

The interaction and effects between pregnancy and oral health

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Introduction

Oral health has a large influence on overall health. Oral health can increase the risks of heart disease and stroke (Hwang et. al, 2012). Untreated dental disease is very common in the United States, which include the two most common dental diseases—dental caries and periodontal disease (Russell and Mayberry, 2008).

Although the amount of dental caries has decreased in the past 20 years with the increase of knowledge and treatment of the disease, it remains one of the largest causes of oral health issues (Featherstone, 1999). Dental caries is caused by bacteria that ferment carbohydrates on the teeth and cause the enamel to break down (Silk et. al, 2008). Two of the main bacteria that do this are *Streptococcus mutans* and *Streptococcus sobrinus*. When they ferment these carbohydrates, they produce acids. This is what breaks down the phosphate and calcium minerals of the enamel or dentin of the tooth. By going to a dentist and having a filling done, it removes the bacteria and the decay the bacteria have caused and halts the progression of the decay. One discovered way to protect the teeth from dental caries is by using fluoride. Fluoride helps the saliva to return these minerals back to the teeth and inhibit the decay caused by the oral bacteria (Featherstone, 1999).

Another big disease affecting oral health is periodontal infections. Periodontal disease is associated with multiple other systemic health issues, such as heart disease, stroke, diabetes, respiratory disease, and preterm births (Colgate, 2013). Periodontal disease is an infection of any structure around the tooth. This can cause severe damage to the structures such as the jaw bone, causing bone loss around the tooth and possibly requiring extraction. Gingivitis is an early form of periodontal disease, which is an infection of the gums. These infections are caused by the bacteria in plaque, which are the same bacteria that causes dental caries within the tooth. The

body's immune system releases white blood cells in order to kill the bacteria. This causes blood to rush to that area to get the white blood cells there, which causes inflammation and easy bleeding of gums; this is gingivitis. When the gum inflames it can detach from the bone, causing a pocket, which allows more bacteria to enter deeper. This can cause damage to the bone surrounding the teeth and cause the teeth to become loose and require extraction (Colgate, 2013).

A specific health issue that has been studied to possibly be influenced by oral health is pregnancies. Although the preventative strategies for reducing oral health problems are known and practiced, not many people, including pregnant women, adhere to this knowledge, and this is a large issue this thesis focuses on. Due to the hormones, pregnancy can cause a larger intake of carbohydrates, which means it is very important for the women to take care of their oral health. However, although 63% of pregnant women increase carbohydrate intake during pregnancy, 65% of them only admit to brushing their teeth. Of that 65%, 59% have bleeding gums while brushing their teeth, a sign of periodontal disease (Bakhtiar et. al, 2017). According to the Michigan Department of Health and Human Services, after being examined and completing a survey, out of the 26% of pregnant women that were told they needed dental treatment done, only 58.4% received the treatments. This was dependent on race, age, education, marital status, and insurance status. Pregnant women older than 30, white women, married women, insured women, and women who had a college education or higher were more likely to have the treatments done (MDHHS, 2013). This brings light to another large issue this thesis will focus on: the lack of treatment even when treatment is understood to be important.

The intent of this thesis is to research the effects between pregnancy and oral health and promote awareness of the need for a better systemic approach through a national organization to inform pregnant women of the need for proper oral health care before, during, and after

pregnancy. This thesis will aim to examine pregnant women's knowledge on oral health, the effect of a fetus on a woman's oral health, the effects of the woman's oral health on the fetus, how the mother's oral health can have long term effects on the growing child's oral health, and suggestions on how to improve the oral health of pregnant women.

Pregnant Women's Knowledge of Oral Health Care

The cause of women neglecting oral health during pregnancy could be influenced by their knowledge on the importance of oral health during pregnancy. In the studies mentioned above, many women did not consider oral health as a way to protect and keep their fetus safe. However, this may be due to a lack of understanding that oral health may be correlated to the health of their child. According to Silk et. al (2008), only 22-34% of women consult a dentist during pregnancy and only half of pregnant women attend to a dental emergency. This is due to the limited availability of knowledge provided by the American Dental Association and the American College of Obstetricians and Gynecologists. These organizations only provide brochures and few sources to read. However, there are no clinical guidelines that must be followed for a pregnant patient (Silk et. al, 2008). This is an issue because many women rely on these organizations and trust these organizations to give them all the information needed, but without proper consultation, women are not receiving the information they need. This causes fewer women to understand the severity of dental visits and oral health care during pregnancy.

Alongside the lack of knowledge of oral health care caused by the lack of information given, pregnant women's knowledge of oral health care during pregnancy may be affected by demographics.

Figure 2. Prevalence of not receiving dental care by maternal age and race

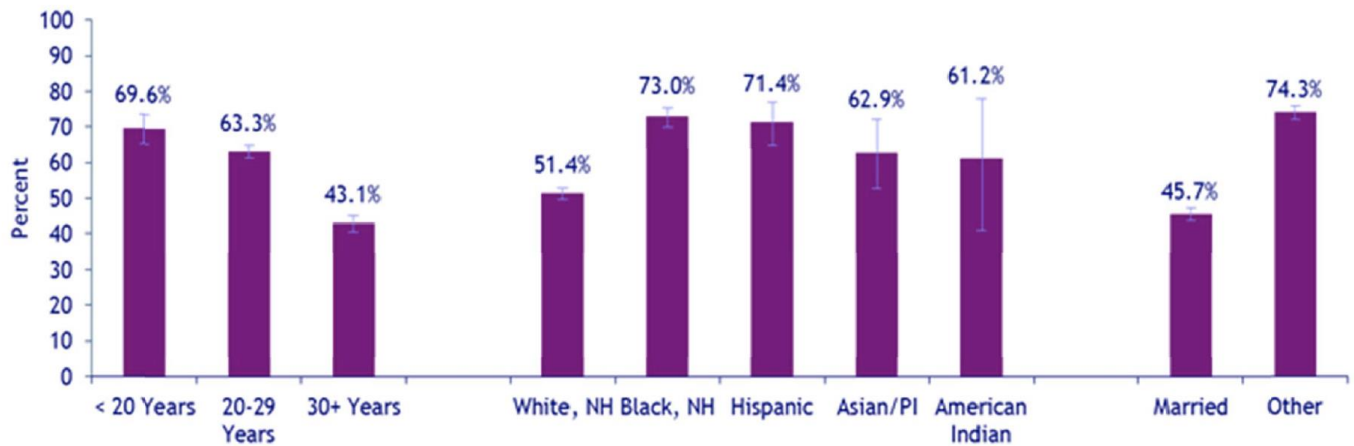


Figure 1: This figure shows the percent of pregnant women whom did not receive dental care during their pregnancy dependent on demographics of age, race, and marital status (MDHHS, 2013).

Figure 3. Prevalence of not receiving dental care by maternal education and pre-pregnancy insurance status

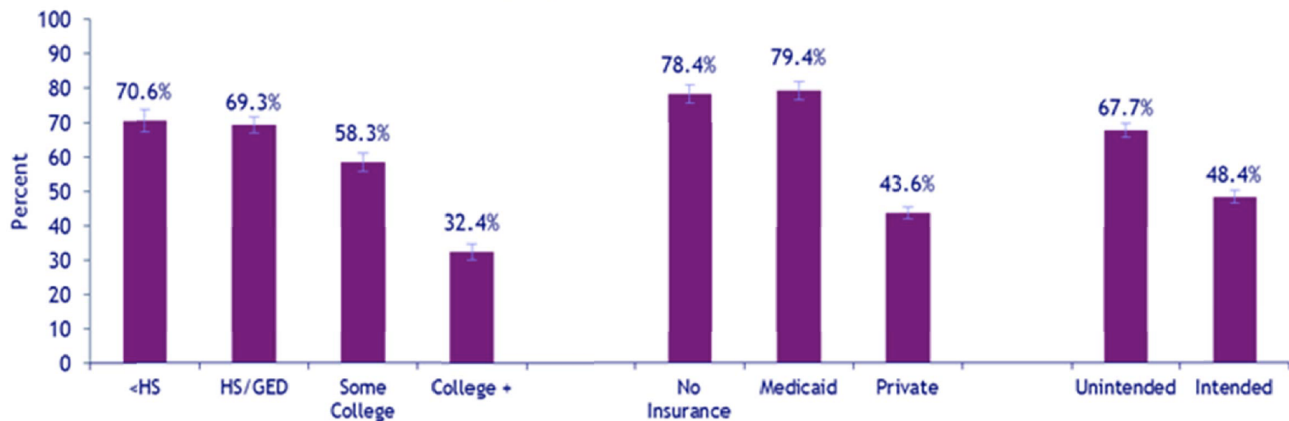


Figure 2: This figure shows the percent of pregnant women whom did not receive dental care during their pregnancy dependent on demographics of maternal education and insurance status (MDHHS, 2013).

Figure 1 indicates that pregnant women above the age of 30, white women, and married women are more likely to receive dental care during pregnancy. Figure 2 indicates that pregnant women with a college education or higher or are insured prior to their pregnancy are more likely to receive dental care during their pregnancy (MDHHS, 2013). These results express that due to a woman's circumstances, she may not have the knowledge of receiving proper dental care during her pregnancy. For example, if a woman is uninsured prior to, and during her pregnancy, and she

is not receiving the adequate amount of dental care, she may have not been told even prior to her pregnancy that going to the dentist is important. This indicates that the knowledge that could have been available to her was not, because of her demographic. This can also be applied to education of the woman. With a higher education, the woman has more resources available to her for her to understand the importance of oral health care during her pregnancy. Another example is with a married pregnant woman. Assuming that non-married women are living alone or supporting themselves, with another supporter and another source of income, a woman is more likely to receive dental care.

It is important to acknowledge why pregnant women are not receiving the care they need. Issues such as national organizations not providing adequate guidelines for general dentists to follow along with pregnant women's demographics could be a cause.

Effects of Pregnancy on Women's Oral Health

Although there may be underlying reasons as to why pregnant women are not receiving proper oral health care during pregnancy, it is extremely important they do due to the increased risks of oral health issues during pregnancy. A common symptom during early stages of pregnancy is hyperemesis gravidarum, or sickness during pregnancy. This causes nausea and vomiting, which exposes the oral cavity to acidic conditions. As mentioned before, acid breaks down the enamel of the teeth. This allows the bacteria to decay the tooth further and quicker, creating caries (Silk et. al, 2013).

A large cause of common oral health issues during pregnancy is the large fluctuation of the sex hormones of women. During pregnancy, the woman's body goes through increased levels of estrogen and progesterone fluctuations (Steinberg et. al, 2013). Progesterone and estrogen levels rise in pregnant women until the 8th month of pregnancy (Laine, 2002). One direct effect

of these hormonal fluctuations is gingivitis. It affects 60-75% of all pregnant women (Steinberg et. al, 2013). These steroid's receptors are present in gingival tissue. Progesterone and estrogen cause an increase in vascularity and vascular flow in gingival tissue, meaning an increase in blood vessels and blood flow. Alongside the steroid hormones, polymorphonuclear (PMN) leukocytes increase during pregnancy. These cells are part of the nonspecific immune system and cause inflammation. With the increase of steroid hormones and PMN cells during pregnancy, gingivitis is a lot more likely to occur. According to Loe and Silness, pregnant women start to show signs of gingivitis in their 2nd month. It is during the 3rd and 8th month of pregnancy when signs of gingivitis appear to be the most extreme. Gingivitis is an inflammation of the gum due to irritation and buildup of bacteria in plaque. These are the periods of pregnancy when the hormone levels are the highest, indicating the steroid hormones could be a cause of the inflammation. The severe gingivitis is characterized by a deep red, bleeding gingiva. The inflammation of the gingiva also causes an increase in the mobility of teeth in pregnant women compared to non-pregnant women. Figure 3 shows an image of a pregnant patient with gingivitis. There can also be an increase in gingival pocket depth due to the swelling of the gingiva, meaning a separation of the gingiva from the bone (Laine, 2003).



Figure 3: This figure shows mild to severe pregnancy gingivitis. The left image shows mild gingivitis, the top picture shows worse gingivitis, and the bottom picture shows severe gingivitis (Steinberg et. al, 2013).

Alongside gingivitis, estrogen causes an increase in gingival vasculature, decreased gingival keratinization, and increased epithelial glycogen. This causes the epithelial layer of the gingiva to break down. Progesterone also causes an increase in vascular permeability, allowing for more PMN cells into the tissue. This causes an increase of inflammation. Progesterone also causes a decrease in fibroblast proliferation and changes the rate of repair of collagen. This slows down the reparation of the gingiva. These steroid hormones also cause a breakdown of folate, which is required for a healthy oral mucosa. This also promotes increased inflammation. Progesterone and estrogen also create a more suitable environment for bacteria to grow by creating a more anaerobic environment in the subgingiva, increasing the possibility of caries on the teeth. Pregnant women were found to have more of the *Prevotella intermedia* bacteria than non-pregnant women. These bacteria use vitamin K as an essential growth factor; however, it can substitute vitamin K with progesterone and estrogen (Steinberg et. al, 2013). This indicates that due to the rise of sex hormones in pregnant women, the *Prevotella* bacteria increased in the oral cavity, which could lead to more plaque and inflammation.

Another oral issue caused by pregnancy is a pregnancy tumor, also called pregnancy granuloma. It occurs in 0.2-9.6% of pregnant patients. Pregnancy granulomas are found where there is occurring gingivitis and deposits of plaque surrounding the area. These lesions grow rapidly, but do not usually surpass 2 cm (Steinberg et. al, 2013). Pregnancy granulomas are caused by an increase in progesterone, bacteria, and irritants. They usually occur within the second and third trimester of pregnancy (Silk et. al, 2008). Granulomas are extremely vascular, which may cause bleeding. The granulomas are usually painless and regress on their own; however, they can be recurring during the pregnancy (Laine, 2003). Figure 4 shows an image of a pregnancy granuloma.



Figure 4: This is an image of a pregnancy granuloma on the buccal side of the lower anterior teeth (Silk et. al, 2013).

Effects of Maternal Oral Health on Pregnancy Outcomes

Although pregnancy can negatively affect maternal oral health, these negative effects may also, in turn, affect the fetus. There have been multiple studies on how oral health has the potential to negatively affect the fetus by low birth rate or even preterm pregnancy. Preterm birth is defined as a child being born prior to 37 weeks or 259 days of gestation. Low birth weight is characterized as less than 5.5 pounds or 2,500 grams at birth. Low birth weight could be due to an early birth or a fetus small for gestational age (Steinberg et. al, 2013).

One of the possible causes that has been studied for low birth weight and pre-term birth is periodontitis. This is a chronic gum infection that starts off as gingivitis by a buildup of plaque and anaerobic gram-negative bacteria. This plaque and bacteria start to cause a breakdown of the periodontium, which results in detachment of the periodontium from the bone, otherwise known as pockets. This can cause an increase in recurrent bacteria and a spread of infection. The spread of the bacterial infection causes a release of cytokines, interleukins, and prostaglandins (Kandan, et. al, 2011). As the bacteria spread it can disperse throughout the body, going into the maternal-

fetal-placental complex. In 2011, Han and colleagues discovered an oral pathogen, *Fusobacterium nucleatum*, that had migrated from the mother's subgingival plaque to the placenta, which is shared with the fetus. This woman saw signs of acute inflammation, which led to a stillbirth (Steinberg et. al). Interleukins and prostaglandins cause an acute inflammation cascade, which affects the pregnancy (Heimonen et. al, 2008). This is just one case, and most cases are not this extreme; however, the processes that most likely led to this situation have been found to be similar to those in pregnant women with preterm births and low birth weights.

The mechanism by which oral health correlates to preterm births and low birth weights are suspected to be similar. This is through the compound prostaglandin 2 (PG 2). This restricts blood flow to the placenta and causes placental necrosis, which inhibits intrauterine growth, causing premature birth and low birth weight. Alongside this, oral bacteria have also been found in the amniotic fluid and placenta of pregnant women with periodontitis and had a premature delivery (Heimonen et. al, 2011).

In two other studies, it was found that periodontal disease is correlated with preterm birth. In a study from the University of Alabama, pregnant women with generalized periodontal infections were analyzed. Generalized periodontal infection was defined to be 90 different spots on teeth where there were 3 mm or more pocket depth. This study also kept factors constant, such as maternal age, race, tobacco use, and number of existing children. After adjusting for these factors, the researchers still found a significant increase in risk of preterm birth with these women. Alongside this study, Offenbacher et. al conducted a separate study showing the same results. The researchers adjusted for maternal age, race, parity, previous preterm birth, tobacco use, markers of socioeconomic status, and presence of chorioamnionitis. They defined moderate to severe periodontal infection as 15 or more sites of pockets with 4 mm or more probing. The

researchers found an increase of risk of preterm birth in women higher with periodontal disease as well (Boggess, 2008). The depth of the periodontal pockets did not have an effect on pregnancy outcomes (Ide and Papapanou, 2013). These studies reinforce that periodontal disease do have a negative effect on pregnancy.

In Hwang et. al's analysis, they found that women who delivered preterm were less likely to receive dental care or cleanings before and during pregnancy. Women who did not receive dental care were 15% more likely to have a preterm pregnancy. As shown in table 1, there was a significant difference in preterm deliveries compared to on term deliveries between the women who went for dental care treatment when an issue arose, women who had their teeth cleaned before pregnancy, and women who had their teeth cleaned during pregnancy, and women who did not. Women who did not receive dental cleanings were also more likely to have a preterm pregnancy. For women who did not seek dental care when a dental issue arose, they were more likely to also experience a preterm pregnancy. After considering multiple possible systemic health causes for preterm birth, the researchers found that the lack of dental cleanings accounted for 8.3% of the risk for preterm birth. This was greater than placental issues and high blood pressure, meaning neglecting oral health care affects preterm birth more than actual pregnancy-related complications (Hwang et. al, 2011). As shown in table 2, this research is important because it not only shows the tie between poor oral health care and preterm birth, but it also accounts for other factors such as age, income, education, insurance status before pregnancy, adequacy of prenatal care, smoking, multiple gestation, maternal morbidities: diabetes, hypertension, placental problems, kidney/bladder infections. By accounting for these factors, they can be disregarded when looking at the effects of oral health care, and the association made can be looked at as a more direct relationship. According to the meta-analysis done by Ide and

Papapanou (2013), many different studies analyzed periodontitis in pregnant women and the effects it would have on preterm birth and low birthweight. There is a strong positive association between periodontitis, preterm delivery, and low birth weight.

	≥ 37 Weeks weighted %	< 37 Weeks weighted %	<i>P</i> -value
Teeth problem	26.17	28.24	0.073
Went for care	44.70	39.34	<0.0001
Dental counseling	41.36	39.23	0.099
Teeth clean-ever	94.28	93.93	0.530
Teeth clean-bef	81.13	79.11	0.048
Teeth clean-dur	40.65	32.98	<0.0001

Significance for *P*-values was 0.05

Table 1: This table shows a comparison of maternal oral health care with women who delivered preterm compared to on term (Hwang et. al).

Variable	Relative contribution (%)
Teeth cleaning during pregnancy	8.3
Age	<1
Race	3.0
Income	<1
Maternal education	<1
Insurance	<1
Smoking	<1
Multiples	24.9
Diabetes before or during pregnancy	<1
Kidney/bladder infection	<1
Placental problems	7.9
Blood pressure	4.5
Inadequate, intermediate, adequate plus PNC	49.1

Table 2: This table portrays the relative contribution of different health factors during pregnancy affecting preterm birth. As it shows, teeth cleaning has a significant effect on preterm birth (Hwang et. al).

There have also been studies that have concluded a positive relationship between periodontitis and pre-eclampsia, which is dangerously high blood pressure during pregnancy. They found that women with pre-eclampsia were more likely to have periodontitis and were more likely to have the presence of periodontitis pathogenic bacteria. There have also been

studies that have not found this association. This correlation needs to have more significant research to show this (Boggess, 2008).

Long-Term Effects on the Child

Although there may be negative effects of oral health issues on pregnancy, the long-term effects on the baby are also important to consider. One of the most important aspects of dentistry are habit formation. When a mother forms healthy habits for herself, they are more likely to be passed down to her child. The adverse is also true: without those healthy habits, poor habits are what replace it, and this is well seen in oral health interactions between the mother and her child. According to CDC, these habits should be established with the mother prior to delivery for the best outcome for her child (Johnson et. al, 2006).

Not only do oral health habits get passed down from mother to child, but so do the oral bacteria. *Streptococcus mutans* is the bacteria associated with dental caries, which can be passed on via contact with saliva. Mothers with high levels of this bacteria pose a higher risk of passing it along to their children. This indicates that women can pass along this bacteria to their children when they are infants, when contact with saliva is more frequent. Children who acquire this bacteria at an earlier age are more likely to develop caries than those who acquire the bacteria at an older age. Maternal oral flora is actually a good predictor of the child's oral flora because of how much of an influence the mothers have on the child's oral health. The more knowledge a woman has on her oral health, the more preventable the child's oral health can be from the decay-causing bacteria (Boggess, 2008).

The less a woman knows about oral health and preventions, the less likely the child will receive proper care and treatment as well. This can lead to a neglect of care of the child's oral health even after development of bacteria has begun. Neglecting the buildup of the bacteria, or

plaque, can lead to the bacteria population to change and become more anaerobic. These bacteria are able to produce an inflammatory reaction which can lead to bleeding and tissue destruction. This all leads up to gingivitis and periodontitis (Boggess, 2008). Colonization of *S. mutans* can begin even before an infant's teeth have erupted (MDHHS, 2013). Between the ages of 19 and 33 months is when the child usually starts to acquire *Streptococcus mutans*, which is called the first window of infectivity. The main source of infection at this age is the mother (Damle et. al, 2016). If infants orally acquire these bacteria by age 2, those children have the most caries by age 4. Along with this, pre-term infants are 4.4 times more likely to be colonized by *S. mutans* than normal term babies (MDHHS, 2013).

In Damle et. al's study of risk factors of *Streptococcus mutans* growth in children, they also found that the mother's role plays a significant role in the child's development of the bacteria. As shown in table 3, although kisses from the mother did not have a significant impact on bacterial growth, other close contact encounters such as breast feeding and sharing a spoon had a significant impact on the child's development of *S. mutans*. Another study found that mothers with the bacteria at levels higher than 10^6 organisms per mL of saliva have over 50% rate of transmission to their 10-16-month children. Mothers with 10^3 organisms per mL of saliva had only a 30% rate of transmission of the bacteria to their children. Damle et. al also found that in children from age of birth to 6 months, 30% (3 children) showed signs of the bacteria. These children acquired *S. mutans* prior to their first eruption of teeth. This indicates that the bacteria were acquired from an outside source. The researchers found significant evidence to find a correlation with mother's behaviors and the development of the bacteria. Within the children of 7-18 months, 90% (9 children) of the children showed growth of *S. mutans*. In children aged 19-30 months, 100% (10 children) of children showed growth of the bacteria (Damle et. al, 2016).

All this data shows there is a significant correlation between the maternal oral health and the child's developing oral health. Indicating that the mother has a strong influence on the child's oral health, whether it be via routine or acquired microbiologically.

Table. Association of maternal, birth, hygiene and habit-related variables with mutans streptococci colony count					
Variable	Number of cases	Mean cfu ×10 ² /ml	SD	Median cfu×10 ² /ml	Significance of association (Mann-Whitney U-test)
Mode of delivery					
Normal vaginal	22	3.65	3.95	3.1	P=0.945
Caesarean section	8	2.29	2.31	2	
Teeth eruption					
Yes	20	3.84	2.76	4.3	P=0.003
No	10	0.28	0.48	0	
Feeding habits					
Breast-feed	12	0.35	0.55	0	P<0.001 (Kruskal–Wallis test)
Bottle-feed	8	3.56	2.09	3.2	
Mixed diet & breast-feed + bottle-feed	10	3.98	3.23	2.34	
Gum cleaning habit					
Yes	19	1.86	2.70	1.3	P=0.013
No	11	4.01	2.60	3.9	
Mother kissing baby on mouth					
Yes	22	3.22	2.97	3.1	P=0.067
No	8	1.09	1.69	0.7	
Mother sharing spoon with child					
Yes	17	4.29	2.72	3.9	P<0.001
No	13	0.50	0.76	0.7	
Child sharing food with other family members					
Yes	15	4.42	2.86	3.8	P<0.001
No	15	0.89	1.30	0.8	
SD, standard deviation; cfu, colony-forming unit					

Table 3: This table illustrates the relationships of maternal, birth, hygiene and habit-related variables with significance of *S. mutans* in child. It shows a significance in breast-feeding and mother sharing spoons with the child and *S. mutans* (Damle et. al, 2016).

Contradicting Theories

Although there have been many studies to show that the oral health of a pregnant women has significant impacts on the pregnancy, there have also been studies to find no significance. A recent study showed no significance in preterm births between women who were treated for periodontal disease during their second trimester than women who had no treatment (Hwang et. al, 2011). In another study, there were no differences found between women with preterm births

and women without preterm births when looking at pocket depth, percent of tooth sites with probing greater than 4 mm, percentage of sites with bleeding on gingival probing, and percentage of sites with loss of tooth attachment of either 2 or 3 mm or greater (Bogges, 2008).

Another reason studies don't accept that oral health has a negative effect on pregnancy outcomes is due to the multiple variables that could play a role. Negative pregnancy outcomes could be affected by other outside variables, such as other health issues (Heimonen, 2008). These can disguise the effects that periodontal disease may have. However, by having a study that controls for these outside factors, they can show the genuine effects of periodontal disease on the negative birth outcomes. Also, periodontal disease and negative pregnancy outcomes share common risk factors such as smoking, stress, socioeconomic disadvantages, older age, chronic diseases such as diabetes, and genetic susceptibility. This means that it can be questioned if there is a relationship between the two variables or if one of the risk factors is causing both (Steinberg et. al, 2013). This can be disregarded by also controlling for these factors to show the genuine relationship.

Improving Oral Health During Pregnancy

Although there may be contradictions in the effects of oral health on preterm birth and low birth weights, most studies have found that oral health affects pregnancy one way or another. Along with this, it is important for the mother to take care of her oral health before, during, and after pregnancy. Due to the low amount of information the patient receives, more time should be dedicated to informing the future mother of the importance of oral health care. The health care provider's role should be to inform the pregnant patient of oral health risk assessments, counseling of etiology and transmission of cariogenic bacteria to their newborns, referral to an oral health provider for a comprehensive examination and assistance in the establishment of a

dental home for their infant. This is not just for practicing dentists. This has been seen with OBGYN physicians as well, where they know the importance of oral health during pregnancy but do not advise patients to receive the proper dental care. One of the main issues with these providers is they feel they do not get compensated by insurance companies to spend time informing the patient of the necessary information. However, this is wrong because the patient is not well aware of the risks that her oral health could have on her child (Rainchuso, 2013).

Alongside the dentists not wanting to give proper information to pregnant patients, a survey revealed general dentists were reluctant to give dental services because they simply were not aware they were able to. It is important for the mother to know the risks involved especially because of the large intake of cariogenic foods, which can increase the *S. mutans* bacteria. This is also harmful to the child post-pregnancy because of the increased risk of the child acquiring the bacteria from the mother due to the high levels of bacteria. It is important for mothers to be receiving accurate information regarding oral health and pregnancy. One way to help decrease the *S. mutans* is by xylitol. This is a naturally occurring sugar-alcohol that reduces *S. mutans* levels in biofilm and plaque. Xylitol can be found in chewing gum and has been shown to reduce these levels. Sugar-free xylitol chewing gum can be very beneficial for pregnant women if they had the knowledge about it. Although chewing gum may cause TMJ issues after using it for extended periods of time regularly, using it moderately prior to and during pregnancy can reap benefits to reduce levels of oral bacteria. Another useful element that can be used is Fluoride. Fluoride therapy can be used to strengthen enamel and prevent caries. This can be found in fluoride varnish, mouthwash, and toothpastes (Rainchuso, 2013). General dentists should especially recommend these to pregnant women to use in order to reduce the oral health risks.

Many women are nervous to go to the dentist while pregnant due to common misconceptions about the safety. This is another reason dentists and other health care professionals should be informing women on proper oral health treatment during pregnancy.

Table 4 shows safe treatments during pregnancy.

Clinical Implications for the Dental Treatment of Pregnant Women		
Dental procedure/treatment	Safe during pregnancy?	Specific recommendations for pregnant women
Radiographs	Yes	Always use lead apron with thyroid cuff.
Amalgam restorations	Yes	Removal of old amalgam restorations should be done with a rubber dam in place, and with high speed suction.
Treatment of infection	Yes, Category B ^a	Category B antibiotics (including penicillin, amoxicillin, cephalosporins, and clindamycin) are safe, as are erythromycin ethylsuccinate and stearate (except in estolate form). Category C antibiotics (including erythromycin estolate, quinolones, and clarithromycin) should be avoided but may be used after physician consultation when the benefits outweigh the risk to the fetus. Do not use Category D antibiotics (tetracyclines).
Treatment of pain	Yes, Category B ^a	Category B analgesics (including acetaminophen, meperidine, and morphine) are safe for use during pregnancy; do not exceed recommended dose. Category C analgesics (including codeine and hydrocodone) may be used with caution. Ibuprofen and Naprosyn should be used only after the first trimester, and only for 72 hours or less.
Use of local anesthetics	Yes, Category B ^a	Category B anesthetics (including lidocaine with epinephrine and prilocaine) are safe. Category C anesthetics (including mepivacaine and bupivacaine) should be avoided.
Use of inhalation anesthesia (nitrous oxide)	Use with caution	The use of nitrous oxide should be limited to cases in which topical and local anesthetics are inadequate and should be administered only after consultation with the patient's physician. Adequate precautions should be taken to prevent hypoxia, hypotension, and aspiration. Note that pregnant women require lower levels of nitrous oxide to achieve sedation.

^aPregnancy Risk Categories A and B are safe to use in pregnancy. Category C medications should be used with caution, if at all, under the direction of the physician and should be given only if the potential benefit outweighs the potential risk to the fetus. Drugs are classified as Category C when (a) animal studies show adverse effect and toxicity on fetus and (b) no adequate and well controlled studies have been done on pregnant women. Category D and X drugs should be avoided.

Table 4: This table portrays common drugs and treatments affiliated with dental treatment and the safety consideration during pregnancy (Russell and Mayberry, 2008).

Dental treatment is okay during all three trimesters; however, it is safest to start during the second trimester (14-20 weeks' gestation) because the risk for miscarriage is a lot lower (Russell and Mayberry, 2008). This is because organogenesis of the fetus is complete. Dental emergencies should be all that is treated during the first trimester, avoiding excess visits. The third trimester may be difficult for treatment due to excess discomfort of the patient. This is due to pressure on multiple organs during this time period. By propping a woman on her left side, placing her head above the level of her legs while reclined, repositioning when needed, and

keeping visits short, this can reduce discomfort the patient may be feeling. However, the risks are higher if a tooth is left untreated; therefore, if any issues arise during the third trimester, it is best to have it taken care of (Hugh et. al, 2008).

Some researchers argue that dental treatment during the pregnancy will not improve any risk associated with oral health diseases and pregnancy, only improving oral health prior to pregnancy would lower that risk. One main reason for this is because the mother would have healthier habits prior to pregnancy for her to avoid issues during pregnancy (Hwang et. al, 2011). By taking care of oral health and limiting the levels of *S. mutans*, it would also reduce the risk of transmitting bacteria to the child post-pregnancy. Although treatment during pregnancy may help, Michalowicz et. al state that at that point the inflammatory cascade has begun and the effects on the baby may have already started, and it may be too late to reverse this. Also, treating a patient prior to pregnancy means the treatment can be more aggressive and successful (Michalowicz et. al, 2013). This means it is very important that health care providers inform the patient about the importance of oral health care and pregnancy prior to the pregnancy.

These studies all indicate the importance of informing pregnant women on oral health care during their pregnancy. Most studies claim that it is more important to inform them prior to their pregnancy. However, one issue that has been revealed is the lack of information being relayed, and some of this is due to the lack of knowledge of the health care providers. A good resolution to this is to make it mandatory that health care providers (dentists and OBGYN's) provide information to women about the importance of oral health care during pregnancy. Special lectures and seminars may be given to the health care providers for them to have all the proper information to relay to their patients. The OBGYN is important in all this because this provider sees the patient multiple times before, during, and even after pregnancy. An OBGYN

can have a significant impact on the patient's oral health by stressing the importance of it and receiving dental treatment. Alongside this, the dentist should be informing patients trying to become pregnant about all the necessary steps for proper oral health treatment before, during, and after pregnancy. Steinberg et. al (2013) states that according to the National Consensus, routine dental visits every 6 months should be continued during pregnancy. Along with this, pregnant women should brush their teeth at least twice daily with fluoride toothpaste, floss daily, rinse daily with alcohol-free fluoride mouthwash, chew xylitol gum, rinse with 1 teaspoon baking soda and a cup of water after vomiting to neutralize the acid in the oral cavity, and minimize sugar intake. All this is in order to reduce bacterial and plaque growth and minimize decay.

Conclusion

The lack of knowledge in proper oral health care within pregnant women is significantly high. Pregnancy can lead to an increased risk of oral health care problems such as gingivitis, periodontitis, increased plaque and decay, caries, and pregnancy oral tumors. These risks are also increased with a lack of oral health care treatment. Due to an increased risk of oral health issues, these issues may also lead to adverse pregnancy outcomes. Periodontitis may especially lead to low birth weight and preterm pregnancy. Not only can the pregnant women's oral health affect the fetus and the pregnancy, it may also affect the child's development through the transmission of oral bacteria from the mother. This can lead to increased oral health issues in the child's future.

By giving health care providers the proper information to relay to their patients via seminars and in schooling, they can feel a lot more confident about explaining what is needed of the patient during this time and when treatments should be given. Health care providers also

should be told to highlight the importance of oral health care during pregnancy to have a healthy pregnancy and child. Although the information may not be obvious, there is a significant relationship between oral health care and pregnancy. Many of the negative effects can be avoided with proper knowledge and care. Along with the patients' assistance in going to the proper appointments and staying updated on their oral health, it is the health care providers' jobs to decrease these negative outcomes for their patients to have healthy and safe pregnancies.

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