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Review Article

Sweet taste preferences and dental caries in children

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Abstract

Dental caries is a multifactorial disease in which, besides the classical risk factors (enamel quality, sugar intake, cariogenic microorganisms, time, and salivary properties), individual taste preferences and genetically determined differences in sweet taste perception play a significant role. Sweet taste has an evolutionary function related to the identification of energy sources, and the preference for it is innate but is modified by age and early dietary exposure.

Taste perception is mediated by specific receptors in the taste buds of the tongue, which transmit signals via G-proteins and activate neural pathways associated with hedonic reward. Genetic polymorphisms in genes such as TAS1R3 and GNAT3 determine individual sensitivity to sweet taste and influence dietary behavior. Exposure to sugars during prenatal and early postnatal development, as well as family and social environments, further shape long-lasting taste preferences.

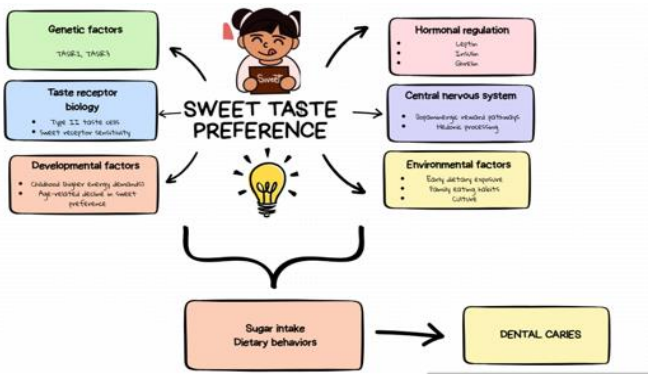
Increased consumption of free sugars leads to acidification of the oral environment, promoting enamel demineralization and the development of dental caries. Evidence shows that children with a higher preference for sweetness consume more sugars and exhibit a greater risk of caries. In addition, media exposure and food advertising further reinforce these behavioral patterns.

In conclusion, sweet taste preference represents a complex endophenotype shaped by the interaction of genetic, biological, and social factors, which plays a key role in dietary behavior and the risk of dental caries in childhood.

Keywords

sweet tooth, sweet taste preference, behavioral endophenotype, pediatric dentistry

The etiology of dental caries is multifactorial. In addition to the main risk factors (enamel quality, fermentable carbohydrates, cariogenic microorganisms, time, and salivary properties), its pathogenesis also involves individual taste preferences and the resulting dietary behavior, as well as single-nucleotide polymorphisms associated with sweet taste perception, swhich are genetically determined in each individual (1, 2, 3, 4, 5). The complex interplay among these biological, genetic, and behavioral factors is summarized in Figure 1.



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Review Methodology

This manuscript is a **narrative review** that aims to summarize the current evidence regarding sweet taste preference and its association with dental caries. A literature search was performed using the PubMed, Scopus, and Web of Science databases to identify relevant publications. The search included combinations of the keywords *sweet taste*, *sweet taste preference*, *sugar*, *sweeteners*, *dental caries*, *children*, *adolescents*, *TAS1R2*, and *TAS1R3*. Original research articles, systematic reviews, and meta-analyses published in English were considered. Reference lists of relevant articles were also screened to identify additional publications.

Physiology of sweet taste preferences

The sweet taste is evolutionarily linked to the organism's ability to identify energy sources, primarily carbohydrates and simple sugars. In newborns and young children, the preference for sweetness is innate and universal. With age and increasing exposure to a variety of tastes, a gradual reduction in this preference threshold is observed, although it remains a significant behavioral motivator (6). Despite the fact that sweet taste preference declines with age, the underlying mechanisms remain incompletely understood. Current evidence does not indicate that this developmental change is primarily explained by alterations in the density or proportion of Type II taste receptor cells. Instead, it is thought to reflect the combined effects of reduced energy requirements after the rapid growth period, maturation of central reward circuits, endocrine regulation of appetite, and accumulated dietary experience. Considering our interest in the caries process in the pediatric population, we recognize the importance of understanding the factors that shape sweet taste preferences early in life. High exposure to sugars in early childhood can establish long-lasting patterns of preference for sweet foods, which poses a serious risk for the development of oral pathology in the oral cavity of adolescents (7).

Although most studies support an association between sweet taste preference and increased sugar intake, the strength of this relationship varies considerably across populations. These discrepancies may reflect differences in participants' age, dietary assessment methods, genetic background, and the psychophysical tests used to evaluate sweet taste preference.

Peripheral receptor system for taste perception

Carbohydrates represent a primary energy source that is often associated with sweet taste and its strong hedonic appeal. The emotions experienced during the consumption of sweet foods (different sugars (e.g., glucose, fructose, and sucrose)) result from complex processes mediated both by peripheral sweet taste receptors and multiple brain structures that are highly conserved from a phylogenetic perspective (8).

In recent years, significant progress has been made in elucidating the initial mechanisms involved in sweet taste recognition (9,10), as well as the brain mechanisms underlying the strong hedonic response that arises during the consumption of sweet stimuli (11,12).

Sweet taste perception as a sensory experience begins on the tongue. The recognition of taste stimuli occurs in taste cells, which are organized into taste buds grouped within different types of papillae on the surface of the tongue. When sweet stimuli activate specific receptors on taste cells, the signal is transmitted via G-proteins, which activate brain circuits responsible for generating pleasure. It is within these pathways that both the perception of sweet taste and the associated hedonic experiences arise (8, 13).

Within each taste bud, taste cells are morphologically classified into three main types—Type I, Type II, and Type III—each performing distinct functional roles. Type II cells express receptors for sweet, bitter, and umami tastes, as well as components of the corresponding intracellular signaling cascades. Unlike classical synapses, these cells do not form traditional chemical synapses with afferent nerve fibers but instead communicate with nerve endings and neighboring cells (14,15,16). Type III cells form conventional synapses with afferent nerve fibers, and evidence suggests that at least some Type III cells function as receptors for sour stimuli (17,18).

Type I cells are primarily regarded as supporting cells with glia-like functions; however, recent studies indicate that they also participate in the detection of salty taste (19,20,21).

Genetic factors related to taste perception

Genetic variability is a key determinant of individual differences in taste perception and, in particular, preferences for sweet foods. Polymorphisms in genes encoding taste receptor proteins and signaling pathways modulate sensitivity to different taste qualities already at the level of taste cells (22). In addition, environmental factors may also influence the expression of these genes, thereby altering perception thresholds, dietary preferences, and potentially the risk of nutrition-related diseases, including dental caries (23). In this context, understanding the genetic determination of taste is

essential for developing more personalized models for assessing caries risk and dietary behavior in children.

Genetic variability has a significant influence on the perception of sweet and umami tastes. Fushan et al. identified two single nucleotide polymorphism SNP variants located in the regulatory region of TAS1R3 that are strongly associated with human sensitivity to sucrose. The same research team also evaluated whether variations in other genes involved in taste signal transduction could affect sweet taste perception. Their comparative analyses revealed a statistically significant association between sucrose responsiveness and genetic variation in GNAT3, a gene encoding the taste-specific G protein α-subunit α-gustducin, a key component of the taste cell signaling pathway (24).

In addition, Raliou et al. suggests that variations in detection thresholds for monosodium glutamate are also associated with polymorphisms in the TAS1R1 and TAS1R3 genes, which are involved in the receptor complex mediating umami taste perception (25). These findings highlight that genetic differences in taste receptors and signaling molecules shape individual taste profiles, with potential implications for dietary behavior and health risks, including a preference for sweetness that influences a caries-prone oral environment.

Current evidence regarding the influence of genetic polymorphisms on sweet taste preference remains inconsistent. While several studies have reported significant associations between TAS1R2 and TAS1R3 variants and sugar consumption, others failed to replicate these findings, suggesting that environmental factors may partially mask genetic effects.

Taste preferences and dental caries in children

Taste is a powerful determinant of dietary behavior throughout the life course and represents the product of several sensory systems, most notably taste and olfaction. The flavors of foods that children initially prefer (e.g., sweet and salty foods) or reject (e.g., bitter foods) largely reflect their fundamental biological characteristics related to survival (4,26,27).

Taste preferences begin to form even before birth, as the fetus's first sensory experiences are shaped through gustatory and olfactory stimuli in the amniotic fluid. Over the past two decades, numerous scientific studies have shown that a variety of flavor compounds—originating from foods and aromas ingested or inhaled by the mother—can pass into the amniotic fluid during pregnancy and are later also detected in breast milk after birth (6). In this way, the fetus and newborn are exposed to a wide spectrum of taste stimuli already in the prenatal and early postnatal periods, laying the foundation for their future taste preferences and dietary patterns.

Consequently, it is not surprising that preferences for salty, sweet, and bitter tastes may be shaped to some extent during early prenatal development through repeated exposure to different flavors consumed by the mother. This early formation of taste preferences has long-term consequences that manifest in childhood and determine preferences for specific flavor profiles, including sweet taste, which is later associated with dietary behavior and oral health.

Preferences for sweetness and frequent intake of fermentable sugars (sucrose) are major risk factors for the development of dental caries in both children and adults. In recent years, the literature has addressed not only the direct relationship between sugar consumption and caries, but also the role of individual taste preferences (a behavioral endophenotype), which are shaped by environmental, behavioral, and genetic determinants (28,29,30).

A large number of scientific studies and meta-analyses show that frequent intake of fermentable sugars is one of the strongest and most well-documented risk factors for the development of dental caries (31). Increased frequency of sugar exposure (sucrose) has been associated with repeated and prolonged drops in the pH of the dental biofilm, creating conditions for enamel demineralization and supporting the growth of acidogenic and aciduric microorganisms such as *Streptococcus mutans* and *Lactobacillus* spp. (32). The World Health Organization emphasizes that even small amounts of fermentable sugars consumed multiple times per day significantly increase the risk of caries, especially in children and adolescents, where salivary regulation and oral hygiene habits are either compromised or not yet well established (33). Dental health specialists recommend limiting fermentable sugar intake to less than 10% of total daily energy intake in order to reduce caries risk (34). From a preventive perspective, this makes the reduction of sugar intake and the frequency of between-meal carbohydrate consumption a key component of both public health strategies and individual oral disease prevention.

Behavioral endophenotype in sweet taste perception

In addition to individual differences in sweet taste perception, people also differ in the degree to which they like foods with high sweetness. Two response patterns have been described: in Type I, preference increases with sucrose concentration up to moderate levels and then declines, whereas in Type II, liking continues to increase with rising sucrose concentration and reaches a plateau without decreasing at higher levels of sweetness (35).

Individual preferences for sweetness can be assessed through questionnaires, behavioral tests, or combined methods. It has been indicated that children with a higher preference for sweet taste consume more sugars (sucrose) and exhibit a higher prevalence of dental caries (26).

Assessment of sweet taste preferences is divided into two main approaches: (1) measurement of sensitivity—through taste detection thresholds and identification of taste quality—and (2) hedonic evaluation—preference and desire for consumption. Taste sensitivity tests assess an individual's ability to detect and identify a specific taste stimulus, whereas hedonic tests measure the inclination toward intake. In many cases, both methods are combined to obtain a more comprehensive picture of the factors shaping the so-called endophenotype (9).

Influence of environmental and social factors on sweet taste preferences

Preference for sweet taste represents a complex endophenotype shaped by the interaction between biological factors (including genetic and epigenetic influences), as well as social and cultural determinants. The innate preference for sweetness is modified early in childhood under the influence of parental dietary behavior, socioeconomic conditions, and access to foods high in sugar content (36,6).

The family environment plays a central role in shaping taste preferences. As previously mentioned, maternal nutrition during pregnancy and after birth creates the initial foundation for the development of specific preferences in children. Infants who are breastfed are exposed to a wider range of flavor stimuli influenced by the mother's diet compared to formula-fed infants (7).

Parental behavior represents one of the strongest external factors shaping taste preferences and dietary choices in childhood. Evidence shows that children acquire eating patterns through observation and imitation, and at an early age they are more likely to try foods when they see them being offered and consumed by a parent. *Harper and Sanders* suggests that young children are more likely to place food in their mouths when following the example of their mother compared to an unfamiliar model, highlighting the strength of family modeling (37).

Children not only observe their parents' dietary behavior but also directly replicate their taste preferences. When there is a strong preference for sweet foods within the family, the home environment is typically one in which such products are constantly available, which greatly facilitates the child's access to them and increases the likelihood of forming similar dietary habits. Thus, the family food environment and parental behavior function as a primary model that shapes early taste choices and reinforces the tendency toward sweet food consumption in childhood (4).

These findings highlight that family modeling plays a key role in the early formation of dietary preferences, including the tendency toward sweet foods, which may have a direct impact on the risk of developing unhealthy eating patterns and dental caries in childhood and adolescence.

In addition, television functions as a pervasive cultural mediator, providing children with numerous models and messages about eating that can significantly influence their taste preferences, food choices, and physical activity behavior (26). Research shows that approximately 80% of television advertisements targeted at children promote foods of low nutritional value—such as breakfast cereals high in simple sugars, as well as snacks with high levels of sugar, fat, and salt (38). Several studies demonstrate that children's food cravings are directly related to the frequency with which they are exposed to advertisements for these products on television. Goldberg et al. observed that children exposed to such advertising selected significantly more sugar-rich foods compared to children who had not been exposed to advertisements (39).

In older children and adolescents, social media further amplifies this effect by providing a constant stream of visual stimuli, product placements, and influencer content that normalizes and reinforces preferences for energy-dense and sugary foods (40).

The accumulated scientific evidence indicates that individual differences in taste behavior in children result from a complex interaction between genetic determinants and social and family environmental factors. Variations in certain genes encoding sweet taste receptors have been shown to influence sensitivity to sweetness and increased sugar intake, which in turn raises the risk of dental caries. When these biological predispositions are combined with adverse environmental factors during development—early exposure to sugary foods, family dietary behavior patterns, as well as intensive food-related messaging from media and social platforms—an intensified sweet-preference endophenotype is formed, which has significant implications for oral health in childhood.

Sugar Substitutes and Non-nutritive Sweeteners: Effects on Sweet Taste Preference and Dental Caries

The SWEET Project was established to evaluate the health effects, safety, and consumer acceptance of sweeteners and sweetness enhancers as alternatives to sugars. The project investigated a broad range of non-nutritive sweeteners, including plant-derived compounds such as steviol glycosides, as well as synthetic sweeteners including sucralose and acesulfame-K. These compounds were incorporated into sugar-reduced foods and beverages and compared with sucrose-containing products in randomized clinical trials. Overall, the findings suggests that replacing sucrose with sweetener blends preserved sweetness perception while substantially reducing energy intake and postprandial glycaemic responses, without adversely affecting appetite or food intake in the short term (41).

An important aspect of the SWEET Project was the evaluation of whether prolonged exposure to sweeteners modifies sweet taste preference or reinforces a preference

for sweet-tasting foods. Current evidence suggests that, although non-nutritive sweeteners activate the same sweet taste receptor as fermentable sugars, they do not appear to enhance sweet taste preference or produce stronger reward-related responses than sucrose (41). Furthermore, unlike fermentable sugars, most non-nutritive sweeteners are considered non-cariogenic because they are not metabolized by oral bacteria to produce acids (42). Sugar alcohols such as xylitol and erythritol may provide additional oral health benefits by reducing the growth and acidogenicity of cariogenic microorganisms, thereby lowering the risk of dental caries (43). Nevertheless, the long-term effects of habitual sweetener consumption on dietary behavior, sweet taste preference, and oral health remain an active area of research.

Overall, the available literature suggests that the growing use of non-nutritive sweeteners (e.g., aspartame, sucralose, stevia) and sugar alcohols (e.g., xylitol and erythritol) has altered the relationship between sweetness perception and sugar intake. These compounds activate sweet taste receptors and provide a sweet sensation while supplying little or no fermentable carbohydrate. Consequently, they generally present a lower cariogenic potential than sucrose. Sugar alcohols, particularly xylitol, have also demonstrated anticariogenic properties by reducing the growth and acid production of cariogenic bacteria and promoting a less favorable oral environment for dental caries development. Although non-nutritive sweeteners preserve sweet taste perception, current evidence is inconclusive regarding their long-term effects on sweet taste preference and whether they elicit stronger neural reward responses than nutritive sugars, especially in children.

Taken together, the available evidence suggests a multifactorial relationship between sweet taste preference and dental caries. However, the predominance of cross-sectional studies limits causal inference, and further longitudinal studies are needed to clarify these associations.

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Ethical compliance

Not applicable.

Conflict of interest

The authors declare that they have no conflict of interest and no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

Author contributions

Data curation: HT. Formal analysis: HT. Resources: HT. Writing - original draft: HT. Writing - review and editing: HT.

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