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Chewing on Change: How Fast Food Shapes Human Tooth Morphology and Oral Health

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Abstract
Background: The worldwide adoption of diets dominated by fast food characterized by refined sugars, simple carbohydrates, and ultra-processed ingredients has been linked to rising rates of tooth decay, enamel erosion, and periodontal disease. These dietary changes also coincide with long-term shifts in dental wear patterns and jaw morphology driven by reduced masticatory demand.
Objective: This review aims to synthesize current evidence on how habitual fast-food consumption affects tooth structure and function, including enamel thickness, occlusal morphology, and mandibular robustness, and to explore the genetic and evolutionary mechanisms that mediate these effects.
Methods: We conducted a targeted search of major scientific databases using keywords related to fast food, dental evolution, oral health, and genetic adaptation. Studies were selected if they examined enamel microstructure, dental wear, epidemiological associations with oral pathology, or the role of genetic variation in enamel resilience. Data from clinical surveys, anthropological analyses, and molecular genetics were extracted and compared to identify common patterns.
Results: Populations with high fast-food intake exhibit notable enamel thinning and elevated prevalence of caries and periodontal conditions. Comparative analyses of prehistoric and modern samples reveal a reduction in dental attrition and a trend toward smaller, less robust molars and narrower jaws following the advent of convenience foods and cooking technologies. Genetic investigations highlight that variation in enamelin and other loci contributes to differential enamel durability, while prolonged consumption of soft, processed diets has relaxed selective pressures on tooth and jaw strength, enabling genetic drift to narrow allelic diversity.
Conclusion: Habitual fast-food diets not only exacerbate immediate oral-health issues but also appear to drive evolutionary trends toward reduced dental robustness. A multidisciplinary approach integrating clinical dentistry, anthropology, and genomics is essential to develop preventive strategies that safeguard both current oral health and the long-term evolutionary potential of the human dentition.

Keywords: Fast food, Tooth evolution, Nutrition, Malocclusion

Background:
Fast food refers to meals that are prepared and served rapidly, typically utilizing processed ingredients

that can be cooked or reheated with minimal effort [1]. Over the past few decades, global fast-food consumption has risen dramatically, driven by rapid urbanization and the widespread proliferation of quick-service restaurants [2]. Socioeconomic factors such as income level and educational attainment also play a significant role: individuals with higher incomes are more inclined to rely on fast food due to its convenience and accessibility [3]. Despite its practical advantages, excessive fast-food intake has been linked to negative health outcomes, notably obesity and cardiovascular disease. Indeed, research indicates that frequent fast-food consumption elevates the risk of obesity and related metabolic disorders, particularly among adolescents and children [4].
Concomitant with this surge in fast-food consumption, human dietary patterns have shifted away from coarse, fiber-rich foods toward more highly processed and refined options. Such changes have profound implications for dental development and wear patterns. During the hunter-gatherer era, the consumption of hard, fibrous foods resulted in pronounced dental attrition. Transitioning to agriculture introduced softer, more easily masticated foods, which in turn altered occlusal wear patterns [5]. The reduced masticatory demand not only diminishes the natural wear that maintains tooth form but also increases susceptibility to demineralization and cariogenic challenges associated with frequent exposure to processed, carbohydrate-rich fast foods [6].
Human dental evolution has been shaped by successive dietary transitions throughout history. The shift from coarse, unprocessed foods to softer, processed diets has influenced tooth morphology most notably molar size and root form [7]. In modern populations, the pervasive consumption of processed, palatable fast foods has attenuated the degree of dental wear characteristic of earlier human groups. Moreover, diets high in refined sugars and starches compromise enamel integrity, reduce functional strength, and elevate caries prevalence [8]. This literature review therefore aims to elucidate the relationship between fast-food consumption and both structural and functional changes in human dentition, situating these findings within the broader context of dental evolutionary dynamics and contemporary oral health challenges.

Methods:
This review explores the potential effects of fast food consumption (“fast food” OR “junk food” OR “processed food” OR “convenience food”) on tooth evolution (“tooth” OR “teeth” OR “dental” OR “oral”) in the context of modern dietary habits (“nutrition” OR “diet” OR “health” OR “lifestyle”). Relevant literature was gathered from scientific journals, books, and credible online databases such as Scopus, PubMed, ScienceDirect, and Web of Science using targeted keyword searches combining terms related to diet, dental morphology, and evolutionary changes. Sources were selected based on their relevance to dental adaptations in response to highly processed diets, with emphasis on morphological changes, enamel wear patterns, and occlusal surface reduction. Comparative insights were drawn from both anthropological data on prehistoric diets and modern clinical observations to highlight how convenience food may contribute to shifts in dental structure and function. The collected information was critically analyzed to synthesize current understanding and propose possible mechanisms linking modern dietary patterns to long-term dental adaptation.

Results:

Table 1. Methodological Study on the Effect of Fast Food on Human Dental Morphology and Oral Health

Writers	Year	Country	Study Design	Result
Montero, J.,*et al.* [9]	2018	Portugal	Cross-sectional epidemiological study on 782 adolescents (11–17 years) from 8 school	A decline in oral health–related quality of life was observed in students who frequently consumed fast food and chocolate flakes (more than once per week), as well as in those who brushed their teeth one time or less per day, compared to students who brushed two to three times daily.
Vignesh, B., *et al.* [10]	2020	India	*Cross-sectional questionnaire* survey	Survey results demonstrated that nearly all respondents (90 %) reported consuming fast food, with a substantial proportion (78 %) identifying as non-vegetarian and 77 % already aware of the etiological factors of dental caries. Following the educational intervention, participants' understanding of the importance of healthy dietary habits and oral hygiene increased significantly.
Gunaseelan, B. V., *et al.* [11]	2020	India	A cross-sectional survey was carried out in 174 primary schools—comprising both urban and rural settings—in the Mayiladuthurai district of Tamil Nadu to assess students' fast-food consumption patterns, dietary status, and oral health knowledge.	Junk food consumption was significantly associated with a higher prevalence of dental caries compared to non–junk food eaters ($p < 0.05$). The junk food–eating group also exhibited a greater mean DMFT score than the non–junk food group ($p < 0.05$). Furthermore, children attending urban schools had a significantly higher caries prevalence than those in rural schools ($p < 0.05$).
Hancock, S., *et al.* [12]	2020	New Zealand	A systematic review was conducted of 5 prospective cohort studies involving children and preadolescents.	Consumption of processed foods containing sugar and starch outside of main meals has consistently been associated with an increased risk of

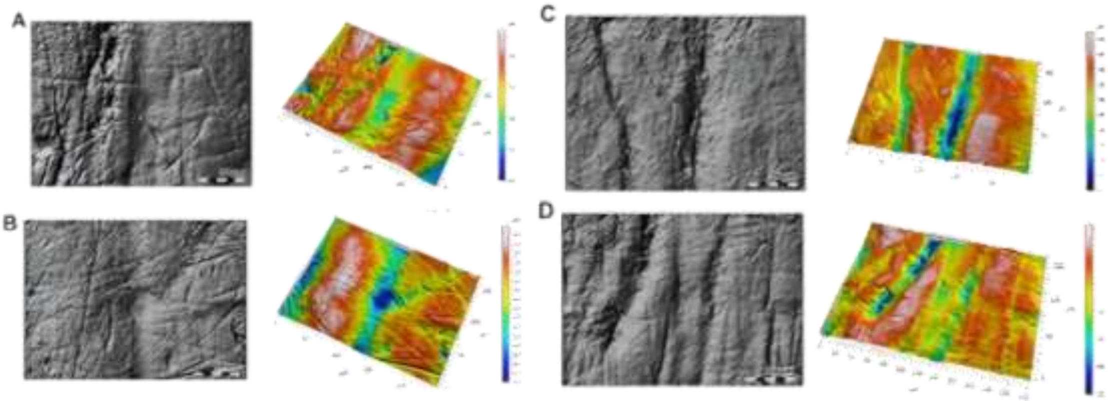
Writers	Year	Country	Study Design	Result
				caries in children and preadolescents. Overall, frequent intake of foods high in sugar and starch demonstrates a strong relationship with caries incidence.
Silvester, C. M., *et al.* [13]	2021	England, German	A cross-sectional comparison of dental microwear was performed on 234 skeletal specimens—104 from the Industrial Revolution period (1700–1900 CE) and 130 from the preindustrial period (1100–1700 CE)—using virtual 3D analysis.	The industrial-era group exhibited a reduction in the transverse component of mandibular movement compared with the pre-industrial cohort. A contraction in the sequence of occlusal contacts was also observed, indicating a dramatic shift in masticatory kinematics in parallel with the increasing consumption of soft, processed foods following the Industrial Revolution.
Hossain, Md. S., *et al.* [14]	2023	Bangladesh	Cross-sectional study was conducted from January to December with a calculated sample size of 345 teenagers from two secondary schools in Dhaka city.	Dental caries affected 36.8% of the teenager who ate fast food ($p<0.05$). A significant association was found between dental caries and the frequency of fast-food consumption. Among the respondents, 4.8% had dental caries who ate fast food daily ($p<0.05$).
Sarhan, M. M. and Alhazmi, H. A. [15]	2024	United States	Cross-sectional (NHANES-based study)	Individuals reporting ≥2 episodes of fast-food consumption in the past 7 days exhibited a higher mean DMFT score (adjusted mean ratio 1.05; 95% CI, 1.01–1.10) and a greater number of untreated carious teeth (adjusted mean ratio 1.22; 95% CI, 1.01–1.47) compared to those reporting fewer than two episodes per week.

Discussion:

Reduction in Enamel Thickness in High–Fast-Food–Consumption Populations

Enamel, the outermost layer of the tooth, serves as a critical barrier against both physical and chemical insult [16]. Diets characterized by excessive fast-food consumption have been shown to exert a significant deleterious effect on enamel thickness and quality [17]. High levels of sugar and simple carbohydrates in

fast foods accelerate bacterial acid production within the oral cavity, initiating the demineralization process that progressively thins enamel and renders it more susceptible to damage [18].
Figure 1. Photosimulation (Left) and 3D View (Right) of (A) Neandertal Krapina 13, A Deciduous Left Lower Lateral Incisor; (B) Early Modern Human from Saint Germain 1970-7-4, A Deciduous Incisor; (C) Recent Modern Human from Amarna Egyptian SK304, A Left Deciduous Central Incisor; (D) Recent Modern Human from Point Hope 108, An Upper Left Deciduous Central Incisor [19].



Histological analysis of dental enamel demonstrates that carbohydrate-rich diets—common among fast-food consumers alter enamel's microstructural integrity [20]. Long-term consumption of high-carbohydrate foods leads to enamel decomposition, evidenced by mineral loss and disruption of the crystalline architecture. These changes accelerate enamel attrition and heighten caries susceptibility. In addition to environmental factors such as diet, genetic variation also influences enamel thickness [21]. Polymorphisms in the enamelin gene (ENAM) that correlate with reduced enamel thickness in certain groups, including African-American cohorts [22]. Individuals bearing these variants are predisposed to thinner enamel, thereby increasing their risk of damage from frequent fast-food exposure. ENAM exhibits signatures of positive selection in human and primate evolution, suggesting that historical dietary shifts—especially rising consumption of processed, carbohydrate-dense foods—drove adaptive changes in this gene [23]. Such genetic adaptations may modulate enamel resilience under modern dietary stresses.

Adaptation of Molar Morphology to Soft versus Hard Diets

Molar form closely reflects the mechanical properties of ingested foods; primarily hardness and shear strength [24]. Habitual chewing of hard items correlates with molars featuring shorter cusps, tighter occlusal fits, and deeper basins [25]. Conversely, diets of moderate mechanical challenge correspond to molars with larger, shallower basins [26]. These morphological adaptations enhance masticatory efficiency by matching tooth form to the physical characteristics of the diet [24].

Among great apes, such adaptations are readily apparent: orangutans possess thick enamel and highly crenulated occlusal surfaces, facilitating the breakdown of hard, fibrous foods like seeds and bark [27]. In contrast, chimpanzees whose diet consists largely of softer seasonal foliage—exhibit thinner enamel and smoother occlusal facets. Dietary consistency also influences mandibular architect: research found that rodents fed a hard-food diet develop more robust mandibles, indicating that supportive skeletal structures co-adapt alongside dental tissues to optimize chewing performance [28].

Researches further documented that platyrrhine molars reflect dietary specialization: primates relying on high occlusal pressures such as insectivores and folivores—display reinforced molar crowns, whereas frugivores and omnivores processing softer foods exhibit reduced occlusal stress adaptations [29]. Crucially, tooth morphology is driven more by the mechanical demands of diet than by its compositional percentages; even predominantly frugivorous species develop robust molars when encountering mechanically challenging textures [26].

Relaxed Natural Selection on Robust Dentition Due to Food-Processing Technologies

The advent of stone tools and controlled use of fire dramatically softened the human diet, diminishing the mechanical demands of mastication and thus relaxing selective pressures on large jaws and robust teeth. As cooking and grinding reduced dietary abrasiveness, microwear patterns on teeth became markedly smoother [5]. This reduction in mechanical stress permitted alleles associated with weaker orofacial morphology to persist and increase in frequency via genetic drift [30]. Over time, the interplay of reduced selective constraint and amplified genetic drift has facilitated the subtle evolution toward smaller teeth and less robust jaws within human populations.

Modern fast foods; characterized by very soft, homogeneous textures, further decrease masticatory loads, reducing chewing cycles and bite force per ingestion by up to 20 % compared to traditionally prepared meals [31]. These contemporary dietary practices reinforce trends toward smaller dento-mandibular structures. Although the high simple-carbohydrate content of fast foods heightens caries risk, lesion patterns are more reflective of oral-processing behaviors than of dental dimensions [32]. Consequently, the combined forces of genetic drift and modern dietary shifts are driving a global homogenization of orofacial phenotypes, diminishing regional variation.

The "Detrimental Drift" Hypothesis

In modern human populations, many alleles that historically governed robust orofacial morphology have become selectively neutral under current dietary regimes, rendering them vulnerable to stochastic loss through genetic drift [33]. This process termed "detrimental drift" results in the erosion of phenotypic diversity, as rare alleles that might confer advantages under extreme masticatory loads or abrupt dietary changes are no longer maintained by selection. Genetic drift exerts its strongest effects in small or isolated populations, where it can outpace natural selection and potentially undermine long-term adaptive capacity. Although some populations may evolve "drift robustness" the capacity to maintain fitness at a peak despite the perturbing effects of genetic drift this protection applies only to combinations of common, pre-existing alleles [34]. In the context of a high–fast-food diet, drift robustness preserves basic masticatory function via the most prevalent molar alleles, yet alleles conferring enhanced bite force or specialized mandibular architecture are lost. Consequently, the genetic reservoir available to respond to novel selective pressures such as the consumption of extremely coarse, fiber-rich foods or new oral-processing behaviors; becomes progressively depleted. Drift robustness cannot prevent the loss of minor alleles; it merely forestalls drastic fitness declines for traits that are already canalized.

Over the long term, detrimental drift may create an "evolutionary trap" when emergent masticatory demands or pathogenic challenges require greater dental morphological variation. The area–heterogeneity trade-off analogy illustrates this risk: just as small, fragmented habitats subject rare species to stochastic extinction, a reduced effective dento-mandibular population size due to drift eliminates rare alleles [35]. The resulting erosion of genetic diversity diminishes evolvability—the capacity of a population to respond to new selective pressures—thereby increasing the likelihood of maladaptation. To prevent future dental evolution from becoming trapped, it is imperative to investigate how modern food-processing practices such as fast-food consumption, demographic shifts, and ongoing genetic drift interact to shape contemporary human dentition [30].

Increased Prevalence of Pathologies

The dietary transition from traditional whole-food diets to modern patterns dominated by processed foods, refined sugars, and carbohydrates has exerted a profound impact on human oral health. One of the most striking consequences of this shift is the rising prevalence of various pathological conditions affecting teeth and their supporting structures. These changes not only impair masticatory function but also alter dental and mandibular morphology [13].

Dental Caries

Dental caries represents the most prevalent disease associated with the move toward a modern diet. Elevated consumption of sucrose and readily fermentable carbohydrates enables oral bacteria most notably *Streptococcus mutans* to metabolize these substrates into acids that erode tooth enamel. The frequent intake of sticky foods and sugary beverages prolongs acid exposure, accelerating demineralization and lesion formation. A strong correlation exists between sugar intake levels and caries prevalence [36]. In addition to caries, periodontal diseases; including gingivitis and periodontitis have also increased in prevalence. Modern diets, characterized by softer, low-fiber foods, are less effective at mechanically cleansing tooth surfaces during mastication. This reduction in natural abrasion facilitates the accumulation of bacterial plaque and calculus, the primary instigators of gingival inflammation. Moreover, high-sugar, high-carbohydrate diets can elicit systemic inflammatory responses that exacerbate periodontal breakdown. Several studies have even demonstrated a link between elevated sugar consumption and increased periodontitis risk, potentially mediated by inflammatory pathways [37].

Conclusion:

The dramatic rise in fast-food consumption rich in refined sugars, simple carbohydrates, and ultra-processed ingredients has not only heightened the prevalence of caries, periodontal disease, and enamel thinning but also relaxed the selective pressures that historically maintained robust dentition, thereby facilitating genetic drift toward smaller teeth and narrower jaws. Although "drift robustness" preserves core masticatory function by retaining common alleles, the loss of minor-allele diversity impairs the population's capacity to adapt to novel dietary or pathogenic challenges, creating a potential evolutionary trap. Addressing this complex interplay of modern dietary practices, demographic shifts, and genetic processes will be critical for developing effective oral-health interventions and for preserving the long-term evolutionary resilience of the human dentition.

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