neck was completed. All examination procedures were performed by a single examiner (UAB, Department of Periodontology) who was trained in study protocol and examination procedures prior to study initiation. Annual retraining sessions were held. Intra-examiner Kappa scores between measurements were 0.962 and 0.884 for PD and CAL, respectively. The overall level of plaque accumulation and gingival inflammation was measured per tooth, using Silness and Löe indices (PI and GI; Löe 1967). Full-mouth periodontal pocket depth (PD), measured from the free gingival margin to the base of the periodontal pocket, and attachment (CAL), measured from the cemento-enamel junction (CEJ) to the depth of the periodontal pocket, were recorded to the nearest millimetre with a manual 15 mm University of North Carolina (UNC-15) periodontal probe. Each measurement was completed at six sites per tooth (mesiobuccal, buccal, distobuccal, mesiolingual, lingual, and distolingual). Sample clinical photographs were obtained of select patients dentition to be used as a teaching tool to demonstrate gross plaque, erythema and oedema to patients during baseline and treatment visits. A digital SLR camera with a macro-lens and intra-oral ring flash were used with a 1:1 magnification.

One-on-one intervention

Dental prophylaxis was performed on each patient by a study periodontist at the University of Alabama at Birmingham Department of Periodontology

using ultrasonic instruments and hand scalers and curettes. Topical anaesthesia was used to improve patient comfort, if necessary. If possible, the procedures were completed in one session; however, an additional session was scheduled to complete therapy based upon overall levels of plaque and calculus deposits, time constraints, and patient needs as is standard of care in many periodontal clinical practice settings (Rode Sde et al. 2012). Individually tailored intensive one-on-one oral hygiene counselling providing feedback regarding both positive and negative aspects of oral hygiene performance coupled with demonstration and instructions for using oral hygiene products (and subsequent visits as needed) were completed for each participant. A personal interview was conducted by a study dentist to determine intra-oral areas and/or oral hygiene techniques about which a patient reported difficulty. These patient-reported factors were coupled with the study examiner's findings to develop a comprehensive oral hygiene plan for the patient using a multiproduct regimen. Intraoral photographs of the patient's dentition were used to demonstrate gingival inflammation and plaque biofilm deposits to patients. A focus on the patient as a co-practitioner and an emphasis on self-care during pregnancy were discussed with each patient as a part of this intervention. An oral health home-care kit was dispensed that was adequate for approximately 6 weeks of use as prescribed. Each kit included: One powered toothbrush (Oral B Triumph®; Procter & Gamble, Cincinnati, OH, USA); 0.454% Stannous fluoride toothpaste (Crest Pro Health®; Procter & Gamble); Dental floss (and interproximal brushes and/or floss-threaders if needed); Cetyl pyridinium chloride 0.07% mouth rinse (Crest Pro Health®).

Follow-up intervention

Reinforcement of home care after tooth cleaning was done with periodic cell phone messages from the study indicating the importance of oral hygiene during pregnancy.

Visit 2

Participants returned 4 weeks (±5 days) after baseline. Participants updated medical history and any adverse reaction in the mouth was recorded. PI and GI were recorded. Based upon clinical findings and at the discretion of the study dentist, learning was reinforced via repeated counselling and demonstration focusing on areas of plaque retention and gingival inflammation identified in clinical examination, as is standard of care in many clinical practice settings (Rode Sde et al. 2012). Home-care kits were replenished. Subjects did not return empty packaging.

Visit 3

Participants returned 8 weeks (±5 days) after baseline visit. Participants updated medical history and any adverse reactions were recorded. Intra and extra-oral evaluation, along with a follow-up comprehensive clinical evaluation of periodontal probing examination, plaque, and gingival measurements were completed identical to the baseline evaluation. A follow-up survey was administered to determine subjects' level of oral hygiene knowledge and current oral hygiene regimen, including product usage and frequency. Additional oral and baby care products including baby toothbrushes and store coupons were dispensed to participants who completed the study.

Pregnancy outcomes

A blinded examiner (University of Alabama, Department of Obstetrics and Gynecology) recorded gestational age (GA) at the end of pregnancy for all participants and these data were sealed until all enrolled subjects had reached parturition. GA was calculated in this study based upon last menstrual period (LMP) confirmed with ultrasound measure at <20 weeks gestation. If LMP and ultrasound measure did not agree within 7 days or if the subject did not have a sure LMP, ultrasound measure was used to determine gestational age. Prematurity was defined in this study as birth prior to 37 completed weeks (259 days) of gestation and prior to 35 complete weeks (245 days) of gestation as these GA benchmarks were used in similar recent studies (Jeffcoat et al. 2011a,b).

Data analysis

Mixed-model analysis of variance (ANOVA) was used to compare measurements of PI, GI, PD, and CAL between the baseline and follow-up examinations, accounting for correlations among measurements made on the same patient and controlling for tooth and surface. Time, tooth, and surface were included as fixed effects in each model and a compound symmetric variance structure was assumed. The maximum value of each measurement across the buccal, lingual, distal and mesial sites on each tooth was used in the analysis. Statistical significance was set at $p < 0.01$ so that the data were comparable to similar experiments in previously published reports.

Results

One hundred and nineteen pregnant participants were treated with dental prophylaxis and intensive oral hygiene instructions. No significant adverse reactions were reported after dental prophylaxis or to any of the home-care aids provided to the patients. The demographics of the study participants are detailed in Table 1. Twenty-three patients were lost to follow-up. Patients did not complete study procedures due to missing prenatal appointments and the oral hygiene appointments scheduled in conjunction with these prenatal visits. There were no statistically significant differences between subjects who completed all oral hygiene procedures and those who failed to complete all study procedures. All enrolled subjects were evaluated for parturition outcomes. Whole mouth plaque index scores were significantly reduced from a mean value of 1.35 (SD = 0.07) at baseline to 0.61 (SD = 0.07) at the 8 week follow-up visit. In addition, whole mouth gingival index scores showed a significant reduction from a mean value of 1.45 (SD = 0.07) at baseline to 0.75 (SD = 0.07) at the 8 week follow-up visit. Whole mouth mean probing depths were significantly reduced from 3.41 mm (SD = 0.10) at baseline to 2.97 mm (SD = 0.10) at the 8-week follow-up visit. Whole mouth mean clinical attachment levels were also significantly reduced from 2.26 mm (SD = 0.10) at baseline to 2.02 mm (SD = 0.10) at the 8 week follow-up visit (Table 2). A typical clinical response from baseline to

Table 1. Study population demographics

	Total enrolled* $n = 119$ (%)	Enrolled* (loss to follow-up) $n = 23$ (%)	*p*-Value
Race/Ethnicity			
Black	82.5	69.9	0.0838
White, non-hispanic	10.8	26.1	
Hispanic/Latino	5.8	0	
Other	0.8	4.3	
Education level			
Less than high school	1.7	4.3	0.2778
High school diploma	70.0	78.3	
Some college or college	27.5	13.0	
Marital status			
Married	10.8	13.0	0.7550
Unmarried	88.3	82.6	
Age			
15–20	33.3	39.1	0.4941
21–25	47.5	52.2	
25–30	12.5	0.0	
31–35	5.8	8.7	
35+	0.8	0.0	
Smoking prior to pregnancy			
Yes	24.2	34.8	0.1877
No	75.0	60.9	
Smoking during pregnancy			
Yes	13.3	26.1	0.0825
No	85.8	69.6	
Alcohol/drug use			
Yes	0.8	0.0	0.6634
No	98.3	95.7	
Total	119	23	

*Marital status, education, smoking, alcohol variables missing on one enrolled patient.

Table 2. Periodontal measurements at baseline and 8 weeks

Mean (SD)	Baseline	8 Weeks	*p*-Value
Plaque index	1.35 (1.28–1.43)	0.61 (0.54–0.69)	<0.0001
Gingival index	1.45 (1.38–1.51)	0.75 (0.68–0.81)	<0.0001
Probing depth	3.41 mm (3.31–3.52)	2.97 mm (2.87–3.07)	<0.0001
Clinical attachment levels	2.26 mm (2.16–2.37)	2.02 mm (1.92–2.12)	<0.0001

8 weeks post- intervention is illustrated in Figs 1 and 2 respectively.

Mean number of baseline sites with PI ≥ 2 were 21.5 (SD = 14.4) which was significantly reduced to 10.1 (SD = 9.06) at 8 weeks after prophylaxis and intensive oral hygiene measures. Similarly, the number of mean sites per individual with GI ≥ 2 were significantly reduced from 30 sites (SD = 13.5) at baseline to 12 sites (SD = 11.3) at 8-week follow-up. The percentage of sites with PI ≥ 2 was 40% of sites (SD = 25) at baseline which decreased significantly to 17% of sites (SD = 14.6) after prophylaxis and oral hygiene measures. GI ≥ 2 was present at 53% of sites (SD = 23) at baseline and 21.8% of sites (SD = 20.1) after the intervention. These findings demonstrate an overall decrease in detectable plaque and the signs and symptoms of gingival inflammation after oral hygiene intervention and are often used in clinical decision making regarding further active periodontal therapy in patients undergoing initial periodontal treatment (Table 3).

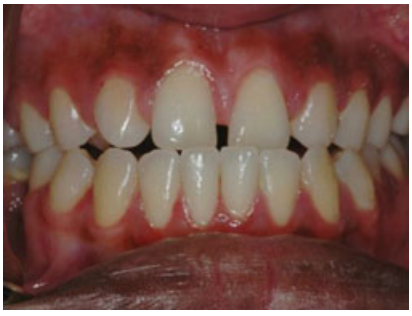

Fig. 1. Baseline frontal intraoral photographs prior to intensive oral hygiene regimen at 16 weeks gestation in a pregnant subject.

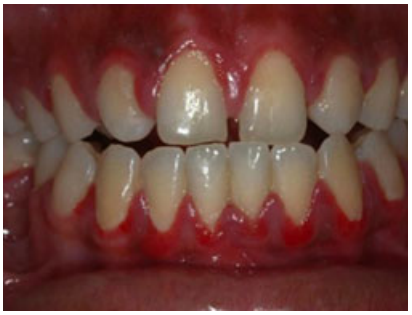

Fig. 2. Eight-week intra-oral frontal photographs demonstrating a typical clinical response to the intensive oral hygiene regimen from 16 to 24 weeks gestation in a pregnant subject.

Preterm birth rates of <37 weeks GA for the 119 patients whose pregnancy outcomes could be determined was 6.84%. Preterm birth rate <35 weeks GA in patients receiving intensive oral hygiene instructions was 1.9% For the 87 patients who completed all oral hygiene visits, the preterm birth rate <37 weeks GA was 5.75% and for those patients who were enrolled but did not complete the study, the preterm birth rate <37 weeks GA was 10.0%. These preterm birth rates did not differ significantly from historic controls recruited with the same inclusion/exclusion criteria approximately 10 years prior (Jeffcoat et al. 2001).

Discussion

An increase in the clinical signs and symptoms associated with gingivitis without marked changes in the quantity of bacterial flora has been noted in pregnant females (Maier & Orban 1949, Löe & Silness 1963, Cohen et al. 1971, Kornman & Loesche 1980, Tilakaratne et al. 2000, Taani et al. 2003, Figuero et al. 2013). The levels of female gonadotropins during pregnancy correlate with the severity of gingivitis. Increased levels of progesterone are associated with increased membrane permeability, which may contribute to vascular permeability and subsequent oedema of gingival tissues (O'Neil 1979, Raber-Durlcher et al. 1991, Raber-Durlacher et al. 1993). Furthermore,

Table 3. Threshold Plaque index (PI) and Gingival index (GI) ≥ 2 at baseline and 8 weeks

	Baseline		8 weeks		*p*-Value
	PI ≥ 2	GI ≥ 2	PI ≥ 2	GI ≥ 2	
Mean number of sites, *n* (SD)	21.5 (14.4)	30.0 (13.5)	10.1 (9.06)	12.0 (11.3)	<0.0001
Mean percentage of sites, % (SD)	40% (25)	53% (23)	17% (14.6)	21.8% (20.1)	<0.0001

increasing salivary levels of estradiol and progesterone have been correlated with a 55-fold increase in the proportion of *P. intermedia* in the bacterial flora during pregnancy (Kornman & Loesche 1980, Jansen et al. 1981, Raber-Durlacher et al. 1994, Adriaens et al. 2009). This bacterial shift may be due to the opportunistic substitution by *P. intermedia* and other *Bacteroides spp.* of progesterone and oestrogen for Vitamin K, and essential growth factor (Kornman & Loesche 1982). Oestrogen receptors (ERβ) have been identified on gingival epithelium and periodontal ligament (Jönsson et al. 2007, Nebel et al. 2011) and the direct effects of pregnancy hormones on periodontal tissues (Mascarenhas et al. 2003) may account for an increase in gingivitis incidence during pregnancy.

Despite the increased severity of gingivitis and qualitative differences in subgingival plaque composition in pregnant females, in the absence of pathologic periodontal pocketing and attachment loss, the condition is usually self-limiting and reversible after parturition and/or lactation when hormone balance is achieved. Since gingivitis and its effects on the periodontium are reversible there is a common misconception that a prolonged state of gingival inflammation during pregnancy does no potential harm. Because women with pregnancy gingivitis demonstrate increased bleeding and gingival crevicular fluid production, the potential for bacteremias and increased serum levels of pro-inflammatory cytokines may make effective treatment of gingivitis during pregnancy important for overall maternal and foetal health. Reports identifying periodontal disease as a risk factor for preterm and low birth weight delivery underscore the need for improved oral care as a part of prenatal care (Offenbacher et al. 1996, Institute for Medicine 2007). As prevalence rates for pregnancy gingivitis have been reported between 36% and 100% (Löe & Silness 1963, Löe 1965, Cohen et al. 1971, Jansen et al. 1981), an effective and non-invasive intervention to reduce gingivitis could be a low cost, preventative measure to improve oral health in primary care or public health settings.

The products included in the home-care kit were selected based Cochrane review data demonstrating improved oral hygiene outcomes in patients using an oscillating-rotating mechanical toothbrush compared with manual toothbrushes or other powered or manual toothbrushes (Robinson et al. 2005) and the adjunctive use of flossing as an effective tool in the management of dental caries and periodontal diseases in adults (Sambunjak et al. 2011). Furthermore, recent investigations have noted antimicrobial properties of stannous fluoride dentifrice and the efficacy of 0.454% Stannous fluoride dentifrice in reducing gingival inflammation as compared to positive (tricolosan/copolymer) control (He et al. 2012) and the effectiveness of cetyl pyridinium chloride mouthrinse in the reduction of preterm birth rates in a high-risk population (Jeffcoat et al. 2011a).

Care was taken to evaluate study participants at baseline and intermediate visits and assess their oral hygiene to allow for individualized interventions and most effectively eliminate clinical signs and symptoms of gingival inflammation. Repetition and reinforcement of oral hygiene instructions have been shown to be critical in improving overall performance of oral hygiene measures in periodontal patients (Emler et al. 1980). Recent systematic reviews have demonstrated that application of psychological interventions including individualized feedback and personalized care can improve oral hygiene behaviours (Niederman 2007, Renz et al. 2008). Furthermore, younger patients have been shown to benefit from repeated sessions of prophylaxis and oral hygiene instructions (Hamp & Johansson 1982), while all subjects demonstrated overwhelmingly positive attitudes towards their oral heath regardless of the current state of their gingival condition (Bergendal et al. 1982). This may indicate that, particularly for a young population, frequent personal interaction and emphasis on the significant health benefits of proper oral home care may be beneficial.

The combined approach of one-on-one oral hygiene counselling with a dentist or dental hygienist, DVD oral hygiene instruction, powered tooth brushing, dentifrice, dental floss and cetylpyridinium chloride mouth rinse, and dental prophylaxis was effective in significantly reducing the whole-mouth PI, GI, PD and CAL values in pregnant patients over an 8-week treatment time. Previous studies indicate that in the absence of intervention, GI levels and/or bleeding upon probing (BOP) increased into the second trimester and remained elevated until parturition (Adriaens et al. 2009, Buduneli et al. 2010). Despite the elevated hormone levels (Mealey & Moritz 2003) in these patients, the intervention was effective in reducing the patients' overall gingivitis levels. This indicates that improved plaque removal is adequate to improve pregnancy gingiviitis. Many previous investigations did not consider plaque levels when assessing clinical signs of gingival inflammation, it has been reported that plaque is the primary factor in GI findings during pregnancy (Carrillo-De-Abornoz et al. 2012). While previous interventions did include oral hygiene instructions and/or monthly supragingival tooth polishing (Michalowicz et al. 2006), the regimen of mechanical toothbrushing, floss, alcohol-free mouthrinse, a take-home instructional DVD discussing oral hygiene and its importance, and monthly oral hygiene instructions may have more effectively decreased pregnancy gingivitis. Further, since the periodontal care was provided at the Center for Women's Reproductive

Health in conjunction with the subjects' prenatal visits, the connection between periodontal and foetal/maternal health may have been a more impactful message leading to behavioural changes. Although some subjects were lost to follow-up, the levels of non-compliance (19.3%) with prenatal appointments in this population are similar those demonstrated in US populations with similar demographics, which range from 23% to 44% (Haas et al. 1996, Riley et al. 2011).

A body of evidence exists that maternal periodontal disease and oral inflammation are associated with preterm birth and low birth weight in infants (Jeffcoat et al. 2001, Scannepieco et al. 2003, Wimmer & Pihlstrom 2008, Heimonen et al. 2009, Kunnen et al. 2010). Despite these associations, large-scale interventional trials for periodontal disease have been largely ineffective (Michalowicz et al. 2006, Offenbacher et al. 2009, Ham 2010). This lack of effect may reflect a focus on treating periodontal disease and periodontal clinical attachment loss without a concomitant focus on the elimination of gingivitis.

Periodontal disease severity has been linked to the same pro-inflammatory markers, such as C-reactive protein (CRP), IL-1, IL-6, tumour necrosis factor alpha (TNF-α), platelet-derived growth factor (PDGF) and transforming growth factor-beta (TGF-β) that are associated with preterm births (Kornman et al. 1997, Reddy et al. 2003, Lyttle et al. 2009, Eberhard et al. 2013). Furthermore, periodontal intervention has been shown to decrease serum levels of these markers, with the greatest reduction seen in patients who demonstrated decreases in clinical measures of gingival inflammation (D'Aiuto et al. 2004, Alzaharni et al. 2013). This pilot study may have identified a novel approach for intervention in pregnant patients with pregnancy gingivitis.

A disadvantage of this study design is the lack of control subjects who were observed, but did not receive prophylaxis and intensive oral hygiene instructions during pregnancy. This approach, while it allows for observations and pilot data for future trials, does not allow for conclusions to be made regarding the efficacy of the proposed intervention as observed patients, particularly pregnant women, may have altered their hygiene habits strictly due to observation alone. While this study design was based on previous investigations that demonstrated increasing gingivitis throughout pregnancy (Löe et al. 1965, Gursoy et al. 2008), future investigations should include a randomized controlled trial study design with standardized intervention procedures to allow for additional conclusions about the effectiveness about this oral hygiene regimen in pregnant patients. Further investigation on the effects of reducing gingivitis on pregnancy outcomes is necessary and these data could allow for sample size calculations for large-scale controlled interventional studies on oral and perinatal outcomes.

Furthermore, this intervention may be well suited for a widespread public health intervention performed by dental and/or medical auxiliary personnel. Rates of pregnancy gingivitis have been demonstrated to be higher in African American women (Lieff et al. 2004) and those with lower socio-economic status (Sarlati et al. 2004). In these high-risk populations, low cost interventions may result in overall improvement of maternal and foetal oral and systemic health. Limitations for large-scale application of this type of treatment may include, cost–benefit analysis of the cost of the study materials and personnel requirements as compared with the economic and health benefits of the intervention on oral health and pregnancy outcomes. Further studies may focus on the feasibility and cost-utility analysis (CUA; Cohen 2003) of application of these interventions for public health and in clinical practice.

This study included the pregnancy outcome data so that other research groups could use the data for planning the treatment timing and intensity of randomized control trials. Care should be taken not to interpret the data as an indication that eliminating gingivitis with an oral hygiene regimen reduces the incidence of preterm birth in pregnant women. Additional larger scale prospective interventional trials are needed to determine the true effect of these interventions on pregnancy outcomes.

Conclusions

An intensive regimen of repeated and systematic oral hygiene instructions combined with a multiproduct oral hygiene regimen was able to statistically significantly reduce all clinical signs of gingivitis in pregnant women. This pilot study has resulted in preliminary data on perinatal outcomes that will allow sample size calculation for a large-scale multicenter controlled clinical trial.

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Clinical Relevance

Scientific rationale for the study: To evaluate a protocol to reduce or prevent the progression of gingivitis during pregnancy and provide pilot data for future randomized controlled trials evaluating interventions in pregnant women on gingival inflammation and pregnancy outcomes.
Principal findings: An intense oral hygiene regimen reduces clinical measures of gingivitis in pregnant women. This study provides pilot data for planning the timing and intensity of further randomized controlled clinical trials to determine if treatment of gingivitis in pregnant women reduces preterm birth rates.
Practical implications: Treating gingivitis in pregnant women is critical to improving their oral health. An intensive oral hygiene regimen is a minimally invasive, cost-effective method of treating gingivitis in pregnant patients.