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Obstetricians' Knowledge and Practice Behaviors Concerning Periodontal Health and Preterm Delivery and Low Birth Weight

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Introduction. Investigators have reported that periodontal disease may be a risk factor for pregnancy complications including preterm delivery (PTD) and low birth weight (LBW). This study assessed obstetricians' knowledge and practice behaviors concerning periodontal disease and its role in adverse pregnancy outcomes.

Methods. One hundred ninety four practicing obstetricians in a 5 county area in central North Carolina were surveyed. Of the 138 eligible physicians, 55 responded yielding a 40% response rate.

Results. Most answered correctly when asked about the description of gingivitis (95%). A lower number of respondents were correct when asked about the description of periodontitis (67%). When asked about what causes periodontal disease or what is associated with periodontal disease, most answered correctly with bacteria (94%), although many answered tooth decay (73%), aging (69%), and excess dietary sugar (51%). Most were correct in responding that periodontitis was more serious than gingivitis (80%). Twenty-two percent looked into patients' mouths at initial prenatal examination, 9% periodically, and 48% only when a problem was mentioned by the patient. Forty-nine percent rarely or never recommended a dental examination. Most (84%) considered periodontal disease to be as important a risk factor to adverse pregnancy events as those currently known in obstetrics practice.

Conclusions. Data from this study demonstrate that there is knowledge of periodontal disease and its potential role as a pregnancy risk factor but suggest limited incorporation of dental care into clinical medical practice.

Keywords: Dental Hygiene, Physician's Knowledge, Oral Health, Low Birth Weight, Preterm Labor, Physician's Practice Behaviors, Pregnancy; Periodontitis

Introduction

Preterm birth, low birth weight infants, and infant mortality are major health concerns in the United States and are considered leading perinatal problems in the developed world.¹ A preterm delivery (PTD) is an infant born less than 37 completed weeks gestation.² A low birth weight (LBW) infant is an infant born weighing less than 2500 g.³ In 2004, of all live births,

12.5% were born premature, and 8.1% were born weighing less than 2500 g.⁴ Infant mortality has decreased 18% between 1992-2002; however, it still remains high with 7 out of every 1000 infants dying before their first birthday.⁴ The economic impact for these infants is estimated at \$5.5 billion, annually.⁵ Children born premature or LBW have an increased risk for neurodevelopmental problems, learning disabilities, and other health disparities.⁶

Potential conditions and risk factors regarding periodontal disease and PTD and LBW are being studied. Recent research suggests that periodontal disease may be an important risk factor in determining poor pregnancy outcomes.^{1-3, 7-17} The purpose of this study was to assess a group of North Carolina obstetricians' knowledge of periodontal disease, their beliefs regarding periodontal disease as a potential risk factor for PTD and LBW, and whether practice behaviors reflected these beliefs. This study provides information about these obstetricians' knowledge of periodontal health and how it may relate to preterm delivery or low birth weight infants. These findings may contribute to the literature pertaining to knowledge of physicians regarding oral health and particularly periodontal health for pregnant patients.

Review of the Literature

Periodontal Disease and the Immune Response

Periodontal disease is a group of infections and conditions that cause inflammation of the gingiva and the surrounding structures, which leads to destruction of the supporting tooth structures. Periodontitis is an anaerobic infection with gram-negative bacteria that leads to the destruction of the periodontal tissue and adjacent bone. Many of the predominate organisms associated with periodontal disease are *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, *Treponema denticola*, *Bacteriodes forsythus*, *Fusobacterium nucleatum*, *Prevotella intermedia*, *Campylobacter rectus*, *Peptostreptococcus micros*, and *Eikenella corrodens*. The vesicles of gram-negative bacteria shed lipopolysaccharide (or endotoxin), activate the host immune response, and penetrate into gingival tissues, causing the host to secrete cytokines (IL-1, TNF- α , IL-6), prostaglandins (PGE₂), and matrix metalloproteinases (MMPs). This infiltration and inflammatory response can also lead to the damage of soft tissue and bone that is seen in periodontal disease. During periodontal inflammation, bacteremias and endotoxemias occur and initiate a strong systemic antibody response due to the large surface area of the infected gingival area.¹⁶ Host immune factors inhibit bacterial invasion and proliferation as well as cause damage to the host via prostaglandins, complement factors, cytokines, and antigen-antibody complexes.¹⁸ In the attempt to rid the tissues of the bacterial invasion of the periodontal tissues, the host defenses contribute to the destruction of tissues locally. It has been established that in response to infection/LPS/endotoxin, endogenous host products are produced and are responsible for many effects of the infection to the body, and potentially to systemic health.

Initiation of Labor

The initiation of normal labor at term involves the triggering of prostaglandin production.¹⁹⁻²² The prostaglandins ripen the cervix, change membrane structure, and cause myometrial contraction.²¹ Throughout the course of normal pregnancy, intraamniotic levels of PGE₂ and TNF- α rise steadily until a critical threshold is reached to induce labor, cervical dilation, and delivery.²² The amniotic fluid of patients in labor contain TNF- α and IL-1.²³ Evidence that prostaglandins participate in the mechanisms of labor in humans stems from the fact that (1) abortion and labor result from administration of prostaglandins, (2) inhibitors of prostaglandins delay the onset of labor and can arrest preterm labor, (3) elevated prostaglandins are found in amniotic fluid and maternal plasma at term deliveries, (4) prostaglandin precursors, arachidonic acid, are increased in the amniotic fluid during labor, and (5) labor results from intraamniotic administration of arachidonic acid.¹⁹ Increased production of cytokines is associated with term as well as preterm labor.²⁴ Preterm labor may be a result of maternal infection before normal labor is initiated.

Maternal Infection and Pregnancy

Maternal infection during pregnancy is a risk factor for infant brain damage, cerebral palsy periventricular leukoplakia, major pulmonary or bronchopulmonary dysplasia, and ultimately death.³ Evidence of subclinical infection as a cause of PTD and LBW is demonstrated by abnormal amniotic fluid findings, and elevated maternal serum C-reactive protein (CRP) levels.¹⁹ Maternal infections can lead to preterm premature rupture of the membranes (pPROM) and preterm labor (PTL).²⁵ Bacterial vaginosis (BV) is a condition where the normal balance of bacteria in the vagina is disrupted and replaced by an overgrowth of anaerobic bacterial species. BV is associated with increased risks for PTL and pPROM. Women whose genital tracts harbor gram-negative anaerobic bacteria similar to the type of gram-negative infection that causes periodontal infections are at high risk for preterm birth.²⁵

Three mechanisms linking oral infections to secondary systemic effects have been proposed. They include metastatic spread of infection from the oral cavity as a result of transient bacteria, metastatic inflammation caused by immunological injury induced by oral organisms, and metastatic injury from the effects of circulating oral microbial toxins.²⁶⁻²⁸

Fusobacterium nucleatum, a common oral species, is the most frequently cultured oral species from amniotic fluid in women with preterm labor.²⁵ Bacterial and host secretory products activate the production of prostaglandins, leading to the onset of labor by inducing uterine contractions and cervical ripening.²⁹ Elevated levels of IL-6 and IL-8 have been observed in patients with preterm labor.²⁹⁻³⁰ Maintenance of uterine activity may depend on an ongoing infection or the presence of cytokines. TNF- α production before onset of labor suggests that cytokines may play a role in the induction and persistence of labor. Inflammatory stimuli induce hyperirritability of uterine smooth muscle, enhancing contractions, cervical thinning, and cervical dilation, causing preterm labor.⁸

Association Between Periodontal Disease and PTL and LBW

The hypothesis for the association between periodontal disease and PTL and LBW is that in the presence of periodontal disease, lipopolysaccharide (LPS) exposure, inflammatory mediators, and maternal cytokine production in the maternal serum places the patient at risk for poor pregnancy outcomes. Serving as a chronic reservoir of LPS, periodontal infection could target the placental membranes via the bloodstream.^{7,11} Produced locally in the periodontal tissues, inflammatory mediators such as TNF- α and PGE₂ can act as a potential systemic source of fetotoxic cytokines due to the high vascularity of the periodontium.⁷ Preterm delivery is believed to be initiated by the release of cytokines such as PGE₂ and TNF- α .³¹

The production of maternal cytokines, TNF- α , and prostaglandins in response to the gram-negative periodontal infection effect the onset of labor by signaling to the body that it is time for delivery, regardless of the age of the fetus.³² Bacterial seeding from the oral cavity through a hematogenous route is a potential pathway of infection.

Periodontal Disease and PTL and LBW Research

Much research has been conducted in the last decade and a half on the relationship between periodontal disease and adverse pregnancy events. Collins et al demonstrated that pregnant hamsters infected with *Porphyromonas gingivalis* (*P. gingivalis*) could lead to adverse pregnancy outcomes.³²⁻³⁴ These included decreased fetal weight, an increase in embryo-lethal events, and fetal malformations. Significant associations were found between increasing levels of PGE₂ and TNF- α , fetal growth restriction, and embryo lethality. This study demonstrated that periodontal pathogens can elicit poor pregnancy outcomes and that the levels of PGE₂ and TNF- α produced were associated with severity of effect on the fetus.

One study reported intravenous challenges with *Escherichia coli* and *P. gingivalis* to the pregnant hamster.³⁴ These challenges produced embryo lethal effects on the fetus. Multiple exposures to *P. gingivalis* resulted in decreased fetal weight and increased fetal mortality. Study outcomes suggested a relationship between periodontal pathogens and poor pregnancy

outcomes. These studies using the pregnant hamster model also suggested that inoculation and intravenous challenges of *P gingivalis* resulted in decreased fetal weight, fetal malformations, fetal growth restriction, and increased fetal mortality.^{32,34}

In another study, Collins et al fed hamsters a plaque promoting diet and evaluated the microbial challenge from the plaque to pregnancy outcomes. This study established that periodontal infection could provide a microbial challenge sufficient to produce poor pregnancy outcomes, including growth restriction.³³

In a landmark study, Offenbacher et al assessed the potential role of maternal periodontal infections as a risk factor for abnormal pregnancy outcomes. After controlling for other risk factors and covariates, this study demonstrated that periodontal disease was a statistically significant risk factor for preterm birth (PTB) and LBW infants and that maternal periodontal disease could lead to a 7-fold increased risk of delivering a preterm or low birth weight infant.⁷

Damare et al conducted a pilot investigation that studied the associations among the levels of PGE₂ in gingival crevicular fluid (GCF), serum, and amniotic fluid of women who had an amniocentesis.⁹ Examiners collected periodontal health status, GCF, serum, and amniotic fluid. It was found that PGE₂ levels in the GCF are positively associated with amniotic fluid levels of PGE₂, and therefore may be an indicator of cytokine present in the amniotic fluid.

In 1998, Dasanayake et al conducted a case control study with a hypothesis that poor oral health could be a risk factor for PTB and LBW.³⁵ While controlling for obstetric risk factors, they evaluated the effects of periodontal status and dental caries of the woman at the time of delivery on the birth weight of the infant. It was reported that mothers of LBW infants were more likely to be shorter and less educated, have gained less weight during their pregnancy, and had more areas of gingival bleeding and calculus accumulation. They also reported that the risk of LBW was higher in mothers who had no or late prenatal care.

Offenbacher et al studied potential pathogenic mechanisms of periodontitis- associated pregnancy complications in 1998.¹¹ The study was undertaken to determine if periodontal infections could provide sufficient challenge to the mother to trigger premature labor. Forty eight case-controlled subjects were measured for GCF levels, levels of PGE₂ and IL-1B to determine whether maternal mediator levels were related to pregnancy outcomes. The levels of 4 periodontal pathogens were measured by using DNA probes. Results demonstrated the levels of GCF-PGE₂ were significantly higher in PTL and LBW mothers as compared to the controls. In mothers who were pregnant for the first time and had a PTL and LBW infant, there was a significant inverse association between birth weight, gestational age, and GCF-PGE₂ levels. Data indicated a dose-response relationship for increasing GCF-PGE₂ as an indicator of current periodontal disease activity and decreasing birth weight. Results demonstrated that 4 organisms were associated with periodontitis. *Actinobacillus actinomycetemcomitans*, *Tannerella forsythia* (*Bacteriodes forsythus*), *Porphyromonas gingivalis*, and *Treponema denticola* were detected at higher levels in PTL and LBW mothers than in the controls. The results indicated that infection is a risk factor for PTL and LBW and that periodontal disease is a sufficient infectious challenge to cause PTL and LBW.

Mitchell-Lewis et al reported early data from an ongoing study examining PTL and LBW and periodontal disease in a group of young, minority, pregnant, and post-partum women that included an intervention.³⁶ Oral examinations were performed for decay and periodontal disease. Subgingival plaque was obtained and DNA tests performed for periodontal pathogens. Two groups were randomized to a control (did not receive treatment) and experimental group (received periodontal treatment). After baseline data was collected, a full mouth debridement and oral hygiene instructions were provided to the patients in the experimental group. It was found that PTL and LBW mothers had greater numbers of *Tannerella forsythia* (*Bacteria forsythus*) and *Campylobacter rectus* and consistently higher counts of all other organisms than mothers who delivered at term. In addition, they reported that periodontal therapy during pregnancy substantially reduced PTL and LBW, although the reduction was not statistically significant due to the small sample size. Of the women who were not treated with periodontal therapy, 18.9% gave birth premature or delivered a LBW infant as compared to 13.5% who did receive treatment. Although not significant, the difference represented a reduction of 28.6%. The findings agreed with the hypothesis that a subgingival periodontal infection by gram-negative, LPS-producing species may be a factor in the pathogenesis of PTL and LBW.

Jeffcoat et al performed a large prospective study (n = 1313) that showed a significant association between PTL and LBW and periodontal disease in the second trimester of pregnancy.³⁷ Medical, periodontal, and behavioral assessments were made between 21 and 24 weeks gestation. Medical records were consulted after birth to determine the infants' gestational ages. While adjusting for other risk factors such as smoking, race, and maternal age, it was determined that the risk for prematurity in patients with periodontal disease was 4.5 to 7 times higher than in periodontally healthy patients. Jeffcoat et al followed this study with an intervention study of 366 women with periodontitis between 21-25 weeks gestation and found that performing scaling and root planning in pregnant women with periodontitis may reduce PTB in this population.³⁸

An intervention study by Lopez et al was undertaken to examine the association between periodontal disease and PTL and LBW.³⁹ Two groups of women were studied during pregnancy. One group had gingivitis or mild periodontal disease and received periodontal treatment before 28 weeks' gestation, while another group with periodontal disease had no treatment. The incidence of PTL and LBW was 8.6% in women with periodontal disease as opposed to 2.5% in women with no periodontal disease. The incidence of preterm birth was 1.5% in periodontally healthy women and 5.2% in women with periodontal disease. The incidence of LBW was 1.0% in periodontally healthy women versus 3.4% in women with periodontal disease. Periodontal disease was deemed a significant risk factor for prematurity and LBW and was associated with both, independent of other risk factors.

The Oral Conditions and Pregnancy (OCAP) study was a 5-year prospective cohort investigation by Offenbacher et al that demonstrated that periodontal disease is an independent risk factor for PTL and LBW.⁸ Full mouth periodontal examinations were performed at enrollment (prior to 26 weeks gestational age) and again within 48 hours postpartum in order to assess changes in periodontal status during pregnancy. The prevalence of prematurity was greater in mothers with periodontal disease when compared to mothers with healthy periodontium, P=0.017. The findings demonstrated that periodontal disease or disease progression had significant effects on gestational age and birth weight. The study also demonstrated that mothers with the most severe periodontal disease had the smallest infants and that maternal infection may impair fetal growth and promote prematurity. Finally, the authors suggested that periodontal disease is a significant risk factor for poor pregnancy outcomes and may be as important as other known risk factors such as smoking, alcohol, or genitourinary tract infections.

Madianos et al evaluated the maternal and fetal antibody response to periodontal organisms.¹² Maternal serum samples were assayed for IgG antibody levels against 15 periodontal organisms using the checkerboard immunoblotting technique. Positive reactions were detected by Western Blot. Fetal exposure of the fetus to periodontal organisms was indicated by the high amount of antibody seropositivity to oral organisms. There was a 2.9-fold increase of IgM seropositivity among PTL and LBW infants as compared to infants delivered at term. The study found that a hematogenous spread of infection leading to fetal exposure was a major pathogenic mechanism of periodontitis-associated prematurity. As evidenced by the presence of IgM antibody against periodontal pathogens in cord blood, it was concluded that oral organisms can present an antigenic challenge to the fetus and that this IgM seropositivity was much greater in preterm births. The data from this study provides initial evidence that specific oral pathogens may be important in maternal periodontal infections leading to PTL and LBW.

Physicians' Knowledge and Practice Behaviors Regarding Oral Health

Although many studies have been conducted to investigate the link between periodontal disease and PTB/LBW, little is known about the practice implications of this potential relationship to patient care. How do physicians view this area of research and are they using it to counsel their pregnant patients?

Several studies have been performed to determine physicians' knowledge and practice behaviors regarding oral health care. In a study by Lewis et al, half of the physicians reported that they had no training in medical school or residency regarding oral health.⁴⁰ In addition, only 9% had current knowledge regarding oral or periodontal health, as evaluated by a questionnaire.⁴⁰⁻⁴²

Physicians have reported that they are not sufficiently trained to perform a dental examination on their patients. In a national survey by Lewis et al, 90% of the pediatricians felt that they had an important role in identifying dental problems and teaching prevention to families. Interestingly, half of them reported that they had no training in medical school or residency

regarding dental issues.⁴⁰ McCundiff et al reported that only 7% of primary care physicians performed an examination for oropharyngeal cancer on their patients, and that their knowledge in this area needed to be more current.⁴¹ Yellowitz et al found that 82% of physicians never completed a routine oral cancer examination on most of their patients.⁴² Pediatricians have reported that they are not educated about dental health, even though they are the first health professional to consult with expectant parents and examine infants.⁴³ In a study that assessed the knowledge, attitudes, and beliefs of pediatricians and family practice physicians toward pediatric preventive care, Sanchez et al demonstrated that both groups recognized that they receive inadequate training about pediatric dental care during medical school and residency.⁴⁴ Of these physicians, only a few provided their patients with oral health education during the prenatal period. According to a 1992 publication by Wender et al, pediatricians' education about oral health has not changed in 20 years.⁴⁵

Only one study to date has been performed that surveyed obstetricians regarding oral evaluations performed during prenatal examinations and referrals of their patients to dentists.⁴⁶ The purpose of the study was to investigate if obstetricians perform oral examinations; if they consult with patients' dentists regarding oral health; and, whether there was interest in attending dental continuing education to learn more about oral health. Almost half of the obstetricians (46.8%) indicated that they never had the time to perform an oral examination. When an examination was made, the posterior pharynx was examined each time by 46% of the obstetricians, the gums were examined by 24%, and the teeth by 30%. Forty-five percent of the obstetricians reported that 1 to 5 referrals to dentists were made in a year. Seventy-eight percent were interested in continuing education regarding periodontal infection and PTL and LBW. It was concluded that there was need and interest in this group of obstetricians in obtaining new information regarding periodontal disease and PTL and LBW.

Since so little is known about obstetricians and their performance of dental examinations and referrals of patients to dentists during pregnancy, the current study was deemed essential to add to the body of knowledge regarding obstetricians' practice behaviors and knowledge of periodontal disease and pregnancy outcomes.

Methods

This study was an observational study, utilizing a descriptive study design. A survey was drafted and pilot tested at the University of North Carolina School of Dentistry for validity and reliability. Revisions were made and the survey was pilot tested twice at the Department of Maternal and Fetal Medicine at the University of North Carolina School of Medicine. Additional revisions were made to the survey. The project was approved by the Investigational Review Board at the University of North Carolina School of Dentistry. Surveys were sent to 194 practicing obstetricians in North Carolina, from Alamance (N=5), Durham (N=27), Guilford (N=39), Orange (N=34), and Wake (N=89) counties. The targeted area in central North Carolina included 3 teaching hospitals. The study sample included all obstetricians in private practice, teaching, and community hospitals and clinics in the geographic area. Obstetricians were selected from directory and phone listings from the designated areas.

Survey questions were designed to include demographic variables, knowledge variables, attitudinal variables, and practice behavior variables. The survey design consisted of 20 multiple-choice questions. Some questions could be answered with more than one response, and therefore were not mutually exclusive. Likert scales were used to assess views on risk factors and practice behavior.

Three mailings were conducted over the course of 3 months between 2002-2003. Data were entered into an Excel database. Descriptive statistics, Chi Square and Fisher's Exact tests were calculated using SAS software (Cary, North Carolina, USA).

Results

Of the 194 surveys sent, 55 obstetricians were ineligible due to retirement, no longer practicing obstetrics, or no longer in the study area. Of the remaining 139 eligible obstetricians, 55 responded with complete data yielding a 40% response rate.

Sixty-six percent were male, the mean age was 46 years, most worked in private practice, and 44% had been practicing for more than 15 years. One third instructed medical students, residents, nursing students, and physicians' assistant students (Table 1). About 42% treated more than 80 prenatal patients per week.

Table 1. Demographic and Professional Characteristics of Survey Respondents (N=55)

	N(%)
<u>Gender</u>	
Male	36 (66%)
Female	19 (34%)
<u>Age</u>	
Mean	46 years
Range	31-69 years
SD	
<u>Practice Setting</u>	
Group private practice	44 (78%)
University based practice	13 (23%)
Solo Private practice	2 (3%)
Obstetric Clinic	2 (3%)
*More than one response given by some respondents	
<u>Instruct Students</u>	
Residents	22 (39%)
Medical Students	18 (32%)
Nursing Students	9 (16%)
PA Students	12 (21%)
<u>Number of Years in Practice</u>	
< One Year	0
1-5 Years	8 (15%)
6-10 Years	9 (16%)
11-15 Years	14 (24%)
> 15 Years	24 (44%)

Table 2 reports the respondents' personal experience with dentistry and their knowledge about gingivitis and periodontitis. Most (69%) were current with regular dental checkups (69%) and only 20% had been told that they had periodontal disease. Regarding knowledge about gingivitis, the majority answered that it was a reversible infection (66%) with reversible redness and swelling (83%). When asked about periodontitis, 76% answered that it was a reversible infection and 32% thought it involved tooth decay. Eighty percent knew that periodontitis was more serious than gingivitis. When asked what causes periodontal disease, 94% indicated bacteria, 73% tooth decay, 69% aging, and 51% answered that excess sugar were possible indicators for the condition.

Table 2. Respondents' Personal Experience and Views of Oral Health (N=55)

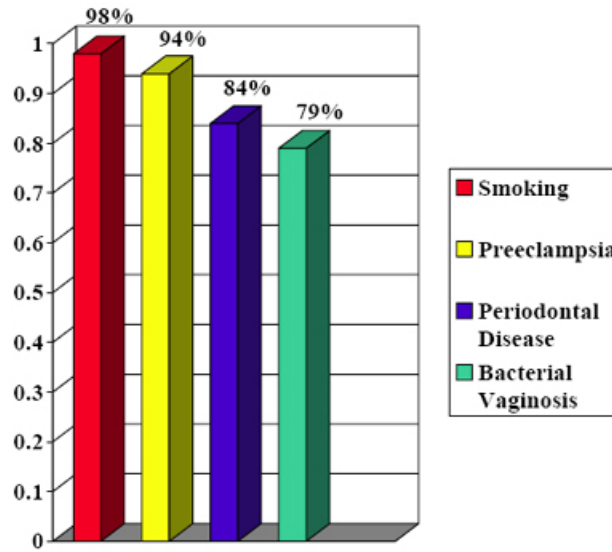
	N (%)
<u>Last seen by dentist</u>	
within last 6 months	38 (69%)
6 months - 1 year	8 (15%)
1-2 years	6 (11%)
>2 years	3 (5%)
<u>Last dental exam to assess gingival health</u>	
within last 6 months	38 (69%)
6 months - 1 year	8 (15%)
1-2 years	6 (11%)
> 2 years	3 (5%)
<u>Have you ever been told that you have Periodontal Disease</u>	
Yes	11 (20%)
No	44 (80%)
<u>*Which of the Following cause/are related to periodontal disease?</u>	
Excess sugar	29 (51%)
Bacteria	52 (94%)
Tooth decay	41 (73%)
Aging	39 (69%)
<u>*Which of the following describes gingivitis?</u>	
Tooth decay	3 (5%)
Potentially reversible infection of the gums	37 (66%)
Reversible redness and/or swelling of the gums	47 (83%)
Lesions on the tongue	0 (0%)
<u>*Which of the following describes periodontitis?</u>	
Tooth decay	18 (32%)
Potentially reversible infection of the gums	43 (76%)
Lesions on the tongue	1 (1%)
<u>Which condition is more serious?</u>	
Gingivitis	11 (20%)
Periodontitis	44 (80%)

*Respondents were allowed to check more than one

Table 3 reports the respondents' knowledge of the relationship between pregnancy and oral health. Forty-seven percent felt that excess decay definitely or may worsen during pregnancy. Ninety-one percent answered that swelling of the gums definitely or may worsen during pregnancy and 98% answered that bleeding gums occurs or worsens during pregnancy. Regarding tooth loss during pregnancy, 53% answered that it probably doesn't or definitely doesn't occur during pregnancy and 28% answered that it may or definitely occurs. Regarding pregnancy risk factors and PTD and LBW, most (98%) regarded maternal smoking as the highest risk factor followed by preeclampsia (94%), periodontal disease (84%), and bacterial vaginosis (79%) (Figure 1). When asked about issues related to periodontal disease such as decay, swollen gums, bleeding gums, and tooth loss, younger female obstetricians that worked in a University-based practice answered with more accuracy (Table 4).

Figure 1.

**RESPONDENTS' ANSWERS TO VIEWS REGARDING
 RISK FACTORS FOR PTL and LBW**



**Table 3. Respondents' Knowledge of the Relationship
 Between Pregnancy and Oral Health**

	Definitely Occurs	May Occur	Uncertain	Probably Does Not Occur	Definitely Does Not Occur
	N (%)	N (%)	N (%)	N (%)	N (%)
How certain are you that excess decay occurs or worsens during pregnancy?	3 (5%)	23 (42%)	9 (16%)	17 (31%)	3 (5%)
How certain are you that swollen gums occurs or worsens during pregnancy?	22 (40%)	28 (51%)	3 (5%)	2 (4%)	0 (0%)
How certain are you that bleeding gums occurs or worsens during pregnancy?	28 (52%)	25 (46%)	1 (2%)	0 (0%)	0 (0%)
How certain are you that tooth loss occurs or worsens during pregnancy?	2 (3%)	13 (25%)	10 (19%)	20 (38%)	8 (15%)

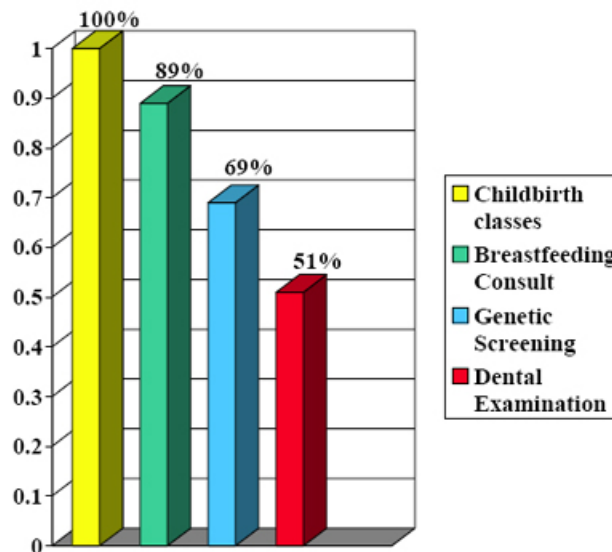
**Table 4. Knowledge of Cause of Issues Related to Periodontal Disease
 By Practice Setting, Gender and Length of Time in Practice**

	N	Correct (%) N (%)	Incorrect N (%)
Gender:			
Male	37	2 (5%)	35 (95%)
Female	18	1 (6%)	17 (94%)
*Setting:			
Private Practice	45	2 (5%)	43 (95%)
University	13	2 (15%)	11 (85%)
Length of time in Practice:			
≤ 10 years	17	2 (12%)	15 (88%)
> 10 years	38	1 (3%)	37 (97%)

The obstetricians in the study recommended childbirth classes (100%), breastfeeding consultations (89%), and genetic screening (69%), while only 51% recommended dental exams during pregnancy (Figure 2). Regarding recommendations for dental examinations, those in private practice were similar to those in University settings.

Figure 2.

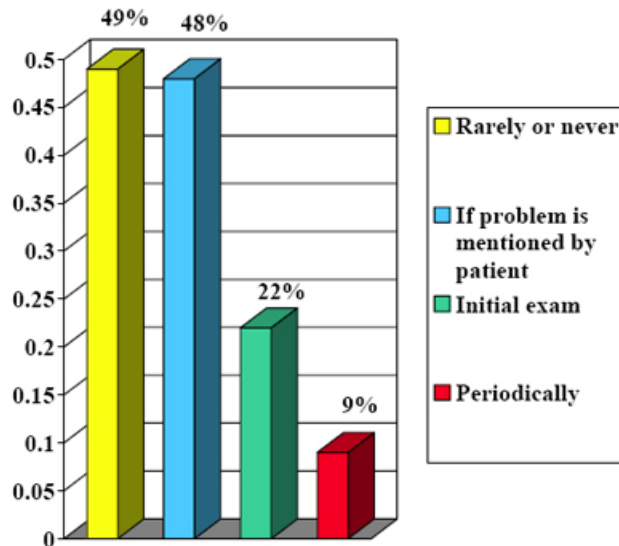
**RESPONDENTS' ANSWERS TO QUESTIONS REGARDING
 RECOMMENDATIONS TO PATIENTS**



When the obstetricians looked into patients' mouths, 22% did so at the initial prenatal examination, and 49% rarely or never looked (Figure 3). For those in private practice and in a University setting, both groups looked into patients' mouths (55% and 39%, respectively) only when a problem was mentioned by the patient. More obstetricians who had been practicing for more than 10 years (33%) looked into patients' mouths at the initial visit, and more obstetricians who had been practicing for less than 10 years (59%) looked into patients' mouths only when a problem was mentioned by the patient.

Figure 3

VISUAL DENTAL EXAMS
PERFORMED BY RESPONDENTS



Discussion

Since little is currently known in the literature about provider knowledge of periodontal disease and PTL and LBW, it was most appropriate to utilize the survey approach for this investigation. There were no previous measures of knowledge of this topic in this population. Although family practice physicians, nurse practitioners, physicians' assistants, and midwives also provide prenatal care to North Carolina women, a decision was made to include obstetricians for 2 reasons. Obstetricians provide the majority of prenatal care in North Carolina. They are trained differently and practice in settings that differ from other prenatal care providers, thereby preventing confounded study results. The 5 counties included in the study are diverse in their demographic makeup and proximity to major medical centers and therefore provide a good study population.

There was an adequate number of obstetricians identified in the geographical area allowing for an appropriate sample size. A high response rate is desirable in order to decrease nonresponse bias. A response rate higher than 40% was anticipated from this group. Historically, physicians' response rates to questionnaires have varied substantially.⁴⁷⁻⁴⁸ Van Guest Cartwright investigated physician response rates in over 19 professional study samples and found response rates for professionals to range from 56% to 99%.⁴⁷ There was only a 21.8% response to a similar study in West Virginia that surveyed obstetricians regarding oral evaluations performed and referrals of their patients to dentists.⁴⁶

It is important to note that a sample such as this group may not be representative of obstetric providers everywhere, thus limiting the external validity. Nonresponse bias is a consideration in research. In this study, an analysis utilizing Chi Square and Fisher's Exact tests showed that differences and patterns of response between the respondents and nonrespondents were not extreme enough to be statistically different. The gender and county of the respondents and nonrespondents were very similar. There were no differences in respondents vs. nonrespondents with respect to urban areas vs rural areas. According to the US Census Bureau's definition of an Metropolitan Statistical Area (MSA) by county population, all 5 counties were defined as cosmopolitan areas.⁴⁹

A high number correctly associated periodontal disease with bacteria, yet erroneously believed that tooth decay, aging, and excess sugar were also associated. This indicated that there is awareness of the cause of periodontal disease but the information that they have may not be totally accurate. The respondents had knowledge of gingivitis, yet 76% thought

that periodontitis is reversible. Those answering most questions correctly regarding gingivitis were those in private practice, female, and had been in practice for more than 10 years. Those answering most questions correctly regarding periodontitis were those in private practice, female, and had been in practice for less than 10 years. It is interesting to note that those in private practice were more accurate in their responses than those in academia. As shown by the responses, periodontal disease was considered a potential risk factor in obstetrics.

Regarding practice behaviors and recommending consultations, all recommend childbirth classes, most recommend lactation consultations, nutrition consultations, and genetic screening, yet only 51% recommend a dental examination. Less than 22% look into patients' mouths at the initial prenatal visit, 10% periodically, and 54% only when a problem is mentioned by the patient. Previous investigators have suggested that physicians may not look into patients' mouths due to lack of training.^{40,43-45,50} One study reported that one half of the physicians surveyed had no training on oral examinations during medical school or residency.⁴⁰ Physicians may feel insecure in their knowledge about oral conditions. With time constraints on physicians, this may result in oral health being a minor aspect of care.⁴¹ In one study of obstetricians, it was indicated that they never had time to perform a dental examination.⁴⁶

Regarding risk factors related to PTL and LBW, smoking, preeclampsia, and bacterial vaginosis and periodontal disease were all cited as risk factors for PTL and LBW by over 75% of the participants. Smoking, preeclampsia, and bacterial vaginosis are commonly known obstetrics risk factors. In this study, periodontal disease was regarded as a greater risk factor than bacterial vaginosis. This could be due to the fact that the use of antibiotics in patients with bacterial vaginosis has decreased the risk of preterm low weight births.⁵¹

The concept of "periodontal medicine" has recently emerged to address dental health and its connection with systemic diseases. It refers to a new field of investigation that may have a dramatic effect on dentistry.⁵² It is based on the emerging data that suggests that periodontal disease contributes to the morbidity and mortality of individuals with systemic diseases such as premature delivery, diabetes, atherosclerosis, stroke, and myocardial infarction.⁵² According to the Surgeon General's Report, changes in education need to take place to incorporate this concept.⁵³⁻⁵⁴ Many medical professionals do not have knowledge of periodontal disease and the potential infection that may exist in the oral cavity. Dental and medical school curricula should include a greater emphasis on systemic medicine and how to integrate this research information into clinical applications.⁵⁵ Patients need education in the prevention of disease and the relationship between oral disease and systemic health just as they need education in the control of diabetes, smoking cessation, weight reduction, and lowering of cholesterol. Continuing education for health professionals about the oral health-systemic health relationship is essential, and optimizing communication and collaboration between dental and medical professionals will be beneficial for patients.

Since this study was conducted, a paper has been published describing an oral health curriculum for medical students at the University of Washington.⁵⁵ Prior to the development of the curriculum, a pilot study of 229 medical students at the University of Washington revealed a generally positive attitude about the importance of oral health training but low student knowledge of caries, oral-systemic interactions, and oral health disparities across all training years. Their estimation was that medical students received about 2 hours of oral health related education across the 4 years of medical school. Their curriculum will incorporate 5 key oral health themes including oral-systemic health interactions and periodontal disease.

The research on PTL and LBW is nonconclusive. Since this study was conducted, studies have been published that have found an association between periodontal disease and PTL and LBW.⁵⁶⁻⁵⁷ Others have looked at the impact of interventions in decreasing the incidence of PTL and LBW.⁵⁸⁻⁶⁰ Two studies have found no association between periodontitis and adverse pregnancy outcomes.⁶¹⁻⁶² Future studies may conclude whether there is a direct relationship. Regardless, this area of investigation has raised the consciousness about the importance of oral health. For example, insurers such as Cigna and Aetna have expanded dental coverage offerings for enrollees who might benefit from additional treatment. These insurers include pregnant women and people with cardiac disease. The increased coverage will include such services as an additional third scaling per year (including scaling and root planing).⁶³

In the future, policies can be developed that improve the communication of good oral health care practices between physicians and dental hygienists, dentists, patients, and other health care providers. Formal education strategies will be

needed in medical and dental school curriculums regarding the association between oral health and systemic health for practitioners to be able to fully understand the health consequences of an untreated oral infection. In addition, a higher level of education in this area will be needed for dental hygienists, advance nurse practitioners, registered nurses, and others who come into frequent contact with patients. Improved communication between practitioners will become vital as increased knowledge is gained in this important area of health care.

Further investigation in this area is planned by the authors. Questions have arisen from this study that pertain to other health care providers and their knowledge of periodontal disease and oral-systemic conditions. In addition, no papers appear in the literature regarding curricula of dental and dental hygiene students in oral-systemic conditions and their relationship to periodontal diseases. Many questions need to be answered as we not only discover the physical mechanism of action between periodontal disease and oral-systemic conditions but also as we incorporate this knowledge into the medical and dental healthcare system.

Conclusion

Current research efforts demonstrate a possible association between periodontal disease and a number of systemic illnesses. The link between periodontal disease and adverse pregnancy outcomes needs further research. As more knowledge is gained regarding periodontal diseases and systemic health and specifically maternal and infant health, there will be an increased opportunity for improved patient care. New standards could emerge from medical and dental/dental hygiene education as well as improved standards of communicating good oral health practices.

This study demonstrates that while there is some knowledge of periodontal disease as a potential risk factor for PTL and LBW among obstetricians, there is limited incorporation of this knowledge into clinical practice. Incorporation of dental information into medical curricula would increase knowledge of periodontal disease and its effects on the body as a whole. In addition, investigations are needed in effective ways to incorporate important science into clinical practice to benefit the health of all patients.

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Notes

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