

Parental Influences on Early Childhood Caries in the Corvallis Community

by
Sarah Elizabeth Darst

A THESIS

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Oregon State University
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AN ABSTRACT OF THE THESIS OF

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Dr. Ray Tricker

Early Childhood Caries (ECC) is the most common chronic childhood disease, affecting more than 40% of children by the time they reach kindergarten. A bacterium known as *Streptococcus mutans* is the primary source of infection, but multiple other factors play a significant role in the progression of the disease. Studies have shown that diet, socioeconomic status, and ethnicity are a few of the important influencing factors, but there is a need for more research concerning the influence parents have on the development and progression of this disease. The goal of this study was to examine parental influences including parental oral health, parental value of oral health, parenting style, and parental value of primary teeth in relation to a child's oral health. A survey questionnaire was used to examine a small sample of parental perceptions, opinions and beliefs regarding oral health. The observations from the survey, along with an extensive literature review showed that a child's oral health may be related to their parent's oral health, parenting style, and parental consistency of oral health. It is not clear whether or not parents understand the importance of primary teeth. Parents in the sample were very involved in their child's oral health, and eager to learn more about the importance of primary teeth and how to properly care for them. This study provided interesting insights and a good starting point for future research and the development of educational programs for parents in this community.

Key Words: dental, health, children, parent, influences

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I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

Sarah Darst, Author

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1. Introduction

Most parents will do whatever it takes to protect their children from chronic and infectious diseases, but what many may not realize is that the single-most common chronic childhood disease is known as Early Childhood Caries (ECC). Characterized by one or more missing or decayed teeth in any child ages 0-6 years old, ECC is four times more common than childhood obesity, five times more common than asthma, and 20 times more common than diabetes (American Academy of Pediatric Dentistry, 2012). The outstanding prevalence of this disease among children (both locally and globally) is not even the most concerning part- ECC has very serious implications for those who have been diagnosed with it.

There are significant social, personal, and health related consequences for children who experience ECC. From a personal and social perspective, it is common for children who have ECC to also have low self-esteem due to the unaesthetic nature of the disease, have communication and speech problems, have higher rates of hospitalization, and be more prone to missing school (American Academy of Pediatric Dentistry, 2012). Children who are affected by ECC are not only more likely to continue having oral health problems into adulthood, but also can suffer from other serious overall health concerns. Many children diagnosed with ECC suffer height and weight problems due to the pain associated with eating, and already poor nutritional habits. Acs et al. (1992) reported that children with ECC weighed less than 80% of the optimal weight for their age group.

In addition to the social and health concerns associated with ECC, treatment can be a large burden for families, with many cases requiring that the child be put under general anesthesia. One review done in California stated that treatment of ECC under general anesthesia at the University of California San Francisco Hospital ranges between \$2000 and \$4500 and that even after extensive treatment, the majority of children had new dental caries within just 4 to 6 months (Denbesten et al., 2003).

One thing that makes ECC more difficult to understand and prevent than some other infectious and chronic diseases is that it can be considered “multi-factorial”. Its etiology cannot be traced simply to the presence of one pathogen- instead there are many additional factors that must also be considered when looking at the origin of this disease

in an individual. The primary cause of ECC is the presence, and rapid growth of a bacterial species known as *Streptococcus mutans*. However, family health history, race, diet, and socioeconomic status are all things that have long been known to also influence a patient's oral health. More recently, researchers are beginning to study the influence of factors such as family environment, parenting styles, and parental attitudes on dental disease in children. Although it is most parent's goal to keep their children happy and healthy, their everyday decisions and behaviors may be influencing whether or not their child is at risk of ECC more than they realize.

The purpose of this study is to explore the parental influences on ECC and use the findings to propose ideas for educational and prevention programs that can be implemented in the Corvallis, Oregon community to help decrease the prevalence of this disease. After performing an extensive literature review, a survey was developed for the parents of patients at a local pediatric dental clinic that asks questions about their child's oral health status, their oral hygiene behaviors, the value they place on oral health, the value they place on primary teeth, and the appreciation they would or would not have if new dental education programs for parents were implemented in their community. The expected outcomes of the survey were as follows:

1. Parents who rank their own oral health poorly and place little to no value on their own oral health will have children who also have a poor oral health status.
2. Parents who follow a strict oral hygiene routine daily will rank both their own and their child's oral health higher than those parents who do not follow a strict oral hygiene routine.
3. Parents who believe that parental involvement strongly influences children's oral health will be more involved in their child's oral health, and will rank their children's oral health status higher than parents who do not believe that parental involvement matters.

4. Parents who respond “True” to the statement “Children’s primary teeth don’t matter because they will fall out anyway “ will have children with a lower oral health status than parents who answer false.
5. The majority of parents, regardless of their own child’s oral health status will answer on the survey that they believe an educational program for parents about dental health would increase oral health in children, and that parental knowledge does influence children’s oral health.

Due to the nature of this particular research project, confidential dental and medical records could not be obtained, so the survey is entirely subjective, but the responses received might provide direct insight to parental attitudes about the importance of oral health, and the willingness of parents to actively participate in an effort to reduce the issue of Early Childhood Caries.

2. Literature Review

ECC is an infectious chronic disease characterized by “one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in children ages 0-6 years old” (Poureslami et al., 2009). Dental caries is more commonly known as tooth decay. Tooth decay first appears as “white spot lesions”, or non-cavitated lesions (Figure 1, A). These white spot lesions are the initial

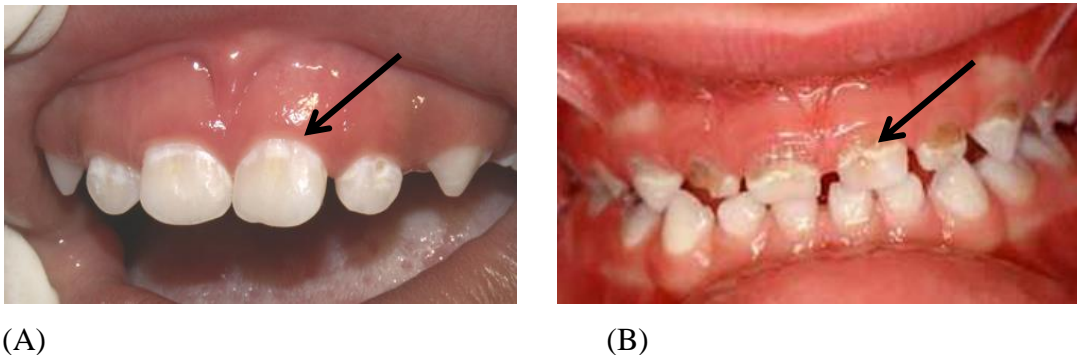


Figure 1. (A) White spot lesions (Joanna Douglas, 2010) (B) Cavitated lesions (Griffith Dental Lounge, 2016)

demineralization of the enamel (the outer-most layer of the tooth) caused by bacteria that have developed biofilms on the tooth surface (Dental Health Foundation, 2002). Eventually, if not treated or properly cared for, the decay will continue to deeper layers of the tooth, becoming a cavitated lesion, also known as a cavity (Figure 1, B).

The process of tooth decay follows the same general process in adults and children, except for the pattern by which decay develops throughout the mouth. In young children, especially those who are still nursing or drinking from a bottle, the first signs of decay usually appear in the following order: upper incisors first, followed by upper first molars, upper canines, and finally lower first molars (Poureslami et al., 2009).

The lower incisors are almost never affected by ECC because while

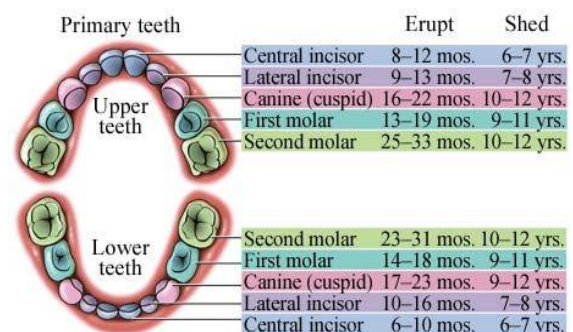


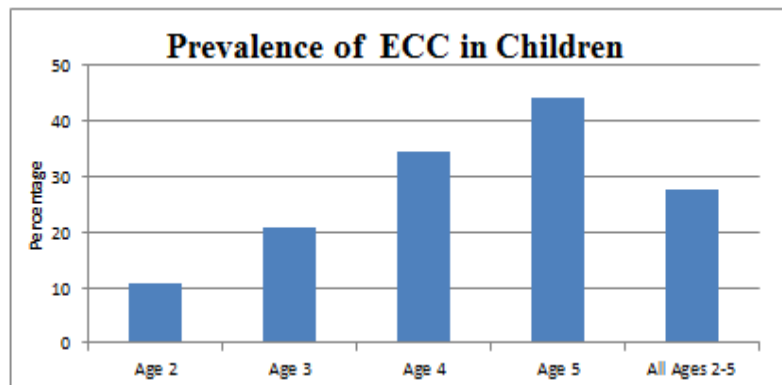
Figure 2. Diagram of primary teeth (Healthwise Staff WebMD 2014)

children are feeding their lower teeth are protected by their lips and tongue (Figure 1,B) (Poureslami et al., 2009). The development of ECC can result in local swelling of gums and include more global symptoms such as, acute and chronic pain, fever, and loss of appetite (Poureslami et al., 2009).

Even though the number of children who were reported as having ECC varies slightly between sources, all researchers concluded that ECC is a significant health problem requiring more attention than it currently gets. The American Academy of Pediatric Dentistry (2012) reported that 15% of children in America present mild to moderate levels of ECC, with an additional 5% presenting a severe form of the condition. Another source stated that when the prevalence of ECC in America was measured in 1994, 24% of children were found to have the condition. Just ten years later this frequency had already increased to 28% (Dye et al., 2011).

In an effort to determine the prevalence of ECC at different stages of childhood, Iida et al. (2007) used information from the National Health and Nutrition Examination Survey which was

completed for 1576 children between the ages of two and five years old. A reconstruction of the data found in tables from Iida et al.'s (2007) article



is displayed in Figure 3. It

shows that for this group of children, almost 28% of

children aged 2-5 years were diagnosed with ECC, and that prevalence of the disease increased with age.

ECC is as significant worldwide as it is in the United States, with developing countries having the highest rates of the disease (Shabahno et al., n.d.). Shabahno et al. (n.d.) in Pakistan summarized the global prevalence of the disease in different countries, which has been organized into Table 1.

Country or Region	Percentage of Children Infected
Western European Countries	1-32%
Eastern European Countries	1-56%
Canada	5-80%
East Asian Countries	36-85%
India	44-61%
Middle East Countries	22-61%
African Countries	1-70%

Table 1. Global prevalence of ECC (Data adapted from Shabahno et al., n.d)

2.1 Bacterial Causes

A variety of bacterial strains are normally found on the surfaces of teeth and in the oral cavity, but pathogenic bacteria can cause infectious diseases such as ECC. The microorganism primarily responsible for ECC is a bacterial strain known as *Streptococcus mutans*. The mechanism by which *S. mutans* causes carious lesions is via the metabolism of carbohydrates. When a person consumes any foods that contain sugars such as fructose, sucrose, and/or glucose, the bacteria ferments the sugar and produces an acidic byproduct (Kawashita et al., 2011). *S. mutans* are able to thrive in this acidic environment compared to other bacterial species. When this lactic acid comes into contact with the tooth surface it breaks down the enamel, and eventually reaches the deeper dentin layer of the tooth. This breakdown of the tooth layers is what causes white spot lesions that progress to cavitated lesions (Figure 1 A and B). Once a cavity has developed, the bacteria become much harder to reach when brushing and/or flossing, allowing bacterial cells to divide more rapidly and form larger aggregates or biofilms than would occur in a person with intact teeth (Kawashita et al., 2011).

Although the progression of caries occurs rapidly once the enamel is broken down, there is a natural defense system known as remineralization (Kawashita et al., 2011). Minerals in the saliva are allowed to enter through the tooth's porous lesions and can rebuild what has been broken down by the acidic environment. This process of

demineralization by *S. mutans* and remineralization by saliva is commonly known as the caries balance (Kawashita et al., 2011). When the caries balance is in favor of demineralization, ECC is allowed to progress in the child's mouth.

Arguably even more important than the progression of biofilms into cavitated lesions, is the process by which a child originally acquires *S. mutans*. A paper published in the Pakistan Oral and Dental Journal described a time period called the window of infectivity, between 19 and 30 months of age. During this time the proportion of children infected with *S. mutans* increased by 50% (Javed et al., 2012). Phenotypic and genotypic testing of bacterial species that colonized the oral cavities of children compared to those of their parents, peers and other caregivers has indicated that *S. mutans* can be acquired via both vertical and horizontal transmission.

Vertical transmission appears to be the primary source of transmission. *S. mutans* can be transferred via saliva, milk, or through the placenta (Javed et al., 2012). In most cases maternal vertical transmission can be attributed to an exchange of saliva (Javed et al., 2012). For example when eating utensils are being shared without being cleaned between uses saliva containing *S. mutans* is passed between a mother and her child. One guide for perinatal oral health care states that mothers with high levels of *S. mutans* colonization in their mouths are at a much higher risk of transmitting to their children than those with lower levels (Originating Council, American Academy of Pediatric Dentistry, n.d.). This guide also suggested that extra precautionary and preventative measures should be taken with regards to dental treatment of pregnant mothers (Originating Council, American Academy of Pediatric Dentistry, n.d.). During pregnancy the oral health of women can suffer significantly due to increased vomiting coupled with a failure to increase oral hygiene to compensate. During pregnancy an increased presence of untreated caries in the mother may result in greater risks of her child contracting ECC (Originating Council, American Academy of Pediatric Dentistry, n.d.).

The other type of *S. mutans* transmission is horizontal between a child and his or her siblings, peers at day-care or school, and caregivers such as babysitters or nursery school teachers. Alves et al. (2208) followed 160 children their caregivers from nursery schools in Brazil for one and a half years. Salivary samples and clinical exams were taken

at the beginning of the study and after 6, 12, and 18 months had passed (Alves et al., 2008). The research team cultured the bacteria samples and studied both the levels and genotypes of *S. mutans* present in each patient's saliva. The study reported that a small number of children from the same nursery schools had identical strains of *S. mutans*, unique from their parents, suggesting child-to-child transmission is possible, but infrequent. This study also found that child and caregivers had no identical strains between them (Alves et al., 2008). Only half of the children who were infected with caries had bacterial strains identical to their mother's, leading Alves et al. (2008) to conclude that it must be possible for a child to acquire *S. mutans* from non-familial sources, although those sources were not identified. The results from this study are valuable because it provides a basic understanding of the frequency of horizontal transmission of *S. mutans* in children. However, due to some inconsistencies in the numbers of participants throughout the study, and a lack of consideration for common bacterial strains in the general population, this data cannot be considered conclusive, and opens the door to further studies.

2.2 Additional Influences

Several risk factors have been identified that increase the likelihood a child will acquire *S. mutans* and that the infection will progress into the development of carious lesions. Each of these factors can directly influence whether or not a child is likely to have ECC, and as displayed in Figure 4, many of these influences and risk factors are highly intertwined. For example, if a child belongs to an ethnic minority, there is an increased risk of contracting ECC, and also increased likelihood that their

family is of low socioeconomic status. Being of a low socioeconomic status is often

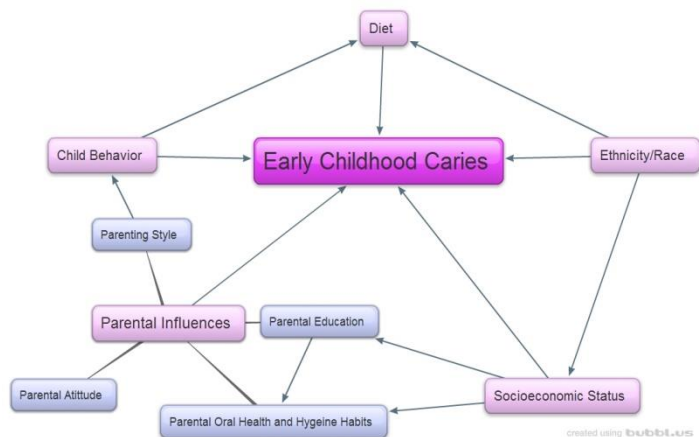


Figure 4. Concept map of additional influences on ECC.

associated with lower education and income levels. All of these factors might contribute to a type of child's diet that is more conducive to promotion of dental caries. Each of these categories will be briefly explored in the following sections.

Ethnicity/Race

Based on a review of many articles, it is generally agreed that a child's ethnicity or race is a significant factor in a child's risk of contracting ECC, particularly if they belong to a minority group. Individuals belonging to minority groups often may have lower income, less education, differing cultural values, and perhaps food choices that are more likely to promote the colonization of cariogenic bacteria such as *S. mutans*. Psoter et al. (2006) physically examined 3850 children whose socioeconomic and other demographic information was provided by a caregiver. The information was then used to study the caries development pattern, as well as the following risk factors: age, ethnicity, household income, and parent's education (Psoter et al., 2006). After a statistical analysis of all of the data, results indicated Native American, Hispanic, and Black ethnicities were at a statistically higher risk of contracting ECC (Psoter et al., 2006). The data indicated the following compared to Caucasian children: Native American children were 3.57 times more likely to have caries; Hispanic children were 1.87 times more likely to have caries; black children were 1.41 times more likely than Caucasian children to have caries. Children that were reported as "other" (such as Asian), were 1.89 times more likely than Caucasian children to have caries (Psoter et al., 2006). It is important to note that these scores were reported after the data had been adjusted for all other factors such as gender, income, parent's education level and so on.

Socioeconomic Status

A very powerful statement was provided by the United States Surgeon General regarding dental disease: "oral diseases represent what amounts to a silent epidemic affecting our most vulnerable citizens-poor children." (Psoter et al, 2006). Data has consistently shown that the frequency of ECC in children has a directly inverse relationship with parental income. The data provided by Psoter et al. (2006), described in the previous section, are consistent with this claim. The data displayed in Figure 5

presents their data adapted into a graphical format to represent the inverse relationship between family income and ECC.

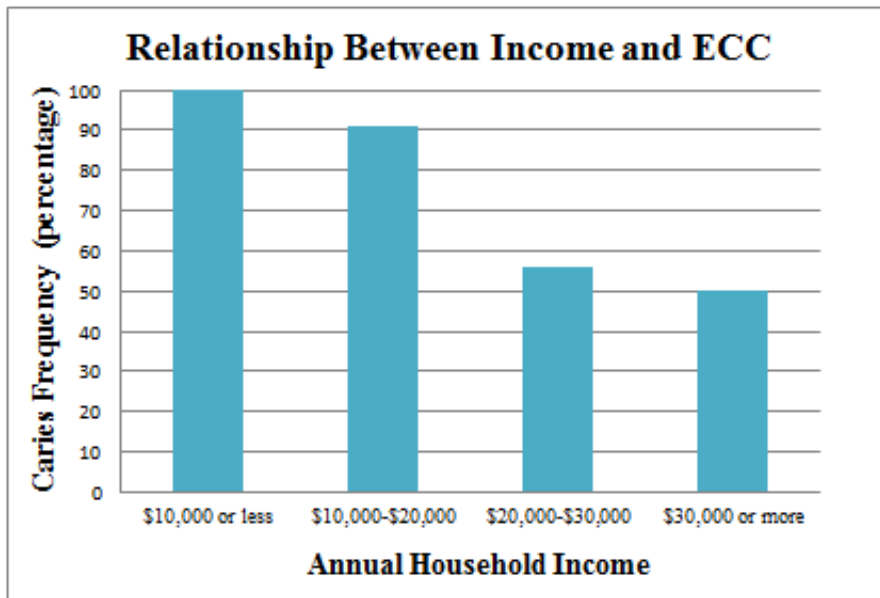


Figure 5. Relationship between income and ECC (Data adapted from Psoter et. al, 2006)

Diet

Poor diets, particularly those with high-sugar content, are well-known to play a significant role in the cause of dental caries in both children and adults. Palmer et al. (2010) provided a comprehensive overview of the relationship between diet and caries in children. The parents of 110 children were surveyed about their child's diet, and samples of plaque were taken from each child's mouth to detect colonization by *S. mutans* using Polymerase chain reaction (PCR) methods for genotyping bacteria (Palmer et al., 2010). The researchers compared each child's caries status with reported information about the beverages they had at meal time and in-between meals, types of food they consumed, and how often they ate.

The data indicated that children infected with ECC drank milk or juice with meals and juice between meals (Palmer et al., 2010). The majority of caries-free children drank water with meals, and both water and milk between meals (Palmer et al., 2010). It was

also reported that children with ECC ate many more times throughout the day than caries free children (Palmer et al., 2010). Sixty percent of children who ate four or less times per day were caries free, and 80% of the children who ate eight or more times were infected with caries (Palmer et al., 2010).

The likelihood of certain foods and beverages to cause caries is referred to as cariogenicity. In the second half of his study, Palmer et al. (2010) categorized common foods and beverages based on increasing cariogenicity (Table 2).

	Cariogenicity Category	Examples
1	Caries-protective	Cheese, nuts, xylitol
2	Non-cariogenic	Meat, fish, poultry, eggs, raw vegetables, oil
3	Low cariogenicity	Rice, pasta, milk, fresh fruit, yogurt
4	Liquids	Juice, ice cream, diet and regular soda
5	Solid/Retentive Food	Bread, crackers, jelly, cookies, hard candies

Table 2. Cariogenicity of foods (Data adapted form Palmer et al., 2010)

The frequency of consumption of foods in each of the cariogenicity categories was recorded for caries-free children and compared to children diagnosed with severe ECC. Researchers determined that there was no difference in consumption of caries protective, non-cariogenic, and low cariogenicity foods between the two groups. The following formula was used to calculate a “food cariogenicity score” for each group: $0(\text{frequency caries protective}) + 1(\text{frequency non-cariogenic}) + 2(\text{low cariogenicity}) + 3(\text{frequency liquids}) + 4(\text{frequency solid/retentive foods})$ (Palmer et al., 2010). It was reported that the cariogenicity of food and beverages consumed by children with severe caries was significantly higher than caries free children (Palmer et al., 2010). The report concluded that food frequency, food cariogenicity, and presence of *S. mutans* were associated with severe early childhood caries on both individual levels and when combined (Palmer et al., 2010).

Parental Influences

Parental Health

A number of dental researchers have reported direct associations between oral health status and oral health behaviors of parents and their children. This section will report on two particular studies, one by Dye et al. (2011) as well as an international perspective from Bozorgmehr et al. (2013) in Kerman, Iran. Both sets of researchers utilized data from the National Health and Nutrition Examination survey which was described in the first section of this literature review. Dye et al. (2011) performed multiple regression analyses using children as the dependent variable, and mother's caries status and tooth loss status as independent variables amongst other things. The analysis yielded the following odds ratios relating childhood caries to maternal dental health: children were three times more likely to have caries if their mothers reported high levels of untreated dental caries and were also 3.5 times more likely to have dental caries if their mothers reported high levels of tooth loss (Dye et al., 2011). Dye et al. (2011) concluded that "mother's oral health status is a strong predictor of the oral health status of their children".

Bozorgmehr et al. (2013) addressed the relationship between oral health behavior of parents and the oral health status of their children. Bozorgmehr et al. (2013) acknowledged that ties between parental and child oral health are widely accepted, but hoped to quantify this relationship in a more detailed manner. They also wanted to explore if global trends differed from what had been published in America. Some of the characteristics and behaviors the researchers believed would play an important role in the oral health of children include: education of mother and father, parental frequency of tooth brushing, parental consumption of sweet foods, parental dental visits in the last year, and parental history of dental problems (Bozorgmehr et al., 2013). In order to gain information, they designed a survey for parents to complete that would provide personal information regarding each of these characteristics. Quantitative data regarding the children's oral health was gathered during a clinical examination using three well known and widely accepted dental indices: the gingival inflammation, the plaque, and the decay, missing, filled teeth (dmft) indices (Bozorgmehr et al., 2013). The survey responses and

index measurements were then compared using a regression analysis (Bozorgmehr et al., 2013).

The most important findings were that a little over 73% of the children had moderate to medium inflammation of their gum tissue (gingiva), and just over 87% of them ranked medium or poor on the plaque index (Bozorgmehr et al., 2013). However, only a few relationships were found between the factors expected to influence childhood dental health and the presence of poor dental condition. The level of inflammation determined by the gingival index was not significantly related to any of the factors examined in the study. The degree of plaque present in the plaque index was correlated with the parent's education level and a history of dental problems in parents (Bozorgmehr et al., 2013). Finally, the dmft index score had a statistically significant relationship only with a parental history of dental problems (Bozorgmehr et al., 2013).

The team also analyzed health behaviors in children and parents. Two behavior patterns were reported to be significantly correlated. Frequency of tooth brushing in parents and children showed a significant relationship, and frequency of consumption of sweet foods in parents and children was also significantly associated (Bozorgmehr et al., 2013). Perhaps surprisingly, the frequency of dental visits was not significantly correlated between parents and their children (Bozorgmehr et al., 2013). The researchers hypothesized that this difference could be due to the common misconception among adults that primary teeth are not important (Bozorgmehr et al., 2013).

Bozorgmehr et al. (2013) concluded by acknowledging some of the possible limitations in their study. One such limitation was that the study was cross-sectional and thus not necessarily representative of the entire population. The sample size was also considered small, and with questionnaires there is always a risk of parental bias in responses. However, despite these potential errors in data analysis, the majority of their reported findings were in line with what the body of literature says regarding the relationship between parent and child oral health status and behaviors.

Parenting Style

There are four widely accepted and studied parenting styles: authoritarian, authoritative, permissive, and neglectful. Information was adapted from the California

Dental Association Journal into a tool to help visualize the difference between each of the categories (Figure 6) (Law, 2007). Authoritarian households are defined as being “high control” and “low warmth”, which often involves a lot of yelling, harsh punishments, and will likely lead to a child who has trouble trusting authority figures (Howenstein et al., 2015). Authoritative households are defined as “high control, high warmth” which is considered to be the most positive parenting style and involves a lot of bidirectional communication (Howenstein et al., 2015). Permissive parenting styles often involve few rules or responsibilities for the children are defined as “low control, high warmth”, while a neglectful style is defined as “low control, low warmth” and is considered to be the worst form of parenting (Howenstein et al., 2015).

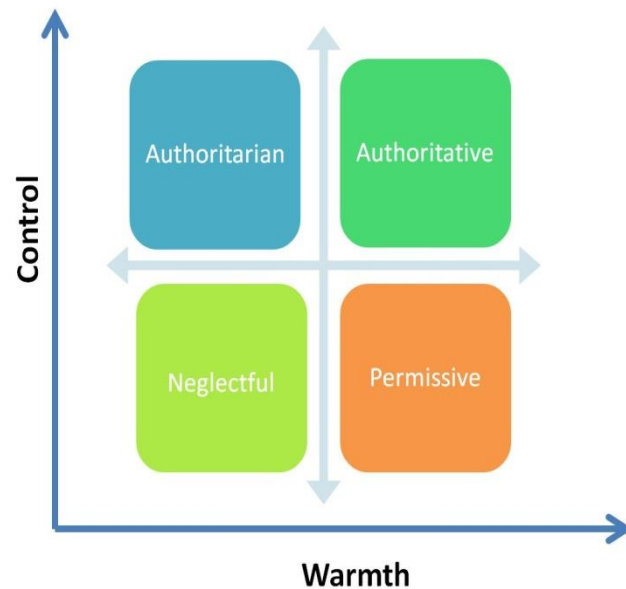


Figure 6. Parenting styles

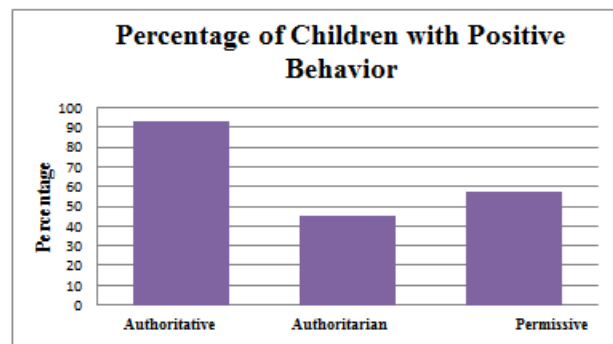
It is generally accepted that parenting styles can influence a child’s psychological and social development, academic performance, personality traits, and emotional health. More recently, research has been conducted to explore the influence of parenting styles on a child’s physical health. Goldschmidt et al. (2010) showed that childhood obesity is interestingly related to both authoritarian and permissive parenting styles. They reported that children from homes with less control have twice the risk of experiencing childhood obesity than those from homes with authoritative parenting styles (Goldschmidt et al., 2010). Childhood obesity often stems from high intake of sugary foods and an unbalanced diet and is considered a risk factor directly associated with ECC. Inspired by the study on obesity and parenting styles, dental professionals from the Ohio State University Dental School decided to explore the relationship between parenting style and ECC (Howenstein et al., 2015).

Howenstein et al. (2015) used three of these parenting styles to categorize their study participants. One category, neglectful parents often don't volunteer for research projects, and therefore were not included in the study. The parents involved in the study filled out a questionnaire known as the Parenting Styles and Dimensions Questionnaire (PSDQ) that was used to split themselves and their children into one of the three categories (authoritative, authoritarian, and permissive). The children were examined and categorized as "caries present" or "no caries present" by hygienists at the dental school. Children were also observed and evaluated based on their behavior at the dental appointment using the Frankl scale which involves simply placing them into positive or negative behavior groups (Howenstein et al., 2015).

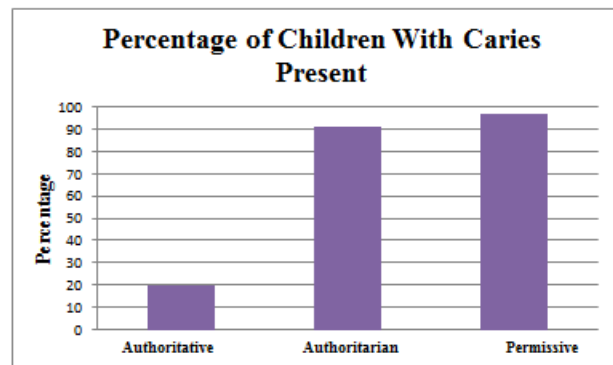
An analysis of the questionnaires and hygienists' observations provided interesting results (Figure 7, A and B). Children with authoritative parents had the most positive results, with 93% displaying positive behavior, and only 20% with caries present (Howenstein et al., 2015). Authoritarian parenting styles yielded 45% positive behavior and 91% with caries present, and 57% of permissive parents had children with positive behavior but 97% of them had caries present (Howenstein et al., 2015).

In response to Goldschmidt et al.'s report, de Johng-Lenters et al. (2014) pointed out the potential for bias

and error associated with using questionnaires such as the PSDQ used by Howenstein et al.. It can be difficult for people to perform an accurate self-reflection when filling out questionnaires, and sometimes participants will even alter their answers to make themselves look better. To avoid this type of bias, the dentists and psychologists involved



(A)



(B)

Figure 7. (A) Parenting styles and positive behavior (B) Parenting styles and active caries (Data adapted from Howenstein et al., 2015)

observed the parenting styles their participants displayed while completing assigned tasks with their children (de Jong-Lenters et al., 2014). Parents were monitored for encouragement, positive interaction, coercion, discipline, and interpersonal atmosphere while they worked with their children to draw a picture of their house, plan a fun activity for the weekend, solve a problem, and perform other similar tasks (de Jong-Lenters et al., 2014).

The children were then assigned to two groups: “cases” were children with dental caries and “controls” were caries free children. Both groups were assessed to see which types of parental interactions were most common during the team activities. Parents of children classified as controls had significantly higher scores in encouragement, positive interaction, problem solving, and interpersonal atmosphere than parents of children classified as cases (de Jong-Lenters et al., 2014). After the initial observations, parental education level, frequency of tooth brushing, and frequency of consuming sugary foods were accounted for and the scores were adjusted accordingly. It was reported that after adjusting scores, parenting style and positive parent- child interactions such as encouragement, problem solving, and interpersonal atmosphere still had a statistically significant effect on the reduced presence of dental caries in children (de Jong-Lenters et al., 2014).

However, a parent’s relationship with their child and family environment is defined by much more than the “warmth-control” standards used to categorize the participants in these two studies. There are a wide range of parental actions and emotions that influence their children beyond just the amount of warmth and control they show. Dental professionals are beginning to pay more attention to the role that parental locus of control and stress play in pediatric dental health, which will be discussed in the following section.

Other Parental Influences

Locus of control (LoC) is the degree to which an individual’s behavior is influenced by their ability to control events (Lenčová, Pikhart, Broukal, & Tsakos, 2008). A person who adopts a belief in an external locus of control experiences the outcome of events in their life as being controlled by luck, fate or chance. A person who adopts an

internal locus of control considers that the outcomes of events in their life are controlled by their own actions. A European study utilized a questionnaire to determine the LoC of their participants followed by a linear regression analysis to compare LoC to caries presence in children. It was reported that a linear relationship between increased parental internal locus of control and probability of their children to be caries-free (Lenčová et al., 2008).

Parental stress has proven more difficult for dental researchers to study than some of the previously described topics because of the variety of stressors and their intensity to consider. However, one study reported that a parent's self-reported increased experience of general life stressors does have an inverse relationship with their child's oral health (Jabbarifar, Ahmady, Sahafian, Samei, & Soheillipour, 2009). This study also claimed that "30% of parents in a stressful family environment show low engagement in their child's oral health" (Jabbarifar et al., 2009). At the conclusion of the article, the authors emphasized the need for a longitudinal study related to parental stress and its effect on the presence of caries in children in order to track long-term results.

Child Behavior

A child's behavior can influence his or her health and well-being in a variety of ways. In addition to the nature of how a child and parent interact with each other, aspects of a child's behavior can affect the ability of a medical professional to interact with them and provide treatment. Williamson et al. (2008) were the first to use the Child Behavior Checklist (CBC) to look for relationships with dental caries in children. The CBC is a widely used questionnaire (completed by parents) that is 100 questions long regarding different behaviors displayed by their children. Children participating in this study were selected from the Nationwide Children's Hospital as well as two private practices in Ohio. The children were placed into one of two categories: caries free or caries active (Williamson et al., 2008). Results from the CBC completed by each of the children's parents were used to determine if there was a relationship between having active caries and certain child behaviors. The list of subcategories that Williamson et al. (2008) focused on included emotional reactivity, anxiety/depression, physical complaints, being withdrawn, total internalization, sleep problems, attention problems, aggressive behavior,

pervasive developmental problems, hyperactivity problems, oppositional defiant problems, and total problems. Children who were caries free scored lower in each of these subcategories (Williamson et al., 2008). The only associations that were reported as statistically significant included being caries free and scoring low on anxiety/depression, total internalizing, sleep problems, aggressive behavior, and attention deficit (Williamson et al., 2008).

Spitz et al. (2006) performed a similar study, but focused primarily on the way child behavior influences how a parent acts. In the review of the literature, Spitz et al. (2006) quoted an article which reported that “children behave similarly with their mothers regardless of whether the mother has classified her child as “difficult” or “easy”. Instead, it is the mother who showed behavioral differences as a function of how she classified her child”. Using this statement as inspiration, Spitz et al. (2006) completed a study of their own with the purpose of determining if there is a relationship between a mother’s perception of her child’s temperament and risk factors for ECC. Medical records were obtained from the Iowa Public Health Department for 629 children ages 0-5 years old (Spitz et al., 2006). Mothers of these children were also asked to classify their children as calm, fussy, crying, demanding, stubborn or other. Calm children were categorized as “easy”, and all other groups were categorized as “difficult” for the purpose of her study (Spitz et al., 2006).

The following relationships were reported: male children were more likely to be classified as “difficult” than female children; difficult children were more likely to be bottle fed while being put to sleep at night; “difficult” children were more likely to have their teeth brushed once a day, while “easy” children were more likely to have their teeth brushed twice a day (Spitz et al., 2006). Lastly, Spitz et al. (2006) reported that “difficult” children were more likely to have numerous dental lesions, and at an earlier age than “easy” children.

These findings cannot be considered completely conclusive because the classifications are totally subjective and just based on what each mother individually experiences with their child. However, this can still provide very good insight on the importance of parental perceptions, whether or not they are accurate. The findings from these two studies have shown that regardless of whether or not a child actually has

attention deficit issues, or is stubborn and demanding, or if their parent just feels that way, it can have a large impact on the type of oral health care and treatment they receive.

2.3 Long Term Implications

ECC has immediate consequences including pain, swelling, difficulty chewing, speech problems, and decreased self-esteem. In addition to these issues, ECC has a number of severe long-term implications, several of which can become permanent. One of the main purposes of primary teeth is to be a placeholder for the permanent teeth that grow in behind them. If a child loses any of his or her primary teeth prematurely due to ECC, the other teeth will shift, which results in a loss of space for the adult teeth to grow in when they are ready. This problem often requires extensive orthodontic treatment and can be expensive and painful (California Dental Association, n.d.). Other medical conditions that can result from untreated ECC are tooth loss, bone loss in the jaw, periodontal disease, cellulitis of the face, and development of painful abscesses (California Dental Association, n.d.).

2.4 Treatment

Typically, whether or not a child receives treatment for active dental caries depends on a combination of what their dentist recommends and what their parents deem necessary. One study utilized a questionnaire to examine parental preferences for their child's dental treatment in a variety of scenarios. It was reported that in all scenarios the majority of parents were willing to leave the final decision about treatment up to the dentist (Tickle et al., 2003). Interestingly, only 6% of parents wished to have teeth treated in scenarios where a child had active carious lesions, but no pain or other symptoms (Tickle et al., 2003). Also, parents of children who had previously received dental treatment such as fillings or extractions were more likely to desire restorative care for their children in all scenarios (Tickle et al., 2003). It was noted that there was no relationship between parental perception of their child's dental anxiety and whether or not the parent wished for the caries to be treated (Tickle et al., 2003).

Treatment for ECC often requires the use of general anesthesia due to the limited ability of young children to hold still for long periods of time and cooperate or communicate with a dentist who is working with them. The cost of undergoing dental treatment with general anesthesia can be between \$2,000 and \$4,700, depending on the facilities used and the extent of the decay (Denbesten et al., 2003). Unfortunately, an expensive one-time treatment of ECC is rarely ever the case. Denbesten et al. (2003) reported that 4-6 months after receiving treatment for ECC under general anesthesia, 53% of children had new carious lesions. A similar study completed in Boston reported that 45% of children who had received ECC treatment had developed new lesions after 12 months (Denbesten et al., 2003).

Professionals emphasize that clinical treatment after ECC has developed should not be the answer to this problem. Instead, preventative measures, and continued post-treatment care are necessary steps to truly curing a child of this disease. Preventative measures such as reducing the amount of sugars in the child's diet, and making a habit of daily brushing and flossing are absolutely essential. It has also been suggested that a mother's chewing of xylitol mints and gum in the child's first few years of life can reduce the transmissibility of *S. mutans* (Denbesten et al., 2003). Currently the only post-treatment antimicrobial agent available that is both safe for pediatric use and successful in minimizing oral *S. mutans* reservoirs is a topical iodine treatment (Denbesten et al., 2003). It has been suggested that professionals in the field should put effort into creating similar formulas for increased long-term use in children with ECC.

3. Summary of the Literature Review

A modified version of the concept map from the literature review shows all of the influencing factors that can play a role in the development and progression of ECC (Figure 8). ECC is a chronic, infectious childhood disease that is caused primarily by transmission of a

bacterial species known as *S. mutans*.

Consequences of ECC include pain, difficulty chewing or speaking, and decreased self-esteem. If left

untreated, carious primary teeth can cause spacing issues for

permanent teeth, bone loss, and periodontal disease. Treatment for ECC often involves general anesthesia and is very costly. It is recommended that along with immediate treatment of active caries, preventative measures are taken to ensure a child does not develop more carious lesions post-treatment.

Studies have indicated that diets with high sugar content, belonging to a minority ethnic group or low socioeconomic status all put children at higher risk for developing ECC. Levels of *S. mutans* present in a mother's mouth can be a predictor of a child's oral health. Parenting style and locus of control have also been reported to influence the oral health of children; authoritative parenting styles and an internal locus of control are positive influences on dental health in children. More research needs to be done in many of these areas before significant conclusions can be drawn.

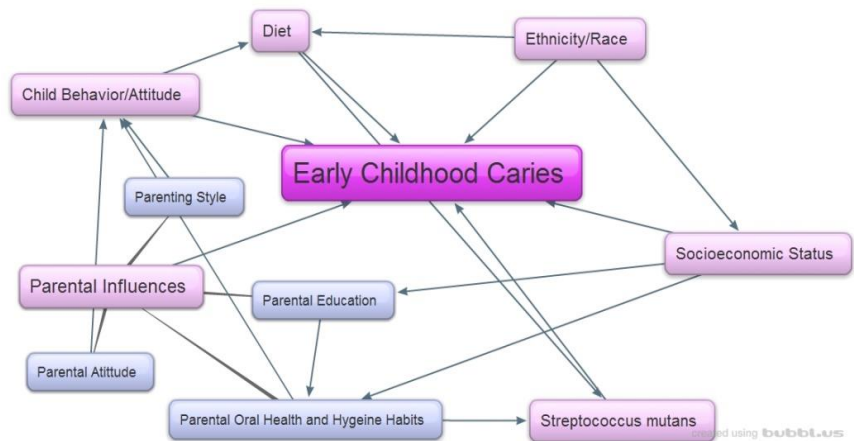


Figure 8. Concept map of influences on ECC examined in literature review

4. Research Questions

1. How does parent's oral health status, value of their own oral health, and oral hygiene habits affect the prevalence of decay/cavities in their child?
2. How does parenting style and parental locus of control (perceived and actual) affect the prevalence of decay/cavities in their child?
3. Does parental belief or disbelief that "primary teeth don't matter because they will fall out anyway" influence the prevalence of decay/cavities in children?
4. How does parental (perceived or actual) knowledge about the importance and value of primary teeth influence the prevalence of decay/cavities in a child's mouth?
5. Are children with cavities/ who have received dental treatment more curious or educated about their teeth and oral health than children who are caries free?

5. Limitations of the Study

The return rate for the survey questionnaire was much lower than expected, and thus the resulting sample size was too small to draw any significant conclusions about larger populations such as the Corvallis community or parents in general. Also, due to the nature of this project it was not possible to obtain dental records for the children and their parents that participated in the study. The data reported in the study is based entirely on parent's perception of their child's oral health and their opinion on the other questions included in the survey. Other possible limitations include social-desirability response bias, misinterpretation or misunderstanding of the survey questions, and a sample that is not truly representative of the target population. Each of these limitations will be described in further detail in section 8. The observations from this sample are reported on in a qualitative manner, allowing this survey sample to be treated as a "pilot study", and follow up research to be proposed based on insights gained from the review of the literature.

6. Methods and Materials

Survey

A brief survey questionnaire was designed to collect data for this project. The questionnaire included ten questions that were designed to identify parental beliefs and perspectives about their own and their child's oral health (see Appendix A). The survey was translated into Spanish by Ana Warren (an Oregon State University instructor) so that as many parent-child subjects as possible could participate. Copies of both the English and Spanish versions of the survey and consent forms can be found in Appendix A. The survey questionnaire was approved by the Oregon State University Institutional Review Board (IRB #7262), via the exempt review process (see Appendix B and C).

Location

The Johnson Dental Clinic served as the site of survey distribution and is located inside the Boys and Girls Club of Corvallis building in Northwest Corvallis, Oregon. It is a pediatric dental clinic serving children ages 0-18 years old, and pregnant mothers. Dr. Kenneth Johnson, a retired local dentist, had the idea of opening a clinic in the Boys and Girls Club of Corvallis, and his idea became a reality on February 28th, 2008 when the clinic opened. The clinic serves children in the Corvallis community who qualify for free lunch from school, and/or are insured through the Oregon Health Plan ("Johnson Dental Clinic | Boys & Girls Club of Corvallis," n.d.). The services provided by the clinic include dental exams, cleanings, sealants, restorative treatment, x-rays, preventative care, and extractions. The Johnson Dental Clinic is partnered closely with Benton County Health Department to contract dental assistants, hygienists, dentists, and materials to keep the clinic running and meet the high demands of the community. It also receives donations of money and supplies, as well as volunteer help from many members of the community. This clinic was chosen as the site of the study because I was a volunteer intern for the clinic from 2013-2016 and very familiar with Dr. Johnson and the employees who operate the clinic. It is a great location for a survey regarding ECC because the clinic serves many young children who require both preventative and

restorative care, and the results would represent a parental population that may not often be surveyed for their opinions on dental health.

Study Sample

The survey participants were all parents (or other caregivers) of juvenile patients at the Johnson Dental Clinic. Although patients and their parents at this clinic can come from a variety of ethnic backgrounds and speak an assortment of languages, only English or Spanish speaking parents completed the surveys. The clinic coordinator was provided with guidelines (see Appendix B) for verbally recruiting parents who visited the clinic from March 2nd, 2016 to April 26th, 2016. If a parent or caregiver wished to participate, they were handed a consent form and survey questionnaire to complete. Participants completed the questionnaire while their child received dental treatment at the clinic. All participation in this study was voluntary, and no incentives were provided.

Data Collection

As questionnaires were completed, the clinic coordinator filed them into envelopes until I could pick them up from the clinic. The surveys were collected once a week for eight weeks. After eight weeks all of the unused questionnaires and the envelopes with completed questionnaires were collected by the investigator from the Johnson Dental Clinic. The completed surveys and consent forms will be stored in sealed envelopes in Dr. Indira Rajagopal's office at Oregon State University until 2019, per IRB policy.

Data Analysis

The data from the surveys were tallied and organized from the surveys using a Microsoft Excel Spreadsheet (see Appendix D). Survey questions were designed with four possible categorical answers that each corresponded to a number (1-4). A score of one indicated the most positive answer choice, while a score of four indicated less positive answer choices. For example, the first question had four options to choose from: well above average, average, below average, well below average. In this scenario, well

above average=1, average=2, below average=3, and well below average=4. The scores for each of the ten questions were recorded in the spreadsheet.

The total number of surveys collected was 25, which was many fewer than I had anticipated. Because the sample size was so small, no statistical tests for association could be performed. For each question, the mean of the scores and the standard error of means (SEM)s were calculated using Minitab statistical software (version 17; Minitab Inc., State College, Pennsylvania). The distributions of the scores for each question were displayed as a percentage of respondents using the English or the Spanish survey who chose answers 1-4 using stacked column graphs created in Microsoft Excel.

7. Results

7.1 Research Question 1

How does parent's oral health status, value of their own oral health, and oral hygiene habits affect the prevalence of decay/cavities in their child?

The first four questions of the survey were designed to provide data on the relationships listed in this research question. The first survey question (see appendix A) was intended to measure the parent's perception of oral health status of children. Comparing the average responses to this question to each of the other survey questions would show if there is or is not a relationship between child's oral health status and various parental influences. The majority of the respondents reported that their child had "average" oral health (score of 2). The average response for this survey question (2.48) fell between "average" and "below average" (Figure 9, A). Interestingly, 36% of the respondents reported their child as having "below average" or "well below average" oral health. It is also interesting that 67% of the respondents who chose either "below average" or "well below average" completed the survey in Spanish.

The second survey question (see appendix A) was intended to measure the perceived oral health status of parents. Again, the majority of respondents reported that they had "average" oral health (score of 2). The average response (2.67) was similar to the average response for survey question 1 (Figure 9, B). Fifty percent of parents reported themselves in the bottom two categories. Similar to the responses to question 1, the majority of respondents reporting their oral health in the lowest category speak Spanish as their primary language. In the responses to questions 1 and 2, relatively few parents reported that their own or child's oral health was well above average.

The third survey question (see appendix A) was intended to measure to what extent parents value their oral health. The majority of respondents reported that they valued oral health "somewhat" (score of 2). The average response (2.00) corresponds directly with the "somewhat" category (Figure 9, C). No participants chose the "not at all" option, indicating that all of the people in this study value oral health to at least some degree, regardless of how they ranked themselves or their children in questions 1 and 2.

Unlike response for survey questions 1 and 2, the distribution of English and Spanish scores across the four categories is fairly consistent.

The fourth survey question (see appendix A) was intended to measure how strictly parents follow a tooth brushing and flossing routine. The majority of respondents chose “not strictly” (score of 3). The average response for this survey question (2.60) was between “somewhat strictly” and “not strictly” (Figure 9, D). Similar to the response for survey questions 1 and 2, the majority of responses in the fourth category were chosen by participants completing the Spanish version of the survey.

In summary, the majority of parents who completed the survey reported both their own and their child’s oral health as average, although responses were distributed across all four categories (Figure 9, A and B). All respondents valued oral health to at least some degree, with the majority selecting that they valued it “somewhat” (Figure 9, C). The majority of respondents reported that they did not strictly follow a brushing and flossing oral hygiene routine (Figure 9, D).

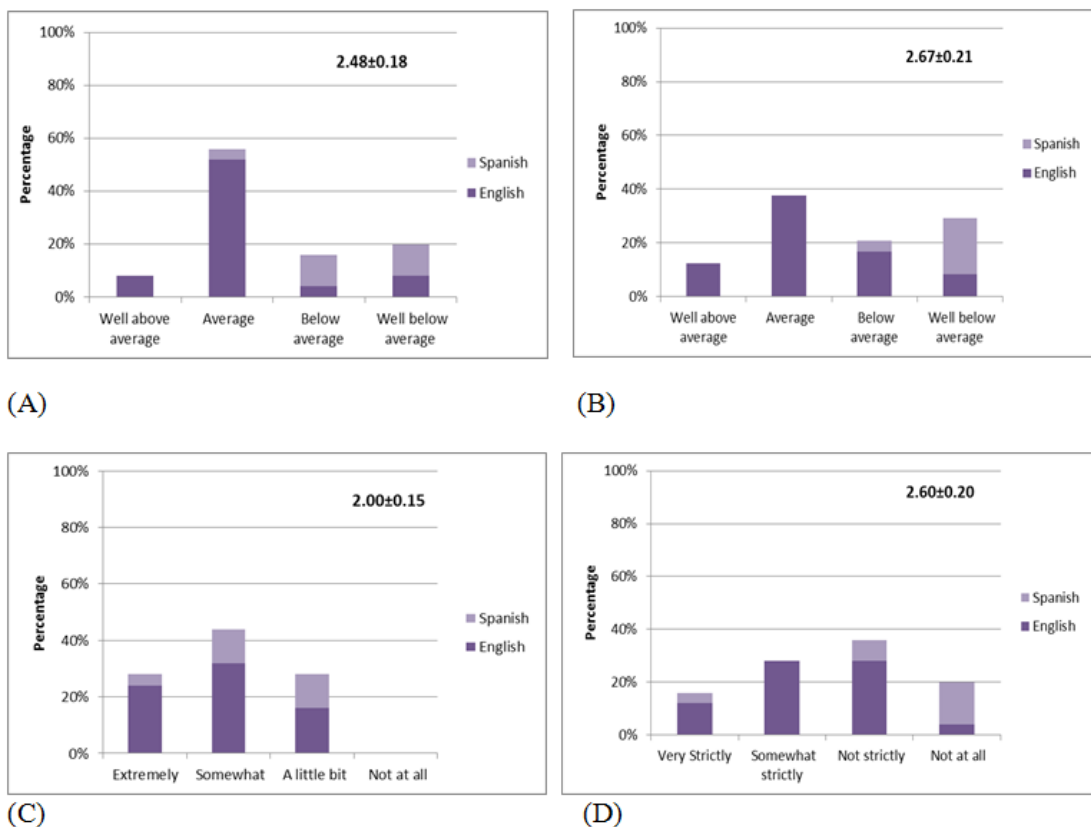


Figure 9. Distribution of responses for: (A) Parental perception of child’s oral health. (B) Parental perception of their own oral health. (C) Extent to which parents value oral health. (D) Parent reported oral hygiene routine.

7.2 Research Question 2

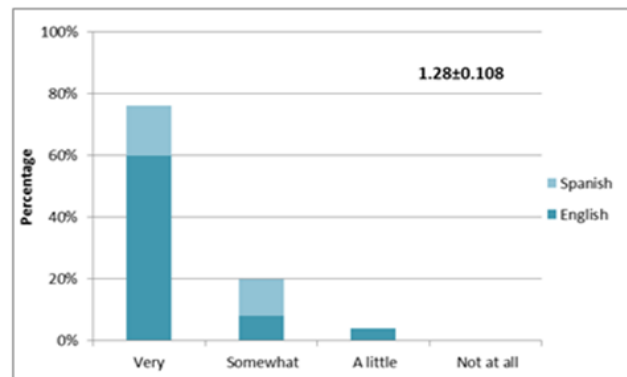
How does parenting style and parental locus of control (perceived and actual) affect the prevalence of decay/cavities in their child?

The first, fifth, and sixth questions of the survey were designed to provide data on this relationship. The results of the first survey question were summarized in section 5.1.

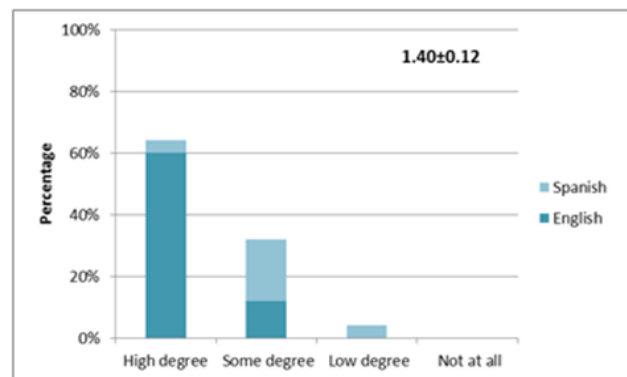
The fifth survey question (see appendix A) was intended to measure how involved parents believe they should be in the oral health status of their children. A large majority (76%) of respondents reported that they believed parents should be very involved in their child's oral health, with 20% believing they should be somewhat involved. The average response for this survey question (1.28) was between "very" and "somewhat" involved (Figure 10, A). No parents believed that they shouldn't be involved at all in their child's oral health. There was no outstanding difference in the distribution of English vs. Spanish responses.

The sixth survey question (see appendix A) was intended to measure to what degree parents

believe their involvement affects the quality of their child's dental health status. With a distribution similar to survey question 5, 64% percent of parents believed that their involvement affects their child's oral health to a high degree, and 34% of parents believing their involvement affects it to some degree. The average score of responses for



(A)



(B)

Figure 10. Distribution of responses for: (A) Parental opinion on the importance of involvement in child's oral health. (B) Parental perceived impact of involvement in child's oral health.

this survey question (1.40) was between “high degree” and “some degree” (Figure 10, B). No parents believed that their involvement has no effect on their child’s oral health. The majority of Spanish-speaking respondents believed that their involvement affects their child’s oral health to “some” degree or to a “low” degree.

In summary, the majority of parents in this sample believed that they should be very involved in the oral health of their child, and that this involvement influences their child’s oral health to a high degree. All participants believed that they should be involved to at least a low degree, and that it influences their child’s health to at least a low degree. There were no obvious differences in distribution between respondents who completed the English and Spanish versions of the survey.

7.3 Research Question 3

Does parental belief or disbelief that “primary teeth don’t matter because they will fall out anyway” influence the prevalence of decay/cavities in children?

The first and seventh questions of the survey were designed to provide insight on this relationship. The results of the first survey question were summarized in section 5.1. The seventh survey question asked parents to choose True or False in regards to the following statement: children’s primary teeth don’t matter because they will fall out anyway. Sixty percent of respondents chose false, while the remaining 40% chose true. Six out of the seven Spanish-speaking respondents chose to answer “true” (Figure 11).

In summary, there was no obvious preference for one choice or the other as there have been in the previously described survey questions. It is not clear from these data whether or not parents, on average, understand the importance of primary teeth.

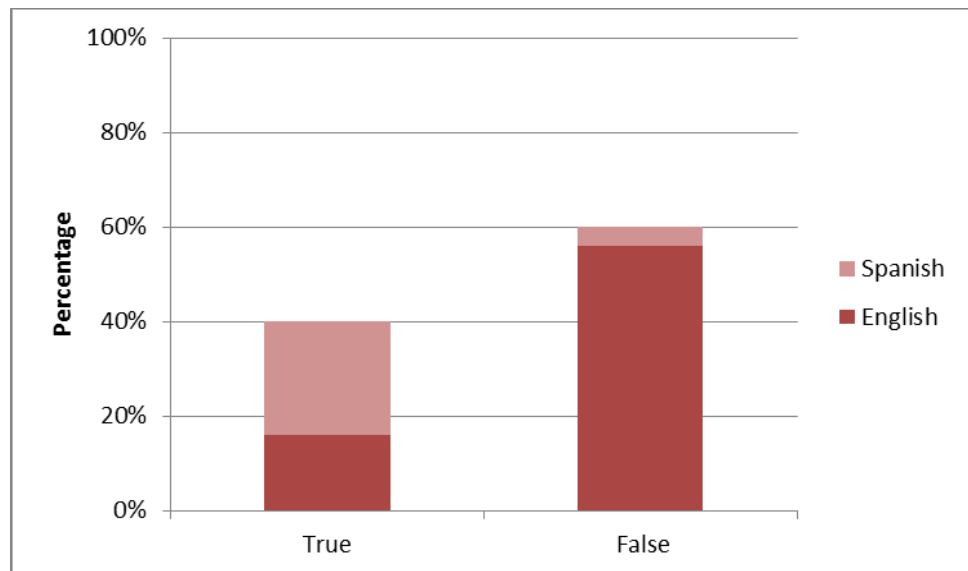


Figure 11. Distribution of responses to the statement “T/F primary teeth don’t matter because they fall out anyway.”

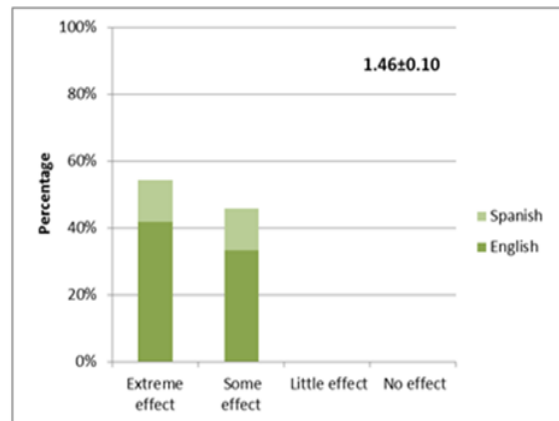
7.4 Research Question 4

How does parental (perceived or actual) knowledge about the importance and value of primary teeth influence the prevalence of decay/cavities in a child's mouth?

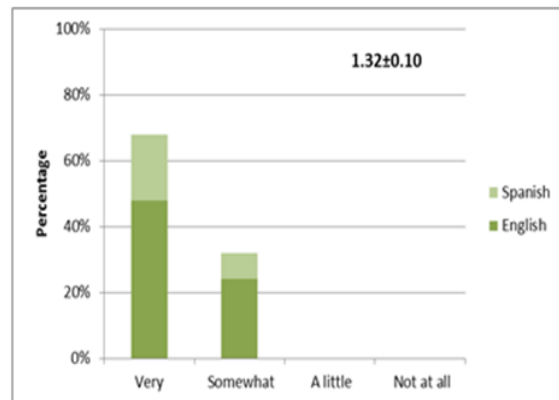
The first, eighth, and ninth questions of the survey were designed to help answer were designed to provide data on this relationship. The results of the first survey question were summarized in section 5.1. The eighth survey question (see appendix A) was intended to measure how strong of an effect parents believe their understanding of the value of primary teeth affects their child's oral health. All of the respondents chose that their understanding has either an "extreme" or "some" effect, with the average score of all responses being 1.46 (Figure 12, A). The distribution of responses between these two categories was fairly even, and there was no obvious difference in the distribution of English vs. Spanish responses.

The ninth survey question (see appendix A) was intended to measure whether or not parents feel they would benefit from an educational program regarding oral health in children. The majority of respondents (68%)

reported that an educational program would be "very" valuable; with the remainder choosing that it would be "somewhat" valuable. The average score for all responses (1.32) was between these two options (Figure 12, B). No respondents chose that an



(A)



(B)

Figure 12. Distribution of responses for: (A) Parental understanding of how their own knowledge about primary teeth affects their child's oral health. (B) Parental opinion of how valuable an educational program about childhood oral health would be.

educational program would be only a little bit or not valuable at all. There was no significant observation made regarding the distribution of English vs. Spanish responses for this survey question.

In summary, parents reported that they believed their understanding of the value of primary teeth does have an influence on their child's oral health, and that they would value an educational program about their child's oral health. This was the consensus for all respondents, for both versions of the survey.

7.5 Research Question 5

Are children with cavities/who have received dental treatment more curious or educated about their teeth and oral health than children who are caries free?

The tenth question of the survey was designed to examine this idea. The tenth survey question (see appendix A) was intended to measure to what extent having dental treatment increases kid's curiosity about their oral health. The majority (64%) of respondents reported that they believed that receiving dental treatment increases a child's curiosity about his or her oral health to a great extent, with the remainder believing that it increases it to some extent. The average score of responses for this survey question was 1.36, which falls between "a great extent" and "no extent" (Figure 13). No respondents chose that it increases it to "a little extent" or "no extent". There is no obvious difference in the distribution of English vs. Spanish responses for this survey question.

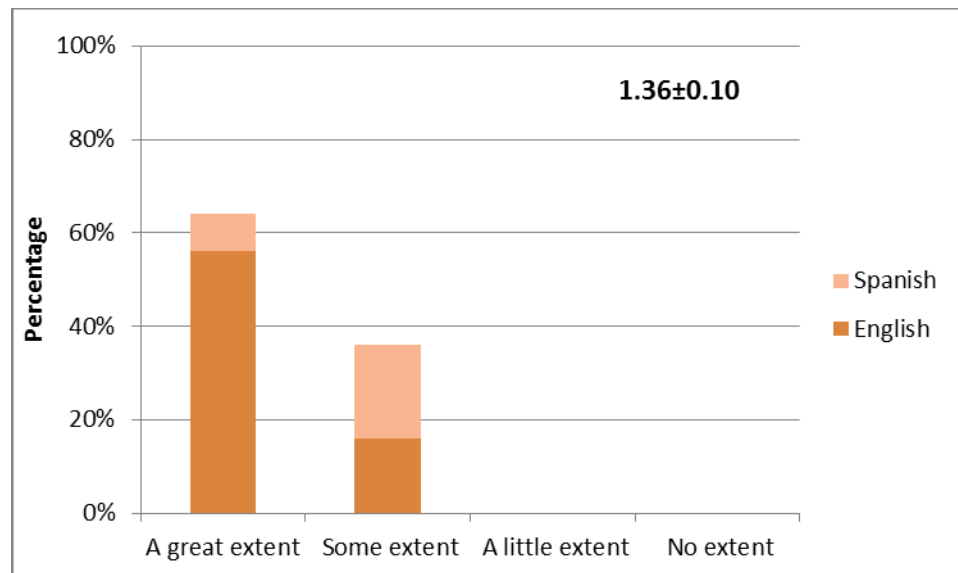


Figure 13. Distribution of parental response to what extent a child's curiosity increases after receiving dental treatment.

8. Discussion

Despite the limitations of the study previously described, the data provided interesting insights to parental values and beliefs in the group of participants surveyed.

The perception about the oral health of children and parents participating in the study was distributed among all four categories of possible responses, indicating that the parents were likely being honest in their responses. Many of the averages of responses and parental majorities described in the results section were “middle of the road” choices. One possible explanation for this pattern is a social-desirability response bias. Often, with self-response questionnaires it is common for respondents to choose answers that may be considered more socially acceptable than answers that would be honest (Furnham, 1986). This survey asked questions about a topic that could be considered sensitive for some people, and thus has a potential for self-response bias, which could explain the mostly neutral response averages.

The goal of the survey questionnaire was to gain local parental perspectives about several of the topics covered in the literature review. The various factors that influence the development of ECC,

and their relationship to each other were displayed in Figure 7. A modified version of this concept map (Figure 14), displays the select factors that were examined by the survey questionnaire. Interesting observations were made in each of these categories, and are discussed in each of the sections below.

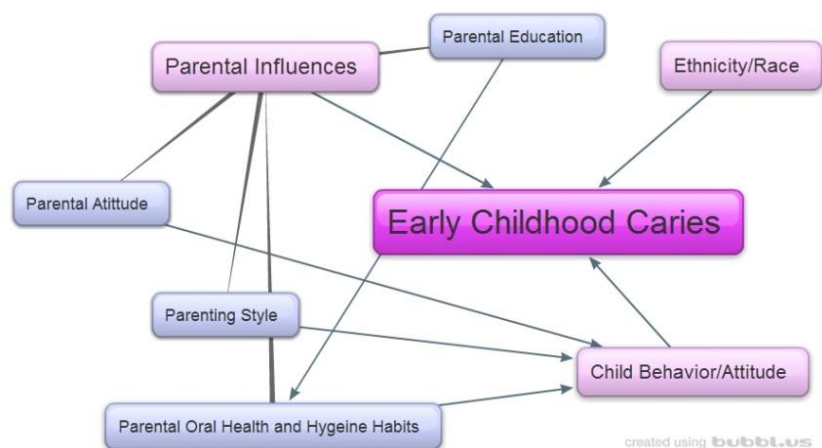


Figure 14. Influences on ECC discussed for the survey questionnaire.

Ethnicity/ Race

Although parents completing the survey were given the option to complete it in either English or Spanish, I was not expecting to find any noticeable differences in the responses between the two versions. As was previously described in the results section, there were a few questions with very obvious distributional differences between English and Spanish speaking respondents. The majority of Spanish-speaking respondents in this sample rated their own and their child's oral health in the bottom two categories. Also, all but one of the Spanish-speaking respondents answered "true" on survey question 7, indicating that they believed primary teeth don't matter since they will fall out anyway. The remainder of the survey questions did not present any major differences between English and Spanish responses. It is possible that the differences in responses for questions 1, 2 and 7 were due to some misinterpretation of the question that occurred in the process of translating the questionnaire document from English to Spanish, or different cultural expectations for what "average" means. However, a review of the literature also indicated that there may be a correlation between ethnicity/race and ECC. Psoter et al. reported that children from Hispanic families are 1.87 times more likely to have ECC than children from Caucasian families (Psoter et al., 2006). The survey responses were consistent with this study, by showing that children from Hispanic families were the most likely to have their oral health rated "below and well below average" by their parents.

Parent's Oral Health and Hygiene Habits

The average responses for survey questions 1 and 2 showed that this sample of parents rated their own oral health very similarly to how they rated their child's. The review of the literature indicated that there may be some relationship between the oral health of children and their parents and caregivers. The American academy of Pediatric Dentistry (2012) reported that mothers with the highest levels of *S. mutans* and active caries in their mouths were at the highest risk of transmitting this bacterial strain to their children. Alves et al. (2008) attempted to determine the relationship between parent and child oral health by tracking genotypes of *S. mutans* and determining where children were

contracting the bacteria from, however no significant conclusions could be drawn. While it is interesting to study the relationship of parent and child oral health statuses, it is worth considering that where/how children contract *S. mutans* and other caries-causing bacterial strains is perhaps less important than at what age this happens and finding ways to prevent it.

One interesting observation from the survey questionnaire was that no matter how highly or poorly the respondents ranked their oral health status, they all reported that they valued oral health to at least some degree. This could be partially explained by the fact that parents who completed the survey were already at a dental clinic, making an effort to have their child receive some level of care. Regardless of whether or not this opinion is representative of the entire Corvallis community, it is a positive observation that indicates that if these parents were given the right tools they would likely do what they could to improve their own and their child's oral health.

The fourth survey question, regarding oral hygiene routines, indicated that the majority of the respondents do not follow an oral hygiene routine strictly, or even at all. The distribution of the scores for this question that was described in the results section is highly concerning. One possible explanation for this response is misinterpretation of the question. It is possible that people interpreted the question to mean if you don't do *both* brushing *and* flossing every single day then your daily routine doesn't exist at all. Many people neglect to floss on a daily basis, but still brush their teeth twice a day and thus have an oral hygiene routine. If this study were to be repeated, this question should be reworded to more clearly display the respondent's true oral hygiene routines. Related to this survey question, the review of the literature included a report which indicated frequency of tooth brushing in parents and frequency of tooth brushing in children was statistically significant ($p=0.05$) (Bozorgmehr et al., 2013). Although the author reported this relationship to be significant, this should be accepted with caution. Usually a p-value can only be considered significant if it is less than 0.001 and only under very specific conditions (Colquhoun, 2014). The inconclusive survey results, and the ambiguous results of Bozorgmehr et al.'s (2013) report show that more research should be done in order to determine the relationship between parental and child oral hygiene habits.

Parenting Style

Similar to the value placed on oral health, survey questions 5 and 6 showed that regardless of how parents ranked their own and their child's oral health, the majority of parents believed they should be very involved in their child's oral health and that being involved affects their child's health to a high degree. It makes sense that the averages and score distributions for questions 5 and 6 were very similar, because if a parent feels strongly that they should be involved in the oral health of their children, then they likely believe that there is some positive effect of that involvement (or negative effect of neglecting to be involved).

The fifth survey question was intended to provide insight on parenting style with relation to a child's oral health. The parenting styles described in the review of the literature included authoritarian, authoritative, permissive, and neglectful. Each of the four survey questions can be thought of as corresponding to one of these four parenting styles (1=authoritarian, 2=authoritative, etc.). According to the results from this sample, the majority of parents would be considered authoritarian, a few authoritative, even less permissive, and none neglectful. This is likely not an accurate representation of the actual parenting style of the parents in this sample because parents may treat their involvement with health-related issues differently than they would their involvement in their child's school, friends, chores, hobbies, and so on. It is hard to draw any conclusions about parenting style and oral health in children based on the survey questions. However, the literature review indicated that parents who use authoritative parenting styles tend to have children with fewer dental caries, and more positive behavior.

The sixth survey question is closely related to the concept of parental locus of control that was examined in the review of the literature. Parents with an internal locus of control believe they control events by their own actions. Lenčová et al. (2008) described a significant linear relationship between internal locus of control in parents and probability of their child to be caries-free. All of the parents in this sample displayed an internal locus of control to at least some degree by responding that they believed that their actions (involvement in their child's oral health) have an effect on what happens with their child's health.

Parental Education

The second half of the survey focused primarily on the value of primary teeth and approached this topic from a few different angles. Survey question 7 intended to get an idea of how many parents believed that primary teeth matter regardless of the fact that they eventually fall out. The responses showed an interesting split, described in the results section. I was surprised by the number of people who chose “true”, indicating that they believed primary teeth do not matter, although this could be due to possible misinterpretation of the question. If in fact 40% of people believe that primary teeth don’t matter because they will fall out anyway, that would pose a significant problem for trying to reduce the ECC problem in our society. As the review of the literature mentioned, primary teeth serve many important functions including chewing, speaking, and most importantly creating proper spacing for permanent teeth that will come in behind them. If parents do not understand the value of these functions, they are less likely to take the appropriate preventative and restorative treatment steps necessary to ensure healthy primary teeth for their children.

Interestingly, regardless of whether or not parents believed that primary teeth have value, all of the parents believed that their knowledge about primary teeth affects their child’s oral health. These responses display a similar pattern to each of the previously described survey questions- parents may not have the best oral health, or understand the value of primary teeth, but they acknowledge that understanding these things and being involved does matter.

Responses to survey question 9 indicated that parents in this sample were very eager to learn more about the value of primary teeth, and would appreciate access to an educational program about childhood oral health. One comment that was left on one of the surveys was related to this idea, and read: “a timeline would be helpful for new parents regarding when to take baby into the dentist for the first time”. An educational program for parents that would inform them of things like when to take the baby in for their first visit with a dentist, the effects of being put to sleep with a bottle, and *S. mutans* and its transmissibility is something that many people would likely find valuable and helpful. The observations from this sample indicated that if parents were provided with

this type of information in some sort of formal manner, it could potentially have an impact on the oral health of children in the Corvallis Community.

Child Behavior/ Attitude

The last research question was chosen because a review of the literature showed that very little research has been completed focusing on children's curiosity about their own teeth and oral health. The survey responses indicated that parents in this sample believed that receiving dental treatment does in fact increase a child's curiosity about their teeth and oral health. This is an important area to research because it can influence how educational and preventative programs are designed. Some ideas for future studies aiming to answer this research question include asking questions about the age at which children become curious about their teeth, the types of questions they ask their parents, if visual or tactile activities are more helpful for learning about the importance of dental care, and if educational information is best received from parental figures or health care professionals. Getting children interested in their own health and excited to learn about the importance of caring for their teeth may be one of the most important steps in the process of reducing the ECC problem our society is facing. Educating parents is certainly necessary and helpful, but without cooperation and partnership of the child whose teeth are the very thing at risk, it would all be pointless.

Conclusions

The survey responses indicated that parents who participated in this study:

- believed, on average, that their own and their child's oral health was between "average" and "below average"
- valued oral health, regardless of how they ranked their own and their child's oral health
- were not very strict with brushing and flossing routines
- believed they should be involved in their child's oral health care and that this impacted their child's oral health

- believed that their own knowledge about primary teeth influenced their child's health
- did not appear to be well-informed about the value of primary teeth
- were eager to learn more about the value of primary teeth
- believed that children become more curious about their teeth and oral health after receiving dental care

Future Research

The review of the literature indicated that ECC is a significant problem that is worth more attention than it generally receives. If the disease is allowed to run its course in a child's mouth, the consequences can be devastating and permanent. There are many factors at work in the development of the disease- parents being a main contributor in many ways. It is important that research continues to be done in this field so that both parents and children can be better educated about the value of primary teeth, and how to take the necessary steps to keep them healthy so they may serve their function.

A follow-up survey, or interviews with the participants in this study would provide further insight on what kind of educational programs or interventional steps might help parents at this particular clinic understand the value of primary teeth, and promote the well-being of their child's oral health. Suggestions for future research include designing a more extensive questionnaire to gain further insight on each of the five research questions. These questions should include information pertaining to the parent and child's beliefs and behavior outside of just the dental setting. In order to draw conclusions about the association between any of the parental influences and a child's oral health, access to dental records would also be essential. In addition to examining records and developing a more detailed survey, data should be collected from a larger number of patients, and at multiple dental clinics including private practices, government-funded clinics, and corporate dental practices. Making the survey available in multiple forms such as paper copies and electronic copies may also help to increase the return rate.

9. Personal Viewpoint

I have wanted to become a dentist for as long as I can remember; as a child I would pull my own teeth, my brother's teeth, and my best friend's teeth while pretending to be a dentist. I never quite grew out of this "I'm going to be a dentist when I grow up" phase, and when I reached high-school age I began to shadow dentists in my community. I was so excited to stand over each doctor's shoulder and peer into the mouths of their patients while they filled cavities, seated crowns, and performed root canals. Each doctor that I shadowed in high school was a private-practice dentist who knew his patients personally and worked with people who could afford top-notch dental care.

When I got to Oregon State in 2012 I began volunteering at the local Boys and Girls club elementary learning center, and in the spring of 2014 I was taken off of the waitlist and given one of the highly popular Johnson Dental Clinic volunteer intern positions. I was excited to be volunteering while simultaneously learning more about the career field I planned to enter, but I was not prepared for what I was about to see over the course of the next two years. Children at this clinic generally come from families of lower socioeconomic status, and many of them are only there because their teeth hurt so bad the pain keeps them up at night, or the decay is so visibly noticeable that their school has required their parents take them to the clinic to be treated. I have been at the clinic when kids as young as 3 years old are being treated for rampant decay, and teenagers as old as 17 are having their first ever appointment with a dentist.

There is one patient in particular that I will never forget. She was a 3 year old girl, whose mother spoke little English. The first time I saw her, she waddled back to the treatment room, climbed up in the chair, let the dental assistant put the "bunny nose" (nitrous oxide nasal inhaler) on her face, put the sunglasses on, and laid there "still as a statue", as we ask the kids to do while the doctor is working in their mouth. I was shocked- how could such a tiny, young girl be so cooperative and brave about something most 10 year olds throw tantrums over? When the assistant showed me her charts, and the doctor let me look in her mouth it all made sense, she was very familiar with this process already. In the chair was a toddler who had 26 cavities in her mouth. Children only have 20 teeth in their mouth total. This little girl came to the clinic every single Tuesday

afternoon, and the doctor would treat as much of the decay as he could, send her home, and she would come back and do it all again the next week. I was still at the clinic when this girl's treatment plan was completed, but unfortunately I am sure that she will be back before her primary teeth fall out. The part about this patient that was the hardest for me to accept and understand was how the decay got to that point. This patient was three years old; this wasn't caused by her own irresponsibility and lack of caring about her own health- there had to be other factors at play. What was she eating? Did her parents put her to sleep with a bottle full of juice or soda? Did they ever brush her teeth? Was this some sort of genetic disposition of being more prone to tooth decay?

These were the experiences and questions that fueled my desire to learn more about ECC and the influences that allow it to progress to a point like what I saw in the little girl. I knew that diet and socioeconomic status played a role in the dental health of people, but I didn't know much more than that. I was particularly curious about just how much of an impact parents had on their child's oral health. When I originally started the honor's thesis process I was working in a lab in the College of Pharmacy, and planned on doing a project with Dr. Mark Leid there. Unfortunately, a shoulder injury that required surgery and months of rehab became too large of an obstacle in that project's timeline to overcome. I am so thankful that Dr. Ray Tricker welcomed me and my ideas with open mind and willingness to help when I approached him about working together on a new thesis, with a limited amount of time. Designing a new thesis project allowed me to think about everything I am passionate about, and learn more about essentially anything I wanted- the perfect opportunity to hopefully have some of my questions about ECC answered.

I designed the survey, anticipating at least 100 responses so that I could perform statistical tests for associations between each child's oral health status and their own parent's responses to each of the other questions. Unfortunately my survey response rate was far below 100, and I wasn't left with many options for analyzing the data. Despite being unable to draw any conclusions about correlations or about the larger Corvallis Community as I had planned to do, I still learned so much by completing this project. The literature review taught me countless things I never knew about ECC and showed me some fascinating ideas that other researchers have had that I never would have considered

before. Even though I was very frustrated with the survey process, from struggling with the IRB application and approval process, to the lack of respondents, I ended with a very positive feeling knowing that the parents who did participate value oral health and are eager to learn more so that they can help their children. I have spent the last year as a coordinator for a dental outreach program for children in Benton country, but I have never had any contact with the parents of the children. After completing this project, one of my recommendations would be for leaders of the Benton County Health Department to work on developing a program to give parents the opportunity to learn basic facts about their child's oral health, and ask specific questions that they may have. I truly believe that this simple step has the potential to have a significant impact on reducing the prevalence of ECC in our community.

This has been a learning experience that I value very much. I am so grateful for everyone who has helped push and guide me along the way so that I could complete a meaningful project that I will be able to take with me onto dental school and my future career.

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Appendix A- Survey Questionnaire

Information about this study: This study will focus on oral health in children, and will survey parents to examine factors that have the most impact on their child's oral health. Results of this study will be used to formulate practical insights on how to improve the oral health of children. Participation in this study is voluntary, and responses will remain confidential. In addition, your decision to take part or not take part in this research will not impact your relationship with the researcher or your services through Johnson Dental Clinic.

Any questions, comments, or concerns can be directed to:

Sarah Darst
503-580-1033
darsts@oregonstate.edu

If you have any questions about this research project, please contact:

Indira Rajagopal
Phone: 541.737.4014
rajagopi@oregonstate.edu

If you have questions about your rights or welfare as a participant, please contact the Oregon State University Institutional Review Board (IRB) Office, at (541) 737-8008 or by email at IRB@oregonstate.edu

1. In my opinion, the status of my child's oral health is:

- Well above average
- Average
- Below average
- Well below average

2. In my opinion the status of my own oral health is:

- Well above Average
- Average
- Below average
- Well below average

3. To what extent do you value your own oral health?

- Extremely
- Somewhat
- A little bit
- Not at all

4. How strictly do you follow a daily brushing and flossing routine?
 - Very strictly
 - Somewhat strictly
 - Not strictly
 - Not at all
5. How involved should a parent be in the dental health status of their child?
 - Very involved
 - Somewhat involved
 - A little bit involved
 - Not involved at all
6. To what degree does a parent's involvement in their child's dental health care affect the quality of that child's dental health status?
 - To a high degree
 - To some degree
 - To a very low degree
 - Not at all
7. Children's primary teeth don't matter because they will fall out anyway
 - True
 - False
8. How strongly do you feel that a parent's knowledge on the value of primary teeth affects the amount of decay/cavities in a young child?
 - Extreme effect
 - Some effect
 - Little effect
 - No effect
9. In your opinion how valuable would an educational program for parents about dental health care be to the dental health status of children?
 - Very valuable
 - Somewhat valuable
 - A little bit valuable
 - Not valuable

10. “To what extent do you feel that having regular dental care increases a child’s curiosity about their dental health?”

- A great extent
- To some extent
- To a little extent
- To no extent

Do you have any suggestions about promoting oral health in children?

Información sobre este estudio: Este estudio se enfocará en la salud bucal de los niños, y va a cuestionar a los padres para examinar los factores que tienen el mayor impacto en la salud bucal de sus niños. Los resultados de este estudio se usarán para formular una comprensión práctica de cómo mejorar la salud bucal de los niños.

La participación en este estudio es voluntaria y las respuestas permanecerán confidenciales. Además su decisión de participar o no participar en este estudio no afectará su relación con el investigador o sus servicios por la clínica dental de Johnson.

Cualquier pregunta, comentario, o inquietudes se pueden dirigir a:

Sarah Darst

503-580-1033

darsts@oregonstate.edu

Si tiene más preguntas sobre este proyecto de investigación, por favor póngase en contacto con:

Dr. Indira Rajagopal

541-737-4014

rajagopi@oregonstate.edu

Si tiene preguntas sobre sus derechos o su asistencia social como participante, por favor póngase en contacto con el oficio de la International Review Board (la Junta de Revisión Internacional) de Oregon State University (la Universidad del Estado de Oregon) al teléfono 541-737-8008 o en el email IRB@oregonstate.edu.

1. En mi opinión, el estado de la salud bucal de mi niño está:

- Mejor que la del promedio
- Como la del promedio
- Peor que la del promedio
- Muy por debajo que la del promedio

2. En mi opinión, el estado de mi propia salud bucal está:

- Mejor que la del promedio
- Como la del promedio
- Peor que la del promedio
- Muy por debajo que la del promedio

3. ¿Qué importancia tiene para usted su propia salud bucal?

- Extrema importancia
- Alguna importancia
- Poca importancia
- Ninguna importancia

4. ¿Con qué consistencia sigue usted una rutina diaria de cepillarse los dientes y de usar el hilo dental?
 - Muy estrictamente
 - Algo estrictamente
 - Nada estrictamente
 - Sin ninguna consistencia
5. ¿Qué papel juegan los padres dentro de la salud bucal de sus niños?
 - Uno muy importante
 - Uno algo importante
 - Uno poco importante
 - No tienen papel alguno
6. ¿A qué grado el involucramiento de los padres en la salud bucal de sus hijos afecta la calidad del estatus dental de su niño?
 - A un alto grado
 - Hasta cierto grado
 - Tiene poco impacto
 - No afecta en nada
7. Los primeros dientes de los niños no importan porque se van a caer de cualquier manera
 - Verdadero
 - Falso
8. ¿A qué grado considera que los conocimientos de los padres sobre el valor de los primeros dientes afecta el número de caries en un niño pequeño?
 - Tiene un gran efecto
 - Tiene un efecto mediano
 - Tiene poco efecto
 - No tiene efecto
9. En su opinión, ¿qué tan valioso sería para la salud dental de los niños un programa educacional para padres sobre el cuidado y salud dental?
 - Muy valioso
 - Algo valioso
 - Poco valioso
 - No sería nada valioso

10. “¿A qué grado considera que tener un mantenimiento dental regular aumenta el interés de los niños sobre su propia salud dental?

- A un alto grado
- Hasta un punto
- Tiene poco impacto
- No afecta en nada

¿Tiene sugerencias sobre cómo promover la salud bucal en los niños?

Appendix B- IRB Application

Submission Type	INITIAL APPLICATION		
Study Title	The Parental Effect on Early Childhood Caries in the Corvallis Community		
Principal Investigator	Dr. Indira Rajagopal	Appointment Type ¹	Senior Instructor I or II
Email Address	rajagopi@oregonstate.edu	Telephone No.	541-737-4014
College or Administrative Office	College of Science		
School	School of Life Sciences		
Department, Program, Unit, Center, or Institute	Biochemistry and Biophysics		

1. In one paragraph, state your primary research question or purpose: The purpose of this study is to explore to what degree certain parental behaviors, attitudes, and beliefs have an effect on the prevalence of Early Childhood Cavities, and general oral health. The study will question whether there is any relationship between children's oral health and each of the following: parental oral health, parenting style, parental locus of control, parental value placed on primary teeth, and the parental belief/disbelief that "primary teeth don't matter because they will fall out anyway". The information gathered will be used to brainstorm ideas of possible intervention or educational programs that would help minimize the problem of Early Childhood Cavities in the community.

2. Anticipated Level of Review – *If uncertain, complete the Review Level Determination form*

☒ Exempt ☐ Expedited ☐ Full Board

3. Funding

☐ External funding ☐ Internal funding ☒ Unfunded

4. Ethics and Compliance Training

All study team members involved in this project must complete training in the ethical use of human participants in research prior to submitting an IRB application. Please refer to the Education Requirement Policy on the IRB website. If you have additional study team members, please submit the information on a separate sheet.

Study Team	Role in Project	OSU Email Address	Copy on Correspondence	Ethics Training	Student-driven (e.g.,
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¹ Please see the [FAQ on who may be a Principal Investigator](#)

Member(s)				Completed	for thesis or dissertation)
Dr. Indira Rajagopal	Principal Investigator	rajagopi@oregonstate.edu		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Sarah Darst	Student Researcher	darsts@oregonstate.edu	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	(Select)		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
	(Select)		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
	(Select)		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

5. Risk/Benefit Assessment for adults and/or children

Minimal risk: The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

Adults

- ☐ Not enrolling adults
☒ Minimal risk
☐ Greater than minimal risk

Children

- ☒ Not enrolling children
☐ Minimal risk
☐ Greater than minimal risk, but holds prospect of direct benefit to subjects
☐ Greater than minimal risk; no prospect of direct benefit to subjects but likely to yield generalizable knowledge about the subject's disorder or condition
☐ Research not otherwise approvable but presents an opportunity to understand, prevent, or alleviate a serious problem affecting the health or welfare of the subjects

6. Maximum number of subjects (not a range) that will be enrolled over the course of the study: 200

*Enrollment must not exceed this number without prior IRB approval.
See Protocol Template for additional details.*

7. Participant age range (check all that apply):

- ☐ 0-7: include parental consent form (unless seeking waiver) and description of verbal assent process

☐ 8-17: include parental consent form and assent form for children (unless seeking waiver)

☒ ≥18: include consent form or verbal consent guide (unless seeking waiver)

8. Target population(s)

Populations	Excluded	Permitted	Targeted
Adults lacking capacity to consent	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <i>Note: Protocol must include additional safeguards</i>
Children in foster care or wards of the state	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <i>Note: There are additional safeguards that may need to be in place when children in foster care or wards of the state will be enrolled. If research poses greater than minimal risk to subjects, see the IRB website for guidance on children.</i>
Prisoners	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <i>Note: Will be reviewed at the full board level. If the correctional facility is under the purview of the Oregon Department of Corrections (DOC), complete the DOC application and consult with them regarding feasibility before submitting an application to the OSU IRB. See IRB website for the DOC application.</i>
Pregnant women	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> <i>Note: Please explain in the risks section of the protocol whether there are any additional risks to pregnant women and/or fetuses. If excluding, please provide justification in the protocol.</i>
OSU Students or employees	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> <i>See IRB website for guidance on enrolling students and employees.</i>
Non-English speakers	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> <i>Note: Protocol must include qualifications of the translator(s) and of the study team members if obtaining consent in a language other than English. All written information to be seen by subjects must be translated and submitted with the application.</i>
American Indians and/or Alaska Natives	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> <i>See IRB website for guidance on enrolling tribal populations. If excluding please provide justification in the protocol.</i>

If the research involves any of the following, check the appropriate box

<input checked="" type="checkbox"/>	Submission to Scholars Archive or Special Collections and Archives	<i>Confidentiality section of the protocol must indicate planned submission of manuscript or data to the archives; include plans for any restrictions or embargoes. If raw data or transcripts will be submitted to the archives without restrictions, this must be disclosed to research participants in advance.</i>
<input type="checkbox"/>	Deception	<i>See policy on IRB website</i>
<input type="checkbox"/>	Audio or video recording	<i>Consent document must indicate whether recording is optional or a required study activity. If optional, include an opt-in/opt-out section for subjects to initial</i>
<input type="checkbox"/>	Drugs, devices, biologics, or supplements	<i>Complete relevant sections of the protocol template</i>
<input type="checkbox"/>	Radiation	<i>Complete Radiation Use Form IRB will forward submission to Radiation Safety</i>
<input type="checkbox"/>	Human biological materials	<i>Complete Biological Materials Form IRB will forward submission to Biosafety Attach CLIA lab certification, if applicable</i>
<input type="checkbox"/>	Microorganisms or Recombinant DNA	<i>IRB will forward submission to Biosafety</i>
<input type="checkbox"/>	Sending or receiving biological materials	<i>Contact the Office for Commercialization and Corporate Development regarding the potential need for a Material Transfer Agreement (541) 737-4437</i>
<input type="checkbox"/>	Using Chemical Carcinogens	<i>List of applicable chemicals: http://oregonstate.edu/ehs/carlist IRB will forward to Chemical Safety</i>
<input type="checkbox"/>	Waiver of parental consent/permission	<i>If you do not think that the requirement for obtaining parental consent/permission for children under 18 is appropriate for this study, include justification in consent section of protocol</i>
<input checked="" type="checkbox"/>	Waiver of documentation (signature) of informed consent	<i>If you do not think that the requirement for a <u>signed</u> consent document is appropriate for this study, include justification in consent section of protocol. See IRB website for guidance on a verbal or alternative consent process</i>
<input type="checkbox"/>	Waiver of informed consent	<i>The required elements of consent are listed here: http://www.hhs.gov/ohrp/policy/consentckls.html <i>If you do not think that the requirement for obtaining consent to participate in research is appropriate for this study, or if you plan to omit or alter <u>any</u> of the required elements of consent, include justification in consent section of protocol</i></i>
<input checked="" type="checkbox"/>	Translated documents	<i>Include material in English and translated into a language spoken by participants</i>
<input type="checkbox"/>	Multi-center study	<i>Complete relevant section of the protocol</i>
<input checked="" type="checkbox"/>	External research or recruitment sites	<i>Complete relevant section of the protocol</i>

9. Attachments (check all that apply):

<input checked="" type="checkbox"/>	Protocol <i>Required</i>	<input type="checkbox"/>	Attachment A: Radiation <i>Required if participants will be exposed to radiation</i>
<input checked="" type="checkbox"/>	Consent Document(s) – Consent Form(s) <i>Required if adults, unless consent or signatures will not be sought</i>	<input type="checkbox"/>	Attachment B: Human Materials <i>Required if study involves the collection or receipt of any biological materials</i>
<input type="checkbox"/>	– Verbal Consent Guide(s) <u>and/or</u>	<input type="checkbox"/>	Material(s) in Other Languages <i>Required for study documents that will be seen by non-English speakers</i>
<input type="checkbox"/>	– Explanation of Research Handout <i>Required if no signatures will be obtained</i>	<input type="checkbox"/>	External IRB Approval(s) <i>Submit if available. If there are external collaborators who do not yet have IRB approval, contact the OSU IRB Office for additional guidance</i>
<input type="checkbox"/>	– Assent Form(s) <i>Required if minors, unless assent will not be sought</i>	<input type="checkbox"/>	CLIA Lab Certification <i>Required if results of lab tests will be disclosed to research participants, including urine pregnancy tests and glucose tests. For more information, please see the OSU Guidance for CLIA Certification.</i>
<input type="checkbox"/>	– Parental Consent Form(s) <i>May be required if minors. Please see our guidance for more information: http://oregonstate.edu/research/irb/obtaining-parental-permission</i>	<input checked="" type="checkbox"/>	Letters of Support from External Research Sites <i>If research will be conducted in schools, hospitals, or similar settings; or will be conducted internationally and/or with a vulnerable population, a letter of support may be required.</i>
<input type="checkbox"/>	Recruiting Tools <i>Required to submit final content if using emails, social media posts, flyers, letters, blackboard, verbal recruitment guide, SONA, MTurk, etc. See additional guidance at http://oregonstate.edu/research/irb/recruitment-research-participants</i>	<input type="checkbox"/>	Individual Investigator Agreements <i>May be required if external collaborators will not be covered under an external IRB. Contact the IRB Office for more information</i>
<input type="checkbox"/>	Test Instruments <i>Required to submit if using questionnaires, surveys, interview guides, focus group guides, etc.</i>	<input type="checkbox"/>	Other: <i>e.g., agendas for professional development workshops that are a research intervention; VO2 Max Exercise Test Supervision Competency Forms; Material Transfer Agreement; audio, video, or image files if included in the intervention; etc.</i>
<input type="checkbox"/>	Grant Application or Funding Contract <i>Required if research has pending or awarded funding; other examples may include applications for student research scholarships, URISC, URAP, etc.</i>		

10. Does the study need to be registered with ClinicalTrials.gov?

- ☐ **Yes** A research study in which one or more human subjects are prospectively assigned to one or more interventions (which may include placebo or other control) to evaluate the effects of those interventions on health-related biomedical or behavioral outcomes.²

For more information, please see the [NIH Clinical Trials webpage](#).

- ☒ **No**

11. Conflict of Interest

Federal Guidelines require assurances that there are no conflicts of interest in research projects that could affect the welfare of human subjects. If this study presents a potential conflict of interest, additional information will need to be provided to the IRB.

Examples of potential conflicts of interest in research involving human subjects may include, but are not limited to:

- An investigator or family member participates in research on a technology, process or product owned by a business in which the faculty member holds a financial interest. Any interest should be disclosed to the IRB, regardless of whether it meets the threshold of a “significant financial interest,” as defined by the Public Health Service (PHS).
- An investigator or family member has a financial or other business interest in an entity that is supplying funding, materials, products, equipment, research subjects, or the site of data collection for the current research project.
- An investigator or family member serves on the Board of Directors of a business that is supplying funding, materials, products, equipment, research subjects, or the site of data collection for the current research project.
- An investigator or family member is employed by the organization under study.
- An investigator receives consulting income from an entity that is funding the current research project.
- An investigator participates in research on a technology, process or product developed for which the investigator has intellectual property rights (e.g., copyrights, trademarks, patents, or trade secrets) or receives royalties.

Do any members of the study team, or any of their family members, have a financial or other non-research interest in the source(s) of funding, materials, equipment, data, research subjects, or site of research related to this study?

- ☒ No
☐ Yes – Please describe:

² National Institute of Health. 2014.

PRINCIPAL INVESTIGATOR'S ASSURANCE STATEMENT

I understand Oregon State University's policies concerning research involving human subjects and I attest:

- ☒ that the information contained in this application is accurate and complete;
- ☒ that research involving humans, including recruitment, will not begin until IRB approval has been granted;
- ☒ to the scientific merit and importance of this study;
- ☒ to the competency and availability of the study team member(s) to conduct the project;
- ☒ that facilities, equipment, and personnel are adequate to conduct the research.

Furthermore, I agree to:

- ☒ comply with all IRB policies, decisions, conditions, and requirements;
- ☒ accept responsibility for every aspect of the conduct of this study;
- ☒ obtain prior approval from the IRB before amending or altering the study and/or study documents;
- ☒ report to the IRB in accord with current policy, any adverse event(s) and/or unanticipated problem(s);
- ☒ inform the IRB if one or more of my study team members leaves OSU;
- ☒ complete and submit continuing review documentation or a final report prior to the expiration date;
- ☒ notify the IRB immediately of the development of any potential conflict of interest not already disclosed.

Study Title:	Parental Influences on Early Childhood Caries in the Corvallis Community
Principal Investigator:	Dr. Indira Rajagopal
Date:	2/20/2016

Applications will only be accepted if submitted by the Principal Investigator

Email completed application and all relevant attachments to IRB@oregonstate.edu

- File names for all attachments should include the last name of the Principal Investigator, document title, and version date. For example: Smith_Protocol_10272014.doc
- All attachments should include the last name of the Principal Investigator, document title, version date, and page numbers.

Appendix C- IRB Research Protocol

RESEARCH PROTOCOL

9/30/2015

1. The Parental Effect on Early Childhood Caries in the Corvallis Community

PERSONNEL

2. Principal Investigator Dr. Indira Rajagopal
3. Student Researcher(s) Sarah Darst
4. Co-investigator(s)
5. Study Staff Ana Warren (document translator)
6. Investigator Qualifications

The PI has a Ph.D. in Biochemistry and is a senior instructor in biochemistry, biophysics and biology at Oregon State University. She is interested in all areas of the life sciences, and very knowledgeable regarding the Honors College Thesis process.

The student researcher has done extensive research on previous publications pertinent to the topic, is working with a mentor from the public health department, and has been involved in volunteering in the clinic where the study will occur for two years.

Ana Warren, the initial translator of the survey, has a M.A. degree in Spanish Literature from the University of Oregon, and is currently an instructor of Spanish at Oregon State University.

7. Training and Oversight

The staff members at the Johnson Dental Clinic, primarily the clinic coordinator Amanda Lindsey, will be responsible for simply forwarding the consent form and survey onto study participants. Staff members who will be doing this will be trained on how to briefly introduce what the project is (see recruitment section of "Subject Population", page 4).

8. Conflict of Interest

There are no conflicts of interest in this study.

FUNDING

9. Sources of Support for this project (unfunded, pending, or awarded)

This study is unfunded.

DESCRIPTION OF RESEARCH

10. Description of Research

The intended use for this research project is as an Honors College thesis. The main focus of the research is to analyze the relationship between various parental influences on early childhood cavities and overall oral health of children. Five main research questions will be addressed in the thesis.

- 1) What is the relationship of a parent's oral health status, value of their own oral health, and oral hygiene habits and the prevalence of decay/cavities in their child?
- 2) What is the relationship between parenting style, parental locus of control (perceived and actual), and the prevention of decay/cavities in their child?
- 3) Is there a relationship between the prevalence of decay/cavities in a child and the parental belief or disbelief that "primary teeth don't matter because they will fall out anyway"?
- 4) Is there a relationship between parental (perceived or actual) knowledge about the importance and value of primary teeth and the prevalence of decay/cavities in a child's mouth?
- 5) Are children with cavities/ who have received dental treatment more curious or educated about their teeth and oral health than children who are caries free?

It has been hypothesized that there will be a strong correlation between parental habits and beliefs, and the oral health of their children. A survey has been designed to help answer the study questions and will be administered to parents of children receiving dental treatment. The results of the survey will be analyzed, and conclusions drawn. The information gained from this research study will give the investigators a better understanding of the parental role in childhood oral health, and how this can relationship can be improved.

11. Background Justification

Early Childhood Caries is the single most common chronic childhood disease. A lot of previous research has addressed how the disease develops and common causes, such as poor dietary and hygiene habits. Since Early Childhood Caries is a condition affecting children as young as ages 0-7, there are obviously other factors (adult influences) that play a role in this disease. Research has indicated that a child's behavior relates to oral health, how dental office anxiety (in parents and children) affects oral health, and how parenting style and parent's own oral health correlates with that of their child. This study aims to focus closely on the ways parents influence their child's oral health, particularly the effect parental knowledge and understanding of the importance of primary teeth can have. Closing some of the gaps between the knowledge that health care providers, parents, and patients (children) have are important factors that could lead to a decrease in the prevalence of this disease and offer significant benefit for the oral health of children.

12. Multi-center Study

Not applicable.

13. External Research or Recruitment Site(s)

- a) Name or description of each research site:

Johnson Dental Clinic at the Boys and Girls Club of Corvallis

- b) Name and role of appropriate authority from each site providing a letter of support or permission (when applicable):

Amanda Lindsey, Dental Services Coordinator

- c) Name of each recruitment site:

None

- d) If recruitment method involves more than an advertisement (newspaper classified, flier, listserv email), name and role of appropriate authority from each site providing a letter of support:

None

- e) Attach or include the final content of the ad or correspondence to be used for recruitment

Not applicable.

14. Subject Population

- A description of participant characteristics:

The participants of this study will be the parents of children who have dental appointments at the Johnson Dental Clinic at the Boys and Girls Club of Corvallis. The only restriction placed on this subject population is that participants must be able to read and comprehend English or Spanish, as those are the languages the survey will be offered in.

- Total target enrollment number:

100

- Description of any vulnerable population(s):

Vulnerable populations may include mothers who are currently pregnant and people who do not speak English, should they choose to participate.

- Inclusion and exclusion criteria:

The only criteria for enrollment in the study, is that the participant must be a parent of a child who is receiving dental treatment at the Johnson Dental Clinic

at the Boys and Girls Club of Corvallis.

- Recruitment:

Upon arrival for their child's dental appointment, the potential participant will be verbally informed about the opportunity to voluntarily participate in this research study. If the person wishes to participate they will be handed the survey and consent form. The following guide for what to say to potential participants will be provided to the dental clinic staff who will be forwarding the study materials to participants:

"An Oregon State student is carrying out a research project regarding the oral health of children in our community. Her project is titled "Parental Influences on Early Childhood Caries in the Corvallis Community", and all parents of patients at our clinic are being given the opportunity to participate. Participation is voluntary, and involves filling out a 10 question survey that will remain confidential. This is a student-driven project that is being done under the supervision of Dr. Indira Rajagopal from OSU, and for further information you can contact Sarah Darst, whose contact information is listed on the consent form."

There will also be a brief explanation on the consent form regarding the topic and purpose of the study.

15. Consent Process

A written consent form will be presented to potential participants that provides a brief summary of the purpose of the survey and explains that it is voluntary and confidential. A waiver of documentation of informed consent is being requested for this study, as participants will be subjected to minimal risk, and not required to perform any activities outside of completing the survey. After being handed a consent form and survey, completion of the survey will imply consent to participate in the study.

16. Assent Process

Not applicable.

17. Eligibility Screening

No screening process.

18. Methods and Procedures

This research project will be carried out via the following steps:

- 1) Survey design that will provide information regarding the research questions
- 2) Survey and consent forms will be translated into Spanish
- 3) Training of Johnson Dental Clinic staff on guidelines of survey and how it should be forwarded to participants (procedure is as follows):
 - a) Upon patient arrival and check-in for appointment explain that this research project (by an undergraduate OSU student) focuses on children's oral health (following guide in section 16).

b) Obtain consent from parents who wish to participate.

- Participants will be notified that: their answers will be confidential, the survey will take no more than 10 minutes of their time, the survey is offered in both English and Spanish, and participation is voluntary.

4) Surveys and consent forms will be supplied for participants to voluntarily fill out while they wait for their child's dental appointment.

5) Investigator check in with the dental clinic each week to pick up completed survey forms and answer any questions

6) After desired amount of surveys have been collected, or after a 1-2 month period collect all surveys and consent forms (finished or unfinished) from dental clinic

7) Analyze results of survey and draw conclusions

- The survey will be designed so that each response can be assigned a number score of 1-4. The total quantity of each score will be tallied up for each of the survey questions, and results compared. A score of one will indicate little to no relevance, and a score of 4 will indicate a very strong relationship.

8) Add information about the survey and what the results suggest into written thesis project

9) Submit thesis project

19. Compensation

This is a completely voluntary survey and no compensation, monetary or otherwise will be provided to participants.

20. Costs

The participants should not face any costs related to participating in this survey, as they would have already been traveling to the dental clinic for dental treatment regardless of participation in the study or not.

21. Drugs or Biologics

Not applicable.

22. Dietary Supplements or Food

Not applicable.

23. Medical Devices

Not applicable.

24. Radiation

Not applicable

25. Biological Samples

Not applicable.

26. Anonymity or Confidentiality

Participant's responses to the survey will be kept confidential throughout the process of study. When the results of this study are published no individuals will be identified, and participation in the study will be confidential. Responses will be scored (as described in the procedures) and the results will be compiled. There is no risk that participants will be identified. Following the data collection, the survey and consent forms will be stored in their original manila envelopes in the possession of the principal investigator for three years after the study is completed, and shredded and recycled after this time period has passed.

27. Risks

There are no risks, physical, mental, social or otherwise, associated with participating in this survey.

28. Benefits

This study has the potential to provide valuable information about the relationship between parental behaviors and beliefs and the oral health of their children. Recommendations will be compiled following the completion of the study. The results of the study will provide information to focus on educational materials or programs designed to will reduce the oral health problems experienced by children in our community.

29. Assessment of the risks and benefits.

Given that there are no risks to mental or physical health, and that the potential benefits include educating health care providers, parents, and children themselves on ways to improve and maintain good childhood oral health, it is fair to say that the benefits far outweigh the risks.

Appendix D- Survey Data Table

Survey Number	Span Engl.	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Comments
1	E	2	3	2	3	1	1	F	2	2	1	No
2	S	2	3	2	3	2	2	F	1	1	1	No
3	S	4	4	3	4	1	2	T	1	1	2	No
4	E	2	2	2	2	1	2	F	1	1	1	No
5	E	2	3	3	3	1	1	F	2	2	2	No
6	E	4	4	3	4	3	1	T	2	1	1	No
7	E	2	4	3	3	1	1	F	2	2	1	No
8	E	3	3	3	3	2	2	T	2	2	2	No
9	E	2	2	2	2	1	1	F	1	1	1	No
10	S	3	?	1	1	1	2	T	1	1	2	No
11	E	2	2	1	2	1	1	F	1	2	1	No
12	E	2	2	2	2	1	1	F	1	1	1	Yes
13	E	4	2	1	2	1	1	F	1	1	1	Yes
14	E	2	3	2	3	1	2	T	2	2	2	No
15	E	1	1	1	1	1	1	F	1	1	1	No
16	E	2	2	2	3	2	1	T	2	1	2	No
17	E	1	1	1	1	1	1	F	1	1	1	No
18	E	2	1	2	3	1	1	F	1	1	1	Yes
19	E	2	2	1	2	1	1	F	1	1	1	No
20	S	4	4	2	4	1	2	T	2	2	2	No
21	E	2	2	2	2	1	1	F	2	1	1	No
22	S	4	4	2	4	2	2	T	?	2	2	No
23	E	2	2	1	1	1	1	F	1	1	1	No
24	S	3	4	3	4	2	3	T	2	1	2	No
25	S	3	4	3	3	1	1	T	2	1	1	No