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Emma Barnes

University of Nebraska - Lincoln

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THE IMPORTANCE OF NUTRITION IN ORAL HEALTH
IN THE GENERAL POPULATION AND AMONG CHILDREN AND ADOLESCENTS

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by
Emma Barnes, BS
Nutrition and Health Sciences
College of Education and Human Sciences

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Faculty Mentors:
Linda Young, M.S., Human Nutrition and Food Service Management

Abstract

Having good oral health is vital for the U.S. population. Although there have been improvements, too many suffer from dental caries and tooth loss. Providing education, dental procedures, and nutritional foods can help prevent these issues. Healthy choices include having a diet with adequate protein, vitamin A, vitamin C, and the vitamin B complex to support proper tissue development in the oral cavity.

Keeping good oral health is crucial for those suffering from diabetes mellitus. Studies show that doing this can help lower the patient's A1C, therefore helping with the management of blood glucose levels and potentially slowing the progression of the disease.

As children transition into adolescents, the prevalence of e-cigarette usage increases. Additional studies are needed to ensure validity with the relationship between tooth decay and use, but the studies currently show a negative impact.

Sweetened beverages are another factor in the progression of poor oral health. It is necessary to ensure proper oral hygiene if regular consumption of these products occurs.

Preventative measures against poor oral health include fluoride in the community water supply or oral hygiene routine, sealants, dietary choices, proper oral hygiene, and seeing a dentist. With these measures, the U.S. population can make progress in helping those suffering from poor oral health.

Keywords: nutrition, caries, diabetes, e-cigarettes, sweetened beverages

Introduction

The role of nutrition in children and adolescents is important because what they consume at this age is critical for adulthood. One aspect of their health that diet affects is their oral health. For many nutritional impacts, the oral cavity can be a gateway for assessment by medical professionals to determine deficiencies.

Because of this, it is significant for dentists and other oral professionals to understand these impacts to give excellent care to their patients. Dentists are unique because they can see their patients twice a year, whereas most other medical physicians have only yearly checkups. Because of the increased visits, they can notice nutritional disturbances sooner and help prevent their progression.

There is not enough education surrounding nutrition and oral health. On several government websites, the only nutritional advice for oral health is to be vigilant with brushing and flossing and avoid a sugary diet. In the Oral and Dental Health section of the Centers for Control and Prevention (CDC) website, this kind of information was all that was readily available about the subject. Scholarly journals are the only place to find nutritional deficiencies of the oral cavity. Although most research articles are available for the public, this does not mean its easily accessible. Most of the population does not read these articles regularly, and some may not understand the material. Therefore, medical professionals need to know this information to familiarize their patients in an easy-to-understand manner.

The same goes for dentists. If they can readily notice problems with their patients early on, they can prevent hardships in the future. This paper looks at what nutritional concerns are associated with the dental health of the general population and critical preventative measures.

Statistics

The first step in taking preventative measures for oral health is visiting the dentist. According to Child Stats, 92% of children ages 5-11 had a dental visit in the past year in 2019, but compared to adolescents ages 12-17, the percentage drops to 90% (2021). Once the child reaches adulthood, this number drops significantly. According to the CDC, the percent of adults aged 18 and over with a dental visit in the past year was 64.9% (*Oral and dental health*, 2020).

These numbers correlate with the percentages of people suffering from untreated dental caries. Between 2015 to 2018, in children aged 5-19 years, 13.2% of them had untreated caries. In the same years, the percentages of adults aged 20-44 with untreated caries increased to 25.9% (CDC, *Oral and dental health*, 2020). These results show how important visiting the dentist is for maintaining good oral health.

Although visiting the dental office is essential, this might not be an option due to financial concerns. Dental health can be costly for people and is affected by race and ethnicity. According to the CDC, in children aged 12 to 19, about 70% of Mexican American children have had caries in their permanent teeth, in contrast to 54% of non-Hispanic White children being affected (*Disparities*, 2021). Dental health can be a luxury for those less fortunate. According to the same website, in ages 2 to 5 years, 17% of children from low-income households have untreated caries, which is three times higher than children from higher-income families. In ages 12 to 19, this number jumps to 23% for children in low-income households for permanent teeth, which is twice as high as children from high-income families (*Disparities*, 2021).

Although there has been improvement since the 1990s and early 2000s with dental caries and tooth decay (CDC, *Oral health surveillance*, 2021), these statistics still show the need for modification.

Dental Caries Process

Shown by these statistics, dental caries are still affecting much of the U.S. population. Because of this, it is meaningful to understand the caries process to understand what is happening in the oral cavity. This process is due to an intake of fermentable carbohydrates like sucrose, glucose, fructose, lactose, maltose, and starch and having these sugars reside on the tooth (Ujoel & Lingstrom, 2017). When the bacteria that live on the teeth start fermenting these food sources, their metabolism releases acidic end products that demineralize the enamel. The enamel has a critical pH of 5.5-5.7, which the fermentation process and acidic foods and drinks can reach. Ujoel and Lingstrom say that products like candy, soft drinks, fruit juices, or sugars added to coffee can cause the enamel to decrease to the critical pH to start the demineralization process.

It is critical to have an appropriate diet to prevent the caries process. This diet includes an optimal intake of minerals and vitamins for proper enamel mineralization. Some of the essential vitamins and minerals that aid in protection include vitamin D, calcium, phosphate, vitamin B6, and vitamin K (Ujoel & Lingstrom, 2017). Foods like dark, green-leafed vegetables, cheese, milk, cod-liver oil, oyster mushrooms, eggs, and certain species of wild salmon are rich in these vitamins and minerals. Foods like this are essential to incorporate into the diet of pregnant women and young children for proper tooth mineralization as the child develops. Lastly, having an adequate protein intake ensures appropriate cell turnover, and without it, tooth loss and periodontal lesions can happen. In general, it is important to minimize excessive intake of carbohydrate high foods and drinks to avoid the development of dental caries. Many studies show that people on a low carbohydrate diet are less susceptible to caries and gingival bleeding.

One study that Ujoel and Lingstrom (2017) include in their review is a study where participants went on a stone age diet (a diet of mostly protein and low sugar sources) without any access to toothbrushes and dental floss. The results were astonishing because although there were increases in plaque, there was no gingival bleeding. This shows that although having good oral hygiene is important, it is not the only factor to keep in mind for taking care of teeth.

A condition associated with dental caries is Early Childhood Caries (ECC). ECC is the presence of one or more decayed, missing, or filled tooth surfaces due to caries in any primary tooth from birth through 71 months of age (Marshall, 2003). The development of ECC usually requires hospitalization, which can impact the family. Marshall also states that dental caries among children are associated with self-esteem issues, missed school days, behavior problems, oral pain, impaired eating, oral abscesses, and poor growth (2003). For these reasons, it is necessary to monitor the child's dietary choices to ensure proper tooth mineralization and development.

Nutritional Deficiencies that Affect Oral Health

According to Sheetal et al. (2013), many nutritional deficiencies can first be seen in the oral cavity. Below shows what effects nutrient deficiencies have on oral structures based on this article.

Table 1: Effect of Nutrient Deficiencies on Oral Health

Deficient Nutrient	Effect on Oral Structures
Protein Energy Malnutrition	Delayed eruption of permanent teeth Reduced tooth size Decreased enamel solubility Salivary gland dysfunction
Vitamin A	Decreased epithelial tissue development

	Impaired tooth formation Enamel hypoplasia (grooves and pits along tooth)
Vitamin D/calcium phosphorus	Lowered plasma calcium Hypomineralization Compromised tooth integrity Delayed eruption pattern Absence of lamina dura (compact bone that helps attach tooth to socket) Abnormal alveolar bone patterns
Vitamin C	Irregular dentin formation Dental pulpal alterations Bleeding gums Delayed wound healing Defective collagen formation
Vitamin B1 (thiamine)	Cracked lips Angular cheilosis (cracks at the corner of the mouth)
Vitamin B2 (riboflavin) Vitamin B3 (niacin)	Inflammation of the tongue Angular cheilosis Ulcerative gingivitis
Vitamin B6	Periodontal disease Anemia Sore tongue Burning sensation in the oral cavity
Vitamin B12	Angular cheilosis Halitosis (bad breath) Bone loss Hemorrhagic gingivitis Detachment of periodontal fibers Painful ulcers in the mouth
Iron	Salivary gland dysfunction Very red, painful tongue with a burning sensation Dysphagia Angular cheilosis

Protein Energy Malnutrition (PEM) leads to enamel hypoplasia, which develops into grooves and pits in the enamel that are often horizontal or linear in appearance (Sheetal et al.,

2013). Having hypoplastic grooves in the enamel can lead to dental caries because of the thinning enamel. Vitamin A and vitamin D are also associated with enamel hypoplasia to a lesser extent. In addition, PEM and vitamin A deficiency lead to hypofunctioning of the salivary glands. The salivary glands are a significant part of oral health. They produce products that keep the oral cavity healthy by fighting off infections, offering a buffering capacity against acidic conditions, and aiding digestion (Sheetal et al., 2013). Since PEM causes decreased salivary flow, problems can emerge. In general, PEM causes delayed tooth development, increased development of caries, and numerous other developmental issues for children.

Vitamin C is an essential nutrient for healthy periodontal health. Vitamin C works to maintain and repair healthy connective tissue and has antioxidant properties (Sheetal et al., 2013). If this nutrient is deficient, there can be disturbances in collagen synthesis in the gums, leading to a disease called scurvy. This disease is associated with bleeding and inflamed gums.

The vitamin B complex is beneficial for healthy tissue in the oral cavity. Deficiencies in these vitamins lead to cracked and red lips, inflammation of the lining of the oral cavity and the tongue, oral ulcers, cracks at the corners of the mouth (angular cheilitis), and a sore throat (Sheetal et al., 2013). Iron and folic acid deficiency have similar effects. Iron, vitamin B12, and folic acid are required to produce healthy red blood cells. If the body is inadequate with these nutrients, pernicious anemia can develop where the immune system attacks the mucosal lining leading to inflammation. Lastly, vitamin B2 aids in the breakdown of fat, ketone bodies, carbohydrates, and proteins. Without this vitamin, ariboflavinosis occurs and causes the cracking of the lips and inflammation and burning of the tongue (Sheetal et al., 2013).

Additional Nutritional Considerations that Affect Oral Health

Sweetened Beverages

Products in the marketplace are also affecting oral health. The biggest one of these is sweetened beverages. These beverages include soft drinks, fruit juices, sports drinks, and energy drinks. These are known to have high amounts of sugar that have cariogenic potential. For example, a 12-ounce bottle of a carbonated beverage has around ten teaspoons or 40 grams of sugar in one serving, which exceeds the recommended daily intake (Tahmassebi and BanHani, 2019).

In addition to having lots of sugar, sweetened beverages cause teeth erosion by being acidic. As described earlier, the enamel has a critical pH of around 5.5, and if the pH of the mouth goes below this, tooth erosion is possible. Tahmassebi and BanHani detail that most soft drinks have a pH between 2.5 to 3.5, with an average of 3.44 for carbonated beverages and fruit juices (2019). Since this pH is low, some tooth erosion is almost always occurring. In addition to having a low pH, sweetened beverages contain erosive substances such as carbonic acid, phosphoric acid, malic acid, and citric acid that contribute to tooth surface loss. When tooth surface loss occurs, the results include teeth sensitivity, eating and drinking difficulties, dissatisfaction with appearance, and potential dental caries.

Diet drinks are a helpful alternative for someone that needs to have less sugar intake, but they can have consequences for dental health. They are non-cariogenic since they contain artificial sweeteners; however, they contain acids like phosphoric acid and citric acid, which have a similar acidic potential for the enamel (Tahmassebi & BaniHani, 2019). An example includes diet Coca Cola, where this drink has a pH of 2.61.

In general, it is best to limit the consumption of soft drinks, especially if there is a history of tooth loss and caries. However, there are ways to help minimize the damage done by

sweetened or acidic beverages. First, it is better to consume it with meals. If consumption happens between meals, there is less time for the plaque pH to return to normal. Second, drinking the beverage at bedtime has been shown to increase the severity of dental erosion (Tahmassebi & BaniHani, 2019). Third, the more exposure teeth have to the drink, the more dental decay. It is helpful to avoid swishing the liquid around and using a straw to avoid contact. Lastly, avoid sipping or taking longer to finish the drink. The less exposure to the beverage, the better. Then after consuming the drink, rinse the mouth with water or brush the teeth to make sure there is no residing sugar that bacteria can ferment.

Additional Factors That Can Impact Oral Health

Diabetes Mellitus

Good oral hygiene is beneficial for someone diagnosed with diabetes mellitus since it can develop into oral problems. Poor management of blood glucose levels can lead to less saliva production, which increases the risk of cavities and infections in the mouth, inflammation, bleeding of gums, and problems tasting food (Martin, n.d.). For children, diabetes can result in teeth erupting at an earlier age. Understanding these signs is necessary to help manage the patient's blood glucose levels or discover undiagnosed diabetes mellitus.

With poor blood glucose management, periodontal disease can develop. Periodontal disease is the most common dental disease affecting nearly 22% of diagnoses (Martin, n.d.). Since there is less saliva production, more bacteria and germs build up along the gum line resulting in gingivitis. The tooth becomes unstable since the inflammation causes a weakened connection.

Periodontal disease can also raise blood glucose levels, worsening the prognosis. With the increasing infection along the gum line, an infection can rapidly spread into the bloodstream, especially after eating or brushing teeth (Vinas & Hess-Fischl, 2018). The body will start to allocate resources to prevent the spread of the infection, resulting in increased blood glucose levels. As a result, it is challenging to control periodontal health with this diagnosis.

Because of this cycle, it is necessary to establish a dental action plan. Research has shown that treating gum disease helps improve blood sugar in patients with diabetes, slowing the progression of the disease (Martin, n.d.). According to a study posted by Vinas and Hess-Fischl, a dental treatment called scaling and root planing, which is a procedure that is a more intensive way to scrape plaque under the gumline, lowered A1C in type 2 diabetic individuals (2018). This study randomly assigned 90 people with type 2 diabetes mellitus who had an average A1C of 7.7 at the start to either a group with ultrasound treatment or a group with scaling and planing. At the end of six months, the group that had plaque removed by use of ultrasound alone lowered their A1C by 0.06%. The root planing and scaling group had a significant average reduction of 0.51%. A percentage like this may not seem influential, but a decline of just 1% of the A1C can reduce diabetes-related death by 21% and heart attack risk by 14% (Vinas & Hess-Fischl, 2018).

With these considerations, it is especially crucial to visit a dentist at least every six months and possibly every three months if the severity of the periodontitis is high (Vinas & Hess-Fischl, 2018). This webpage also cites the American Academy of Periodontology, which states that it is crucial to brush teeth after each meal and before bedtime and floss well once a day to prevent infection. If the gingivitis worsens, there may be a need to see a periodontologist.

E-cigarette Use

The prevalence of e-cigarettes has begun to increase among the younger population. The use of these devices has increased from 1.8% of adults in the U.S. to 13% by 2013 (Huilgol et al., 2018). Research on this subject has expanded to determine any health consequences for this growing population. While most research has covered their impact on the respiratory and cardiovascular systems, there is minimal research on their connection with oral health. The questionnaire study done by Huilgol et al. claims that their investigation was the first to assess a relationship between e-cigarette exposure and poor dental health in adults in the U.S.

The authors detail that the contents of the devices worsen oral health. The contents often include propylene glycol, glycerol, nicotine, flavoring agents, and dyes. Nicotine has a pathogenic role in tooth loss because it can reduce tooth mineralization through altered genetic signaling and activation of inflammatory pathways (Huigol et al., 2018). Propylene glycol is known to modify calcium release for tooth mineralization. Other contents can lead to inflammation, oxidative stress, and altered repair mechanisms.

This questionnaire study found that daily and intermittent e-cigarette users had increased odds of developing poor oral health. Intermittent users were 18% more likely than non-users, and everyday users were 42% more likely. After adjusting from other variables, Huilgol et al. found that daily users had 78% higher odds of having poor oral health. The study did not find poor oral health currently, but it showed that they have more chances to develop it in the future. Since this trend is relatively new, it is meaningful to keep studies like this in mind when caring for a patient.

Prevention of Dental Caries and Poor Oral Health

Fluoridation

Having community water fluoridation has improved the prevalence of dental caries. Slade et al. (2018) say:

“Community water fluoridates (CWF) in the United States rank among the great public health achievements of the 20th century for their effectiveness in preventing dental caries.”

Previous studies show that children living in fluoridated areas are less likely to develop caries than in non-fluoridated areas. The analysis done by Slade et al. wanted to assess this result again and to find how much of the population had CWF.

After data collection, they found that 28.8% of U.S. counties were greater than 75% fluoridated, and 52.4% of the U.S. population lived in those counties. Also, those counties accounted for 74.5% of 207.1 million Americans served by fluoridated drinking water. From the results, rural counties were least likely to have CWF, and because of this, dental caries tended to increase in those areas.

These results indicate that fluoride in the water plays a role in dental caries. The CDC has a resource to verify if a county water supply has fluoride. If it does not, it is difficult to promote healthy teeth. If this is the case, consider purchasing anticavity mouthwash with fluoride. Having anticavity mouthwash is, in general, an excellent resource for anyone interested in preventing caries or for those who have a family history of dental caries. Incorporating fluoride into the daily routine ensures good oral health and prevents the onset of dental caries.

Sealants

Sealants are another improvement for preventing dental deterioration. Most tooth decay occurs in molars, where chewing of food primarily occurs. Griffin et al. say that 90% of this

decay occurs in the permanent molars (2016). Sealants prevent this by placing a plastic coating on the pits and fissures of the tooth surface so that bacteria cannot proliferate and cause demineralization to the hardest to clean teeth.

Previous studies show that sealants delivered in clinical or school settings can prevent 81% of decay at two years after placement, 50% at four years, and continue to be effective for up to 9 years (Griffin et al., 2016). However, dental sealants are still underused in low-income families, which is the group that suffers from dental caries the most. Griffin et al. found that 60% of children aged 6-11 years from low-income families did not have sealants (2016). The development of school-based programs has helped bring these protective coverings at reduced or zero costs. Programs like these can help communities prevent future dental caries that can be more costly in the future.

Children without sealants have three times more cavities in permanent first molars than those who do (Griffin et al., 2016). Because of this, it is valuable to provide sealants to all children. Keeping the school-based programs available for children is easy and cost-effective in the long run. Griffin et al. also say providing dental sealants to the 6.5 million low-income children who do not have them would prevent 3.4 million caries in four years (2016).

Dietary Habits and Food Choices

As discussed earlier, if fluoride and dental sealants are not an option, protection of the teeth can be influenced by our dietary choices. Certain nutrients play a critical role in protecting the teeth and the other structures of the oral cavity. Ensuring maintenance of an adequate diet in childhood and the rest of life keeps the teeth strong and resistant to demineralizing activities. Also, restricting the consumption of products high in sugar and acidic compounds is another way

to protect the oral cavity. Limiting sweetened beverages to a couple of times a week gives the teeth that much more time to heal.

Having enough time between meals or snacks can give teeth proper remineralization time to prepare for the next meal. Marshall (2003) says the following:

“A daily habit of three meals and three snacks, each 30 minutes in length, with an additional 30 minutes for plaque pH to return to normal, theoretically supports 6 hours of demineralization and 18 hours of remineralization.”

Just giving 30 minutes between meals and snacks allows the pH to return to normal to avoid falling below the critical pH for an extended period. Minimizing demineralization can also be accomplished by not sipping on an acidic beverage for more than 30 minutes. Keeping this time prevents sufficient demineralization for tooth decay. By following this guideline, teeth will stay healthy and maintain a better appearance.

Oral Hygiene

Even with these preventative measures, it is still necessary to have good oral hygiene. Brushing teeth two times a day has stood the test of time and has shown significant benefits in keeping the oral cavity healthy. Brushing the teeth removes cariogenic plaque that builds up throughout the day and night and helps prevent infection throughout the teeth and gumline. In addition, flossing at least once daily is recommended. Plaque can still build up between the teeth, and since a brush cannot clean as well there, dental floss is needed to help clean this area.

Lastly, one of the most prominent recommendations is to see a dentist every six months. If this frequency is not an option, once a year will suffice. A dentist can notice problems that the patient cannot. They help stop these problems from progressing, which prevents issues later in

life. Since the mouth is a gateway to the rest of the body, dentists also detect nutritional deficiencies before they worsen and affect daily activities. Retaining oral hygiene and dental visits can be life-benefiting steps for better oral health.

Conclusion

In conclusion, the U.S. has made progress in preventing dental caries and problems associated with poor oral health. However, statistics show that it is still a problem nationwide, especially for minorities and low-income families. There is no information readily available that details nutritional actions families can take to prevent tooth decay. Schools' actions to control health issues usually include banning high sugar products from vending machines and cafeterias. There cannot just be restrictions because children will find ways to access these products or will still have them available in their households. Providing education to children on exactly why these products can be detrimental to their health can help them make decisions for themselves in the future.

Having good oral health leads to good overall health in the body. It is critical to begin health education at an early age. If this occurs, then habits can form earlier that proceed to adulthood. Lastly, preventative measures, like fluoride and dental sealants, can significantly protect children's teeth. Incorporating these measures and nutritional considerations can lower the prevalence of poor oral health that impacts many communities in the United States.

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