

AN ABSTRACT OF THE THESIS OF

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In this thesis I examine the biocultural affects of nutrition and pregnancy on dental health throughout Ecuador. Factors such as diet, fertility rates, cultural practices and barriers to health care are investigated through a review of the existing literature. Three main regions of Ecuador were selected for examination -- the highlands, the coast and the Amazon. Through a focus on the cultural construction of diet, nutritional intake and changing fertility rates, I discuss the main issues and barriers to comprehensive oral health facing low-income Ecuadorians. I argue that a poor understanding of the connections between oral and reproductive health and wide spread poverty interact to produce high rates of stunting, micronutrient deficiencies and poor pregnancy outcomes, especially for Ecuador's rural populations. In addition, I discuss cultural barriers and, particularly the lack of culturally sensitive care for indigenous populations, as major contributors to mortality and morbidity. I end with recommendations for increasing awareness of cultural barriers to dental health that are relevant throughout various parts of Latin America. This thesis presents new perspectives on dental care and reproductive health that have the potential to improve overall health for Ecuadorians.

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**Biocultural perspectives on pregnancy and nutrition and its impact on dental
health in Ecuador**

by

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I understand that my thesis will become part of the collection of the Oregon State University. My signature below authorizes release of my thesis to any reader upon request. I also affirm that the work represented in this thesis is my own work.

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TABLE OF CONTENTS

Page

Biocultural perspectives on pregnancy and nutrition

and its impact on dental health in Ecuador.....1

INTRODUCTION.....1

DIET AND NUTRITION.....3

MALNUTRITION.....5

Stunting.....5

Underweight.....7

Deficiency in Micronutrients.....7

a. Deficiency in Iron.....8

b. Deficiency in Iodine.....9

c. Deficiency in Vitamin A.....9

FACTORS AFFECTING DIET AND NUTRITION.....10

Poverty.....10

Culture.....11

NUTRITION AND ITS AFFECTS ON ORAL HEALTH.....12

Dental Caries.....15

Periodontal Disease16

Socio-cultural Factors Affecting Dental Health17

NUTRITION AND PREGNANCY.....17

FERTILITY RATES IN ECUADOR.....18

FACTORS AFFECTING FERTILITY.....19

Altitude.....19

Lack of Prenatal Care.....20

Cultural Practices.....20

ADVERSE PREGNANCY OUTCOMES.....	21
Preterm Birth.....	21
The Prenatal Period and Maternal Oral Health	22
Clefting	26
BARRIERS TO SEEKING CARE.....	29
Safety.....	29
Poverty.....	30
Beliefs Held by Professionals and Patients.....	31
APPROACHES.....	32
A Need for Increased Cultural Understanding.....	32
Global Approaches.....	34
CONCLUSIONS.....	36
BIBLIOGRAPHY.....	39

*Biocultural perspectives on pregnancy and nutrition
and its impact on dental health in Ecuador*

INTRODUCTION

There is an underlying and important connection between nutrition, pregnancy and dental health. These factors affect each other in many ways. For example, ones diet may change during pregnancy, resulting in physiological changes in the oral cavity. Increased consumption of acidic foods can cause tooth decay, more nutrients may be demanded by the body, and hormone levels change and alter the strength of the gum tissue. Even factors such as nausea and vomiting during pregnancy can result in tooth erosion. However, there is a lack of dental literature on Ecuador, because there have been so few studies implemented throughout the region. The purpose of this study is to examine the connection between pregnancy, nutrition and oral health and to reflect on how approaches to health care and other socio-cultural factors may be affecting dental and reproductive health in Ecuador. In this paper, I will argue that dental health is influenced by numerous bio-cultural factors including diet and nutrition, fertility and pregnancy, and cultural practices and barriers.

Through exploration of the various diets in the costal, the highlands and the Amazon regions of Ecuador, the prevalence of malnutrition will be discussed on three different levels: the effects of under-nutrition, obesity and over-nutrition, and deficiency in micronutrients, which are often times measured by stunting and wasting. Along with affects on systemic health, lack of nutrition and/or poor dietary practices can give rise to problems in the oral cavity and with reproductive success.

Fertility rates in the Andes region and specific provinces of Ecuador have generally declined and may have links to many factors (LOC, 2005). Reproductive success depends

upon environmental, cultural, and medical components, which play a large role in the fertility rates among women in Ecuador. Nutritional needs of females in gestation are always particularly important because higher nutritional values are demanded by the baby. These factors are interrelated because specific nutritional plans are determined during prenatal care and women have increased of nutrient demands during gestation. Other important biological factors during pregnancy demonstrate the relationship between oral and gestational health.

Although research on the connections between dental and reproductive health has increased over the years, there is a lack on literature of women in Ecuador. Although some outdated (Ingle, 1978) literature found on dental health in Ecuador has offered some data on Decayed/Missing/Filled teeth (DMFT) and caries rates factors such as periodontal disease and prevalence of cleft lip and cleft palate, I will demonstrate an extremely relevant connection between nutrition and other health precautions needed to be taken during pregnancy.

In addition to the relationship between nutrition, pregnancy and dental health, this thesis will explore socio-cultural barriers, which may explain the lack of accessibility to health care services. Ecuador is unique for the various people and traditions that inhabit it. Traditional and modern views will be explored, along with an understanding of health from both sides. Language and education place each group in a social status, which is also explored along with the greatest barrier to accessibility of health care – poverty. However, a common link within all these groups is the loss of traditional cultures in the face of the population with the increasing in urbanization. As youngsters change diets to more packaged and processed foods, they also lose many of their traditional dietary practices and

turn to a more urbanized culture. With this, they gain more knowledge of modern dental practices through commercialization, and a generation gap arises.

Through discussion of diet and nutrition, pregnancy and fertility, and cultural backgrounds, a more holistic perspective on dental and systemic health will be advocated. The goal of this thesis will be to inform the public and health care professionals that by improving dental health, nutrition and pregnancy will also show positive outcomes by increasing reproductive success and health of the mother and child.

DIET AND NUTRITION

Diet and nutrition are often used interchangeably; however, they are not synonyms. A diet is the food one consumes, and is the first step in determining a person's nutrition. In the diverse country of Ecuador, there is a variety of food that is either specific to or shared throughout the region. The main regions of Ecuador consist of the highlands, the coast, and the Amazon. The cultural and racial *mestizos* of European and Indian descent live in rural and urban zones, dispersed throughout the country. The highlands of the Andes and the lower levels of the Amazon are occupied by the indigenous populations and the Afroecuadorian people live along the coastal areas. The population consists of 65% *mestizos*, 25% of indigenous people, 7% of Spanish and others and 3% of black (World Bank, 2007).

The World Bank provides facts on the different diets in each region of the country, providing for a better understanding of nutritional intake by cultural groups. In the highlands, mostly occupied by the indigenous, there is very little variety in diet. The quality usually depends on money and resources such as access to land, altitude, type of soil, and the variety of climate (World Bank, 2007). The climate stays within a moderate to

cool temperature. This results in a diet that is usually poor in micronutrients, consisting of grains, rice, cereals, beans, barley, flour, tubers, and corn in the lower altitudes. Eggs and cheese are considered luxury foods, and meat, such as guinea pig, is only consumed during celebrations. Processed foods are seldom eaten in this area, and if they are, they include oatmeal as a beverage or a soup (LOC, 2005). This diet does not cover the five basic food groups, and often does not provide adequate nutritional intake, especially for pregnant and nursing women or growing children who have higher requirements.

The transitional zone between the highlands to the Amazon region has an abundance of coffee and tea; however, the Amazon is mainly made up of poor soil, and not much can be grown in that region. *Yucca*, also known as cassava, is a starchy root that is found in abundance (LOC, 2005). A traditional drink called *chicha* that the indigenous people of the Oriente prepare from *yucca* is used to suppress feelings of hunger and quench thirst in the heat. This is often a large source of supplementation, however it does not provide the micronutrients needed. *Yucca* is also used in soups, which may be eaten with rice or fish caught from the river that day. Other foods include fruits or vegetables that can be found throughout the Amazon, however with the lack of refrigeration, foods are often not stored and must be eaten the same day.

Afroecuadorians inhabit the coastal regions where the climate is warm and the fertile soils provide for a variety in agriculture. They enjoy plantains in many different forms, including cooked, ripened, unripened, fried, etc. and have a variety of export crops such as coffee, bananas, sugar, cacao, palm oil, and rice. There is also significantly more protein in their diet from animals, such as fish, hunted wild animals, and domesticated

animals such as pork, along side their rice (LOC, 2005). With a greater variety of foods, this population can generally be found at lower risk for nutritional deficiencies.

MALNUTRITION

Malnutrition results from under nutrition, obesity or over nutrition, or a deficiency in micronutrients. Poor dietary practices and lack of resources can lead to increased risk of chronic and oral diseases and can also lead to craniofacial birth defects or negative reproductive success in fertile women (Snider, 2007). Consequently, if dental problems arise, they can equally inhibit proper nutritional intake by affecting eating habits. The greatest indicator of childhood malnutrition is measured through the prevalence of stunting (low height-for-age) and underweight (low weight-for-age). In Ecuador, the main prevalence of malnutrition can be seen in rates of stunting (World Bank, 2007).

Stunting

Throughout 16 countries in Latin America, 61% of the children that are underweight are found in low-income homes with mothers that have less than six years of education. Thirty-percent of children live without safe drinking water, and they are also at risk when eating raw foods that have been prepared with infected water. This puts 40% of the population at risk of disease (PAHO, 2002).

Research from World Bank (2007) estimates 23.1% of children in Ecuador under the age of five, have low height-for-age, or stunting. Of those, 77,095 are estimated to have severe cases of stunting. Of the total amount of children, 20% of stunting and 28% of severe stunting are found among indigenous children, while 72% of *mestizo* children are stunted, and only 5% are severely stunted (World Bank, 2007).

The rural population of Ecuador makes up 45% of the total population. When the numbers are defined by region, 70% of the children in the rural community have stunting, and 71% have severe stunting (World Bank, 2007). In the highlands of Ecuador, 60% of the children have stunting, and 63% have severe cases. From the 60% of children in the highlands that suffer from stunting, 71% are poor, and 81% are poor who have severe stunting. The indigenous groups have the greatest stunting with 46.6% prevalence of the total population with stunting, and 16.8% with severe cases. The Afroecuadorians have a very low prevalence at 14.2%. Furthermore, boys have a slightly higher prevalence of stunting than girls, with 24% and 22.1%, respectively.

The prevalence of low height-for-age in Ecuador is directly proportional to the age of the children (World Bank, 2007). Only 3% of children younger than 5 months show stunting. This number increases almost 10% in each group of 6-11 month-olds, and jumps to 28% for children between 12-23 months. This trend is similar with the severe cases of stunting with 0.1%, 2.6% and 7.5%, respectively. This shows that small stature is not completely a product of heredity, but is more likely due to the nutritional intake and caloric expenditure of children as they develop. In the costal region, 15.6% of the children show stunting, and 3.4% are severe cases. In the highlands and in the large urban city of Quito, there are 31.9% and 8.7% that experience low height-for-age rates. In the Amazon region, the numbers are quite similar to the highland regions at 27.7% and 7.37%, respectively. Dietary practices in the highlands and the Amazon are poor, which can explain the rate of stunting and why it is higher than in the costal areas where nutrients are slightly more abundant.

Not only is malnutrition a factor, but altitude may also contribute to rates of short stature by age. Below 1500m, there is a prevalence of 16.6% stunting and 4% severe stunting, where as above 1500m there is 35% and 10%, respectively (World Bank, 2007) likely due to decrease oxygen availability in high altitude. There is a proportional relationship to poverty and stunting, which helps to show that deficiency of nutrients that are found in rural and indigenous populations plays an important role in determining the height-for-age.

Underweight

Underweight is defined as a low weight-per-height. For all children across the region, there are 9.3% that are underweight, and 1.2% that have severe cases of underweight (World Bank, 2007). Underweight can be affected by insufficient nutritional intake and premature births. Premature births, resulting in low birth weight babies can be caused by numerous factors, one being gum disease (Boggess et al, 2006), which will later be discussed in the oral physiology of the mother and fetus. In addition, decreased oxygen concentration at high altitude is correlated with low birth weight.

Deficiency of micronutrients

Iron, iodine and vitamin A are essentials necessary for development and growth. If there is a deficiency in one of these micronutrients in the diet, health and capacity to learn and the ability to be productive are at risk. Health is affected by deficiencies, placing individuals at risk for infectious diseases, which negatively influence pregnancy and dental health (Hung 2003).

a. Deficiency of Iron

Within the Americas, iron deficiency affects 77 million children and women, including 6 million infants, 13 million preschool-aged children, 31 million school children, 24 million fertile women and 4 million pregnant women (PAHO, 2002). These deficiencies create a vicious cycle of underdevelopment and worsen conditions. An effect of iron deficiency is anemia, also important during gestation. Some of these numbers include non-nutritional causes of iron deficiency, such as menstruation, genetics, and diseases that may destroy red blood cells. Due to unsanitary conditions in some rural areas, anemia is also more prevalent because of increased rates of parasitic infections that lead to blood loss.

A study done by *Diagnostico de la Situacion Alimentaria* (DANS) in 1986 showed that 22% of children from 6-59 months suffered from anemia. Freire (1988) demonstrated that these rates had increased to 69% of children from 6-12 months and 46% of children from 12-24 months. A total of 61% of children below the age of six were anemic in 2004, according to a survey by the IIDES (Institute for Developmental Health) (World Bank, 2007).

Pregnant women are also at an increased risk of anemia, due to the nutrients used by the fetus. The probability of anemia is found to increase among people of low economic status and low educational levels (World Bank, 2007). If we consider the foods that are consumed in regions of the highlands, meat is very scarce. Five times as much iron can be consumed from a portion of meat than from vegetables. In the regions of the Andes where meat is scarce, it can be assumed that anemia may have an increased prevalence relative to other regions of the country. This has negative implications both for pregnancy and for dental health. Most countries fortify their wheat and corn flour products, margarine, milk

and sugar with a combination of iron, vitamin A, B vitamins, folate, niacin, riboflavin and thiamin (PAHO, 2002). Growing urbanization and increased production of processed foods has guided Latin America to become one of the leaders in food fortification. Ecuador has mandatory fortification of wheat flour, margarine, cereals, and fats and oils, as well as mandatory salt iodization of foods (FAO, 1992).

b. Deficiency of Iodine

Iodine helps promote health of teeth, skin, nails and hair. Deficiencies lead to infant mortality and decreased mental capacities. Iodine is necessary for the synthesis of thyroid hormones and serves in cellular replication. Iodine deficiencies were also very prevalent in several regions of Ecuador. In 1983, there were 11 provinces throughout Ecuador with a 36.5% prevalence rate of goiters (PAHO, 2002). Goiters are an enlargement of the throat region, more specifically the thyroid gland. Since the thyroid gland is essential in maintaining the homeostasis of the body through hormone production and secretion, it is essential. Although the thyroid gland can help to show the levels of iodine production in the body, goiters can also be affected by many other factors, such as hormones produced during pregnancy like human chorionic gonadotropin (HCG) (Mayo, 2007). However, in the mid-1980's, the country initiated iodization of salts, which helped decrease this number. Salt iodization reached 90% of homes in Latin America, including Ecuador, which has been recognized to be free of iodine deficiency disorders (PAHO, 2002).

c. Deficiency of Vitamin A

Vitamin A is important for aiding in prevention of child blindness, which can lead to high morbidity and mortality. In Ecuador, and other countries such as Mexico and the Dominican Republic, 15% or more of preschool-aged children are affected by a clinical

vitamin A deficiency (PAHO, 2002). Vitamin A usually comes from animal products with high content of retinol, or vegetable products with high content of beta-carotene.

Deficiencies cause night blindness, blindness and in young children it can cause severe diarrhea and respiratory infections. Vitamin A deficiency is also associated with an increased mortality rate and is also essential for healthy teeth and gums. In rural areas, 14% of children had deficiencies in 1986. In 1995, this rate increased to 17.4%. However, when the rates are divided into regions, the highlands have the greatest deficiency of 22.1%, followed by 14.9% in the Amazon and 12.5% in the coastal regions (World Bank, 2007). Once again, there is a deficiency of animal and vegetable products in the diet of the indigenous people of the highlands and the Amazon which explains this high rate of vitamin A deficiencies throughout this region relative to coastal areas.

A well balanced understanding of micronutrient intake is needed. The imbalance in consumption of one nutrient can affect the absorption of other nutrients within the body (Touger-Decker, 2007). For example, an overconsumption of vitamin A will reduce bone mineral density, and vitamin C will cause erosion of the tooth enamel.

FACTORS AFFECTING DIET AND NUTRITION

Poverty

Of the total population that inhabits Ecuador, 17% are living just above the poverty levels, while 33% are impoverished (World Bank, 2007). Poverty is mostly concentrated in the rural areas, where two of every three people are considered to be poor. Among the poor, it is difficult to maintain a properly balanced diet. Their food is often eaten cold and dry. The indigenous people of these regions constantly snack on toasted maize. When they do have food, they tend to snack periodically, and usually rely fully on the land to provide

them their daily nutrients. Nutrients are not abundant in most communities, and these deficiencies often lead to health problems.

In 2000, 36% of children in Latin America under the age of two years old were at high nutritional risk. Almost half this number were found in rural areas where unsanitary conditions increase nutritional risk (PAHO, 2002). The children, mothers, and indigenous people are thought to suffer the most. In 1990, a study found that 45% of children below the age of five suffered from chronic malnutrition (World Bank, 2007).

Culture

Nutritional deficiencies in rural and indigenous populations can also be explained by factors of traditional beliefs and behaviors. Socio-cultural determinants influence dietary intake cross culturally, and Ecuador is no different. Cultural factors not only influence what is eaten and by whom, but it can also contribute barriers to overall health.

Culture and tradition are important to indigenous people of all regions of Ecuador—the highlands, the coast, and the Amazon. Although their practices and origins are very different, they share some interrelated beliefs and values. The ideas of “natural sickness” and “supernatural sickness” are differentiated in these cultures. The other concept shared is the idea of dichotomies, which are used to explain the nature of all things. Understanding such dichotomies allow the people to find origins and treatments for diseases. The most commonly understood is the concept of “hot” and “cold”, referred to as the humoral system. This does not refer to the temperature, but the characteristics of all things found in nature, such as foods, drinks, and remedies that come from plants. They are thought to all have either a “hot” or a “cold” nature. Distinguishing weakness versus strength, hard versus soft, masculine versus feminine and other such dichotomies leads to

an understanding of equilibrium, or a lack of, which is important in diagnosing health problems. When this equilibrium is challenged, sickness can occur. Treatments and herbal remedies are used to balance out the sickness so that equilibrium can be found again (World Bank, 2007).

NUTRITION AND ITS AFFECTS ON ORAL HEALTH

Nutrition is important for growth and repair in the human body, and more specifically in the oral cavity, it can maintain the integrity of oral tissues and structures. New Dietary Guidelines for Americans were formulated in 2005, and encouraged to be enforced by dentists as well as other medical practitioners. As a deeper understanding of the relationship between oral and systemic health emerged, health researchers realized that nutrient intake via dietary choices could improve or yield negative results on both oral and systemic health. The Food and Nutrition Board, the Institute of Medicine, and the U.S. Department of Health and Human Services introduced new dietary recommendations to dental practitioners in order to prevent chronic disease (Marshall, 2006). These recommendations include nutrient standards, dietary guidelines, and food group plans. Many of the recommendations focus on balancing the proper nutrient intake: reducing saturated, trans and total fats, selecting fruits high in fiber, limiting sugars to prevent caries, limiting sodium and consuming potassium, physical activity, practicing safe food handling to reduce food-borne illness, and conducting a responsible lifestyle. These guidelines are also aimed towards reducing malnutrition and other food-related diseases which have been found to have direct effects on oral disease, such as periodontal diseases, leading to larger systemic problems.

To provide some physiology on the oral cavity, the normal mouth pH is 7, which is neutral (Palmer, 2001). When anything interrupts the homeostasis of the mouth by lowering pH to between 5.2 and 5.5, it can cause demineralization of the enamel. Acidogenic potential foods may include cooked veggies, fresh fruits, sweetened canned/cooked fruits, sweetened beverages, juices, non-dairy creamers, ice cream, sherbet, pudding, gelatin, potato chips, pretzels, crackers, marshmallows, bread, rice, pasta, sweetened cereals, french fries, cookies, cakes, pies, pastry, candy, bananas, dried fruits, and fruit rolls.

Saliva usually protects against demineralization of enamel. It cleanses the mouth, neutralizes the acidity, and re-mineralizes tooth enamel (Palmer, 2001). The following foods are less harmful in demineralization of the teeth: broccoli, cauliflower, cucumbers, lettuce, dill pickles, carrots, meat, fish, poultry, beans, peas, nuts, natural peanut butter, milk, cheeses, flavored yogurts, corn chips, peanuts, popcorn, fats, oils, butter, margarine and non-sugar sweeteners.

The oral cavity produces plaque, which forms on the teeth and gums. The bacteria in the plaque react with sugars, resulting in formation of acid. This acid attacks the surface of the tooth, and will begin to cause decay. All monosaccharide and disaccharides are cariogenic, meaning these simple sugars are caries causing factors when broken down by bacteria (Palmer, 2001). Lactose found in milk has low cariogenicity; however, it is not recommended that infants suck on a bottle of milk in bed. The orders in which foods are eaten also affects the pH levels of teeth. If one were to eat an acidogenic food after an unsweetened food, it would have more potential to lower the oral pH than if a low acidogenic food was consumed after sweetened foods. Cooked starch foods such as

pastries, cookies, and breakfast cereals produce prolonged acidogenic responses. The saliva contains enzymes that breakdown our foods, such as starch, and convert them into simple sugars, like maltose. Frequent snacking is also discouraged because it can increase plaque formation between meals.

Consuming small, frequent meals of high sugar foods is common in the U.S., but these habits are also beginning to spread in response to globalization. Ecuador is a developing country, and it is becoming more westernized, with the introduction of processed and packaged snacks. These snacks include candy bars, potato chips, sweetened cereals, and soda pop, which are cheap and convenient resources for many people. One will find vendors on every street corner or at soccer games selling sweets and junk food, such as french fries and sausages. Other common acidogenic foods found in Ecuador are anything made in a bakery. Since bread is inexpensive, it is many Ecuadorians main source of food. Common meals are a bread roll and milk, though healthier foods like fresh fruits are abundant in Ecuador, and often snacked on between meals.

A lack of knowledge and practice of proper oral hygiene causes many problems to occur. The foods consumed, the order in which they are consumed, and the cariogenic causation of these foods are all exogenous factors that leave the teeth in a vulnerable state if not cared for properly. However, micronutrients also affect within the body, and provide the nutrients needed to maintain strong and healthy tissues. If these micronutrients are deficient, the oral cavity becomes an ideal environment for bacteria to grow, which will weaken the surrounding tissues of the teeth.

Dental Caries

Dental caries are one of the most common oral diseases. Tooth decay and the development of cavities occur when acid is produced at the tooth surface by cariogenic bacteria in the dental plaque that metabolize dietary carbohydrates.

In 1990 in Latin America, all the countries showed a declining trend in the prevalence of dental caries (PAHO, 2002). The important factors affecting these changes were the salt and water fluoridation programs. By this time, the goal of a maximum of three Decayed/Missing/Filled teeth (DMFT) was successfully achieved in many countries, including Ecuador. This is an improvement from the DMFT of five found in 1988. The most recent data shows that in 1996, the DMFT improved to 2.9 in 12 year old children. However, in Ecuador more than 10% of 12 year olds have seven or more teeth with dental caries and more than 80% of DMFT go untreated. Children with four to six DMFT rate was 26.2%, one to three DMFT was 41.2%, and zero DMFT was 22.4%.

In developing countries, it was found that sugar intake was associated with DMFT counts; however, these results were not the same in developed countries. A 2003 study called “Diet and Nutrition and the Prevention of Chronic Disease” done by the WHO (WHO 2008) found evidence supporting the association of the quantity of free sugars with dental caries. The frequency of sugar intake was just as important as the amount of sugar. Increased amounts of sugar and different types of sugars consumed could affect the risk of dental caries. In developing countries, sugars have increased during the past 30 years. Dietary sugars were placed into two categories: non-milk extrinsic (NMES) and non-milk intrinsic (NMIS). Lactose found in milk was not considered a sugar because it is less cariogenic than most sugars. NMES are found in processed foods, usually in juice or added

into foods as a confection. NMIS naturally occur within cells. NMES were found to be more cariogenic than non-milk intrinsic sugars, as evidenced by increased dental caries in children who had higher NMES intake, consumed mostly through high fructose beverages (Marshall et al, 2007). Despite how much sugar is consumed, it is not the primary factor for dental caries. The primary factors include frequency of eating, physical form of carbohydrates that are consumed (liquid versus solid), the order of consumption, the retentiveness of the food, and the presence of cariogenic factors in the food (WHO 2008).

Not only are higher levels of cariogenicity evident by sugar type, but the frequency of consumption, and the mixing of other foods also plays a role. It was found that when sugars were consumed with foods containing fats, proteins, calcium (perhaps foods that stimulated the saliva), it can limit caries produced by NMES. This data showed that the frequency and length of eating events is more likely a function of cariogenicity, than the type of sugar. Sugar categories are a factor, but sugar amounts and frequency of intake are more important influence on caries development.

Periodontal Disease

Periodontal disease is the also a common chronic oral disease and attacks the gingiva and bone that supports the teeth. it can be caused by diabetes, genetics (IL-1 genotype), malnutrition, and smoking. *Mutans streptococcus* is a plaque that can cause disease by infecting the tissues that surround the tooth. This will form gingivitis, which is a mild form of periodontal disease that can turn into severe periodontitis. The later will recede the gums and jaw bone and infect the oral cavity, leading to tooth loss. Although nutritional deficiencies do not directly cause periodontal disease, it can make the oral cavity more susceptible to periodontal disease (Palmer, 2001). There are two methods of

damage to the tissue caused by periodontal disease. The first method is direct tissue damage caused by the plaque bacterial products. The other method is indirectly through bacterial induction of the host inflammatory markers and immune responses. Gingival crevicular fluid surrounds the tooth at the gingiva margin, and this is where the inflammatory mediators and oral pathogens associated with periodontal disease reside (Boggess et al, 2006).

Socio-cultural factors affecting dental health

The socio-cultural factors that lead to an increased intake of cariogenic foods, which lead to an increased rate of dental disease, are more prevalent in lower income levels, lower levels of education, and in younger mothers and fathers. However, in the United States it was found that high levels of NMFES did not necessarily mean higher prevalence of caries. This was because fluoride intake is more prevalent in the US than in developing countries (PAHO, 2002).

In indigenous cultures, snacking occurs more often. This is because of the lack of consistent nutritious meals, so food is consumed whenever it is available. Dentists often recommend limiting of snacking because it increases the incidence of caries. An assumption can be made that this eating pattern leads to a greater incidence of caries among this population. In the urban areas of Ecuador, processed foods with more refined sugars are available (Goodman, 2001). However, other factors including the nutrients and micronutrients in the diets are considered and dental health must consider all these factors.

NUTRITION AND PREGNANCY

The Ministry of Health suggests that inadequate food intake can cause lower birth weight and increased childhood disease (World Bank, 2007). It is also assumed that large

families and short birth spacing leads to high birth rates, which can cause poor feeding practices during one's pregnancy, as is common case for indigenous families. Even when there are not economic constraints, there may be poor feeding practices and habits that lead to inadequate nutritional intake (World Bank, 2007), which may usually result from a lack of knowledge in proper nutrition. Some examples are eating foods that do not cover the five main food groups, consuming in large quantities of over processed foods, foods high in unnatural fats, and refined sugars. When diet has limited variety, it is difficult to ensure that adequate micronutrients are being consumed.

It is particularly important to care for the nutritional state of females, especially those of reproductive age. If a girl is able to be rescued from her state of stunting, it will reduce her likelihood of giving birth to a child that will be stunted (World Bank 2007). Appropriate birth spacing and reduced family size also reduces the prevalence of stunting, which requires education and cultural change to be reinforced. Often short-for-age mothers have a high chance of giving birth to a low birth weight child, which is true among non-indigenous and indigenous women. Also, in several cases where the mother is both stunted and overweight, the child is often stunted as well. Twenty-four percent of overweight mothers bear stunted children.

FERTILITY RATES IN ECUADOR

The birth rate was high in Ecuador compared to the rest of Latin America in 1994, with a total fertility rate (TFR) of 3.6 births per women; Latin America had 3.2 births. Ecuadorians begin childbirth at an early age, yet fecundity nationwide has dropped tremendously. In 1965-69, the TFR was 7 children (Avalos, 1994). The latest study by the World Health Organization shows that the fertility rate has dropped to 2.7 births per

woman in 2004 (WHO, 2008). In 1994, the median age of marriage was 20.7 years and the median age of first birth was 21.5 years. However, when we divide these rates among educated women with some college and women with no formal education, we find there is a significant difference. Women with some college typically married and had children more than six years later with the median age of 24.9-26 years of age. Those without any formal education had children at 18.6-19.8 years (Avalos, 1994). More recent studies by region of Ecuador, are lacking. However, studies from 1994 provide an idea of the general trends that are found throughout the different areas of Ecuador. Fertility rate was especially high in the rural sierra with a TFR of 4.8, which is where the largest indigenous population resides. The coastal regions had seen a decline from 1984-1989 to 1989-1994, with fertility rates of 5.2 and 4.2, respectively. Most Ecuadorian women wanted 2.7 children, which is about one less than their actual number. There were about 19% unwanted children, and 16% were mistimed. If children are unwanted, they are at higher risk for poor care and poor nutrition because of lack of preparation and lack of resources (Avalos, 1994).

FACTORS AFFECTING FERTILITY

Altitude

Altitude has been shown to reduce reproductive success. High altitude affects fertility in three ways (Whitehead, 1968). Men that go upland will temporarily suffer from a decline in sperm count, referred to as azoospermia. This occurs when a man travels and works in higher elevations for brief periods of time and then returns home with the effects of altitude. Neonatal mortality is also more prevalent. Once the child is born, the pressure of the altitude and lower oxygen concentration affects the newborn and result in death. At higher elevations, oxygen levels are much lower and will cause outcomes of low birth

weight. In higher altitudes, there has also been a prevalence of increased spontaneous abortions.

Lack of prenatal care

In 2004, the World Bank found that with less education on prenatal care, there is an increase in mortality, increase in underweight, and an increase in stunting. It was estimated that infants born to women with no prenatal care are twice as likely to die during their first year. There were 60 deaths out of 1,000 live births to women with no prenatal care and 30-34 deaths out of 1,000 live births to women who had some prenatal care, and this includes a rate of at least one hospital visit during pregnancy (World Bank, 2007). Prenatal care is very important during pregnancy because the doctor can examine nutritional values and intake the mother must have in order to support her and the fetus. If a mother were to visit a prenatal clinic more frequently, the prevalence of malnutrition in her and the infant might decrease. However, poverty and education play a role in access to prenatal care programs, as well as to the food women would be counseled to eat during pregnancy. It can be assumed that women who can afford prenatal care can also afford food. Conversely, those that cannot seek prenatal care will perhaps not have access know the proper nutrients and the prenatal care that is needed during pregnancy, resulting in negative pregnancy outcomes.

Cultural practices

Following their traditions, indigenous women abide by some basic cultural guidelines during pregnancy. Although there are subtle differences within different regions, most of the ideals are similar. In the rural highland regions of Pichincha, indigenous women are told to avoid getting wet or cold and to avoid “cold” or “heavy” foods,

referring to humoral system dichotomies (World Bank, 2007). They are given good sources of protein from sheep meat, eggs, milk, and cheese. Food such as chicken, broth and hot chocolate are encouraged, but pork, salts, sweets, and leftover foods must be avoided. They also have many rules that are based on supernatural signs they are given. They must stay away from malformed children, rainbows, hills, heavy workloads, and sexual relations. They must also remain in bed to protect themselves from the wind and cannot bathe or wash their hair for five days after giving birth. Women of the southern part of the Pichincha province avoid foods that are considered “infected”, such as cabbage and peanuts. Alcohol is also recommended instead of water, so that “women’s stomach will not explode.”

ADVERSE PREGNANCY OUTCOMES

Preterm Birth

Preterm birth (PTB) is the leading cause of infant morbidity and prenatal death, and the infants that do survive have a greater likelihood of long-term health problems throughout their lifetime (Bobesteis, 2006). PTB is determined by any delivery less than 37 weeks of gestation. PTB is caused by many factors including low maternal body mass index, maternal smoking, maternal infections and periodontal disease. Researchers have studied risk factors for PTB because PTB rates have not decreased for some time, although survival rates have improved. Periodontal disease is a risk factor because not only does it affect the oral cavity, it can also affect the maternal body system and pass on to the infant’s system as well. This is discussed further below.

In 1996, potential associations between maternal periodontal disease and delivery of a preterm/low birth weight (<2500g, 5lbs 8oz) infant were first reported. Studies showed

that women who had delivered less than 37 weeks into pregnancy had a more severe case of periodontal disease than women who had healthy, normal births (Boggess et al, 2006). Other adverse pregnancy outcomes are miscarriages and pre-eclampsia, which is a condition that involves an increase in the maternal blood pressure and proteinuria during pregnancy (Bobesteis, 2006).

The Prenatal Period and Maternal Oral Health

Maternal oral health has many implications for the health of the mother, as well as for the infant. The prenatal period can have major effects on a child's dental development and his or her risk of oral disease because the formation of dentition begins before birth. Due to inadequate maternal nutrition, infection or use of drugs, damage to fetal dental tissues can occur (Palmer, 2001). Periodontal disease and dental caries are the two most prevalent diseases of the mouth and can affect the mother's oral health, increase her risk of atherosclerosis, rheumatoid arthritis, and diabetes (Boggess et al, 2006). Negative pregnancy outcomes and an increase in the child's risk of developing early and severe dental caries occurs if the mothers oral health is not cared for. Fortunately, these are preventable problems in women who have access to dental care.

Studies show that during pregnancy, hormones affect the oral health and can cause gingivitis (Gaffield, 2001). About 10 percent of women develop pyogenic granuloma, also referred to as pregnancy tumor. This is an overgrowth that develops in tissues that have been widely irritated or affected by trauma. Changes in the gums, or gingival, during pregnancy have been studied. Estrogen metabolism by the gingiva and the synthesis of prostaglandins increase during pregnancy and contribute to gingival changes. Changes in progesterone and estrogen levels affect the immune system, as well as the rate and

production of collagen in the gingiva. These are negative affects that make it difficult to maintain the gum tissue (Boggess et al, 2006).

Periodontitis and pregnancy outcomes are associated by the transmission of *streptococcus mutans* from mother to child (Han et al, 2006). Maternal saliva transfers these bacteria, which increases the child's risk of having childhood caries. The transmission of this bacterium can cause early childhood caries. Periodontal infections are a reservoir for inflammatory mediators and can threaten the placenta and fetus leading to preterm births. Mothers with high levels of blood prostaglandins deliver preterm babies. It is suggested that increased levels of prostaglandins can cause early uterine contractions, as well as increased sensitivity to irritants that cause inflammation (Gaffield, 2001).

A study by Boggess et al. (2006) illustrates that women with healthy gingiva have a lower risk for low birth weight infants. Throughout the research, it was found that a periodontopathic bacterium could be the source of endotoxins and lipopolysaccharides, which are gram-negative anaerobes (Boggess et al, 2006). Acute phase response (APR) is a severe inflammation locally or systemically stimulated by bacterium. Pro-inflammatory cytokines are produced and travel throughout the blood (Enwonwu et al, 2007). Tissue damage can occur because of pro-inflammatory cytokines, such as interleukin-1 (IL-1) or tumor necrosis factor-alpha (TNF-alpha). This production is stimulated by activated leukocytes, which release reactive oxygen species (ROS) as part of their attack against bacteria.

Since periodontal disease increases serum levels of C-reactive protein (CRP), fibrinogen, haptoglobin, and pro-inflammatory cytokines, tissue damage and inflammation of the gums result, as well as systemic inflammation can result (Enwonwu et al, 2007).

Inflammation can change the composition of the body (systemic) or the oral cavity (local). The body's utilization of macronutrients, such as fats, carbohydrates, and proteins are altered as a result and the demand for important micronutrients increases. Micronutrients such as vitamin A, iron, copper, selenium, and zinc become isolated in the tissues so they are blocked from cellular use. Breakdown of fat and protein is stimulated, causing loss of muscle mass. These changes will particularly increase the negative effect of malnourished on individuals because they increase the body's demand for nutrients.

Inflammation requires tissue repair, which increases the need for amino acids. Many times, these essential amino acids must be replenished through the diet. The increased production of ROS also increases the need for lost micronutrients as antioxidants (Enwonwu et al, 2007). Since the micronutrients have been depleted during inflammation, the diet must have supplements for these losses. Vitamin C, for example, enters the mitochondria where it protects against oxidative injury. Omega-3 is a polyunsaturated fatty acid found in fish and nuts, which reduces cytokine production and works toward decreasing inflammation and its negative effects.

Preventive measures for caries can delay the formation of *mutans streptococci* colonies in young children. Fluoride and chlorhexidine have been found to reduce salivary mutans streptococci (Brambilla, 1998). Preventative measures can be taken by improving oral hygiene, which reduces these levels, or blocking production of pro-inflammatory cytokines (IL-1 and TNF-alpha) (Enwonwu et al, 2007).

A study done by Han et al. (2006) examined two possibilities for periodontal disease affects on pregnancy. The authors concluded that periodontal disease stimulated inflammatory markers that cause adverse pregnancy outcomes and supported that mothers'

oral bacteria could be localized in the uterus and cause infection. Intrauterine infections most commonly originate from the lower genital tract as microorganism invade the pregnant uterus via the vagina. The other possibility is hematogenous transmissions of the infection via the blood stream where the infectious organisms may originate from other parts of the body. These studies were done on fetal mice. However, oral *Bergeyella sp. strain* in woman were also found and associated with PTB. One subject diagnosed with intrauterine infection had 90% of her white blood cell count within the amniotic fluid composed of neutrophils. This shows that infection was present because of this increase in leukocyte as well as a decrease in glucose level. Since the amniotic fluid and chorion are infected by the bacterium, this places the child at risk as well, which calls for early delivery of the fetus resulting in PTB (Han et al, 2006).

Another finding was that periodontal disease diagnosed early in pregnancy is associated with an increased risk of spontaneous PTB (Boggess et al, 2006). By studying amniotic fluid samples of women that were in preterm labor at less than 35 weeks of gestation, researchers could test for intrauterine infection. The results showed that the earlier the gestational age, the more positive cultures for intrauterine infections were found. The frequencies of bacteria that were found were inversely related to the gestational age. During 23 to 24 weeks, 67% of subjects were found with positive cultures of bacteria at, 25 to 26 weeks 36% at, 27 to 30 weeks, 17% at 31 to 32 weeks, 12% and at 33 to 34 weeks, 11% cultured positive for infection (Han et al, 2006).

Cariogenic bacteria are acquired by young children through direct salivary transmission from their mothers through maternal salivary reservoirs (Han et al, 2006). However, the child's receptivity to this bacterium is based on several factors. These factors

include diet, the time of transmission, and the composition of the flow of the child's saliva. If the diet is more cariogenic and the transmission of maternal saliva via the blood and through the placenta occurs earlier in the pregnancy, then it is more likely that caries will occur within the child. If the mother experienced tooth decay and carries *mutans streptococci* in her saliva, this infection will be transmitted directly and put the children at increased risk of childhood caries. Although the child can have these bacteria stored in their pre-dentate, it only affects the child once their first teeth appear (Boggess et al, 2006). Therefore, other factors are involved when an infection occurs, such as the amount of simple carbohydrates in the child's diet, the exposure to fluorides and oral hygiene.

Another cause of maternal and fetal morbidity and mortality is pre-eclampsia, a condition in which hypertension occurs during pregnancy. It is also associated with large amounts of protein in the urine. There are many factors that can cause pre-eclampsia; however, some researchers believe that a potential cause could be maternal periodontal disease (Boggess et al, 2006). Women that have severe periodontal disease during birth were reported to have a higher risk for pre-eclampsia. However, it seems unclear if periodontal disease and pre-eclampsia are associative or causal.

Clefting

The nutrients consumed by the pregnant mother contribute to the environment in which the fetus grows. Folic acid is a prenatal supplement usually taken to guarantee full development of the embryo's neural tube. Research has shown that folic acid supplements or folates in the diet of 400µg or more daily can reduce the chances of cleft lip, with or without cleft palate, by one-third (Snider, 2007). However, the risk of developing a cleft palate is not completely omitted. Cleft lip is a result of incomplete development of the

nasal cavity, with an un-fused upper lip. A cleft palate results when the palatine shelves do not meet in the midline, due to deficient development of the shelves. In addition to nutritional factors, there are other etiologic factors that contribute to clefting. The environment of the fetus is sensitive and can be affected by vitamins, alcohol, illegal drug use, cigarette smoking, and excesses or deficiencies in nutrients. There has also been research that shows genetic predispositions to clefting. In Latin America, 12,975 cases of clefting occur per year, and 30% are left untreated due to economic factors (PAHO, 2002).

A study in 1995 showed that 75% of the Ecuadorian population had begun smoking under the age of 18 (PAHO, 2002). Teratogens, produced by cigarette smoking and alcohol consumption, during pregnancy were found to be a cause of clefting. Women, who smoke and drink during pregnancy will increase the risk of cleft lip or cleft palate in their fetuses. During the embryo's development, the chances of cleft lip or palate developing occur in the first five to twelve weeks of pregnancy (Abramowicz, 2003). Research done on mice shows that teratogen exposure during the early gastrulating stages result in cynocephali or anencephaly, which are both facial and cranial anomalies. Clefting results from toxicity in the presomite through early somite stages of embryonic development.

Genetic predisposition is also involved and increases the risk of clefting. If the fetus lacks the GSTTI enzyme, an enzyme highly expressed during craniofacial structure development, chances of cleft lip or cleft palate are very high (Garvin, 2007). When a pregnant mother is a smoker, the developments of these enzymes that the GSTT gene encodes for are impeded, increasing the risk of developing a cleft. A fetus that lacks both copies of the gene in their DNA that is responsible for detoxifying cigarette smoke will be

at even greater risk of a cleft lip or cleft palate development. Other genes that influence palate formation include transforming growth factor-beta 3 (TGFA-3), transforming growth factor-beta 2 (TGFA-2), the muscle segment homeobox (MSX1), retinoic acid receptor alpha and the proto-oncogene BCL3. MSX1 is missing in 4p-/Wolf-Hirschhorn syndrome, where cleft lip/palate occurs. Mutations in these specific genes have been found to contribute to non-syndromic forms of oral clefts however, the interactions are still unclear.

A study from 1998 to 2000 done by the Latin American Collaborative Study of Congenital Malformations (ECLAMC) showed the relation between MSXI and TGFB-3 to clefting. Blood spots were collected from patients from various regions of South America, DNA was extracted, and allele variables of genes were tested through PCR (polymerase chain reactions) (Vieira et al, 2003). MSX1 was shown to have a greater effect on cases with only the cleft lip defect. It was found that there are repeat mutations within a single intron in MSX. These mutations cause a loss of function and increase clefting because the introns are the essential information providing portion of the gene. The TGFB3 gene also shows strong effects on these craniofacial disorders. However, TGFB3 was also found to have a stronger effect on cleft palate over cleft lip (Vieira et al, 2003). Studies on MSX1 and TGFB3 have shown a strong relation in cleft lip with or without cleft palate. Since this study was only performed in South American countries, it cannot verify ethnic predisposition, however it was found that in Bolivia, the frequency of cleft lip with or without cleft palate was higher. Bolivia has a high percent of indigenous populations, however, further studies must be done to differentiate causal factors, such as ethnicity and other socio-economic barriers.

BARRIERS TO SEEKING CARE

Safety

It is important to learn about dental and oral health, especially during pregnancy when it can affect the mother and the infant's health. Seeking dental care is essential during the second trimester, however many do not because they are unsure if it is safe. Women's beliefs about dental treatment, lack of insurance coverage, obstetrician and dentist's attitudes and beliefs about pregnancy and oral health can all influence whether or not women seek dental care during pregnancy.

The ADA recommends that dental care should be avoided by pregnant women during the first trimester, and again at the end of the third trimester. The first trimester is a sensitive time, in which the fetus is at increased risk of birth defects due to teratogens, from radiation, drugs, and infections. The mother is also at risk for spontaneous abortion during this time. At the end of the third trimester, the uterus is ultra sensitive to external factors that can cause premature birth (Gaffield, 2001). For these reasons, women are recommended to have dental visits during their second trimester of pregnancy (Boggess et al 2006).

However, if care for maternal periodontal disease does yield positive effects, it is important to take preventative measures or to seek care very early on in pregnancy. In order to avoid caries, it is important to understand dietary guidelines, use proper fluoride treatments, chlorhexidene gels and varnishes, and xylitol (Boggess et al, 2006). These reduce the probability of caries transmission to the child by reducing salivary cariogenic flora, as well by improving the mother's oral health.

Poverty

Dental caries and periodontal disease are in high prevalence throughout many Latin American countries (PAHO 2002). As societies develop, they adopt westernized lifestyles that increase sugar consumption and caries prevalence increases from what was an initially low level (Goodman, 2007). If the country is already developed, prevalence is not as high because of accessibility to proper fluoride treatments. However, in low income or developing countries, this is not usually the case. Sugars is often relatively cheap, especially for a country like Ecuador where it is a main export good, and fluoride treatment or toothpaste is relatively expensive.

In 1998 the CDC issued an ongoing project called the Pregnancy Risk Assessment Monitoring System (PRAMS) in order to understand the experience of pregnant women and their beliefs about seeking dental care in the United States (Gaffield, 2001). The assessment showed that only 23-58% of pregnant women received dental care during their pregnancies. Women who initiated prenatal care later than the first trimester, who had an unplanned pregnancy and who were in lower socio-economic status were less likely to obtain dental care.

A study in 2001 revealed that only a small percent of women visited the dentist during their most recent pregnancy (Gaffield, 2001). Women with the highest household incomes or with education beyond high school were more likely to visit the dentist than those who had lower incomes and less educational attainment. Another factor was the lack of insurance coverage. Many times dental insurance is not covered under Medicaid or basic health care plans. Dental care is not feasible in low-income developing countries and there is a need for health professionals to recognize the urgent need for dental care and to

eliminate the poverty that keeps individuals from accessing dental care where it is available.

Beliefs Held by Professionals and Patients

A questionnaire was given to various medical practitioners and patients in the United States, asking about their perspectives on the importance of oral health screens as a necessary asset to prenatal care (Shellhaas et al, 2005). The study included 66% dentists, 50% obstetricians, and 46% patients. From the dentists and obstetricians that were interviewed, 97% and 64%, respectively, said that oral health screens are necessary in prenatal care. On the safety of dental visits during pregnancy, 84% of the patients believed that these were safe, 54% listed screenings as necessary, 40% advised to have an assessment, and 32% actually received care during their prenatal period. The most common reason that patients chose not to seek care was because of insufficient funds, not perceptions of safety or lack of necessity. Most of these providers agreed that poor dental hygiene was related to adverse pregnancy outcomes with low birth weight as the most frequently cited complication and pre-eclampsia as the least. Ninety percent of obstetricians said that consultations with dentists before dental treatment were unnecessary, and 60% said that dentists were too cautious in their care of pregnant patients. Eighty-one percent of respondents were concerned that dentists may prescribe antibiotics without a consultation (Gaffield, 2001). The results provided information on how providers and patients view the necessity, accessibility and safety of dental care during pregnancy.

APPROACHES

A Need for Increased Cultural Understanding

Cultural sensitivity is one of the strongest tools of communication. Understanding the indigenous people's needs, especially when it comes to women's reproductive rights, is an important step to take when considering health care. The indigenous people have traditions that are highly valued in their communities, but unrecognized in Western practices. Healthcare providers must understand these differences if culturally appropriate care is to be offered. Based on my field work, it is difficult for indigenous women of the Amazon and the highlands of the Andes to feel comfortable in modern health care facilities. Quechua women often turn to their traditional birthing methods because of their culture. In 2004, the Demographic and Maternal and Child Health Survey found that only 30% of indigenous women and 80% of non-indigenous women received modern care during delivery (Vivar, 2007). The remaining women gave birth at home or under skilled traditional midwives. Many women still prefer the upright position for birth and to be surrounded by their family and a midwife when they deliver. It is rare that they are provided with prenatal or postnatal care, causing problems to arise, such as high mortality rates for mothers and infants. Because indigenous women live in remote rural villages and it is difficult to find immediate, skilled care, complications arise and data for deaths are often left un-registered.

In many countries, these complications have been recognized and changes have been implemented. In 2006, Ecuador's Ministry of Health guaranteed integration of intercultural approaches in sexual and reproductive health services, which includes maternal health. The National Sexual and Reproductive Health Rights Plan works toward

adapting policies for indigenous women, rather than imposing western traditions. For example, “Technical Standard for Vertical Delivery with Intercultural Adaptation Plan,” is a strategy to introduce upright vertical delivery positions, such as squatting (Velasco, 2008). This plan will allow for improved cultural understanding within modern clinics and provide a more welcoming atmosphere to indigenous women. By implementing this plan, there are hopes that more indigenous women will want to give birth in modern clinics, and that this will decrease chances of birthing complications. The ultimate goal of the “vertical delivery” plan is to reduce maternal mortality rates to 66 per 1,000,000 live births by 2015. They would like to increase skilled medical deliveries to rural areas by 70%. In the year 2000, the number of institutional deliveries was 24% and it increased in these rural areas to 42.5% in 2005 (Velasco, 2008). The services also include free reproductive health care for all women and the establishment of mechanisms for community monitoring and promotion of intercultural models of care (Vivar, 2007). Not only does this allow indigenous women to feel at ease and comfortable with the modern medical clinics, but they are also given the respect that they deserve. In this way, by implementing indigenous traditions in modern medical practices, more indigenous women are likely to approach health care facilities, which will hopefully increase knowledge on prenatal and postnatal care.

There are many traditional health systems and traditional healers in Ecuador, and often times, the number of modern doctors is only slightly higher than traditional healers (PAHO, 2002). Since many times it is not the lack of accessibility, but the financial burden that is placed upon the poor, the government must also intervene. In some regions of Ecuador, the government has established national-level departments for indigenous health in the country in order to strengthen indigenous health systems. In Ecuador, the largest

indigenous population is located in Otavalo, a rural city in the highlands. There, the United Nations Population Fund (UNFPA) has supported Jambi Huasi, a Quechua speaking clinic (Hinrichsen, 2006). This clinic serves the people in this area and surrounding areas, providing modern and traditional care. The Jambi Huasi has become a self-sufficient clinic and donors have graciously added to the budget. As the Ecuadorian Government has seen the progressive success of the Jambi Huasi, they plan to expand into other parts of Ecuador. This clinic provides for a culturally sensitive approach to working with the indigenous communities in Ecuador, and is a model that would be beneficial for many other indigenous communities to replicate.

Global Approaches

Understanding culture opens doors to providing care to a wider spectrum of people. However, there are many obstacles that cultural sensitivity cannot overcome. Poverty is a global issue that serves as an enormous barrier to providing and receiving care among remote regions and even to the poor who live in urban areas. I believe that for all health care providers, it is a social responsibility to recognize this issue and to work towards eliminating poverty. Although this seems a large goal, small steps can lead towards providing care without limits.

Other limitations include the lack of education on basic dental hygiene to the public. The dentists in most developing countries are concentrated in the urban zones (Hobdell, 2007). Seeing that 45% of the Ecuadorian population resides in rural zones, it is difficult for one to seek care, even if finances were available. In many rural areas, it is difficult for health care providers to access the rural poor because of their isolated location, lack of decent roads, sanitary water, and many times, electricity. With these limitations that act as

barriers even to the health care providers, the best method is prevention through education. In countries such as Ecuador, Colombia, Mexico, Nicaragua and Trinidad and Tobago, education and secondary school enrollment have doubled since 1970. However, due to the disparities that cause health issues, nutritionally and emotionally, often times children vary in their readiness to learn. Although Latin American countries have improved in enrollment over the past few decades, school health departments and programs should be aimed towards focusing on disease prevention. If the basic tools of education are provided on dental hygiene for the more remote areas, an improvement will be seen in the oral hygiene through prevention. Prophylaxis will ultimately lessen the effects of long-term disease. An approach that will also lessen risks of long-term disease and reach the large quantity of the population is mandatory fluoridation plans of toothpaste and water throughout the country.

Lastly, there is a need for more research to be done. Through this research, I have ultimately found that information on dental care in Ecuador is very limited. A conclusion that is drawn from this is that dental care is not strongly addressed in this country as an issue of importance to health. Through studying dental health in specific regions and population groups throughout the country, a better understanding of oral health and its connection to reproductive health will alert us to issues that may need to be addressed.

CONCLUSION

The purpose of this research was to examine the connection between pregnancy, nutrition, and oral health. Through research and understanding of the diet and nutrition, pregnancy and fertility, and the cultural practices throughout Ecuador, I was able to demonstrate effects on dental health and reproductive health. By understanding and gaining sensitivity to these factors, new approaches to dental and reproductive health are possible.

Learning the diet of a culture is the only way to understand the nutrients that are being consumed. Through research of the main foods consumed in each region of Ecuador, I was able to conclude that poverty often times plays the most significant role in nutritional intake, along with the geographical location where an individual lives. In Ecuador, the indigenous communities that occupied the highlands and the Amazon region did not have much variety in their diet. The Afroecuadorians on the other hand, who inhabit the coastal regions, have fertile soils from which to harvest a variety of health foods. Understanding these differences in diet allow an understanding of malnutrition within Ecuador. Because the coastal regions are abundant in nutrients, it makes sense that we do not see high stunting rates in Afroecuadorian populations. However, for *mestizo* and indigenous children, stunting is an issue, due to deficiency of both macro- and micronutrients. Other factors are taken into consideration for stunting, such as the cultural differences that affect food consumption and the altitude of the Highlands, where a lack of oxygen inhibits sufficient growth.

Fertility rates have also dramatically decreased since 1965, where seven children were born to each woman on average. The latest research shows that in 2004, each woman

had 2.7 children. There was a slightly higher rate in the rural regions of the Sierra than in the coastal regions. Information on the Amazon region was not found, perhaps due to the difficulty of surveying a remote area. More studies should be implemented.

Periodontal disease and dental caries were found to be the most common oral diseases that occur. Dental caries were found to be caused by the frequency of sugar intake, the order of consumption, the cariogenic factors in food, and the amount of sugar intake. The rates in Ecuador have dropped over the years, however there is still limited research on the oral health of Ecuadorians. An increase in research specific to Ecuador will help to demonstrate the urgent need for oral health interventions.

Periodontal disease affects fertility rates. Adverse pregnancy outcomes result, such as preterm birth, due to periodontal disease, altitude, lack of prenatal care and unsafe cultural practices. Periodontal disease affects the gum tissue of the oral cavity directly through bacterial production from plaque, and it can also indirectly affect the tissues through inflammatory markers. The inflammation spreads systemically and can ultimately deplete micronutrients in the mother's body and the fetus, as well as induce inflammation in the fetus, calling for early delivery.

Increased access to affordable and culturally sensitive reproductive and dental care are needed in Ecuador. There have been plans already implemented that celebrate the indigenous culture and allow for a more comfortable environment in modern care clinics for indigenous people. Other approaches would include an increase in public health education and additional training for health care providers. It is important for the public to know of basic oral hygiene and nutritional information, however it is more important for health care providers to be aware of the issues of poverty and its detrimental effects on the

health of many people. Through education of both sides, other methods of prevention can be put into practice, such as implementation of salt and water fluoridation. Ultimately, this topic calls for more research to be done. Through studies done on all topics concerning diet, pregnancy and oral health in Ecuador, programs and plans of intervention can be carefully considered.

By aiming to understand and to provide for the cultural needs of patients, improvements in health will be seen. As access to culturally appropriate and low cost care is provided, rates of negative pregnancy and dental health outcomes will decline. Together these lead to a greater understanding of the importance of oral health... perhaps even in our own country.

Bibliography

- Abramowicz, S., et al. (2003). Demographic and prenatal factors of patients with cleft lip and cleft palate. *The Journal of the American Dental Association*, 134, 1371-75.
- Avalos, A.P. (1994). La Fecundidad en Imbabura, Los Rios, Carchi, Tungurahua, y Manabi. *Correo Poblacional y de la salud*, 5, 29-36.
- Bogges, K.A., et al. (2006). Oral health in women during preconception and pregnancy: Implications for birth outcomes and infant oral health. *Maternal Child Health Journal*, 10, S169-74.
- Bobesteis, Y.A., et al. (2006). Exploring the relationship between periodontal disease and pregnancy complications. *The Journal of Dental Research*, 137, 7S-13S.
- Brambilla, E., et al. (1998). Caries prevention during pregnancy: Results of a 30-month study. *The Journal of the American Dental Association*, 129, 871-77.
- Eggleston, Elizabeth (2000). Unintended pregnancy and women's use of prenatal care in Ecuador. *Social Science & Medicine*. 51, 1011-1018.
- Enwonwu, C.O., et al. (2007). Nutrition and inflammatory markers. *The Journal of the American Dental Association*, 138, 70-72.
- FAO, (1992). Legislation pertaining to food fortification. Retrieved September 2, 2008, from Food and Agriculture Organization of the United Nation Web site:
<http://www.fao.org/docrep/w2840e/w2840e0e.htm>
- Gaffield, M.L. (2001). Oral health during pregnancy. *The Journal of the American Dental Association*, 132, 1009-16.
- Garvin, J. ed. (2007). Pregnant women who smoke increase risk of cleft lip/palate in infants lacking gene. *The Journal of the American Dental Association*, 138, 156.

- Goodman, A.H. (2000). *Nutritional Anthropology*. Mountain View, CA: Mayfield Publishing Company.
- Han, Y.W., et al. (2006). Transmission of an uncultivated *Bergeyella* Strain from the oral cavity to amniotic fluid in a case of preterm birth. *Journal of clinical microbiology*, 44, 1475-83.
- Hinrichsen, D (2006, January 25). Working with Indigenous Communities in Ecuador. Retrieved September 2, 2008, from United Nations Population Fund (UNFPA) Web site: <http://www.unfpa.org/news/news.cfm?ID=742>
- Hobdell, M.H. (2007). Poverty, oral health and human development. *The Journal of the American Dental Association*, 138, 1433-36.
- Ingle, J., Blair, P (Ed.). (1978). *International Dental Care Delivery Systems*. Cambridge, Massachusetts: Ballinger Publishing Company.
- Marshall, T.A. (2006). Translating the new dietary guidelines. *The Journal of the American Dental Association*, 137, 1258-60.
- Mayo Clinic Staff, (January 9, 2007). Goiters. Retrieved August 30, 2008, from MayoClinic.com Web site: <http://www.mayoclinic.com/health/goiter/DS00217>
- Orbe, G.R. (Ed.). (1983). *Punyaro: Ecuadorian Highlands*. Quito, Ecuador: Editorial Casa de la Cultural Ecuatoriana.
- Palmer, C.A. (2001). Important relationships between diet, nutrition, and oral health. *Nutrition in Clinical care*, 4, 4-12.
- Pan American Health Organization (2002). In *Health in the Americas* (2002 ed., Washington, D.C.: Vol. 1). Scientific and Technical Publication No. 587.

- Sgan-Cohen, H.D. (2007). Health, oral health, and poverty. *The Journal of the American Dental Association*, 138, 1437-41.
- Shellhaas, C., et al. (2005). Provider and patients perceptions about dental care during pregnancy. *American Journal of Obstetrics and Gynecology*, 193, S120.
- Snider, J. (2007). Folic acid supplements taken early in pregnancy reduce facial cleft risk. *The Journal of the American Dental Association*, 138, 452-54.
- Snider, J. (2006). Periodontal treatment does no reduce the risk of preterm delivery, study finds. *The Journal of the American Dental Association*, 137, 1642-44.
- U.S. Library of Congress, (November 8, 2005). A Country Study: Ecuador. Retrieved August 30, 2008, from The Library of Congress Web site:
<http://memory.loc.gov/frd/cs/ectoc.html>
- Velasco, Karim (2008, May 22). Peru Addresses Indigenous Women's Reproductive Rights. Retrieved August 30, 2008, from RH Reality Check Web site:
<http://www.rhrealitycheck.org/print/7384>
- Vieira, A.R., et al. (2003). MSX1 and TGFB3 contribute to clefting in South America. *Journal of Dental Research*, 82, 289-92.
- Vivar, S.C. (2007). Ecuador addresses cultural issues for pregnant women. *The Lancet*, 370, 1302.
- Whitehead, L. (1968). Altitude, Fertility, and Mortality in Andean Countries. *Population Studies*, 22, 335-46.
- WHO Staff, (2008). Ecuador. Retrieved August 30, 2008, from World Health Organization Web site: <http://www.who.int/countries/ecu/en/>

World Bank. Insuficiencia Nutricional en el Ecuador: Causas, consecuencias, y soluciones.

Washington, D.C.: World Bank, 2007.