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Policy Brief

Digital Marketing of Ultra-Processed Foods in Iran: Implications for Adolescents Neurodevelopment and Addiction-Like Eating

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Abstract

Introduction: Digital marketing has become a primary driver of ultra-processed foods (UPFs) consumption among children and adolescents, posing significant risks to neurodevelopment and long-term population health. In Iran, the rapid expansion of digital food marketing has outpaced existing regulatory frameworks, which remain anchored in traditional media models. This brief examines how digitally mediated marketing reinforces addiction-like eating behaviors during critical periods of heightened neuroplasticity and reward sensitivity.

Methods: This policy brief synthesizes current evidence from neuroscience, public health, and regulatory science. The analysis utilizes the commercial determinants of health framework to examine the interaction between economic incentives, digital platform design, and evolving marketing practices in shaping food environments. Furthermore, international regulatory models from Chile, the United Kingdom, and Canada are reviewed to identify best practices for digital governance.

Results: The analysis reveals that current digital marketing practices exploit developmental vulnerabilities, potentially fostering maladaptive eating patterns. Existing Iranian regulations lack the specificity required to address the nuances of digital environments. Findings suggest that effective governance requires a transition from fragmented, reactive measures toward an adaptive approach characterized by transparent product classification and platform-independent principles.

Conclusion: To protect adolescent health and strengthen human capital, Iran requires an integrated policy framework. This entails adopting the NOVA classification system to define regulated foods, enacting comprehensive technology-neutral restrictions on child-directed digital marketing, and establishing robust national surveillance systems using validated instruments to monitor addiction-like eating behaviors. Together, these measures support a necessary transition toward adaptive governance in rapidly evolving digital food environments.

Introduction

The dietary landscape in Iran is undergoing a rapid transition, characterized by a substantial increase in the consumption of energy-dense, ultra-processed food products among adolescents (defined as individuals under 18 years of age).[1] This shift occurs against a challenging macroeconomic background, where persistent inflationary pressures have altered household purchasing power, often leading families to substitute nutrient-dense whole foods with lower-cost industrial alternatives.[2] Concurrently, the expansion of modern distribution logistics and digital commerce within the domestic market has fundamentally modified the accessibility of these products.[3] While traditional public health frameworks often view dietary habits as matters of individual choice or parental oversight, the systemic nature of this transition suggests that current consumption patterns are heavily influenced by broader commercial strategies and market structures.[4] Consequently, voluntary behavioral modifications are increasingly difficult to maintain in an environment where highly processed products are economically and physically prioritized.

This nutrition transition poses a significant challenge to public health governance in Iran.[5] Although Iranian authorities have increasingly restricted the marketing of certain food products through broadcast media such as radio and television, comparable oversight has been largely absent in digitally mediated environments.[6] In recent years, food promotion has rapidly migrated to social media platforms, influencer networks, and digital delivery applications such as SnappFood. Consequently, adolescents are routinely exposed to lifestyle-oriented

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endorsements by online bloggers alongside predatory platform-based promotional tactics, including algorithmic push notifications, dynamic discounts, and high-volume bundling schemes like "buy 4, get 6" offers. These frictionless digital strategies normalize excessive consumption of energy-dense products and exploit the heightened reward sensitivity of the developing adolescent brain. Despite this aggressive commercial shift, a critical knowledge and policy gap persists; Iranian health authorities lack clear legal definitions, dedicated monitoring mechanisms, and technological tools to regulate decentralized digital marketing. Without addressing these structural governance shortcomings, continuous exposure to digital food marketing will exacerbate non-communicable diseases and addiction-like eating behaviors.[7] This policy brief provides an interdisciplinary analysis of the biological vulnerabilities of adolescent populations, examines the digital commercial ecosystems driving demand, and outlines the legal adjustments required to establish an evidence-based regulatory framework in Iran.

Methods

This policy brief developed following the Standard Reporting Guideline for Evidence Briefs for Policy (STEP). We employed an interdisciplinary narrative evidence synthesis integrated with a comparative policy analysis framework to address the digital marketing of ultra-processed foods (UPFs) in Iran.

Evidence Identification and Selection

We conducted a comprehensive literature search across major academic databases, including PubMed and Scopus, and search engine Google Scholar. Our search strategy focused on three core domains: neurobiological reward mechanisms during adolescence, digital food marketing ecosystems, and regulatory interventions. We included peer-reviewed empirical studies, systematic reviews, and policy reports from international health organizations such as the World Health Organization (WHO) and UNICEF. Documents were selected based on their relevance to adolescent nutritional vulnerabilities, the commercial determinants of health, and the efficacy of legislative marketing restrictions.

Evidence Synthesis and Contextualization

We utilized a narrative synthesis approach to integrate diverse streams of evidence. This involved mapping the neurobiological mechanisms of adolescent reward processing, specifically incentive sensitization, against the persuasive techniques utilized in digital food marketing. We then contextualized these findings within the Iranian socioeconomic environment, analyzing how domestic digital platforms and delivery services exploit these developmental vulnerabilities.

Comparative Policy Analysis

We evaluated successful international regulatory models from Chile, the United Kingdom, and Canada to extract core design principles for digital governance. These benchmarks were compared against existing Iranian advertising statutes and commercial codes to identify structural governance gaps. Based on this synthesis and stakeholder analysis, we formulated targeted policy recommendations for Iran, focusing on the NOVA classification system, platform accountability, and behavioral surveillance using the Yale Food Addiction Scale.

Results

Ultra-Processed Foods: Definition And Prevalence In Iran

According to the internationally recognized NOVA classification system, dietary items are categorized into four groups based on the nature, extent, and purpose of industrial processing.[8] While processed foods (Group 3) typically involve simple preservation methods such as the addition of salt or oil to whole foods, UPFs (Group 4) represent industrial formulations of substances derived from foods, often combined with additives, emulsifiers, flavorings, and colorings to enhance hyper-palatability, durability, and commercial appeal.[8] These products are typically characterized by high energy density, excessive refined carbohydrates, trans and saturated fats, and minimal micronutrient and dietary fiber content.

In Iran, the rapid growth of the local industrial food sector and digital food distribution networks has led to a marked increase in the availability and daily consumption of UPFs. The pervasive presence of these energy-dense products is closely linked to emerging patterns of addictive-like eating behaviors across the population. Recent nationwide epidemiological evidence indicates a substantial burden; a large-scale population study of Iranian population (n = 9,345) utilizing the modified Yale Food Addiction Scale 2.0 demonstrated an overall food addiction prevalence of 15.6%, with severe manifestations observed in 7.5% of individuals.[9] Importantly, multivariable analyses confirmed that younger age, female sex, and overweight or obesity were significantly associated with a higher likelihood of food addiction.

Adolescent Food Choice and Neurodevelopmental Vulnerability

Adolescent food choice is driven by a complex interplay of multidimensional determinants spanning individual, social, and environmental domains.[10] While sensory attributes, convenience, and affordability shape immediate preferences, emerging autonomy and emotional states influence adolescents' engagement with food. These processes are further shaped by family practices, peer norms, digital marketing, and the accessibility of the surrounding food environment.[10,11] Ultimately, these diverse influences converge on the adolescent's developing neurobiological systems, particularly during the critical window of maturation in reward processing and inhibitory control.[12] Specifically, subcortical reward processing systems, including the ventral striatum, exhibit accelerated development and heightened reactivity during this stage.[13] In contrast, prefrontal cortical regions responsible for

cognitive control, executive functioning, and long-term goal-directed behavior undergo a more protracted maturation process that continues into early adulthood.[14] This developmental asymmetry creates a temporary imbalance where immediate reward sensitivity frequently outpaces top-down inhibitory control.[15] In the context of dietary choices, this neural configuration increases susceptibility to highly salient external cues, reducing the capacity of adolescents to consistently prioritize long-term health outcomes over immediate gratification.[16]

This neurodevelopmental vulnerability is further explained by the incentive-sensitization theory, which dissociates the neural substrates of reward into wanting (incentive salience) and liking (hedonic impact).[17] Repeated exposure to highly palatable, visually stimulating food cues is hypothesized to selectively sensitize the mesolimbic dopamine pathway, thereby amplifying the wanting system while leaving the liking system unchanged or even downregulated.[18] Consequently, adolescents may experience intense, cue-triggered cravings for specific processed products without deriving a corresponding level of physical satisfaction from consumption.[19] This dissociation provides a neurobiological explanation for habitual, compulsive consumption patterns that persist even when the subjective pleasure of eating is diminished.[20]

Beyond immediate reward signaling, chronic consumption of highly palatable foods may interact with biological systems to alter long-term behavioral responses.[21] Under conditions of socioeconomic or psychological stress, energy-dense foods are frequently used as accessible instruments for temporary affect regulation, leveraging the acute rewarding properties of these diets to mitigate negative emotional states.[22] Furthermore, emerging translational research suggests that persistent exposure to diets high in refined sugars and fats may lead to epigenetic modifications, including changes in the methylation patterns of genes regulating dopaminergic transmission, such as the dopamine receptor D2 (DRD2) gene.[23,24] Although these biological alterations require cautious interpretation in human populations, they suggest that early dietary environments may induce lasting adaptations in neural circuits, potentially reinforcing vulnerability to addictive-like eating behaviors. The proposed interactions among environmental, commercial, social, psychological, and neurodevelopmental determinants of adolescent food choice are summarized in Figure 1.

Discussion

Political Economy and the Digital Ecosystem In Iran

The high prevalence of processed food consumption in Iran is structurally driven by the commercial determinants of health.[4,25] This framework identifies the strategies, market structures, and political-economic incentives of corporate actors as primary drivers of population health outcomes.[25] In the Iranian context, the domestic food manufacturing sector has optimized the production of highly processed items that offer extended shelf lives, low distribution costs, and high price-to-calorie ratios, aligning corporate profitability with consumer demand in a constrained economy. This commercial expansion is amplified by the rapid integration of local digital delivery platforms and quick-commerce startups, which have transformed the domestic retail environment by lowering physical barriers to acquisition and creating a continuous marketplace.

The digital ecosystem leverages three primary mechanisms to stimulate demand and secure market share among adolescents:

- Economic Push Tactics: Digital platforms utilize real-time data to deploy targeted promotions, push notifications, and dynamic discount codes. These tactics temporarily lower the financial threshold of purchase at critical decision-making points, making processed foods appear economically superior to fresh alternatives.[26]
- Social-Psychological Pull Tactics: Marketing campaigns are increasingly embedded within peer networks and localized influencer content.[27] By integrating brand promotions into lifestyle narratives, these strategies blur the boundary between commercial advertising and authentic social validation, rendering the consumption of processed foods socially normative.
- Friction-Reduction Tactics: The digital purchasing interface is designed to minimize cognitive reflection. Features such as stored payment credentials, one-click ordering systems, and rapid delivery logistics bypass deliberate decision-making, converting spontaneous desire into immediate commercial transactions.[28]

These digital tactics expose critical deficiencies in Iran's historical regulatory framework. The current legal structure, centered on the prohibition of advertising harm-inducing goods, was conceptualized for traditional, centralized, and unidirectional broadcast media. This legacy system is functionally incompatible with modern digital environments, which rely on decentralized distribution, transient content, and personalized algorithms. Because digital promotions are customized for individual users and delivered through private screens, they escape traditional state monitoring and compliance audits. This regulatory mismatch permits the continuous expansion of digital food marketing without public health oversight, highlighting the need for a fundamental transition in regulatory design.

Comparative Policy Analysis

An examination of international regulatory responses to unhealthy food marketing reveals several transferable design principles that transcend specific legal jurisdictions. In Chile, the implementation of a comprehensive regulatory model demonstrated the efficacy of linking clear, objective product criteria directly to marketing restrictions.[29] By utilizing visible warning labels on packages, the Chilean government established an enforceable standard that automatically restricted qualifying products from being advertised to children or sold in school environments.[30] Similarly, the United Kingdom updated its regulatory framework for high fat, salt, and sugar (HFSS) products by focusing on restrictions in online environments,

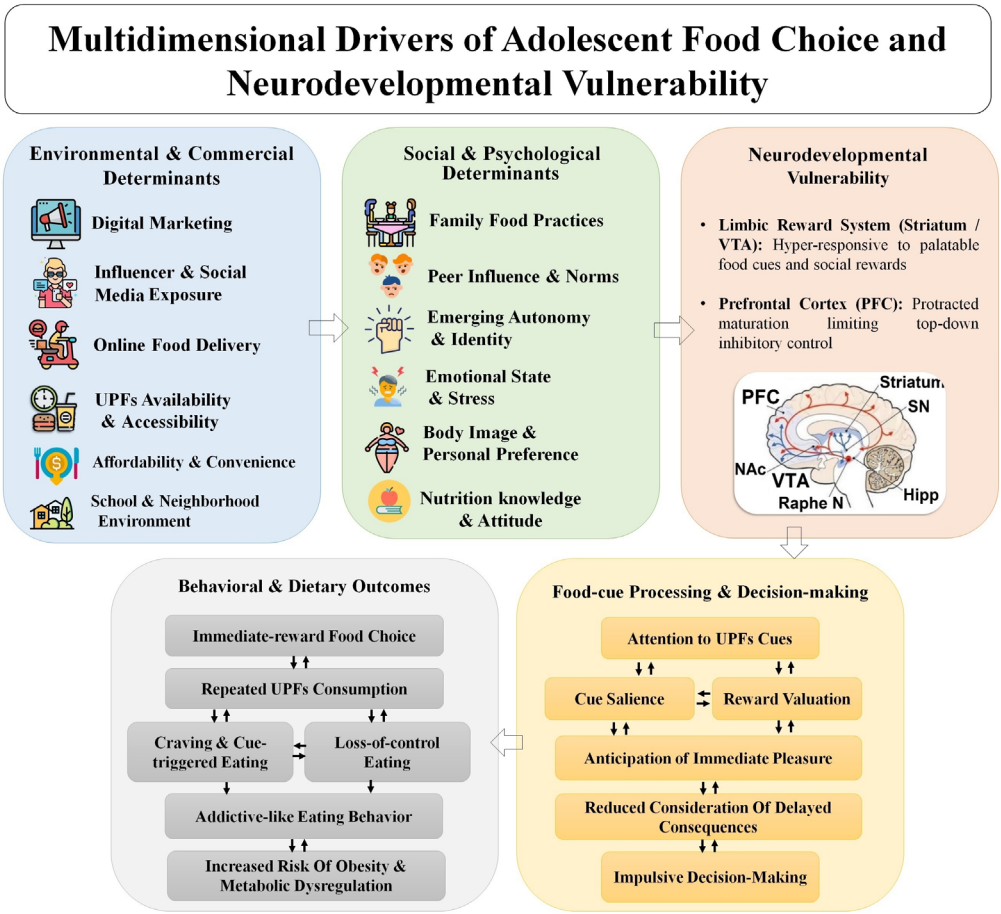


Figure 1. Multilevel determinants and neurodevelopmental mechanisms underlying adolescent food choice. The figure presents a conceptual framework linking environmental, commercial, social, psychological, cognitive, and neurodevelopmental factors to adolescent food choice and addictive-like eating behaviors. It emphasizes the interaction between heightened reward responsivity and still-maturing inhibitory control during adolescence, as well as reciprocal feedback between food-cue processing, repeated ultra-processed food (UPFs) consumption, and addictive-like eating behaviors.

acknowledging that broadcast-era rules are insufficient to govern contemporary digital exposure.[31] Furthermore, Canadian policy discussions have highlighted the necessity of addressing embedded advertising, such as influencer marketing, where commercial intent is integrated directly into entertainment and lifestyle content.[32,33]

Policy Recommendations and Agile Governance

Currently, Iran's regulatory framework for food products is primarily based on nutrient-oriented standards, including requirements related to sugar, salt, fat, labeling, and general product safety. However, it does not currently include a formal regulatory classification or mandatory front-of-package labeling system that identifies UPFs as a distinct category, such as NOVA Group 4. Although general rules govern commercial advertising and electronic commerce, Iran also lacks a comprehensive, food-specific framework that explicitly regulates the digital marketing of UPFs, including targeted advertising, influencer marketing, and marketing directed at children and adolescents. Closing these regulatory gaps will require not only the establishment of clear standards for food classification, labeling, and digital marketing, but also coordinated action among the stakeholders who influence policy development, implementation, and enforcement.

In Iran, regulatory authority is concentrated among governmental institutions, while the food industry, digital platforms, and delivery services hold substantial commercial and technological influence. Public-health professionals, researchers, families, adolescents, and schools contribute evidence and implementation capacity but have less direct influence on formal policy decisions. These power asymmetries may hinder the development and enforcement of effective safeguards against the digital marketing of UPFs. The main stakeholder groups and their anticipated policy positions are summarized in Table 1.

To bridge these structural gaps and transition from fragmented nutrient-based oversight to an agile governance model tailored to Iran's specific challenges, policy-makers should implement a coherent, contextually grounded strategy focusing on regulatory classification, platform accountability, and behavioral surveillance.

First, addressing the current regulatory reliance on single-nutrient thresholds requires institutional capacity-building within Iran's Food and Drug Administration (IFDA). The Ministry of Health and Medical Education, in close coordination with IFDA, should formally integrate the NOVA classification system, specifically targeting Group 4 (UPFs), into national food standards.[34] Rather than relying on nutrient limits that allow manufacturers

Table 1. Key stakeholders and their influence on the digital marketing policy landscape in Iran

Stakeholder group	Main role or interest	Sources of power or influence	Potential policy position
Governmental regulators	Policy development, oversight, and enforcement	Legal authority, regulatory mandates, and institutional legitimacy	May support stronger protections but face intersectoral coordination and implementation constraints
Food and beverage industry	Product promotion, brand visibility, and market expansion	Financial resources, marketing capacity, and commercial influence	May oppose or seek to limit restrictive marketing measures
Digital platforms and food-delivery services	Content distribution, advertising, targeting, and product access	User data, algorithmic control, audience reach, and market access	May prefer self-regulation or less restrictive approaches that preserve commercial flexibility
Researchers and public-health professionals	Evidence generation, policy evaluation, and advocacy	Scientific expertise, credibility, and agenda-setting capacity	Generally supportive of evidence-based protections, although direct policy power may be limited
Parents, adolescents, and schools	Exposure, consumption, prevention, and implementation of protective measures	Public legitimacy, lived experience, educational influence	Likely to support protective policies but may remain underrepresented in formal policy processes

to reformulate products slightly while preserving a hyper-palatable food matrix, IFDA requires technical training, laboratory guidelines, and legal mandates to restrict the marketing of all ultra-processed products. This processing-based standard should be applied uniformly across front-of-package labeling, school food procurement policies, and digital marketing clearances to establish a clear and legally enforceable boundary against industrial food promotion.

Second, to resolve the critical enforcement void across online environments, regulatory frameworks must shift toward technology-neutral platform accountability focused on persuasive techniques rather than specific broadcast media. Legislation should hold both commercial advertisers and digital delivery platforms legally accountable for targeting minors.[35] In the Iranian digital space, platforms and applications should be mandated to introduce verified age-gate mechanisms, disable personalized profiling algorithms for users under eighteen, and maintain transparent, auditable archives of commercial collaborations and influencer marketing campaigns.

Finally, to overcome the current deficit in empirical data on digital exposure and eating pathologies, Iran should establish a national behavioral surveillance system to continuously evaluate policy impact.[36] This mechanism should integrate the validated Persian version of the Yale Food Addiction Scale for Children (dYFAS-C 2.0) into routine school health appraisals and national epidemiological surveillance programs. Tracking addiction-like eating patterns alongside digital media metrics and socioeconomic indicators will provide regulatory bodies with the empirical foundation necessary to refine policy thresholds and target supportive interventions toward high-risk adolescent populations.

Conclusion

In conclusion, the unregulated expansion of digital marketing for UPFs in Iran represents a quiet but significant threat to the cognitive development, metabolic health, and future productivity of the nation's adolescents. By leveraging neurological vulnerabilities such as incentive sensitization and incomplete prefrontal maturation through personalized digital tactics, the food industry shapes eating habits that can persist into adulthood. Addressing this challenge requires moving beyond individual-focused dietary advice toward structural, evidence-based policy reforms. Implementing clear product classifications like the NOVA system, establishing technology-neutral advertising regulations, and monitoring behavioral outcomes such as food addiction through validated tools are not merely public health measures; they are essential investments in protecting the country's human capital. In an era of rapid technological and economic transition, proactive and agile governance is necessary to ensure that the digital environment supports, rather than undermines, the developmental potential of the next generation.

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Artificial Intelligence (AI) Assistance Declaration

During text preparation, AI tools were used solely for language refinement. The scientific content and interpretations were entirely created and verified by the authors.

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The authors declare no conflict of interest.

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