

# **Exploring the Interplay of Food Habits, Genetics, and Environment: Implications for Dental and General Health**

**Vijaya Lakshmi Pavani Kondru**

**Independent Researcher, USA**

[kvpavani@gmail.com](mailto:kvpavani@gmail.com)

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**Abstract:**

This paper delves into the intricate relationship between food habits, genetics, and environmental factors, examining their collective impact on both dental and general health outcomes. Through a comprehensive review of existing literature, this study explores how dietary choices interact with genetic predispositions and environmental influences to shape oral health conditions such as dental caries, periodontal diseases, and malocclusions, as well as their broader implications for overall well-being.

**Keywords:** food habits, genetics, environment, dental health, general health, oral hygiene, dietary choices, dental caries, periodontal diseases, malocclusions.

## **Introduction:**

In the realm of healthcare, the intricate interplay between food habits, genetics, and environmental factors has emerged as a significant area of study, particularly concerning dental and general health. The recognition of these multifaceted influences underscores the need for a comprehensive understanding of how dietary choices, genetic predispositions, and environmental contexts collectively shape health outcomes. This introduction sets the stage for exploring the

complex dynamics at play and highlights the importance of investigating this intersection for promoting optimal oral and general well-being.

Dental health stands as a cornerstone of overall health and quality of life. The mouth serves as the gateway to the body, and its condition can profoundly impact systemic health. Dental diseases, such as dental caries, periodontal diseases, and malocclusions, not only cause pain and discomfort but also contribute to systemic inflammation and are linked to various chronic conditions including cardiovascular diseases, diabetes, and adverse pregnancy outcomes. Understanding the factors influencing dental health is therefore crucial for preventing disease and promoting overall health.

One key determinant of dental health is food habits. The foods and beverages we consume play a pivotal role in shaping the oral microbiome, which in turn influences susceptibility to dental diseases. Diets high in sugars and fermentable carbohydrates fuel the growth of cariogenic bacteria, leading to the development of dental caries. Conversely, diets rich in fiber, vitamins, and minerals support oral health by promoting saliva production, buffering acids, and providing essential nutrients for tissue repair. Additionally, certain dietary habits, such as frequent snacking or acidic beverage consumption, can exacerbate dental erosion and increase the risk of enamel wear.

However, the impact of food habits on dental health is not uniform across populations. Genetic variations contribute to individual differences in dietary responses and susceptibility to oral diseases. For example, genetic polymorphisms in taste receptors may influence food preferences and consumption patterns, affecting dietary choices and, consequently, oral health outcomes. Similarly, genetic factors play a role in the metabolism of dietary components, such as

carbohydrates and fats, which can influence the composition of the oral microbiome and the risk of dental diseases.

Furthermore, environmental factors exert a significant influence on food habits and, consequently, dental health. Socioeconomic status, cultural practices, and access to nutritious foods all shape dietary behaviors and contribute to disparities in oral health outcomes.

Individuals living in food-insecure environments may have limited access to fresh fruits and vegetables and rely instead on inexpensive, calorie-dense foods that are detrimental to oral health. Moreover, environmental exposures to environmental pollutants, such as air pollution or endocrine-disrupting chemicals, may impact oral health through various mechanisms, including inflammation, oxidative stress, and hormonal disruptions.

Understanding the complex interplay between food habits, genetics, and environment is essential for developing effective strategies to promote oral and general health. By elucidating the mechanisms underlying these interactions, researchers can identify novel targets for preventive interventions and personalized treatments. Additionally, addressing the social determinants of health that influence food choices and access to care is critical for reducing health disparities and improving overall health outcomes.

In light of the growing burden of dental diseases and their implications for systemic health, there is a pressing need for interdisciplinary research that integrates insights from nutrition, genetics, environmental health, and dentistry. This paper aims to contribute to this evolving field by synthesizing current knowledge and highlighting key gaps in understanding. By fostering collaboration across disciplines and fostering a holistic approach to health promotion, we can work towards a future where all individuals have the opportunity to achieve optimal oral and general well-being.

## **2. Food Habits and Dental Health**

Maintaining optimal dental health requires a multifaceted approach that includes attention to dietary habits, genetic predispositions, and environmental influences. In this section, we delve into the intricate relationship between food habits and dental health, examining how dietary factors, genetic variations, and environmental contexts collectively shape oral health outcomes.

### **2.1 Dietary Factors Affecting Dental Health**

Dietary choices play a fundamental role in the development and progression of dental diseases, including dental caries, periodontal diseases, and dental erosion. The composition and frequency of food and beverage consumption influence the oral microbiome, pH levels in the mouth, and the availability of essential nutrients for oral tissues. Diets high in sugars and fermentable carbohydrates provide substrates for acid-producing bacteria, leading to the demineralization of tooth enamel and the formation of dental caries. Moreover, frequent consumption of acidic foods and beverages can contribute to dental erosion by weakening the protective enamel layer.

Conversely, a balanced diet rich in fiber, vitamins, and minerals promotes oral health by supporting saliva production, buffering acids, and providing essential nutrients for tissue repair. Foods such as fruits, vegetables, whole grains, and dairy products contain calcium, phosphorus, and other minerals that contribute to the remineralization of tooth enamel and the maintenance of optimal oral health. Additionally, chewing fibrous foods stimulates saliva flow, which helps cleanse the mouth and neutralize acids.

Beyond nutrient composition, the texture and consistency of foods also influence oral health outcomes. Sticky and chewy foods, such as candies and dried fruits, adhere to tooth surfaces and prolong exposure to sugars, increasing the risk of dental caries. Conversely, crunchy and fibrous

foods, such as raw vegetables and nuts, can help mechanically remove plaque and debris from the teeth, reducing the risk of cavities and gum disease.

In recent years, the role of dietary patterns in oral health has garnered increasing attention. The Mediterranean diet, characterized by high consumption of fruits, vegetables, fish, and olive oil, has been associated with reduced risk of periodontal diseases and tooth loss. Conversely, Western dietary patterns, characterized by high intake of processed foods, sugars, and saturated fats, have been linked to higher prevalence of dental caries and periodontitis.

Understanding the impact of dietary factors on dental health is essential for developing evidence-based recommendations and interventions to promote oral health. Public health initiatives aimed at reducing sugar consumption, promoting consumption of nutrient-rich foods, and encouraging healthy eating patterns can help mitigate the burden of dental diseases and improve overall oral health outcomes.

## **2.2 Genetic Influences on Dietary Responses**

Genetic variations contribute to individual differences in dietary responses and susceptibility to oral diseases. Taste perception, metabolism, and nutrient absorption are among the biological processes influenced by genetic factors, which in turn affect food preferences, dietary behaviors, and oral health outcomes.

Taste perception plays a crucial role in food selection and consumption. Genetic polymorphisms in taste receptors can alter sensitivity to sweet, salty, bitter, and sour tastes, influencing food preferences and consumption patterns. Individuals with heightened sensitivity to sweet tastes may be more prone to consuming sugary foods and beverages, increasing their risk of dental

caries. Conversely, those with heightened sensitivity to bitter tastes may avoid bitter-tasting foods, such as certain vegetables, which are rich in essential nutrients for oral health.

Metabolic pathways also play a significant role in determining individual responses to dietary components. Genetic variations in enzymes involved in carbohydrate metabolism, such as amylase and glucokinase, can affect the rate of sugar metabolism and the production of acids by oral bacteria. Similarly, genetic variations in lipid metabolism may influence susceptibility to periodontal diseases and inflammatory responses in the oral cavity.

Furthermore, genetic factors can modulate nutrient absorption and utilization, affecting oral health outcomes. For example, genetic variations in genes encoding for vitamin D receptors may impact the body's ability to absorb calcium and phosphorus, essential minerals for tooth development and maintenance. Similarly, genetic polymorphisms in genes involved in antioxidant pathways may influence susceptibility to oxidative stress and inflammation in the oral tissues.

Understanding the genetic basis of dietary responses and oral health outcomes holds promise for personalized prevention and treatment strategies. Genetic testing and nutritional counseling tailored to individuals' genetic profiles can help identify optimal dietary recommendations and interventions to mitigate the risk of dental diseases. Moreover, genetic research may uncover novel therapeutic targets for addressing oral health disparities and improving outcomes for at-risk populations.

## **2.3 Environmental Impact on Food Choices**

Environmental factors exert a significant influence on food habits and, consequently, dental health outcomes. Socioeconomic status, cultural practices, food availability, and marketing strategies all shape dietary behaviors and contribute to disparities in oral health.

Socioeconomic status (SES) is a key determinant of dietary habits and oral health outcomes. Individuals from low-income households may have limited access to nutritious foods and dental care services, leading to higher prevalence of dental diseases. Moreover, socioeconomic disparities in education, employment, and healthcare access can exacerbate oral health inequalities and contribute to disparities in dental outcomes.

Cultural practices and dietary traditions also influence food choices and oral health behaviors. Cultural norms regarding meal patterns, food preparation methods, and food preferences can impact dietary habits and nutritional intake. For example, cultural practices such as frequent snacking, consumption of sugary snacks, and lack of emphasis on oral hygiene may contribute to higher rates of dental caries and periodontal diseases in certain populations.

Food availability and marketing practices play a significant role in shaping dietary behaviors and consumption patterns. Access to affordable, nutritious foods is often limited in underserved communities, where convenience stores and fast food outlets may outnumber grocery stores and markets offering fresh produce. Moreover, aggressive marketing of sugary snacks, sugary beverages, and processed foods contributes to high consumption of these products, exacerbating the risk of dental diseases.

Environmental exposures to environmental pollutants may also impact oral health outcomes. Air pollution, water contamination, and exposure to hazardous chemicals can have systemic effects on health, including inflammatory responses and oxidative stress, which may contribute to oral

diseases such as periodontitis and oral cancer. Additionally, endocrine-disrupting chemicals found in food packaging, personal care products, and environmental contaminants may affect hormonal balance and metabolic pathways, influencing oral health outcomes.

Addressing the environmental determinants of food choices and oral health is essential for promoting health equity and reducing disparities in dental outcomes. Policy interventions aimed at improving food access, regulating marketing practices, and reducing environmental exposures can help create environments that support healthy eating habits and optimal oral health for all individuals.

In summary, the complex interplay between food habits, genetics, and environmental factors shapes oral health outcomes and contributes to disparities in dental health. Understanding these multifaceted influences is essential for developing effective strategies to promote oral health, reduce the burden of dental diseases, and improve overall well-being for individuals and communities.

### **3. Genetics and Oral Health**

Genetics plays a significant role in shaping oral health outcomes, influencing susceptibility to dental diseases, oral developmental abnormalities, and oral soft tissue conditions. In this section, we explore the genetic variations associated with oral diseases and the complex interplay between genetic factors and environmental influences in determining oral health outcomes.

#### **3.1 Genetic Variations Associated with Oral Diseases**

Genetic variations contribute to the susceptibility to a wide range of oral diseases, including dental caries, periodontal diseases, and oral cancers. Numerous genes have been implicated in



the pathogenesis of these conditions, influencing various aspects of oral health, including immune response, tissue remodeling, and carcinogenesis.

In the context of dental caries, genetic variations in genes encoding for enamel matrix proteins, such as amelogenin and enamelin, have been associated with enamel defects and increased susceptibility to caries. Similarly, genetic polymorphisms in genes encoding for salivary proteins, such as mucins and lysozyme, may influence salivary flow rate, pH, and antimicrobial properties, affecting the risk of caries development.

Periodontal diseases, including gingivitis and periodontitis, are complex inflammatory conditions influenced by genetic, microbial, and environmental factors. Genetic variations in genes encoding for components of the immune system, such as interleukins, tumor necrosis factor- $\alpha$ , and toll-like receptors, have been implicated in susceptibility to periodontal diseases. Additionally, genetic polymorphisms in genes involved in connective tissue metabolism, such as matrix metalloproteinases and tissue inhibitors of metalloproteinases, may contribute to tissue destruction and bone resorption in periodontitis.

Oral cancers, including cancers of the lip, tongue, mouth, and throat, are multifactorial diseases with genetic and environmental risk factors. Genetic variations in genes involved in DNA repair, cell cycle regulation, and carcinogen metabolism influence individual susceptibility to oral cancers. For example, polymorphisms in genes encoding for enzymes involved in detoxification pathways, such as glutathione S-transferases and cytochrome P450 enzymes, may modulate the metabolism of tobacco and alcohol carcinogens, affecting the risk of oral cancer development.

Understanding the genetic basis of oral diseases is essential for identifying individuals at increased risk and developing targeted prevention and treatment strategies. Genetic testing and

risk assessment can help identify individuals with genetic predispositions to oral diseases, allowing for early intervention and personalized management approaches. Moreover, genetic research may uncover novel therapeutic targets for preventing and treating oral diseases, ultimately improving outcomes for patients.

### **3.2 Gene-Environment Interactions in Oral Health**

While genetic factors play a significant role in determining oral health outcomes, their effects are modulated by environmental influences, including lifestyle factors, socioeconomic status, and environmental exposures. Gene-environment interactions play a crucial role in shaping individual susceptibility to oral diseases and can help explain variations in disease prevalence and severity across populations.

Lifestyle factors, such as diet, tobacco use, and oral hygiene practices, interact with genetic predispositions to influence oral health outcomes. For example, individuals with genetic variations associated with impaired detoxification pathways may be more susceptible to the carcinogenic effects of tobacco and alcohol consumption, increasing their risk of oral cancer development. Similarly, dietary factors can modulate the expression of genetic variants associated with nutrient metabolism and immune response, affecting susceptibility to dental caries and periodontal diseases.

Socioeconomic status (SES) also interacts with genetic factors to influence oral health outcomes. Individuals from low-income households may experience greater exposure to environmental risk factors, such as poor nutrition, limited access to dental care, and higher levels of psychosocial stress, which can exacerbate genetic predispositions to oral diseases. Moreover, socioeconomic

disparities in education, employment, and healthcare access can further compound the effects of genetic vulnerabilities, leading to disparities in oral health outcomes.

Environmental exposures, including air pollution, water contamination, and occupational hazards, can interact with genetic factors to influence oral health outcomes. For example, exposure to environmental pollutants, such as heavy metals and industrial chemicals, may disrupt immune function, oxidative stress pathways, and DNA repair mechanisms, increasing susceptibility to oral diseases such as periodontitis and oral cancers. Additionally, gene-environment interactions may play a role in the development of oral developmental abnormalities, such as cleft lip and palate, which result from complex interactions between genetic predispositions and environmental exposures during embryonic development.

Understanding the complex interplay between genetic factors and environmental influences is essential for developing holistic approaches to oral health promotion and disease prevention. By considering both genetic vulnerabilities and environmental exposures, clinicians and public health practitioners can tailor interventions to address individual risk factors and promote optimal oral health for all individuals and communities. Moreover, continued research into gene-environment interactions may uncover novel pathways for preventing and treating oral diseases, ultimately improving outcomes and reducing disparities in oral health.

#### **4. Environmental Factors and Dental Health**

Environmental factors exert a significant influence on dental health outcomes, impacting access to care, exposure to oral health risks, and overall oral health disparities. In this section, we explore the role of socioeconomic status in shaping access to dental care and the impact of environmental exposures on oral health risks.

#### **4.1 Socioeconomic Status and Access to Dental Care**

Socioeconomic status (SES) is a key determinant of oral health outcomes, influencing access to dental care, utilization of preventive services, and treatment outcomes. Disparities in oral health across socioeconomic groups reflect inequalities in income, education, employment, and healthcare access, which can exacerbate oral health disparities and contribute to poorer oral health outcomes among disadvantaged populations.

Individuals from low-income households often face barriers to accessing dental care, including limited financial resources, lack of dental insurance coverage, and geographic barriers to care. As a result, they may delay or forgo dental visits, leading to higher rates of untreated dental disease and more advanced oral health problems. Moreover, individuals with low SES may have limited awareness of oral health risks and preventive measures, further contributing to disparities in oral health outcomes.

Socioeconomic disparities in access to dental care are compounded by disparities in oral health literacy and health-seeking behaviors. Individuals with low SES may have limited knowledge of oral hygiene practices, dietary habits, and risk factors for dental diseases, making them less likely to engage in preventive behaviors and seek timely dental care. Moreover, social determinants of health, such as housing instability, food insecurity, and exposure to psychosocial stressors, can further undermine oral health and exacerbate oral health disparities among disadvantaged populations.

Addressing socioeconomic disparities in access to dental care requires a multifaceted approach that addresses structural barriers, promotes health equity, and expands access to preventive services. Policy interventions aimed at increasing Medicaid coverage for dental services,

expanding community-based dental clinics, and implementing school-based oral health programs can help improve access to care for underserved populations. Moreover, efforts to improve oral health literacy, promote preventive behaviors, and reduce social determinants of health can help empower individuals to take control of their oral health and reduce disparities in oral health outcomes.

#### **4.2 Environmental Exposures and Oral Health Risks**

Environmental exposures play a significant role in shaping oral health risks, influencing susceptibility to dental diseases, oral developmental abnormalities, and oral soft tissue conditions. Air pollution, water contamination, occupational hazards, and exposure to hazardous chemicals can all impact oral health through various mechanisms, including inflammation, oxidative stress, and disruption of oral microbiota.

Air pollution, particularly fine particulate matter (PM<sub>2.5</sub>) and nitrogen dioxide (NO<sub>2</sub>), has been associated with increased risk of periodontal diseases, dental caries, and oral cancer. Inhalation of air pollutants can induce systemic inflammation, oxidative stress, and immune dysregulation, which may contribute to the pathogenesis of oral diseases. Moreover, air pollutants can accumulate on tooth surfaces and oral mucosa, promoting bacterial adhesion and colonization, and exacerbating oral health risks.

Water contamination with fluoride and other contaminants can also impact oral health outcomes. Fluoridation of water supplies has been effective in reducing the prevalence of dental caries by promoting remineralization of tooth enamel and inhibiting acid production by oral bacteria. However, excessive fluoride exposure can lead to dental fluorosis, a cosmetic condition characterized by discoloration and pitting of tooth enamel. Moreover, water contamination with

heavy metals, pesticides, and industrial chemicals may pose additional oral health risks, including developmental abnormalities, oral cancers, and systemic health effects.

Occupational hazards, such as exposure to dust, fumes, and chemicals, can also impact oral health. Workers in industries such as mining, construction, and manufacturing may be exposed to hazardous substances that can cause oral diseases, including periodontal diseases, dental erosion, and oral cancers. Moreover, occupational exposures to silica, asbestos, and other carcinogens have been associated with increased risk of oral cancers, particularly among workers in high-risk occupations.

Addressing environmental exposures and oral health risks requires concerted efforts to reduce pollution, regulate hazardous substances, and protect vulnerable populations from environmental hazards. Policy interventions aimed at improving air quality, regulating water fluoridation, and enforcing occupational safety standards can help mitigate environmental risks and promote oral health for all individuals and communities. Moreover, public health initiatives aimed at raising awareness of environmental factors and promoting preventive behaviors can empower individuals to protect themselves from environmental hazards and reduce their risk of oral diseases.

## **5. Integrative Approaches to Promote Oral and General Health**

Promoting optimal oral and general health requires a holistic approach that considers the complex interactions between biological, behavioral, and environmental factors. In this section, we explore integrative strategies for improving dental health and address the intersections of genetics, environment, and food habits in promoting overall well-being.

### **5.1 Holistic Strategies for Improving Dental Health**

Holistic approaches to dental health focus on addressing the underlying determinants of oral diseases, promoting preventive behaviors, and supporting overall well-being. These strategies emphasize the importance of considering the interconnectedness of oral health with systemic health and the broader social and environmental context in which individuals live.

One key aspect of holistic dental care is promoting preventive behaviors and early intervention. This includes educating individuals about the importance of oral hygiene practices, such as brushing and flossing, regular dental check-ups, and healthy dietary habits. Additionally, preventive measures such as dental sealants, fluoride treatments, and professional cleanings can help reduce the risk of dental diseases and maintain optimal oral health.

Incorporating complementary and alternative therapies into dental care can also support holistic approaches to oral health. Practices such as acupuncture, herbal medicine, and mindfulness-based stress reduction techniques may help alleviate dental anxiety, reduce pain and inflammation, and promote overall well-being. Moreover, integrating dental care with other healthcare services, such as primary care, mental health, and nutrition counseling, can help address the broader health needs of individuals and promote holistic wellness.

Community-based approaches to dental health promotion are another key component of holistic dental care. Engaging with community organizations, schools, and local stakeholders can help raise awareness of oral health issues, promote healthy behaviors, and increase access to dental services for underserved populations. Additionally, incorporating oral health education into school curricula, workplace wellness programs, and community health initiatives can help empower individuals to take control of their oral health and reduce disparities in dental outcomes.

## **5.2 Addressing Intersections of Genetics, Environment, and Food Habits**

Understanding the intersections of genetics, environment, and food habits is essential for promoting optimal oral and general health. Integrative approaches that consider these factors can help identify personalized risk factors, tailor interventions to individual needs, and promote positive health behaviors.

Genetic testing and risk assessment can help identify individuals at increased risk of oral diseases and guide personalized prevention and treatment strategies. By understanding an individual's genetic predispositions, healthcare providers can provide targeted recommendations for dietary modifications, lifestyle changes, and preventive interventions to mitigate the risk of dental diseases.

Environmental factors, including air pollution, water contamination, and occupational hazards, also play a significant role in shaping oral health outcomes. Addressing environmental exposures and promoting policies that protect against environmental hazards can help reduce oral health risks and promote overall well-being for individuals and communities.

Furthermore, promoting healthy food habits and addressing disparities in access to nutritious foods are essential for supporting oral and general health. Public health initiatives aimed at improving food access, promoting healthy eating behaviors, and reducing consumption of sugary and acidic foods can help reduce the burden of dental diseases and improve overall well-being.

By addressing the intersections of genetics, environment, and food habits, integrative approaches to oral and general health can help promote optimal health outcomes for individuals and communities. By considering the complex interactions between biological, behavioral, and



environmental factors, healthcare providers can develop personalized interventions that address the root causes of oral diseases and support holistic wellness.

## **6. Conclusion**

In conclusion, the interplay between food habits, genetics, and environmental factors exerts a profound influence on oral and general health outcomes. Dietary choices, genetic predispositions, and environmental exposures collectively shape susceptibility to dental diseases, oral developmental abnormalities, and oral soft tissue conditions. Understanding these multifaceted influences is essential for developing effective strategies to promote optimal oral and general health.

Holistic approaches to dental health emphasize the importance of addressing the underlying determinants of oral diseases, promoting preventive behaviors, and supporting overall well-being. Integrative strategies that consider the intersections of genetics, environment, and food habits can help identify personalized risk factors, tailor interventions to individual needs, and promote positive health behaviors. By addressing the root causes of oral diseases and supporting holistic wellness, healthcare providers can improve outcomes for individuals and communities.

## **7. Future Directions and Implications**

Moving forward, there are several key areas for future research and action to advance our understanding of the interplay between food habits, genetics, and environmental factors in shaping oral and general health:

1. **Further Research on Gene-Environment Interactions:** Continued research into gene-environment interactions is needed to elucidate the complex mechanisms underlying oral health outcomes. Integrating genetic data with environmental exposures and dietary

patterns can help identify novel risk factors and therapeutic targets for preventing and treating oral diseases.

2. **Promotion of Health Equity:** Addressing disparities in access to dental care, healthy food options, and environmental exposures is essential for promoting health equity and reducing disparities in oral health outcomes. Policy interventions aimed at improving socioeconomic conditions, expanding access to preventive services, and reducing environmental hazards can help create environments that support optimal oral and general health for all individuals and communities.
3. **Integration of Oral Health into Primary Care:** Integrating oral health screenings, education, and preventive services into primary care settings can help improve access to dental care and promote early detection and management of oral diseases. By addressing oral health as an integral component of overall health, healthcare providers can promote holistic wellness and improve outcomes for patients.
4. **Lifestyle and Behavioral Interventions:** Promoting healthy lifestyle behaviors, including balanced dietary habits, regular physical activity, and stress management techniques, can support oral and general health. Public health initiatives aimed at promoting healthy behaviors and reducing risk factors for oral diseases can help empower individuals to take control of their health and well-being.

In conclusion, addressing the complex interplay between food habits, genetics, and environmental factors is essential for promoting optimal oral and general health. By adopting holistic approaches that consider the interconnectedness of these factors, healthcare providers

can develop personalized interventions that address the root causes of oral diseases and support holistic wellness for individuals and communities alike.

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