

Digital Marketing of Sugary Foods and Oral Health Among Children and Adolescents

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ABSTRACT

Digital marketing of sugary foods and beverages has become a significant public health concern due to its growing influence on the dietary behaviors of children and adolescents. Through social media platforms, influencer marketing, advergames, mobile applications, and personalized advertisements, food and beverage companies increasingly promote energy-dense, nutrient-poor products to young audiences. Increased sugar consumption is a major contributor to dental caries, dental erosion, early childhood caries, disruptions in the oral microbiome, and elevated caries risk. Adolescents may be especially vulnerable due to extensive use of digital platforms. Existing policies often remain inadequate in addressing sophisticated digital marketing techniques, including personalized advertising and data-driven promotional strategies directed at young users. Comprehensive measures such as stronger regulation of online food marketing, restrictions on the commercial use of children's personal data, improvements in digital and health literacy, and the strategic use of digital technologies for oral health education are needed to counter these adverse effects. Collaborative efforts involving policymakers, public health organizations, healthcare professionals, educators, families, and technology companies are crucial to reducing the influence of unhealthy food marketing and supporting healthier dietary choices and improved oral health among children and adolescents.

Keywords: Digital food marketing; Sugar-rich foods; Oral health; Dental caries; Dental erosion; Children; Adolescents; Social media; Health promotion.

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INTRODUCTION

Oral health is an essential component of overall systemic health. It is a condition wherein the teeth, mouth and the orofacial structures allow individuals to carry out their daily essential functions such as eating, speaking, breathing and enables the overall well-being and improved self-confidence of the individual ⁽¹⁾. Oral health is a key to both physical and mental well-being. It is continually influenced by an individual's experiences, perceptions, expectations, and capacity to adapt to changing circumstances throughout life. It encompasses the physiological, social, and psychological factors that play a vital role in maintaining a good quality of life. Oral health is a major non-communicable disease that is largely preventable, yet it remains a public health burden. Untreated dental caries is the most prevailing health burden across the world. This burden continues to increase globally with urbanization and adapting sedentary life style changes, increased availability of ultra processed and sugary foods.

Excessive and unrealistic digital advertisements of these ultra-processed foods and non-alcoholic drinks specifically targeting the children and adolescent is incubating the excessive consumption of unhealthy foods. The term “child or adolescent ” is used to cover all children and adolescents under the age of 18 years. The adolescents belonging to upper middle and lower middle-income countries are extensively indulged in digital era and increased consumption of unhealthy and sugar rich foods, irrespective of the platform used. This concept of digital marketing has led to the increase of childhood obesity, increased in dental caries among children and adolescents and can lead to further complications such as Diabetes, Cardiovascular diseases and certain types of cancers ⁽²⁾. The eating behaviors of children and adolescents are largely influenced by the **food environment**, which encompasses the physical, economic, political, and sociocultural settings that shape how individuals access, purchase, prepare, and consume food.⁽³⁾ Modern food environments increasingly provide easy access to inexpensive, highly processed foods and non-alcoholic beverages that are high in unhealthy fats, sugars, and salt, while these products are often heavily promoted to consumers⁽⁴⁻⁶⁾.

Marketing plays a significant role within the food

environment and is commonly encountered by children and adolescents in places such as schools, sports facilities, television programming, and digital platforms, including websites, social media, and online gaming environments.^(7,8) With increased access to electronic devices and greater time spent online compared with previous decades, children and adolescents are exposed to a growing volume of digital food and beverage advertising.⁽⁹⁻¹²⁾ Consequently, the food industry has expanded its use of digital media alongside traditional channels such as television to broaden its marketing reach. Digital advertising is often more cost-effective than conventional forms of marketing. To enhance the effectiveness of their campaigns, food and beverage companies employ various digital marketing techniques specifically designed to attract young audiences. These strategies include colorful and engaging visuals, cartoon and brand characters, social media influencers, humor, fantasy themes, celebrity endorsements from sports and entertainment industries, interactive features such as likes, comments, and shares, as well as promotional links to contests and entertainment events. Children are particularly attracted to advertisements that emphasize enjoyment, fun, and entertainment rather than health-related or nutritional messages. Marketing techniques such as promotional gifts, contests, collectible items, celebrity endorsements, and cartoon characters are especially effective in capturing children's attention. These approaches enhance engagement, improve brand recognition and recall, foster positive attitudes toward products, and ultimately increase children's requests for and purchases of the advertised foods and beverages.⁽¹³⁻¹⁹⁾ Children spend a significant portion of their online time engaging in activities such as social networking, watching videos, listening to music, instant messaging, completing school-related tasks, and playing online games. Consequently, digital marketing strategies delivered through social media platforms and online gaming environments are well aligned with their everyday online behaviors.

Social media refers to a broad range of internet-based platforms that enable users to create, share, and interact with content. These platforms provide companies with opportunities to communicate directly with consumers, promote their products, and strengthen brand loyalty.

Another increasingly common marketing approach is **advergaming**, where advertising content is integrated into video games. By embedding commercial messages within gameplay, advergames blur the distinction between entertainment and advertising. These games are intentionally designed to be engaging and enjoyable, encouraging children to repeatedly visit brand websites and interact with branded content over extended periods.⁽²⁰⁻²⁷⁾

Recognizing these concerns, the World Health Organization (WHO) has advocated for substantial reductions in the marketing of unhealthy foods to children as a key strategy for addressing the global rise in childhood obesity and poor dietary habits. However, in many countries, responsibility for regulating food marketing has largely been delegated to industry-led self-regulatory programs.⁽²⁸⁻³¹⁾

How Digital Marketing Differs from Traditional Advertising:

Although digital food marketing promotes many of the same unhealthy products as traditional media advertising and produces similar adverse effects, it presents additional challenges. Traditional advertising, such as television commercials, delivers marketing messages directly to a broad audience and clearly separates advertisements from entertainment content. Resisting these messages requires individuals to recognize the persuasive intent of the advertisement and critically evaluate its claims, a process that can be difficult even for adults. However, both traditional and digital food marketing are often designed to influence consumers without relying on conscious, rational decision-making.

In digital environments, branded content is frequently integrated into games, videos, influencer posts, and other forms of entertainment, making it more difficult to identify as advertising. This form of **stealth marketing** reduces awareness of persuasive intent while associating brands with positive emotions generated through enjoyable content. Adolescents who show stronger neural responses to food advertisements may be more likely to choose and consume unhealthy foods and may face an increased risk of weight gain over time.⁽³²⁾

Social media marketing further strengthens these

effects by embedding promotional content within peer networks. Children and adolescents often engage with, like, and share branded content, unintentionally becoming promoters of products. Unhealthy food-related posts tend to attract greater attention and engagement than healthy food messages, and exposure to such content can positively influence perceptions of both brands and peers. Digital platforms also allow companies to build direct relationships with young consumers through influencers, celebrities, and virtual identities in online environments.⁽³³⁻³⁶⁾ Another distinctive feature of digital marketing is its reliance on personal data. Online activities can be continuously tracked, analyzed, and used to deliver highly personalized advertising in real time. Food companies and technology firms employ sophisticated data analytics and advertising technologies to target children within their digital spaces. Even educational websites commonly used by children may contain targeted advertisements or have unclear policies regarding behavioral advertising.⁽³³⁾

Adolescents as a Particularly Vulnerable Group:

Most policies regulating unhealthy food marketing focus on children younger than 13 years because research has demonstrated that younger children have limited ability to recognize and resist persuasive messages. These regulations generally assume that adolescents possess sufficient cognitive skills and advertising awareness to protect themselves from marketing influences.

However, while adolescents become better at recognizing advertising, they remain highly susceptible to its effects. Increased cognitive maturity does not diminish their enjoyment of advertisements, reduce positive attitudes toward promoted products, or eliminate brand preferences developed through years of exposure. In addition, developmental characteristics unique to adolescence may actually increase vulnerability to marketing strategies.^(37 38)

Peer influence plays a particularly important role during adolescence, making social media marketing especially powerful. Promotional messages shared by friends, influencers, and celebrities can shape social norms and preferences regarding food choices. Adolescents are highly

sensitive to social acceptance and status, increasing the effectiveness of marketing that emphasizes popularity or uses admired public figures. Furthermore, ongoing brain development during adolescence is associated with heightened reward sensitivity and relatively limited impulse control, making adolescents more responsive to appealing food advertisements.

Adolescents also have greater independence and purchasing power than younger children, allowing them to make their own food choices. Since dietary habits established during adolescence often continue into adulthood, marketing targeted at this age group can have both immediate and long-term effects on health behaviors. Despite this, many countries continue to permit extensive advertising of sugary drinks, fast food, candy, snacks, and energy drinks to adolescents. Data protection regulations likewise tend to focus on younger children, allowing marketers to use adolescents' personal information and online activities to create highly targeted campaigns tailored to their developmental vulnerabilities.

Oral Health Implications:

Dental Caries:

Dental caries is a multi-factorial condition that develops through the interaction of cariogenic bacteria, dietary sugars, and susceptible tooth surfaces over time⁽³⁸⁾. Repeated intake of these

influencer endorsements may further encourage regular intake of these beverages, increasing erosion risk.

Alterations in the Oral Microbiome:

The oral microbiome comprises a diverse community of microorganisms that play a crucial role in maintaining oral health through ecological balance and microbial homeostasis. Disruptions to this balance, known as dysbiosis, can contribute to the development of various oral diseases, including dental caries, periodontal diseases, and oral infections. Dietary habits are among the most important factors influencing the composition and function of the oral microbiome. Frequent sugar consumption influences the ecological balance of the oral microbiome. This shift in microbial composition leads to a more

sugar rich foods throughout the day increases the frequency of acid attacks on tooth surfaces, prolongs periods of low oral pH, and enhances the risk of enamel demineralization. Frequent consumption of sugar-rich foods promoted through digital marketing increases acid production within dental plaque biofilms, leading to enamel demineralization and caries development. Consequently, the widespread promotion of sugary foods and beverages through digital platforms contributes to unhealthy dietary patterns that increase the prevalence and severity of dental caries among children and adolescents⁽³⁹⁾.

Dental Erosion:

Dental erosion is the irreversible loss of dental hard tissues caused by chemical dissolution from acids. Unlike dental caries, which results from acids produced by plaque microorganisms, dental erosion occurs when tooth surfaces are directly exposed to intrinsic acids, such as gastric acid from gastroesophageal reflux or vomiting, or extrinsic acids present in foods and beverages. The repeated exposure of enamel and dentin to acidic substances leads to progressive mineral loss, surface softening, and eventual tooth structure destruction. Digital promotion of carbonated beverages and energy drinks may contribute to increased acidic beverage consumption, which is associated with dental erosion.⁽⁴⁰⁾ Social media advertising and

acidic oral environment, favoring the growth of cariogenic microorganisms and disrupting the ecological balance of the oral cavity. According to the ecological plaque hypothesis, repeated exposure to fermentable carbohydrates favors acidogenic and aciduric bacteria such as *Streptococcus mutans* and *Lactobacillus* species, increasing susceptibility to dental caries⁽⁴¹⁾. By encouraging greater consumption of sugar-rich foods, digital food marketing may indirectly contribute to dysbiosis of the oral microbial ecosystem.

Early Childhood Caries (ECC):

Early Childhood Caries (ECC) is a severe form of dental caries affecting children younger than six years of age and is characterized by the presence of one or more decayed, missing (due to caries),

or filled tooth surfaces in any primary tooth. ECC is recognized as a significant public health problem because of its high prevalence, rapid progression, and substantial impact on children's oral and general health. Untreated ECC can cause pain, infection, difficulty in eating and speaking, impaired growth, disturbed sleep, and reduced quality of life. Marketing strategies directed at parents through social media platforms may influence household purchasing decisions and feeding practices. Increased availability and consumption of sugar-containing snacks and beverages during early childhood have been recognized as major contributors to Early Childhood Caries.⁽⁴²⁾ Digital marketing therefore represents a potential upstream determinant of ECC.

Increased Caries Risk Profile:

Caries risk is determined by the balance between protective factors, such as fluoride exposure, adequate salivary flow, and good oral hygiene, and risk factors, including frequent sugar consumption, poor oral hygiene practices, cariogenic bacterial load, and limited access to preventive dental care. When risk factors outweigh protective factors, the probability of caries initiation and progression increases substantially. Digital marketing of sugary foods and beverages can contribute significantly to an unfavorable caries risk profile, particularly among children and adolescents.⁽⁴³⁾ Increased exposure to digital marketing may promote behaviors that adversely affect multiple caries risk factors, including frequency of sugar consumption and plaque accumulation.

Potential Solutions and Recommendations:

Digital marketing has strengthened the connection between young people and food brands, increasing its influence on dietary behaviors, long-term health, and the protection of fundamental rights. By continuously engaging children and adolescents through personalized and interactive promotional strategies, digital

marketing can shape their preferences, consumption patterns, self-perceptions, and lifestyles. Consequently, stronger government-led regulations are necessary to limit digital marketing of unhealthy foods to children and adolescents and to address the substantial influence that food and technology companies exert over young consumers.⁽⁴⁴⁾

Stakeholder	Recommended Action
Governments	Governments should implement stronger laws and regulations to limit the marketing of unhealthy foods and beverages to children, particularly through digital platforms and online media.
Governments (Data Protection)	Authorities should establish policies that prevent the inappropriate collection, use, and exploitation of children's personal data for targeted online advertising. Protecting children's privacy and safeguarding them from commercial exploitation should be a priority.
Technology Companies	Digital platforms should adopt responsible data practices by reducing or eliminating the collection and use of children's personal information for advertising purposes and by restricting targeted marketing directed at young users.
Food, Beverage, Technology, and Entertainment Industries	Companies should strengthen self-regulatory policies and close existing loopholes that permit the continued promotion of unhealthy products to children and adolescents.
Parents, Educators, and Healthcare Providers	Greater awareness of children's digital experiences and the potential harms of online food marketing can help these groups advocate more effectively for stronger protections and encourage industry accountability.
Public Health Community	Public health professionals and organizations should increase awareness about the extent and consequences of digital food marketing and identify strategies that empower individuals and communities to safeguard children and adolescents from harmful marketing practices.

for improving oral health outcomes, particularly among children, adolescents, and underserved communities.

1. Dissemination of Evidence-Based Oral Health Information

Digital platforms can be used to disseminate accurate and evidence-based information regarding oral hygiene practices, fluoride use, dietary counseling, and preventive dental care. Social media campaigns, educational websites, podcasts, and videos can rapidly reach large populations and promote healthy oral health behaviours.^(44,45)

2. Increasing Oral Health Awareness

Platforms such as Facebook, Instagram, YouTube, WhatsApp, and X can be utilized to increase awareness regarding:

- Prevention of dental caries and periodontal diseases.
- Importance of regular dental visits.

- Harmful effects of excessive sugar consumption.
- Tobacco-related oral diseases.
- Early signs and symptoms of oral cancer.

Such campaigns can improve oral health literacy and encourage preventive behaviors.

3. School-Based Digital Oral Health Education

Digital learning platforms can complement traditional school oral health programs by providing:

- Virtual oral health classes.
- Interactive educational modules.
- Gamified learning experiences.
- Online oral health competitions and awareness campaigns.

These approaches may increase engagement and reinforce positive oral health behaviors among children and adolescents⁽⁴⁶⁾

4. Counter-Marketing Against Sugary Foods and Beverages

Instead of promoting sugar-rich products, digital media should be utilized to disseminate messages that encourage healthier dietary behaviors and highlight the oral health consequences of excessive sugar consumption.

Examples include:

- "Choose water instead of sugary drinks."
- "Reduce sugar, reduce cavities."
- "Protect your smile by making healthier food choices."

Such counter-marketing strategies may help reduce the influence of commercial food advertising and support caries prevention efforts.

5. Early Detection and Screening of Oral Diseases

Digital technologies, including smartphone-based imaging, artificial intelligence-assisted diagnostic tools, and tele-screening platforms, can facilitate early identification of oral diseases.⁽⁴⁷⁾

Applications include:

- Dental caries screening.
- Detection of oral potentially malignant disorders.
- Early diagnosis of oral cancer.
- Monitoring oral lesions and disease progression.

Early detection improves treatment outcomes and reduces disease burden.

6. Reaching Underserved and Rural Populations

One of the greatest advantages of digital media is its ability to overcome geographical barriers. Digital platforms can deliver oral health education, preventive services, and specialist consultations to populations with limited access to oral healthcare.

This can help:

- Reduce oral health disparities.
- Improve access to care.
- Promote health equity.
- Strengthen outreach in resource-limited settings.

This is particularly relevant in countries such as India, where the burden of tobacco-related oral cancer remains substantial.

7. Mobile Health (mHealth) Applications

Mobile applications can facilitate:

- Toothbrushing reminders.
- Dietary tracking.
- Caries risk assessment.
- Appointment scheduling.

- Personalized oral health education.

Such interventions have shown potential to improve oral hygiene compliance and self-care behaviors.

Conclusion

Digital marketing of sugary foods and beverages represents a significant and emerging challenge for oral health promotion among children and adolescents. Through personalized advertisements, influencer endorsements, advergames, and social media campaigns, food companies can shape dietary preferences and consumption patterns in ways that increase exposure to cariogenic products. The resulting increase in sugar intake contributes to the development of dental caries, dental erosion, unfavorable changes in the oral microbiome, and reduced oral health-related quality of life.

Importantly, the impact of digital food marketing extends beyond individual behavior and reflects broader commercial influences on oral health. Children and adolescents are particularly vulnerable to persuasive marketing techniques, and repeated exposure may normalize unhealthy dietary behaviors that persist throughout life. Furthermore, these effects may disproportionately affect disadvantaged populations, thereby contributing to oral health inequalities.

Addressing the oral health consequences of digital food marketing requires a comprehensive public health approach that combines regulatory action, oral health promotion, digital literacy education, and multisectoral collaboration. Future research should investigate the direct relationship between digital marketing exposure and oral health outcomes, particularly dental caries incidence and oral health-related quality of life. Strengthening policies that limit children's exposure to marketing of sugary foods may represent a valuable population-level strategy for reducing the burden of oral diseases and promoting lifelong oral health.

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