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An evaluation of the occurrence of preterm low birth weight infants in mothers who received periodontal therapy during pregnancy

Paige Beven Gordon

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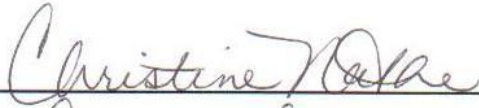
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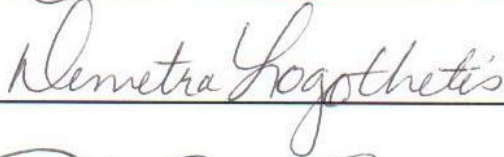
Department

This thesis is approved, and it is acceptable in quality and form for publication:

Approved by the Thesis Committee:



Christine Nathe, RDH, MS, Chairperson



Demetra Logothetis, RDH, MS



Diana Burnham, RDH, MS

**AN EVALUATION OF THE OCCURRENCE OF PRETERM LOW
BIRTH WEIGHT INFANTS IN MOTHERS WHO RECEIVED
PERIODONTAL THERAPY DURING PREGNANCY**

BY

PAIGE BEVEN GORDON

B.S., Dental Hygiene, The University of New Mexico, 2007

THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of

**Master of Science
Dental Hygiene**

The University of New Mexico
Albuquerque, New Mexico

December, 2010

Dedication

This thesis is dedicated to my beautiful daughter,

Brooklyn Grace

Your smile brings immeasurable joy and your
very presence fulfills my life.

I also dedicate this to my mother.

I am able to believe in myself because you have always
believed in me. Your unconditional love and
support will forever light my path.

Acknowledgements

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I would like to also extend a large thank you to Adam Page, for not only the statistical analysis of this research, but for the time and effort made to lend a helping hand.

Thank you to all my friends and family, and especially my brother, Mark – not only for surviving, but for showing me ultimate strength, courage, and what it means to overcome. I love you all very much.

To each and every one listed above, I thank you from the absolute bottom of my heart.

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ABSTRACT

Purpose: The purpose of this research is to determine if evidence exists between the relationship of receiving periodontal therapy during pregnancy and a subsequently-born child's gestational age and birth weight at time of delivery.

Hypothesis: Pregnant mothers who received periodontal therapy during their pregnancy are less likely to have preterm low birth weight infants than those pregnant mothers who did not receive periodontal therapy during pregnancy.

Methods: Data was collected for infants born to 1182 females who utilize the New Mexico Women, Infants and Children supplemental food program. These females were then cross-referenced with the Sandoval County Oral Health Program's dental software database to see which of these females received some kind of periodontal therapy during their pregnancy. The data was analyzed via a standard set of bivariate correlations using the Pearson correlation coefficient as a measure for how inter-dependent all variables in the study are on each other.

Results: A review of the individual models indicates that evidence of periodontal disease has an effect of less than 0.1% on the overall model. In the regression analysis, beta coefficients suggest that only the gestational age and week that the periodontal therapy was received are statistically significant at a 90% confidence level.

The results of a subsequent analysis show that there is a somewhat significant effect ($R^2 = 34.3\%$) on birth weight when the periodontal therapy was received in the 35th week of pregnancy or earlier. This suggests that some threshold level might exist where periodontal disease may have a more significant effect on the birth weight of the baby, and that this threshold could reasonably come approximately at the 35th week of gestation.

Conclusion: The findings of this study suggest that the overall importance of periodontal therapy during pregnancy is minimal, but that a threshold level may exist during gestation where the presence of periodontal disease may have a much more significant effect on a baby's birth weight. Therefore, those mothers who receive periodontal therapy during pregnancy would be better suited to receive the treatment early in the pregnancy to decrease the chances of a preterm low birth weight baby.

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Chapter I

Introduction

Premature births occur in approximately 11% of all singleton babies born in the United States.^{1,5,6} Preterm labor is one of the most prevalent factors for death during the neonatal period. In the first 28 days of life, preterm infants are 40 times more likely to die when compared with full term infants.⁴ Preterm and low birth weight (PLBW) infants are at an increased risk of a number of acute and chronic disorders such as respiratory distress syndrome, cerebral palsy, heart diseases, epilepsy and severe learning disabilities.⁸ Recent studies suggest that over 18% of all preterm births, as well as low birth weight cases, may be attributable to periodontal diseases.⁵ Although some research does not show an association,^{1, 15, 16, 20, 24, 25, 27, 30} many studies have revealed the relationship between periodontal disease and PLBW infants.^{2-8, 13, 14, 17-19, 21-24, 28, 29, 31-35}

The Sandoval County Oral Health Program (SCOHP) is located within the Sandoval County Health Commons facility and offers preventive dental services to clients who are pregnant. These clients are provided with a comprehensive dental and periodontal examination, a series of digital radiographs, and periodontal therapy – either a dental prophylaxis or non-surgical periodontal therapy, depending on the periodontal status of the patient. Referrals to an appropriate dental facility are given for urgent or restorative dental care. This study was designed to assess whether periodontal therapy provided to pregnant women at the SCOHP showed evidence of a reduction in the prevalence of babies delivered before 37 weeks gestation and resulted in more infants born with a birth weight greater than 5.5 pounds.

Statement of the Problem

The general research questions investigated in this study were: What is the prevalence of PLBW infants born to mothers who are clients of the SCOHP and did not receive periodontal therapy during their pregnancy? What is the prevalence of PLBW infants born to mothers who are clients of the SCOHP and did receive periodontal therapy during their pregnancy?

Significance of the Problem

About 11% of single births in the United States occur before the 37th week of gestation and premature birth is one of the highest significant causes for morbidity and mortality among infants.¹ The rate of preterm delivery has increased over the last 15 years despite advances in technology and medicine.^{1,3} There are several factors that have previously been linked to PLBW infants such as maternal genitourinary infections, low maternal height, and absence of prenatal care.² Periodontal infections are preventable and treatable, therefore periodontitis can be viewed as a modifiable risk factor for PLBW. For this very reason, it is imperative that the possible link between periodontal disease and PLBW infants be thoroughly investigated.

Periodontal diseases are a destructive, chronic inflammatory condition of the periodontium and are most commonly associated with anaerobic gram-negative organisms that may also lead to local and systemic infection.^{7,9} This infection results in inflammation of the gingiva and periodontal tissues and leads to the progressive loss of the alveolar bone caused by the production of proinflammatory cells. Recent research shows that these bacteria or their toxins can be released in the blood circulation and activate the body's immune system.⁴ These inflammatory mediators produced in

periodontal diseases also play an important role in labor onset in pregnant women, and it is plausible that biological mechanisms may link both conditions.^{7, 10, 2}

Hypothesis

Pregnant mothers who received periodontal therapy during their pregnancy are less likely to have preterm low birth weight infants than those pregnant mothers who did not receive periodontal therapy during pregnancy.

Assumptions

1. It was assumed that the data in the Sandoval County Oral Health Program database and the New Mexico Women, Infants and Children (WIC) database were both accurate and up to date.
2. It was also assumed that all patient treatment notes documented in the Sandoval County Oral Health Program database were accurate in recording the type of dental treatment received by the patient during pregnancy.

Limitations

The reliability and validity of the study may be limited due to the following factors:

1. The only pregnant women involved in the study were existing patients of the Sandoval County Oral Health Program who were also WIC clients.
2. All patients involved in the study are considered “low-income” due to the fact that one must qualify for WIC benefits based on household size in relation to gross monthly income.
3. The present sample size is small due to the fairly specific criteria that the patients had to fall under in order to be involved in the study.

4. The study does not disclose or take into consideration any other medical conditions that the pregnant mothers may have had at the time of the data collection. The study does not explore the patients' age, weight, ethnicity, marital status, current or past tobacco use, or any history of preterm low birth weight infants or history of miscarriages or induced abortions.

Definition of Terms

Preterm labor: Labor that begins after 20 weeks, when the fetus is considered viable, and before the 37th week, when the baby is considered full-term.

Low birth weight infant: An infant born weighing less than 5.5 pounds (2500 grams) regardless of gestational age.

Periodontal diseases: Inflammatory diseases affecting the periodontium. Also referred to as periodontitis and gingivitis.

Periodontal therapy: Treatment provided to maintain and/or restore the health of the gingiva and its supporting structures. Periodontal therapy can be provided in surgical and non-surgical treatment options. For purposes of this paper, when referring to periodontal therapy, only non-surgical treatment was provided to the subjects and consisted of either an oral prophylaxis or scaling and root planing.

Oral prophylaxis: Cleaning of the teeth which involves calculus removal on the tooth and below the gingiva, fine hand-scaling, polishing, diagnostics and home-care instructions.

Also referred to as prophylaxis.

Inflammatory mediators: Molecules that are released by immune cells when harmful agents enter into the bloodstream. Inflammatory mediators discussed in this paper:

Interleukin-1 α (IL-1 α)

Interleukin-1 β (IL-1 β)

Interleukin-6 (IL-6)

Tumor Necrosis Factor (TNF)

Prostaglandins: a group of hormone-like substances that participate in a wide range of body functions such as the contraction and relaxation of smooth muscle, the dilation and constriction of blood vessels, control of blood pressure, and modulation of inflammation.

Prostaglandin E2 (PGE-2) is released by blood vessel walls in response to infection or inflammation that acts on the brain to induce fever.

Chapter II

Review of Literature

Introduction

This review of literature aims to broaden the understanding of the association between periodontal diseases and preterm low birth weight infants by analyzing earlier studies and data. Although there are different theories pertaining to this association, this review of literature explores the most widely accepted theory of their relationship.

Medical and dental literature was reviewed using the PubMed/MeSH search engines to access the database Medline focusing on keywords such as “periodontal disease”, “pregnancy”, “preterm low birth weight”, among several others.

General information and statistics regarding preterm low birth weight infants will be discussed. The role of periodontal diseases in PLBW, specifically the bacterial pathogens and hormonal influences, will be explored; as well as an overview of the Sandoval County Oral Health Program (SCOHP), its role in this association, and the goals of the program set forth to lower this prevalence.

Preterm Low Birth Weight Defined

Despite the many advances in medicine, the rate of preterm birth in the United States has not significantly decreased over the past several decades. In 2003, the rate rose from 11% to more than 12% of all births in the United States occurring before the 37th week of pregnancy. This equates to over half a million premature births in the United States alone.^{1,32} The delivery of PLBW infants continues to be a public health issue in both developed and developing countries.² Exploration from previous studies linking periodontal disease to PLBW suggested that over 18% of the PLBW infants born

annually might be attributable to periodontal disease, and thus account for a significant proportion of the \$5.5 billion annual hospital costs associated with the care of PLBW infants.^{5,12}

About 25% of PLBW cases occur without even a suspected risk factor. Studies have shown that the patients with the most severe periodontal disease had the greatest risk for PLBW births even after adjusting for other known risk factors. In addition, approximately 25% of pregnant women demonstrate increased periodontal pocketing during pregnancy, which only further increases the risk of preterm birth three to eight fold.⁵ Periodontal infections are both preventable and treatable, therefore, periodontal diseases should be viewed as a modifiable risk factor for the occurrence of preterm labor and low birth weight infants.

Periodontal Diseases Defined

Periodontal diseases are initiated and sustained by a wide spectrum of predominately gram-negative anaerobic and microaerophilic bacteria which colonize in the gingiva below the gumline.⁴ Periodontitis can be considered a continuous pathogenic and inflammatory challenge at a systemic level, due to the large epithelial surface that can be ulcerated in the periodontal pockets. Thus, in the last decade, periodontal infections have been associated with different systemic diseases such as osteoporosis, diabetes mellitus, respiratory diseases, preeclampsia, cardiovascular diseases, other infections, and preterm labor and/or low birth weight infants.⁷

Relationship between Preterm Low Birth Weight Infants and Periodontal Diseases

Periodontal bacteria may be introduced into the blood stream and cause systemic infections and subsequent inflammation. During the second trimester of pregnancy, the

proportion of gram-negative anaerobic bacteria in dental plaque increases in respect to aerobic bacteria. *Fusobacterium nucleatum* and other subspecies coming from the oral flora, have been found in the amniotic fluid of women with preterm birth. The gram-negative bacteria associated with a progressive disease can produce a variety of bioactive molecules that may directly affect the pregnant host. A microbial component, lipopolysaccharide, can activate the macrophages and other cells to synthesize and secrete a wide spectrum of molecules, including cytokines interleukin-1 (IL-1 β), tumor necrosis factor (TNF- α), interleukin-6 (IL-6), prostaglandin E2 (PGE₂) and matrix metalloproteinases.⁴ If these components travel to the blood stream and cross over the placental barrier, the physiological levels of PGE₂ and TNF- α in the amniotic fluid may increase and in turn induce preterm labor.⁴ There is convincing evidence to suggest that infections affecting the mother during pregnancy may produce alterations in the normal cytokine- and hormone-regulated gestation, which could result in preterm labor, preterm birth and even premature rupture of membranes.²⁹

Bacterial Pathogens

Several researchers have evaluated and pinpointed the specific oral bacteria, such as *Streptococcus mutans*, *Streptococcus sobrinus*, *Streptococcus sanguinus*, *Lactobacillus acidophilus*, *Lactobacillus casei*, *Actinomyces naeslundii* genospecies 1 and 2, *Aggregatibacter actinomycetemcomitans* (previously *Actinobacillus actinomycetemcomitans*), *Porphyromonas gingivalis*, *Treponema denticola*, *Tannerella forsythia* (previously *Tannerella forsythensis*), *Prevotella intermedia*, *Campylobacter rectus*, and *Fusobacterium nucleatum* in subgingival dental plaque of pregnant women and their association with birth outcomes.^{4,7,11,23} In these studies, non-surgical

periodontal therapy significantly reduced levels of periodontal pathogens in pregnancy women with periodontal disease.^{11,23}

Hormonal Influences

Hormonal changes during pregnancy must also be investigated when considering periodontal diseases as risk factors for PLBW. Increases in both the rate of estrogen metabolism by the gingiva and in the synthesis of prostaglandins contribute to the gingival changes observed during pregnancy. Alterations in progesterone and estrogen levels have been shown to affect the immune system and the rate and pattern of collagen production in the gingiva, thus reducing the body's ability to repair and maintain gingival tissue. Periodontal infections, which can be a reservoir for inflammatory mediators, may pose a potential threat to the placenta and fetus, thereby increasing the likelihood of preterm delivery. Some data shows that mothers with severe periodontal disease have high levels of prostaglandin in their blood and are more likely to deliver preterm babies. The preliminary analysis suggests that these levels of prostaglandins may be associated with early uterine contractions. In turn, increased levels of prostaglandins in the blood may increase sensitivity to irritants, causing additional inflammation which can even further increase prostaglandin levels until the threshold is surpassed and labor ensues.¹⁰

Although the American Dental Association (ADA) suggest that elective dental care should be avoided, if possible, during the first trimester and the last one-half of the third trimester¹⁰, there is much data in support of thoroughly investigating and treating periodontal infections throughout pregnancy.³³ In fact, one such study conducted by Radnai et al. found that periodontal therapy completed before even the 35th week of pregnancy appeared to have a beneficial effect on birth weight and time of delivery.¹⁷

Another study conducted in 2009 by Wrzosek and Einarson found that scaling and root planing for periodontal disease even with the use of local anesthetics did not increase adverse fetal outcomes and did lower preterm birth rates in the 823 women included in the study who received periodontal therapy between 13 and 21 weeks gestation.⁸ If ongoing large and well-designed randomized trials continue to support such results, there may be a need to reassess current dental practice, as well as the practice of the OB/GYN in taking caution when not referring or rejecting treatment of periodontal diseases with non-surgical periodontal therapy during pregnancy.¹⁸

In 1996, Offenbacher et al. hypothesized that oral infections, such as periodontal disease, can represent a significant source of inflammation and infection during pregnancy which could produce bacterial overload and pregnancy complications, and for the first time, they were able to demonstrate that the risk for a low birth weight infant was seven and a half times higher if there was more than 3 millimeters of attachment loss in 60% of teeth surfaces.^{4,14} This same group of researchers demonstrated that in hamsters, the chronic exposition to *Porphyromona gingivalis* can lead to a decrease of over 15-16% of fetal weight with an increase of PGE₂ and TNF- α . These animal studies suggested the possibility that low level oral infections can produce adverse pregnancy outcomes.²² These early studies led to the hypothesis that periodontopathic bacteria may serve as a source for endotoxin and lipopolysaccharides, which then increases local inflammatory mediators including PGE₂ and cytokines, and that this in turn increases systemic inflammatory mediators that can then lead to preterm birth.¹² Many studies have been conducted since Offenbacher first discovered this link and more and more studies are starting to show that the extent and severity of periodontal diseases are associated with

the increased odds of PLBW delivery.²⁶ Currently, more publications support the statement that maternal periodontal disease may be a risk factor for preterm delivery and low birth weight, than the number of those that suggest opposing evidence.²¹

Since the old wives' tale of "the loss of a tooth for every pregnancy", many women believe that poor oral health during pregnancy is normal.¹⁰ Until recently, many physicians in the United States including obstetrician/gynecologists have been relatively unconcerned with oral health. During most physical examinations, the oral cavity is given only a rudimentary examination.⁹ A questionnaire survey was conducted on gynecologists in the city of Mangalore, India. Out of 93 gynecologists, 59.8% agreed that periodontal disease was considered to be a risk factor in PLBW, while 14.9% stated that it was not a risk factor at all. Fortunately, 77% of the participating gynecologists stated that bleeding/enlargement of the gingiva was a sign of periodontal infection. It was therefore concluded that these gynecologists' knowledge was high regarding the oral manifestations of periodontal diseases, but was low regarding periodontal disease as a risk factor in PLBW. This study concluded that integration of periodontal care into obstetric management may improve pregnancy outcomes as early intervention may reduce the microbial challenge to oral tissues already altered due to hormonal changes.⁵

The CDC's Pregnancy Risk Assessment Monitoring System (PRAMS) reported that only 23-43% of pregnant women received dental care during their pregnancies and of those, only 34.7% of those who are considered low-income residing in one of four low socioeconomic states actually sought dental care during their pregnancy. In three of those states, 12.2–25.4% reported having a dental problem during pregnancy and about one-half of those pregnant women did not seek dental care at all. The PRAMS data also

revealed that overall, pregnant women covered by Medicaid were 24-53% less likely to obtain a dental visit during pregnancy than women who are privately insured.¹⁰

The Sandoval County Oral Health Program

The Sandoval County Oral Health Program (SCOHP) is a program provided by Sandoval County Community Services Division Community Health Program located in Bernalillo, New Mexico. The SCOHP began providing preventive dental services to pregnant women enrolled in the state Medicaid program (and some uninsured/low-income pregnant women) in April of 2008 and is located in the Sandoval County Health Commons. The SCOHP is able to provide these services by utilizing licensed providers (one dental hygienist and one dentist) from the University of New Mexico. Services provided at the SCOHP include comprehensive dental and periodontal examinations, one-on-one oral health and nutritional counseling, digital dental radiographs, intraoral imaging, and non-surgical periodontal therapy including dental prophylaxis or scaling and root planing procedures, based on the periodontal status of the patient. Because some dentists are reportedly reluctant to provide care to pregnant women because of concerns about possible risks, any necessary referrals for dental treatment are directed to facilities that have a thorough understanding of the need for dental treatment during pregnancy and the willingness to treat the pregnant women referred directly from the SCOHP.

The Sandoval County Health Commons also houses a satellite office for the State of New Mexico Department of Health Women, Infants, and Children (WIC) program, which is a food program designed to help low-income pregnant women and children under five years of age receive healthy and nutritional foods and counseling based on their needs. Also located within the Sandoval County Health Commons is the New

Mexico Department of Health Public Health Office, which is primarily staffed by Registered Nurses who provide families with immunizations, pregnancy testing, sexually transmitted disease testing and treatment, annual exams, emergency contraception, various birth control methods, among many other treatment, educational, and preventive services.

This central location within the Sandoval County Health Commons provides optimum access for women who are pregnant to receive dental services during their pregnancy. Capitalizing on this strategic location, collaboration with dental clinics in the community provides the potential to promote preventive dental care services and dental education to a population that might otherwise not find necessary information or resources and to connect those populations to available dental services. In addition to pregnancy presenting an opportunity to receive dental treatment (since it may be the only time some women are eligible for dental benefits), this particular program is also designed, to some degree, around the idea that pregnancy provides a “teachable moment” when women are often very open to oral health education, especially when it relates so closely to the health and well-being of their unborn child.

Chapter III

Materials and Methods

Research Design and Procedures

Subjects for this study were chosen based on the following parameters: if their child was born within the date range of April 2008 to October 2009, their baby was a singleton birth (all multiple-baby births were eliminated from the data pool), and mother of the baby was required to be enrolled in the WIC supplemental food program, receiving those services directly from the Sandoval County Health Commons location. Mother's date of birth, as well as gestational ages and baby's birth weights at the time of delivery, were collected for all mothers in the WIC database within the date range. Of these mothers, further data was collected using the Paterson Eaglesoft dental database to determine which had received periodontal therapy anytime during their pregnancy from the SCOHP hygienist, and furthermore, which of these WIC mothers were diagnosed with having periodontal disease. At the SCOHP, periodontal disease is indicated by periodontal probing depths greater than 4mm in more than 30% of the mouth with associated bleeding on probing, as well as any visible bone loss seen in radiographs. Clinical treatment notes written by the SCOHP hygienist at the time the periodontal therapy was rendered were used to determine the status of periodontal health. Specific levels of periodontal disease (such as slight, moderate and severe) were not considered in this study; only whether or not the disease was present, at any level, at the time of the patient's periodontal therapy.

Hypothesis

Pregnant mothers who received periodontal therapy during their pregnancy will have less preterm low birth weight infants than those pregnant mothers who did not receive periodontal therapy during pregnancy.

Data Collection Procedures

Data consisting of gestational ages at time of birth and birth weights were requested from the New Mexico WIC headquarters, and included all mothers (N=1182) at the SCHC location who delivered a baby within the date range listed above. This data was then cross-referenced with the Sandoval County Oral Health Program's dental database (Patterson Eaglesoft) in order to determine which of these WIC clients were also patients who received periodontal therapy from the SCOHP during their pregnancy (N=104). Combined information from both databases included the following criteria: mother's date of birth, baby's date of birth, baby's gestational age at time of birth, baby's birth weight, whether or not the mother received periodontal therapy at the SCOHP, in what week of pregnancy did the mother receive periodontal therapy, and furthermore, whether or not the mother was diagnosed with any level of periodontal disease by the SCOHP hygienist at the time of treatment (N=32). All mothers and babies were identified using ID numbers to conceal their names and any other personal information. Once the data was collected and cross-referenced, it was submitted to a statistician for analysis.

Study Approval

The study was reviewed and approved by the Human Research Review Committee (HRRC), which is the University of New Mexico Health Science Center's

Institutional Review Board (IRB). Exempt status was granted and consent forms requiring respondents' signature were waived in order to maintain confidentiality.

Data Analysis

Upon receipt of the data for the 1182 mothers fitting within the criterion, the statistician, Adam Page, formatted the data for use in the SPSS 11.5 statistical software package and ran a standard set of bivariate correlations using the Pearson correlation coefficient as a measure for how inter-dependent all variables in the study are on each other. See Figure 1.

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	Gestational Age	.	Stepwise (Criteria: F-to-enter >= .002, F-to-remove <= .001).
2	Week of Pregnancy Cleaning Received	.	Stepwise (Criteria: F-to-enter >= .002, F-to-remove <= .001).
3	Previously Had Periodontal Disease	.	Stepwise (Criteria: F-to-enter >= .002, F-to-remove <= .001).

a. Dependent Variable: Birthweight

Figure 1. Variables Used in Analysis

After determining the level of relationships between the variables, the statistician used a stepwise linear regression analysis to determine the strength of effect each variable had on the baby's birth weight. Several regression analyses were run to look at the data in various ways (e.g. those who had periodontal disease at the time of their periodontal therapy versus those that did not; those who received periodontal therapy before their 35th week of pregnancy versus those who received periodontal therapy during or after their 35th week of pregnancy). Strength of the model was determined using the R^2 calculation. Relevant findings are discussed in the next section.

Chapter IV

Results

The bivariate correlation analysis shows that a moderate correlation exists between birth weight and the following: 1) age of mother, 2) whether or not the mother had periodontal disease, 3) the week of pregnancy the mother received periodontal therapy. Since the purpose of the experiment is to determine the effects of various dental implications on whether or not a mother will deliver a PLBW baby, the age of the mother was not considered a relevant variable for subsequent regression analysis.

As shown in Table 1, a strong correlation exists between birth weight and the following: 1) whether or not the baby was of low birth weight, 2) gestational age, and 3) whether or not the baby was born pre-term. Since gestational age has the strongest correlation with birth weight and is the only variable with a strong correlation that is not a dummy variable, gestational age was considered the most relevant for subsequent regression analysis.

Table 1: Bivariate Correlation Analysis

		Correlations							
		Age of Mother	Birthweight	Low Birthweight	Gestational Age	Pre-term Dummy Variable	Periodontal Therapy Effect	Periodontal Disease Present	Week of Pregnancy Periodontal Therapy Received
Age of Mother	Pearson Correlation	1	.111**	.043	-.040	-.081*	-.038	-.106	-.075
	Sig. (2-tailed)	.	.006	.287	.324	.043	.346	.289	.449
	N	620	620	620	620	620	620	103	103
Birthweight	Pearson Correlation	.111**	1	.481**	.553**	.391**	-.013	.134	-.097
	Sig. (2-tailed)	.006	.	.000	.000	.000	.663	.176	.325
	N	620	1182	1182	1182	1182	1182	104	104
Low Birthweight	Pearson Correlation	.043	.481**	1	.451**	.395**	-.036	.148	.041
	Sig. (2-tailed)	.287	.000	.	.000	.000	.222	.134	.678
	N	620	1182	1182	1182	1182	1182	104	104
Gestational Age	Pearson Correlation	-.040	.553**	.451**	1	.659**	-.012	.170	.127
	Sig. (2-tailed)	.324	.000	.000	.	.000	.674	.085	.198
	N	620	1182	1182	1182	1182	1182	104	104
Pre-term Dummy Variable	Pearson Correlation	-.081*	.391**	.395**	.659**	1	-.031	.142	.113
	Sig. (2-tailed)	.043	.000	.000	.000	.	.284	.149	.252
	N	620	1182	1182	1182	1182	1182	104	104
Periodontal Therapy Effect	Pearson Correlation	-.038	-.013	-.036	-.012	-.031	1	. ^a	. ^a
	Sig. (2-tailed)	.346	.663	.222	.674	.284	.	.	.
	N	620	1182	1182	1182	1182	1182	104	104
Periodontal Disease Present	Pearson Correlation	-.106	.134	.148	.170	.142	. ^a	1	-.088
	Sig. (2-tailed)	.289	.176	.134	.085	.149	.	.	.373
	N	103	104	104	104	104	104	104	104
Week of Pregnancy Periodontal Therapy Received	Pearson Correlation	-.075	-.097	.041	.127	.113	. ^a	-.088	1
	Sig. (2-tailed)	.449	.325	.678	.198	.252	.	.373	.
	N	103	104	104	104	104	104	104	104

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

A stepwise linear regression analysis considering the following variables was then calculated: 1) gestational age, 2) whether or not the mother previously had periodontal disease, and the week of the pregnancy that periodontal therapy was received. Together the three variables produced an R^2 calculation of 30.2%, which is in line with the statistical hypothesis. This calculation is depicted in the scatterplot seen in Figure 1.

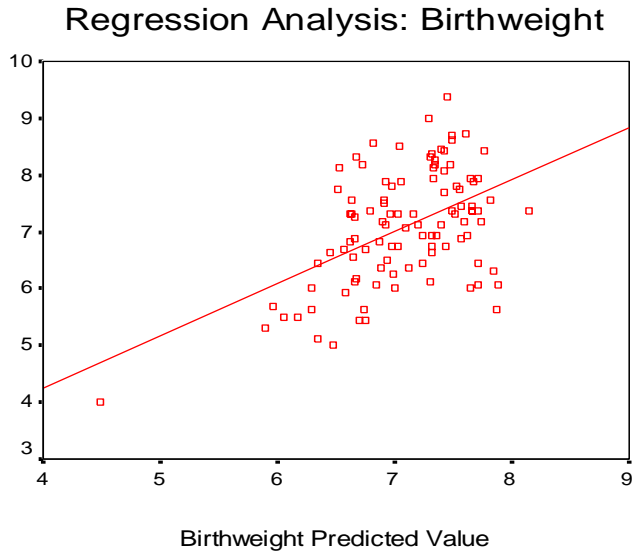


Figure 2: Regression Analysis Scatterplot

However, a review of the individual models indicates that the gestational age of the baby accounts for 27.4% of the model. This suggests that the effect of previous periodontal disease and week of dental work in the pregnancy is not a strong factor in the birth weight of babies born to low-income mothers. As seen in Table 2, further review indicates that evidence of periodontal disease has an effect of less than 0.1% on the overall model, suggesting that the week periodontal therapy received is a more important factor than periodontal disease when concerning the dental implications at play.

Table 2: Overall Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df 2	Sig. F Change
1	.524 ^a	.274	.267	.8575819	.274	38.522	1	102	.000
2	.549 ^b	.302	.288	.8454113	.027	3.958	1	101	.049
3	.550 ^c	.302	.281	.8491892	.001	.103	1	100	.749

a. Predictors: (Constant), Gestational Age

b. Predictors: (Constant), Gestational Age, Week of Pregnancy Periodontal Therapy Received

c. Predictors: (Constant), Gestational Age, Week of Pregnancy Periodontal Therapy Received, Periodontal Disease Present

d. Dependent Variable: Birthweight

In the regression analysis shown in Table 3, beta coefficients (which determine the relative slopes of a regression line for each variable) suggest a logical relationship (e.g. gestational age shows a positive relationship; the week periodontal therapy was received shows an inverse relationship), and the significance levels placed on each variable suggest that only the gestational age and week that periodontal therapy was received are statistically significant at a 90% confidence level.

Table 3: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-6.179	2.138		-2.890	.005
	Gestational Age	.342	.055	.524	6.207	.000
2	(Constant)	-6.095	2.108		-2.891	.005
	Gestational Age	.355	.055	.545	6.498	.000
	Week of Pregnancy Periodontal Therapy Received	-.024	.012	-.167	-1.989	.049
3	(Constant)	-6.079	2.118		-2.870	.005
	Gestational Age	.352	.056	.540	6.300	.000
	Week of Pregnancy Periodontal Therapy Received	-.024	.012	-.164	-1.932	.056
	Periodontal Disease Present	.059	.184	.027	.321	.749

a. Dependent Variable: Birthweight

An additional regression analysis was conducted to test a theory that the week in which periodontal therapy is received is important to a baby's birth weight. To do this, those who received periodontal therapy (n=102 cases) were separated into two groups: those who received periodontal therapy at 34 weeks gestation or earlier (n=90), and those who received periodontal therapy at 35 weeks gestation or later (n=12). Only dental variables (week of pregnancy periodontal therapy was received and whether or not the mother had periodontal disease) were considered.

The results of this subsequent analysis show that there is no reasonable effect ($R^2 = 2.3\%$) when periodontal therapy was received after the 35th week of pregnancy, as seen in Table 4. However, there is a somewhat significant effect ($R^2 = 34.3\%$) on birth weight when the periodontal therapy was received in the 35th week of pregnancy or earlier, which is depicted in Table 5. This suggests that some threshold level might exist where periodontal disease may have a more significant effect on the birth weight of the baby, and that this threshold could reasonably come approximately at the 35th week of gestation. The practical application of such a result is that by not delaying periodontal therapy, mothers may have a better chance of having a baby with a higher or a more "normal" birth weight.

Table 4: Model Summary – Received Periodontal Therapy in 35th Week of Pregnancy or Later

Model Summary - Received Periodontal Therapy in 35th Week of Pregnancy or Later

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.462 ^a	.213	.142	.6371712
2	.586 ^b	.343	.212	.6106459

- a. Predictors: (Constant), Week of Pregnancy Periodontal Therapy Received
- b. Predictors: (Constant), Week of Pregnancy Periodontal Therapy Received, Periodontal Disease Present

Table 5: Model Summary – Periodontal Therapy Received Prior to 35th Week of Pregnancy

Model Summary - Periodontal Therapy Received Prior to 35th Week of Pregnancy

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.144 ^a	.021	.010	1.0338818
2	.152 ^b	.023	.001	1.0384208

- a. Predictors: (Constant), Periodontal Disease Present
- b. Predictors: (Constant), Periodontal Disease Present, Week of Pregnancy Periodontal Therapy Received

Chapter V

Discussion

The findings of this study suggest that the overall importance of periodontal therapy during pregnancy is minimal, but that a threshold level may exist during gestation where the presence of periodontal diseases may have a much more significant effect on a baby's birth weight. Therefore, those mothers who receive periodontal therapy during pregnancy would be better suited to receive the treatment early in the pregnancy to decrease the chances of delivering a baby with PLBW.

Current understanding of maternal and fetal physiology indicates that the benefits of providing dental care during pregnancy far outweigh potential risks. According to the Perinatal Oral Health Consensus, prevention, diagnosis and treatment of oral diseases, including needed dental radiographs and use of local anesthesia, are highly beneficial and can be undertaken during pregnancy with no additional fetal or maternal risk, when compared to the risk of not providing care.³⁶ The American Academy of Periodontology urges oral health professionals to provide preventive services as early in pregnancy as possible to provide treatment for acute infection or sources of sepsis irrespective of the stage of pregnancy.³⁷ The timing of such care is vital given that the oral health of pregnant women has the potential to impact the overall and oral health status of their children.

Good oral health and control of oral disease protects a woman's health and quality of life before and during pregnancy, and has the potential to reduce the transmission of pathogenic bacteria from mothers to their children. Despite this, many women do not seek – and often are not advised to seek – dental care as part of their prenatal care. Not

only does pregnancy provide that invaluable “teachable moment”, but for some women, it may be the only time they are eligible for dental benefits. Barriers and limits to improving oral health and utilizing oral health services for pregnant women and their children are multifaceted and complex, and the factors relate both to the health care system and to the patient herself.

Prenatal and oral health providers are limited in providing oral health care during pregnancy by their lack of understanding about its impact and safety. Many dentists needlessly withhold or delay treatment of pregnant patients because of fear about injuring either the woman or the fetus – or because of fear of litigation. Because they have not been trained to understand the relationship between oral health and overall health, many prenatal providers fail to refer their patients regularly to dental providers. A coordinated effort between the oral health and prenatal communities can benefit maternal and child oral health outcomes.

If ongoing large and well-designed studies continue to support such results, current practice management for pregnant women will need to be reassessed. Such results should be carefully considered by dental providers, cautioning them to reject treatment of all levels of dental health and periodontal diseases with routine prophylaxis and non-surgical periodontal therapy before the 35th week of pregnancy.

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