LUPINE PUBLISHERS

Interventions in Pediatric Dentistry Open Access Journal

DOI: 10.32474/IPDOAJ.2021.07.000254

ISSN: 2637-6636

Review Article

Can Genetics Play A Role in Children's Tooth Decay?

Karimi M DMD, BS*

Department of Pediatric, Sepideh Dental Clinic, Iran

***Corresponding author:** Karimi M, Department of Pediatric, Sepideh Dental Clinic, Iran*

Received: November 01, 2021 **Published:** November 12, 2021

Abstract

Many people still get decay despite regular care of their teeth. Studies over the years have shown genetics has been very influential in the health of teeth. Some people think that genetics only affects the materials of the teeth, while genetics also affects the amount of sugar consumed. Studies have shown that many people are genetically more likely to consume sugars, and their metabolism is adjusted to consume these sugars. Microorganisms are another factor that can cause tooth decay. Our immune system determines what microorganisms are naturally present in our mouths. The immune system is based on genetics, so genetics can affect tooth decay through the immune system and the presence of bacteria. Although the role of genetic factors in the development of dental caries is well established, the role of environmental factors should not be underestimated. That's why in this article we will talk about the role of both genetics and environmental factors in tooth decay.

Keywords: Genetic; tooth decay; sugar consumption; metabolism; microorganism; immune system

Introduction

Tooth decay, oral problems, and diseases are important issues that affect oral health internationally. Dental caries remains the most common chronic childhood disease. About 90% of school children and about 100% of adults worldwide have superficial and deep caries on their teeth [1]. About 20% of middle-aged people also suffer from a severe periodontal disease that causes tooth loss and other health problems [2]. Research shows that genetics play an important role in dental health and related problems such as tooth decay [3-7]. These studies explain why some people have problems with their teeth despite maintaining good dental hygiene, proper nutrition, and regular brushing. A study by the Pittsburgh School of Dentistry found that a polymorphic variation in the beta-defense 1 (DEFB1) gene increases susceptibility to caries [8]. Besides, genetics also play a role in determining the health of teeth. One of these factors is the hardness of tooth tissue, which is determined by the process of amylogenesis. Genetic changes in this process can affect the size and shape of teeth and even increase the vulnerability to caries. Genetics also affects the body's immune response to tooth damages and caries [9]. Another effective factor in determining dental health is glucose metabolism [10]. Genetic factors can also alter this process and increase the risk of tooth damage by increasing sugar intolerance [11]. Furthermore, studies have shown that women have less saliva than men, which increases the risk of caries. It appears that males have inherently higher concentrations of IgA immunoglobulin to defend their oral surfaces against carious activity [12]. Saliva contains natural antibiotics that help keep teeth healthy. Therefore, parents who have a hereditary history of dental health problems should be more careful and increase their attention to their children's dental health as much as possible by performing regular examinations and following the dentist's instructions. The composition and organization of bacteria in the mouth at a younger age are influenced by genetic processes. But as people get older, genetic issues become less common, and diets and oral hygiene replace the formation of oral microbiomes [13]. Most parents consider the role of genetics in dental caries and unfortunately ignore the key role of environmental factors.

Genetic Involvements

An important question comes to mind. How can genetics affect children's teeth? Genetics and genetic factors can also affect oral health that is not under our control. Nelson and colleagues studied a very large group of twin children to investigate their involvement in host genotypes and the early environment in the formation of oral microbiomes for oral health [14]. The twin studies that look into the heritability of dental caries in children revealed the effect of genetics in tooth decay [3,5]. Several genetic factors affect teeth in such conditions. These factors can determine the alignment of the teeth and the development of tooth cavities and other dental problems despite proper dental care. Genetics largely determines the consistency and composition of saliva, which has a direct effect

on tooth decay. The chemical composition of saliva also shows how the mouth can neutralize the acid that leads to the formation of dental plaque and eventually its deterioration. Taranath and et al tried to indicate the genetic influence on salivary parameters and caries experience by correlation of incidence of dental caries and salivary parameters in twin children raised together [15]. The grooves and pits on children's teeth are a good environment for acid penetration into these areas. If the home dental care is not done properly, leads to an increase in the prevalence of tooth decay. Hence, salivary factors can be taken into consideration in analyzing the genetic risk factors correlated to the development of dental caries. Saliva is one of the inherited features that define the risk of susceptibility or resistance of children to the development of caries [11,15].

Periodontitis, or gingivitis, is also linked to genetics. Scientists had researched to find the role of genes and patterns of inheritance in periodontal disease. Saxén showed juvenile periodontitis (aggressive periodontitis) is inherited in an autosomal recessive state [16]. Shapira and et al indicated the family pedigree had been consistent with an autosomal dominant state of transmission in aggressive periodontitis [17]. A family history of gum disease also exposes our children to these diseases. If a child inherited a weak immune system from his parents, it will be more difficult to recover and cure a periodontal disease in which an infection has developed. Dental enamel formation is a significantly controlled genetic process. Abnormalities of enamel are caused by a variety of interrelating genetic and environmental factors. Some people have genetically weak enamel. Developmental enamel defects may present as enamel hypoplasia or hypomineralization. Some studies have emphasized that abnormalities of the developmental pathways may be the result of the reduced quantity of tissue produced and the poor quality of mineralization [18,19]. In children, developmental enamel defects may be associated with problems such as tooth discoloration, tooth sensitivity, susceptibility to caries, tooth wear, and erosion [20].

On the other hand, some children are more prone to caries than others due to having crowded teeth and their irregular formation and improper contacts. Genetic sensitivity to taste is an inherited trait in children [21]. Genetics by taste genes can also play a role in tooth decay. These genes act through their effects on taste and dietary habits that lead to sensitivity or insensitivity to cariogenic foods. Genetic alterations that indicate the differences in eating habits may affect tooth decay [22-24]. Opal and et al. concluded taste preference are significantly modulated by host genetics, and it may play a key factor in food habit development in childhood [11]. Mitsiadis and his colleagues believe that the hardness and composition of tooth enamel can affect the progression of cavities. They have shown that tooth decay is not only related to bacteria but also tooth resistance. Bacteria and their toxic products can easily penetrate the enamel, which has an unstable structure, and lead to caries, even if the person maintains good oral hygiene. Understanding the molecular-biological relationships of tooth enamel formation and the impact of mutations that lead to defective tooth enamel has created new opportunities to prevent dental caries [25,26].

Non-Genetic Factors

These days, scientists are trying to develop an anti-caries vaccine. Besides genetics, environmental determinants also play a crucial role in caries susceptibility in children [27,28]. The following are factors other than genetics that can affect caries that may be more important than genetics in causing caries.

Lack of familiarity with the correct method of brushing

Children's dental care is one of the important factors in the health of primary teeth. Unfortunately, many parents claim that their children brush their teeth but do not know how to brush properly, or spend little time brushing, or do not have the necessary continuity. The oral health of the children should be established during infancy, maintained, and followed throughout adolescence. In children, neglecting oral health hygiene would have the consequences of oral problems such as dental caries, periodontal problems, anomalies of the teeth, and increasing dental expenses [29]. Brushing teeth on a routine basis is the best way to remove dental plaques. If teeth are not cleaned properly, it can cause plaque accumulation that could lead to dental caries in children [30]. Karimi has indicated that "Tooth brushing should be taught in very young children as a hobby, not a task imposed on them. In older children, brushing should be described as an oral health routine in their everyday lives. The role of parents and pediatric dentists as motivators for children to brush their teeth can be an important key. Parents can give a positive impetus to children by training them how to brush their teeth; they also can use specific tricks to encourage them" [32]. Proper brushing technique may take at least two minutes, unfortunately, for children brushing lasts for a much shorter time. Hence, for having a proper tooth brushing, parents should make the brushing fun and enjoyable [32]. Consequently, the appropriate brushing time could reduce the dental plaque, and the child would not be susceptible to dental caries. An electric toothbrush can do a better job of cleaning teeth for children with limited manual dexterity [33].

Impact of environment and geography on teeth

Environment and geography can have a significant impact on dental health. Dental caries, fluorosis (influenced by the food and water quality in a particular topographic area), chemicals in water such as arsenic interference can have a huge impact on teeth and oral mucosa. Moreover, with no access to clean water, children living in developing and underdeveloped countries may experience oral health deterioration [34]. The amount of fluoride that will be present in drinking water and access to food or fluoride-containing substances vary from region to region. Fluoride is an extraordinary supplement to protect the enamel and prevent tooth decay. Fluoride prevents the loss of minerals on the surface of the teeth and prevents decay by remineralizing them [35]. Varnish Fluoride

is used for the prevention of tooth decay especially in children. This flavored gel has a great impact on increasing the strength of the tooth enamel [35].

Prevention of tooth decay

The effect of genetics on tooth decay cannot be ignored, but some steps can be taken to control the factors that affect tooth decay. Tooth decay can be prevented by having an oral hygiene program, regular visits to the dentist, and having a proper diet plan. Dental plaque is one of the most common causes of dental caries and periodontal disease [36]. The plaque is constantly forming on the surface of children's teeth. After eating foods or sugary drinks, the bacterial activity starts and begins to release acidic substances that after a while lead to enamel tissue destruction [30]. Removal of plaque is very important for children's oral health because permanent teeth are forming in this period [30]. The accumulation of plenty of plaque on the teeth surfaces for a long period could cause enamel erosion, teeth decay, gingival inflammation, and stimulation of the pulp [37-40]. It is important to teach children how to properly clean dental plaques. Besides that, parents should constantly observe the children's oral hygiene so that in the future, they could always maintain healthy habits of oral and dental care and have beautiful and caries-free teeth. Flossing is just as important as or even more important than brushing. According to the American Dental Association's recommendation, at least one-time daily use of dental floss is essential to reach the desired level of oral hygiene [41]. In a study, Houjoel and et al. showed that the use of dental floss for about one year among children aged 4 to 13 years reduced the risk of dental decay by 40% [42]. The use of dental floss is required as soon as two teeth erupt side by side of each other. Children should use dental floss at an early age when their posterior teeth are in contact with each other [43].

Conclusion

Oral Health is essential for health and wellbeing; early childhood is the time when most lifetime habits are established. It offers the greatest opportunity for the prevention the oral diseases that in turn can contribute to better health in adulthood. Literature has revealed that genetics is a playing factor in dental health and related problems such as tooth caries. On the other hand, non-genetic factors can affect the development of dental caries. Even though the genetic factors are very important in the prevalence of tooth decay, but environmental factors such as oral hygiene, diet, fluorosis (influenced by the food and water quality in a particular topographic area), and chemicals in the water could be as important as the genetic factors.

References

1. Poul Erik Petersen (2005) The global burden of oral diseases and risks to oral health, Bulletin of the World Health Organization 83: 661-669.
2. Burt BA (1994) Periodontitis and aging: reviewing recent evidence. JADA 125(3): 273-279.
3. Bretz WA (2006) Heritability estimates for dental caries and sucrose sweetness preference. Arch Oral Biol 51: 1156-1160.
4. Hunter PB (1988) Risk factors in dental caries. Int Dent J 38: 211-217.
5. Liu H (1998) Genetic analysis of dental traits in 82 pairs of female-female twins. Chin J Dent Res 1: 12-16.
6. Wang X (2010) Genes and their effects on dental caries may differ between primary and permanent dentitions. Caries Res 44: 277-284.
7. Akshima Sahi (2018) Are genes involved in tooth decay and gum disease?
8. Ozturk Ayla, Famili, Pouran, Vieira A (2010) The Antimicrobial Peptide DEFB1 Is Associated with Caries. Journal of dental research 89: 631-636.
9. Piddennavar (2013) Influence of Host Genes on Dental Caries. IOSR-JDMS 4: 86-92.
10. Bradshaw (2002) Effects of Glucose and Fluoride on Competition and Metabolism within in vitro Dental Bacterial Communities and Biofilms. Caries research 36: 81-86.
11. S Opal (2015) Genetic factors affecting dental caries risk, Australian Dental Journal 60: 2-11
12. Eliasson L (2006) Minor salivary gland secretion rates and immunoglobulin A in adults and the elderly. European Journal of Oral Sciences 114(6): 494-499.
13. Dashper SG (2019) Temporal development of the oral microbiome and prediction of early childhood caries. Sci Rep 9: 19732.
14. Nelson KE (2017) The Oral Microbiome of Children: Development, Disease, and Implications beyond Oral Health. Microb Ecol 73(2): 492-503.
15. Taranath Abhay (2013) An analysis of the genetic influence on salivary parameters and caries experience-by correlation of incidence of dental caries and salivary parameters. International Journal of Dental Research 1(2).
16. Saxén L (1980) Juvenile periodontitis. J Clin Periodontol 7: 1-9.
17. Shapira L, Schlesinger M, Bimstein E (1997) Possible autosomal dominant inheritance of pre-pubertal periodontitis in extended kindred. J Clin Periodontol 24: 388-393.
18. Coxon TL, Brook AH, Barron MJ, Smith RN (2012) Phenotype-genotype correlations in mouse models of amelogenesis imperfecta caused by amelx and enam mutations. Cells Tiss Organs 196: 420-430.
19. Kim JW, Simmer JP (2007) Hereditary dentin defects, J Dent Res 86: 392-399.
20. Musale PK, Soni ASh, Kothare SS (2019) Etiology and Considerations of Developmental Enamel Defects in Children: A Narrative Review. Journal of Pediatrics Review 7(3): 141-150.
21. Anliker JA, Bartoshuk L, Ferris AM (1991) Children's food preferences and genetic sensitivity to the bitter taste of 6-n-propylthiouracil (PROP) taste perception. Am J Clin Nutr 54: 316-320.
22. Pados R (1989) Comparative study of the consumption of cariogenic food in monozygotic and same-sex dizygotic twins, Orv Hetil 130: 503-506.
23. Keskitalo K (2007) Same genetic components underlie different measures of sweet taste preference. Am J Clin Nutr 86: 1663-1669.
24. Krondl M (1983) A twin study examining the genetic influence on food selection. Hum Nutr Appl Nutr 37:189-198.
25. Mitsiadis TA (2017) A cytoplasmic role of Wnt-β-catenin transcriptional cofactors in tooth enamel formation. Science Signaling 10(465): 4598.

26. Mitsiadis Thimios, Harada Hiemitsu (2015) regenerated teeth: an update, Regenerative Medicine Developmental Biology 10(1).
27. Verrips GH, Frencken JE, Kalsbeek H, ter Horst G, Filedt Kok-Weimar TL (1992) Risk indicators and potential risk factors for caries in 5-year-olds of different ethnic groups in Amsterdam, Community Dent Oral Epidemiol 20: 256-260.
28. Lukacs JR, Largaespada LL (2006) Explaining sex differences in dental caries prevalence: Saliva, hormones, and life-history etiologies. AM J Human Biol 18: 540-555.
29. Karimi M (2016) Recommendations to Protect Children's Teeth. BAOJ Dentistry 2(3): 2-5.
30. Karimi M (2021) How Dental Plaque and Dental Calculus can Affect Children's Oral Health?" EC Pediatrics 10(3): 100-105.
31. Karimi M (2019) Ways to Encourage Children to Brush Their Teeth. CPQ Dentistry 1(2): 1-6.
32. Karimi M (2021) What's better for Children; an Electric or Manual Toothbrush? Inter Ped Dent Open Access J 5(5): IPDOAJ.MS.ID.000224.
33. Gerardo (2013) The association between geographical factors and dental caries in a rural area in Mexico. Cad Saúde Pública Rio de Janeiro 29(7): 1407-1414.
34. Mohammad Karimi (2018) The Role of Varnish Fluoride in Preventing Tooth Decay in Young Children. Biomed J Sci&Tech Res 10(4): BJSTR, MS.ID.001996.
35. Loesche WJ, NS Grossman (2001) Periodontal disease is a specific, albeit chronic, infection: diagnosis and treatment. Clinical microbiology reviews 14(4): 727-752.
36. Holt R (2000) ABC of oral health, Dental damage, sequelae, and prevention. BMJ 320(7251): 1717-1719.
37. Löe H (2000) Oral hygiene in the prevention of caries and periodontal disease. International Dental Journal 50: 129-139.
38. Socransky SS, Haffajee AD (2002) Dental biofilms: difficult therapeutic targets. Periodontology 2000 28: 12-55.
39. Ohrn K, Sanz M (2009) Prevention, and therapeutic approaches to gingival inflammation. Journal of Clinical Periodontology 36(10): 20-26.
40. Vahabi S, Nazemi B (2008) A comparison of chlorhexidine impregnated floss vs. conventional dental floss on gingivitis. J Dent Sch Shahid Beheshti Univ Med Sci 25(4): 418-425.
41. Hujoel PP, Cunha-Cruz J, Banting DW, Loesche WJ (2006) Dental flossing and interproximal caries: a systematic review. J Dent Res 85(4): 298-305.
42. Karimi M (2018) The Importance of Dental Floss in Improving Children's Oral Health. CPQ Dentistry 1(1): 1-6.

DOI: 10.32474/IPDOAJ.2021.07.000253