



Original Article



Consumer Behavior Towards Healthy Food Choices: The Role of Digital Marketing and Nutritional Awareness

An Integrative Conceptual Review

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Abstract

Consumer decisions about food are increasingly shaped not only by taste, price, and habit, but by a dense information environment of digital marketing and nutrition communication. This paper presents an integrative conceptual review of social science and consumer behavior research on healthy food choice, with particular attention to two forces reshaping that choice: digital marketing (social media advertising, influencer endorsement, algorithmically targeted content, and mobile applications) and nutritional awareness (consumers' knowledge of, and attentiveness to, nutritional information). Literature was identified through a structured search of Scopus, Web of Science, PubMed, and Google Scholar covering 2010–2025, screened against explicit inclusion criteria, and synthesized thematically. Drawing on the Theory of Planned Behavior, the Health Belief Model, and the Elaboration Likelihood Model, the paper develops an integrative framework in which digital marketing exposure and nutritional literacy jointly — and sometimes contradictorily — shape attitudes, subjective norms, perceived Behavioural control, and ultimately food choice behavior. Four testable propositions are derived and depicted in a conceptual model. The model advances existing research in three respects: it specifies nutritional literacy as a moderator rather than a direct determinant of marketing effects; it identifies elaboration likelihood as the mechanism that determines when that protective effect holds and when it collapses; and it treats digital platforms as a reciprocal channel that both markets food and supplies the nutrition knowledge assumed to protect against marketing. Practically, the review argues that nutrition education delivered as information alone is insufficient: media literacy components, influencer disclosure enforcement, and platform-level restrictions on targeted food advertising are identified as the highest-priority interventions. Implications for health communicators, marketers of healthier products, and policymakers are discussed, alongside a research agenda for empirical validation.

Introduction

Diet-related non-communicable diseases remain among the leading global public health challenges, and consumer food choice sits at the intersection of individual psychology, marketing influence, and information access [64]. Historically, food marketing research focused on mass-media advertising and in-store point-of-purchase influence [12, 40]. The proliferation of social media, influencer culture, algorithmically targeted digital advertising, and nutrition-tracking mobile applications has transformed the information ecosystem within which food decisions are made [42, 38]. Consumers today may encounter a recipe video, a calorie-tracking app notification, a peer's meal photograph, and a targeted advertisement for a snack product within minutes of one another, each exerting a distinct pull on food-related attitudes and behavior.

Simultaneously, nutritional awareness — encompassing knowledge of nutrients, the ability to interpret food labels, and general health literacy — has become a widely studied determinant of dietary quality [26, 42, 63]. Yet nutritional awareness does not operate in isolation from the marketing environment. It interacts with, and is itself shaped by, digital information sources, including the very platforms used for food marketing [73, 11]. Two literatures have therefore developed largely in parallel: a public health literature documenting the reach and effects of digital food marketing, and a consumer research literature documenting how nutrition knowledge and label literacy influence purchase decisions. Each address one side of the same decision, and neither on its own explains why highly informed consumers still respond to persuasive food marketing, or why nutrition

education campaigns frequently underperform in commercially saturated digital environments [74, 1].

This paper addresses that gap by synthesizing the two literatures within a single conceptual framework. Specifically, it aims to:

- 1) synthesizes theoretical and empirical literature on digital marketing and nutritional awareness in consumer food choice;
- 2) develop an integrative conceptual model specifying how these two forces interact, including the mediating and moderating mechanisms involved;
- 3) derive explicit, testable propositions that render the model empirically falsifiable;
- 4) identify methodological gaps and measurement problems in existing research; and
- 5) derive prioritized practical implications for health communication, marketing practice, and public policy.

The paper proceeds as follows. Section - Review Methodology, sets out the review methodology, including the search strategy and inclusion criteria. Section - Theoretical Frameworks and Their Integration, reviews the theoretical frameworks and, importantly, explains how they are integrated rather than merely juxtaposed. Section - Digital Marketing and Food Choice: Mechanisms of Influence, examines the mechanisms through which digital marketing influences food choice and summarizes the empirical evidence base. The Section: The Moderating Role of Nutritional Awareness, develops nutritional awareness as a moderator and examines how it has been measured. Section - The Moderating Role of Nutritional Awareness, presents the integrative model, the accompanying figure, and the propositions. Section - Methodological Considerations for Future Research sets out methodological recommendations for testing the model. Section - Discussion, discusses the findings in relation to previous reviews, contradictory evidence, and unintended consequences. The implications, limitations, and conclusions at the end.

Review Methodology

❖ Type of review and rationale

This paper is an integrative conceptual review. Following Whittemore and Knafl (75), Torraco (67), and Snyder (61), an integrative review combines theoretical and empirical literature of diverse methodological types in order to develop new conceptual understanding, rather than to estimate a pooled effect. This design was selected deliberately for three reasons. First, the relevant evidence is methodologically heterogeneous — randomized experiments on influencer marketing, cross-sectional consumer surveys on label use, content analyses of platform advertising, and app-based intervention trials — and cannot be meaningfully pooled statistically. Second, the review's central objective is theory development: the specification of an interaction between two

constructs that existing frameworks treat separately. Third, the constructs of interest are operationalized so inconsistently across studies that a quantitative synthesis would aggregate measures that are not comparable.

Consequently, this review does not follow the PRISMA 2020 statement [49], which is designed for systematic reviews and meta-analyses of effect estimates, nor PRISMA-ScR for scoping reviews [68]. The search strategy and screening criteria are nevertheless reported transparently below so that the evidence base underlying the model is auditable and the review is reproducible in its essentials. Readers should interpret the synthesis as conceptual and interpretive rather than exhaustive; this is stated as a limitation.

❖ Search strategy

A structured search of Scopus, Web of Science, PubMed, and Google Scholar was conducted, supplemented by targeted searching of the World Health Organization publications repository for grey literature on digital food marketing. Search strings combined terms from three blocks using Boolean operators:

Marketing block: “digital marketing” OR “social media advertising” OR “influencer marketing” OR “online food marketing” OR “targeted advertising” OR “advergame” OR “user-generated content”

Awareness block: “nutritional awareness” OR “nutrition knowledge” OR “nutrition literacy” OR “food literacy” OR “health literacy” OR “food label” OR “front-of-pack”

Outcome block: “food choice” OR “consumer behavior” OR “dietary intake” OR “purchase intention” OR “healthy eating” OR “diet quality”

Theory-specific searches were run separately for “theory of planned behavior,” “health belief model,” “elaboration likelihood model,” and “persuasion knowledge” in combination with food and nutrition terms. The search covered peer-reviewed journal articles, book chapters, and institutional reports published between January 2010 and 2025, with the exception of foundational theoretical sources, for example [2, 51, 56], which were included regardless of date because the frameworks themselves are the object of analysis. Reference lists of identified reviews were screened for additional relevant sources (backward snowballing), and forward citation searching was used for the most frequently cited empirical studies.

❖ Inclusion and exclusion criteria

Table 1. Inclusion and exclusion criteria applied during screening

Criterion	Included	Excluded
Publication type	Peer-reviewed empirical studies, systematic and	Editorials, opinion pieces without evidence, conference

	narrative reviews, meta-analyses, book chapters, WHO and equivalent institutional reports	abstracts, commercial market-research reports, predatory-journal outputs
Language	English	Non-English without an available English full text
Date	2010–2025 for empirical work; any date for foundational theory	Pre-2010 empirical work, unless uniquely cited or foundational
Population	General consumers, adolescents, children, and parents as purchasing agents	Clinical populations receiving therapeutic dietary treatment (e.g. inpatient nutrition therapy)
Exposure	Digital or online food marketing, or nutrition information delivered digitally or via labels	Purely offline broadcast advertising with no digital component, unless used as a comparator
Outcome	Food choice, dietary intake, purchase intention, attitudes, norms, perceived control, or label use	Outcomes unrelated to food (e.g. physical activity alone), brand recall with no behavioral measure
Conceptual relevance	Studies addressing the marketing-awareness intersection, or either construct with a mechanism specified	Descriptive prevalence studies with no mechanism or moderator reported

Conceptual relevance Studies addressing the marketing-awareness intersection, or either construct with a mechanism specified Descriptive prevalence studies with no mechanism or moderator reported

❖ Screening and synthesis

Records were screened first by title and abstract against the criteria in Table 1, then by full text. Retained sources were charted into a matrix recording: theoretical framework invoked, marketing mechanism examined, operationalization of nutritional awareness, study design, population, and reported direction of effect. Synthesis then proceeded thematically in three stages, consistent with integrative review practice [75]. In the first stage, digital marketing mechanisms were grouped into four channels (Digital Marketing and Food Choice: Mechanisms of Influence). In the second, evidence on nutritional awareness was grouped by the mechanism through which it was argued to operate (The Moderating Role of Nutritional Awareness). In the third, points of contradiction between the two bodies of evidence — in particular, cases in which nutritional knowledge failed to protect against marketing influence — were treated as the analytic focus, since it is these inconsistencies that the proposed model seeks to explain. As a single-author conceptual review, the screening and charting were not duplicated by a second reviewer; this is acknowledged in Limitations.

Theoretical Frameworks and Their Integration

Four literatures inform the model developed in The Integrative Conceptual Model. They are summarized briefly below, but the substantive contribution of this section lies in Integration: why no single framework suffices, which specifies how they are combined. Each framework is individually well established and individually insufficient for the problem at hand.

❖ Theory of Planned behavior

Ajzen's [2,3] Theory of Planned behavior (TPB) holds that behavioral intention — the most proximal predictor of behavior — is shaped by attitudes toward the behavior, subjective norms, and perceived behavioral control (PBC). Meta-analytic evidence supports the model's predictive utility across health behaviors, with the three antecedents typically accounting for a substantial share of variance in intention, though a persistent intention–behavior gap remains [5]. Applied to food choice, digital marketing can shift attitudes (portraying a product as desirable or healthy), shape subjective norms (through visible peer engagement and influencer endorsement), and affect PBC (through convenience-oriented messaging emphasizing the ease of healthy meal preparation, or conversely the effort it requires). The TPB thus supplies the mediating architecture of the present model: it specifies through what psychological channels marketing exposure reaches behavior.

❖ Health Belief Model

The Health Belief Model (HBM), originating in public health research associated with Rosenstock [56] and elaborated by Janz and Becker [36], explains health behavior as a function of perceived susceptibility to health threats, perceived severity of consequences, perceived benefits of action, and perceived barriers, moderated by cues to action and self-efficacy. Nutritional awareness campaigns and digital health content frequently operate through this model, using informational cues — statistics on diet-related disease risk, for instance — to activate perceived susceptibility and severity. Meta-analytic evidence indicates that perceived benefits and perceived barriers are the strongest HBM predictors, while susceptibility and severity are comparatively weak [14]. This asymmetry matters: it implies that threat-based nutrition messaging, in the absence of corresponding efficacy and barrier-reduction support, is a weak lever and may produce defensive avoidance rather than behavior change. The HBM contributes to the present model the recognition that nutritional awareness carries an affective and motivational component, not merely a cognitive one.

❖ Elaboration Likelihood Model

Petty and Cacioppo's [51] Elaboration Likelihood Model (ELM) distinguishes central-route persuasion, in which attitude change results from careful evaluation of message content such as scrutinizing a nutritional claim, from peripheral-route persuasion, in which attitude change results from superficial cues such as source attractiveness, emotional appeal, or social proof. The route taken depends on the recipient's motivation and ability to elaborate. This distinction is directly relevant to digital marketing: short-form video, autoplay feeds, and infinite scroll are structurally suited to peripheral-route cues and structurally hostile to deliberation, which helps explain how nutritionally inferior products can be marketed effectively despite minimal informational content. The related Persuasion Knowledge Model [27] adds that consumers deploy stored knowledge about persuasive intent when they

recognize a message as advertising — recognition that native and influencer formats are designed to suppress. The ELM supplies the model's second moderator: it specifies the conditions under which nutritional awareness can be brought to bear at all.

❖ Nutrition literacy and food label research

A distinct stream of research examines how consumers process nutrition labels and front-of-pack claims [20, 28, 29, 13]. This literature consistently demonstrates that possessing nutritional knowledge does not guarantee its application at the point of decision: label use is contingent on motivation, time pressure, numeracy, and label design, and self-reported label use substantially exceeds observed use [29]. Systematic review and meta-analytic evidence indicate that labelling interventions produce real but modest shifts in choice, with interpretive front-of-pack formats outperforming purely numerical ones [15, 32]. Parallel conceptual work distinguishes nutrition literacy from the broader construct of food literacy, which includes planning, selection, preparation, and consumption competencies [71, 69]. The gap between knowledge and applied literacy is central to understanding why nutritional awareness does not uniformly translate into healthier purchasing, even among informed consumers.

❖ Integration: why no single framework suffices

These frameworks are typically applied in isolation, and each fails at a different point in the phenomenon of interest. The TPB specifies the psychological pathways from exposure to behavior but is silent on the processing mode through which a persuasive message enters those pathways; it treats attitudes as inputs without theorizing how they were formed. The ELM specifies processing mode but stops at attitude change and does not model norms or perceived control, both of which are central to food choice in social digital environments. The HBM captures the motivational activation on which nutrition messaging depends but has little to say about commercial persuasion and no account of social influence. The nutrition literacy literature documents the knowledge–action gap with precision but generally treats marketing as background noise rather than as an active countervailing force.

The integration proposed here assigns each framework a distinct structural role rather than layering them additively. The TPB provides the mediating mechanism (attitudes, norms, PBC), the ELM provides the processing-mode moderator that determines which route marketing takes, the nutrition literacy literature provides the substantive content of the awareness moderator and its measurement, and the HBM specifies the motivational conditions under which awareness translates into intention. The critical theoretical move is to place nutritional awareness and elaboration likelihood in a conjoint moderating position: awareness supplies the capacity to evaluate marketing claims, while elaboration likelihood determines whether that capacity is deployed. This predicts — and explains — the otherwise

puzzling finding that nutritional knowledge is only weakly protective in naturalistic settings, since the digital environments in which most food marketing now occurs systematically suppress elaboration.

Table 2. Structural role of each framework in the integrative model

Framework	Core constructs used	Role in the integrative model	Limitation if used alone
Theory of Planned behavior (Ajzen, 1991)	Attitudes, subjective norms, perceived behavioral control, intention	Supplies the mediating pathways linking marketing exposure to choose behavior	Does not explain how attitudes are formed or which processing route is engaged
Elaboration Likelihood Model (Petty & Cacioppo, 1986)	Central vs. peripheral route; motivation and ability to elaborate	Supplies the processing-mode moderator determining whether awareness can be applied	Stops at attitude change; omits norms and perceived control
Health Belief Model (Rosenstock, 1974; Janz & Becker, 1984)	Perceived susceptibility, severity, benefits, barriers, self-efficacy, cues to action	Specifies the motivational activation through which nutrition messaging operates	Weak account of commercial persuasion and social influence
Nutrition and food literacy research (Grunert & Wills, 2007; Vidgen & Gallegos, 2014)	Nutrition knowledge, label literacy, numeracy, applied food competencies	Supplies the content and measurement of the awareness moderator	Treats marketing as background rather than a countervailing force

Digital Marketing and Food Choice: Mechanisms of Influence

Digital food marketing is not a single treatment but a family of mechanisms with different theoretical signatures and different evidentiary strength. Four established channels and one emerging cluster are distinguished below.

❖ Social media advertising and algorithmic targeting

Social media platforms enable granular targeting of food advertisements using demographic, behavioral, and psychographic data, and content analyses have documented extensive promotion of energy-dense, nutrient-poor products through these channels [26, 57]. Reviews of food marketing exposure — much of it originating in studies of adolescent and young-adult populations — associate frequent exposure to such advertising with increased snacking and stronger preference for advertised products [11, 54], and meta-analytic evidence indicates small but consistent effects on intake and choice [10, 58]. Experimental work indicates that sustained exposure to online food advertising increases energy intake relative to non-food advertising controls [47]. Mechanistically,

these effects appear to operate largely through peripheral, low-elaboration processing consistent with the ELM, and are amplified by the personalization of delivery: targeting means the cue arrives pre-matched to the recipient's susceptibilities. Importantly, exposure is not distributed evenly — socio-economically disadvantaged and minority-ethnic groups face disproportionate exposure, with equity consequences [6].

❖ Influencer and peer-driven marketing

Influencer marketing leverages parasocial relationships and perceived source credibility to shape food attitudes, often blurring the boundary between organic content and paid promotion [21, 35]. Randomized experimental evidence shows that exposure to influencer marketing of unhealthy snacks increases children's immediate intake, and — significantly for policy — that a standard advertising disclosure does not eliminate the effect and may not reliably trigger persuasion knowledge in younger audiences [17, 18, 60]. Content analyses further document unhealthy product placement in child-influencer content at scale [4]. Because influencer content frequently appears within lifestyle or wellness framing, it can be persuasive for healthy and unhealthy products alike, illustrating that digital marketing techniques are valence-neutral tools whose well-being impact depends on the nutritional quality of what is promoted and the transparency of the promotional relationship. Disclosure research indicates that when sponsorship is recognized, persuasion knowledge is activated and can reduce persuasive impact — but recognition is precisely what native formats are designed to impede [27, 8].

❖ Health and nutrition applications

Conversely, mobile applications for calorie tracking, recipe recommendation, and grocery planning represent a form of digital information delivery explicitly oriented toward facilitating healthy choice. Such tools can strengthen perceived behavioral control by reducing the practical burden of healthy meal planning, and can embed recognized behavior change techniques including self-monitoring, goal setting, and feedback [45]. Systematic reviews and meta-analyses report small-to-moderate positive effects of app-based interventions on nutrition behaviors and related outcomes, with effects strongest for self-monitoring-intensive designs and weakest where engagement decays [23, 72]. Two caveats are substantial. First, self-selection into app use confounds observational estimates: those who download nutrition apps differ systematically from those who do not. Second, sustained engagement is low, and effect estimates from trials with intensive support may not generalize to organic consumer use. Possible unintended consequences, considers a further concern regarding possible harms in vulnerable subgroups.

❖ User-generated content and social proof

Beyond brand-originated content, peer-generated posts — meal photography, reviews, and recommendation threads — function as informal digital marketing that shapes norms about what constitutes a desirable or normal diet. This channel operates largely through the subjective-norm component of the TPB and can reinforce either health-

conscious or indulgence-oriented eating norms, depending on the composition of a consumer's social network and the platform algorithm curating it [60]. Because the content is not commercially labelled, persuasion knowledge is rarely activated, and because algorithmic curation is responsive to prior engagement, exposure tends to become self-reinforcing. The evidence base here is thinner and more observational than for paid advertising, and effect estimates should be treated as provisional.

❖ Emerging mechanisms

Three developments postdate much of the reviewed evidence and warrant explicit flagging. First, generative AI now permits low-cost production of personalized persuasive food content, including synthetic endorsement, at volumes that outstrip the disclosure and monitoring regimes designed for human influencers. Second, gamified formats — advergames and in-app rewards — have demonstrable persuasive effects on children's food preferences and consumption [25, 24], and their mechanics migrate readily into delivery and loyalty applications. Third, quick-commerce and delivery platforms fuse marketing and purchase into a single interface, collapsing the interval between exposure and transaction in which deliberation might otherwise occur. Each of these developments should, on the logic of the model developed here, further depress elaboration likelihood and therefore weaken the protective value of nutritional awareness — a prediction that is currently untested.

Table 3. Summary of digital marketing mechanisms, theoretical routes, and moderators

Mechanism	Typical examples	Primary theoretical route	Direction of effect on healthy choice	Key moderators
Social media advertising	Targeted feed ads, retargeting, sponsored search, in-video placement	ELM peripheral; TPB attitudes	Predominantly negative (promotes energy-dense products)	Nutrition literacy, involvement, ad recognition, socio-economic position
Influencer marketing	Sponsored content, endorsement s, unboxing, child-influencer placement	TPB subjective norms; ELM peripheral (source cues)	Mixed; negative where products are energy-dense	Source credibility, disclosure salience, parasocial strength, age
Health and nutrition apps	Calorie tracking, meal planning, recipe recommendation, grocery lists	TPB perceived behavioral control; HBM self-efficacy	Positive but modest	Self-selection, sustained engagement, baseline motivation, design quality
User-generated content	Peer meal posts, reviews, recommendation threads, food challenges	TPB subjective norms	Mixed; direction follows network norms	Network composition, algorithmic curation, identification with peers
Emerging: AI content, gamification, quick commerce	Synthetic endorsement, advergames, in-app rewards, one-tap delivery	ELM peripheral; reduced deliberation window	Presumed negative; largely untested	Regulatory disclosure, platform design, elaboration opportunity

Note. Direction of effect reflects the modal finding in the reviewed literature, not a pooled effect estimates; the heterogeneity of designs precludes meta-analytic aggregation.

Table 4. Illustrative empirical studies by theme

Study (theme)	Design and population	Key finding	Implication for the model
Coates et al. (2019a) — influencer marketing	Randomized experiment; children aged 9–11, UK	Exposure to influencer marketing of unhealthy snacks increased immediate energy intake relative to non-food controls	Supports P1: marketing shifts behavior via peripheral cues and social norms
Coates et al. (2019b) — disclosure	Randomized experiment with disclosure manipulation; children, UK	Advertising disclosure did not eliminate the intake effect	Supports P4: without elaboration, informational safeguards are ineffective
Boyland et al. (2022) — marketing exposure	Systematic review and meta-analysis; children and adolescents	Unhealthy food marketing exposure associated with increased intake and preference; small consistent effects	Establishes the antecedent path in the model
Norman et al. (2018) — sustained exposure	Randomized crossover; children, Australia	Sustained online and television food advertising increased intake	Indicates cumulative rather than single-exposure effects
Grunert et al. (2010) — label literacy	Consumer survey and in-store observation; six European countries	High self-reported label use but much lower observed use; understanding varied with motivation	Motivates treating awareness as a moderator, not a determinant
Cecchini & Warin (2016) — labelling	Systematic review and meta-analysis of randomized studies	Labelling shifted choices modestly; interpretive formats outperformed numerical	Bounds the expected magnitude of awareness-based interventions
Chandon & Wansink (2007) — health halo	Experimental studies; adult consumers	Health-positioned outlets produced systematic underestimation of calorie content	Supports P2c: awareness should attenuate health-halo effects
Villinger et al. (2019) — app interventions	Systematic review and meta-analysis of app-based interventions	Small-to-moderate improvements in nutrition behaviors and outcomes	Supports the positive PBC path for app-mediated marketing
Backholer et al. (2021) — equity	Systematic review; children by socio-economic and ethnic group	Differential exposure to unhealthy advertising by socio-economic position	Identifies a boundary condition and equity implication

Note. Table 4 is illustrative rather than exhaustive; it presents studies selected to demonstrate the evidentiary basis for each path in the proposed model. All citation details should be verified against the original sources.

The Moderating Role of Nutritional Awareness

Nutritional awareness is proposed here as a key moderator of digital marketing's effect on food choice, rather than as a direct determinant of dietary quality. The distinction is consequential: a determinant framing predicts that raising knowledge raises diet quality, whereas a moderator framing predicts that raising knowledge changes how strongly marketing acts — an effect that can be large or negligible depending on conditions. The moderating role is argued to operate through at least three mechanisms.

❖ Three moderating mechanisms

Critical evaluation capacity. Consumers with higher nutrition literacy are more likely to engage in central-route processing of marketing claims, scrutinizing health claims rather than accepting peripheral cues at face value [51, 28]. Capacity, however, is not deployment: the ELM specifies that ability without motivation does not produce central processing.

Label and claim verification. Nutritionally aware consumers are more likely to cross-reference marketing claims against nutrition labels, reducing susceptibility to 'health halo' effects in which a product is perceived as healthier than it is because of an isolated positive claim — 'low fat' on a high-sugar product, for example [16, 53]. Interpretive front-of-pack formats appear to lower the literacy threshold required for this verification [15].

Resistance to peripheral persuasion. Greater nutrition knowledge, particularly when coupled with persuasion knowledge, is associated with reduced susceptibility to emotionally or socially driven marketing appeals [27, 8]. This effect is attenuated — in some studies to non-significance — under time pressure, low involvement, cognitive load, or fatigue [44].

The relationship is not unidirectional. Digital platforms are themselves increasingly a primary source through which consumers acquire nutritional knowledge, including from commercially interested actors, meaning that marketing and awareness co-evolve within the same environment rather than operating as independent forces [73]. This reciprocal path is represented explicitly in the model in The Integrative Conceptual Model and, to the author's knowledge, is not incorporated in existing frameworks in this domain.

❖ Measurement and operationalization problems

A central obstacle to synthesizing this literature — and a reason the present review is conceptual rather than meta-analytic — is that 'nutritional awareness' denotes at least five distinguishable constructs across studies, measured with instruments of markedly different provenance and psychometric quality:

- Declarative nutrition knowledge, typically assessed with adapted versions of the General Nutrition Knowledge Questionnaire [50, 39], which has established reliability but measures recall rather than application.
- Label literacy and numeracy, assessed via comprehension tasks on real or simulated labels [29, 13] Campos et al., 2011), which predicts label use better than declarative knowledge but is rarely measured alongside it.
- Functional health literacy, assessed with general instruments not specific to food [48], which travels well across health domains but is insensitive to nutrition-specific competencies.
- Food literacy, a broader competency construct including planning, selection, and preparation [71, 69], conceptually richer but with less measurement consensus.
- Self-reported nutritional attentiveness or involvement, frequently single-item and vulnerable to social desirability, yet common in consumer survey work.

Two consequences follow. First, apparent inconsistency in findings on whether nutritional awareness protects against marketing may partly reflect construct heterogeneity rather than genuine effect heterogeneity: studies reporting null protective effects disproportionately use declarative knowledge measures, whereas those reporting protective effects more often use applied literacy or involvement measures. Second, common-method variance is a serious threat, since awareness, marketing exposure, and dietary outcomes are frequently all self-reported in the same instrument [52, 63]. Empirical tests of the present model should therefore report which construct is measured, justify the instrument, and where possible include both a declarative and an applied measure so that their divergent moderating roles can be estimated separately.

❖ Boundary conditions of the protective effect

The reviewed evidence suggests the protective effect of nutritional awareness is bounded in at least four ways. It weakens sharply under conditions that suppress elaboration — time pressure, decision fatigue, and interfaces engineered for speed. It is largely absent in young children, whose developmental capacity for advertising skepticism is limited, making informational safeguards a poor substitute for exposure restriction [18, 41]. It is weaker where structural barriers dominate: knowledge cannot be enacted where affordable healthy options are unavailable [62, 1]. And it does not extend well to formats that are not recognized as marketing at all, including peer content and native placement. These boundaries are not peripheral caveats; they are the substantive content of the model's moderating claims and the source of its testable predictions.

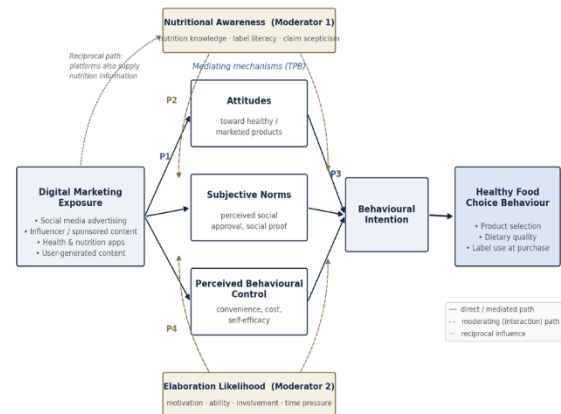
The Integrative Conceptual Model

This section presents the paper's core contribution: a conceptual model of healthy food choice in digitally mediated environments, together with four testable propositions, an account of how the model advances existing frameworks, and a specification of its boundary conditions.

❖ Model logic

The model holds that healthy food choice behavior results from the interaction of digital marketing exposure and nutritional awareness, mediated by attitudes, subjective norms, and perceived behavioral control as specified in the TPB, and moderated by elaboration likelihood as specified in the ELM. High nutritional awareness is hypothesized to shift consumers toward central-route processing of food marketing, strengthening the link between accurate nutritional information and healthy choice, while low nutritional awareness leaves consumers more susceptible to peripheral marketing cues regardless of a product's actual nutritional quality. Critically, the two moderators are conjoint rather than substitutable: awareness supplies evaluative capacity, elaboration likelihood determines whether that capacity is engaged, and neither alone is sufficient. Digital marketing, in this model, is not treated as uniformly harmful or beneficial, but as a channel whose net effect on well-being depends on the nutritional content of what is promoted, the processing mode the format induces, and the literacy of the audience it reaches. A reciprocal path from the digital environment to nutritional awareness acknowledges that the same platforms supply both the marketing and much of the nutrition information assumed to counteract it.

Figure 1. Proposed integrative conceptual model of digital marketing, nutritional awareness, and healthy food choice



Note. Solid arrows denote direct and mediated paths; dashed arrows denote moderating (interaction) paths; the dotted arrow denotes the reciprocal path by which digital platforms also supply nutrition information. P1–P4 correspond to the propositions in Section, Propositions.

❖ Propositions

The following propositions render the model empirically falsifiable. They are stated at the level of directional prediction; operational guidance for testing them appears in Methodological Considerations for Future Research.

P1. Exposure to digital food marketing is positively associated with (a) attitudes toward marketed products, primarily via peripheral-route processing; (b) subjective norms regarding consumption of those products, via visible social proof; and (c) perceived behavioral control over acquiring them, via convenience framing. Where marketed products are energy-dense and nutrient-poor, these paths jointly predict reduced healthy food choice.

P2. Nutritional awareness moderates the effect of digital marketing on food choice, such that (a) higher awareness reduces susceptibility to peripheral marketing cues; (b) higher awareness strengthens central-route processing of nutritional claims; and (c) higher awareness attenuates the health-halo effect. The moderating effect is predicted to be stronger for applied label-literacy measures than for declarative knowledge measures.

P3. The interaction of marketing exposure and nutritional awareness on food choice is mediated by attitudes, subjective norms, and perceived behavioral control, as specified by the TPB. That is, the model predicts moderated mediation rather than a direct interaction on behavior.

P4. Elaboration likelihood moderates the marketing-awareness interaction, such that (a) under high elaboration, nutritional awareness is more protective; and (b) under low elaboration, peripheral marketing cues dominate largely regardless of awareness. This is a three-way interaction and constitutes the model's strongest and most distinctive prediction.

P5. Digital marketing exposure and nutritional awareness are reciprocally related over time: platform use that increases marketing exposure also increases exposure to nutrition information of variable quality, so cross-sectional estimates of the moderating effect will be biased unless this endogeneity is modelled.

❖ How the model advances existing frameworks

Three advances are claimed. First, existing applications of the TPB to food choice typically enter nutrition knowledge as an additional direct predictor of intention; the present model instead specifies it as a moderator of the marketing-mediator paths, which accounts for the repeated finding that knowledge predicts intention better than behavior. Second, existing ELM applications in food marketing treat processing route as an outcome of message design; the present model treats elaboration likelihood as a moderator of a moderation, thereby specifying the conditions under which awareness-based interventions should and should not be expected to work. This yields the concrete, falsifiable prediction that awareness-based interventions will fail in low-elaboration environments even where the awareness gain itself is real — a prediction that distinguishes the model from the general claim that education 'sometimes' works. Third, no existing framework in this literature, to the author's knowledge,

models the reciprocal supply of nutrition information by the marketing channel itself, which has direct implications for research design (P5) as well as for the interpretation of platform-based health promotion.

❖ Boundary conditions

The model is specified for adult and adolescent consumers with the developmental capacity for advertising skepticism; it is not intended to apply to young children, for whom exposure restriction rather than literacy is the appropriate lever. It assumes a choice environment in which healthier alternatives are physically and economically available, since neither awareness nor elaboration can be enacted where structural access is absent. It assumes marketing is at least potentially recognizable as such; fully covert formats are expected to bypass the moderators entirely. Finally, it is specified at the level of discrete choice episodes rather than long-run dietary patterns, and does not model habit formation, which is likely to attenuate all deliberative paths over repeated exposure.

Methodological Considerations for Future Research

❖ Research designs

- Longitudinal panel designs tracking nutrition literacy, digital marketing exposure, and dietary outcomes at three or more waves, to address the causal ambiguity of cross-sectional survey research and to estimate the reciprocal path in P5 using cross-lagged panel or random-intercept cross-lagged models.
- Factorial experiments to test P4 directly. A 2 (marketing cue type: central-route informational vs. peripheral-route affective) $\times$ 2 (nutrition literacy: measured or primed high vs. low) $\times$ 2 (elaboration opportunity: unconstrained vs. time-pressured) design isolates the three-way interaction that constitutes the model's distinctive prediction. Elaboration can be manipulated via response deadlines, concurrent cognitive load, or scroll-paced presentation.
- Ecological momentary assessment pairing in-the-moment exposure prompts with immediate choice reports, reducing the recall error that attends retrospective dietary measures.
- Platform-level behavioral data — ad-exposure logs, screen-capture sampling, app-usage analytics — triangulated with purchase records (loyalty-card or receipt data) rather than self-reported intake, where data-access and ethical approvals permit.
- Field experiments with retailers or delivery platforms, in which interpretive labelling or friction-adding interface changes are randomized, providing external validity that laboratory designs cannot.

❖ Measurement

- Report which awareness construct is measured (Measurement and operationalization problems)

and use instruments with published reliability and validity evidence: the revised General Nutrition Knowledge Questionnaire for declarative knowledge [39], objective label-comprehension tasks for applied literacy, and established persuasion-knowledge scales for advertising skepticism.

- Include both a declarative and an applied awareness measure in the same study, since the model predicts they will moderate differently (P2).
- Use validated TPB item batteries constructed according to Ajzen's elicitation guidance, and report the construct-level reliability of attitude, norm, and PBC scales separately rather than as a composite.
- Avoid single-source designs where possible; where unavoidable, apply and report procedural and statistical remedies for common-method bias [52], and acknowledge the documented limitations of self-reported dietary data [63].

❖ Sampling and statistical power

The model's central predictions are interaction effects, which require substantially larger samples than main-effect tests. As a working guide, detecting a small-to-moderate two-way interaction in a moderated mediation model typically requires several hundred participants, while the three-way interaction in P4 will generally require samples in the high hundreds to low thousands for adequate power; a priori power analysis using Monte Carlo simulation for the specific indirect-effect structure is preferable to rules of thumb. Samples should be stratified by socio-economic position given the documented differential exposure to unhealthy food advertising [6], and adolescent samples should be analyzed separately rather than pooled with adults.

❖ Analytic approaches

- Structural equation modelling with latent constructs for the TPB mediators, permitting simultaneous estimation of the mediation paths while correcting for measurement error.
- Moderated mediation (conditional process) analysis with bias-corrected bootstrap confidence intervals for conditional indirect effects, rather than sequential regression with mean-split moderators [33].
- Multi-group or multilevel models where consumers are nested within platforms, retailers, or countries, since exposure is clustered by design.
- Pre-registration of the interaction hypotheses and the analysis plan, given the known flexibility of interaction testing and the elevated risk of false positives in exploratory moderator search.

❖ Cross-cultural scope and vulnerable populations

Food norms, advertising regulation, and nutrition education systems vary substantially across countries and shape both marketing exposure and literacy levels, yet the reviewed evidence originates disproportionately from high-income

Western settings. Replication in low- and middle-income contexts — where digital penetration is rising rapidly, regulatory capacity is often weaker, and the nutrition transition is ongoing — is a priority, and comparative designs exploiting regulatory variation (for example the Chilean marketing and labelling reforms; Taillie et al., [65]) offer natural-experiment leverage. Attention to vulnerable populations is equally important: children and adolescents exhibit lower resistance to peripheral-route persuasion and are frequent targets of digital food marketing [10, 41], and socio-economically disadvantaged groups face both higher exposure and greater structural barriers to enacting healthier choices.

Discussion

❖ Relation to previous reviews

The conclusions here converge with, and depart from, previous reviews in specific ways. On exposure and effect, this review concurs with meta-analytic syntheses that unhealthy food marketing exerts small but consistent effects on children's and adolescents' intake and preferences [58, 10, 54], and with WHO assessments that digital channels have expanded both the reach and the persuasive power of that marketing while outpacing regulation [77, 78]. On labelling, it concurs with syntheses finding real but modest effects, larger for interpretive formats [15]. The departure is one of framing rather than of finding: the public health reviews largely treat consumer literacy as a weak or supplementary lever and conclude in favor of exposure restriction, while the consumer research literature treats literacy as a determinant to be raised. The present model reconciles these positions by specifying the condition — elaboration likelihood — under which each conclusion holds. On this account the public health reviews are right about the environments in which most digital food marketing occurs, and the consumer research literature is right about the environments in which deliberation is feasible; the disagreement is about the modal case, not about the mechanism.

❖ Contradictory and null evidence

Critical engagement requires acknowledging evidence that does not fit. Several strands qualify the model. First, a number of studies find nutrition knowledge to be a weak or non-significant predictor of dietary quality once socio-economic position and food access are controlled, which is consistent with the moderator framing but also raises the possibility that awareness effects are partly confounded by unmeasured resources. Second, effect sizes in marketing-exposure meta-analyses are small, and are drawn substantially from short-term laboratory measures of intake whose relationship to habitual diet is unestablished; publication and small-study effects have been raised as concerns in this literature. Third, evidence on app-based interventions is heterogeneous, with several trials reporting null effects on dietary outcomes and attrition frequently exceeding half the sample, so the positive PBC path in the model should be regarded as the weakest-supported. Fourth, disclosure research yields mixed results:

recognition of sponsorship sometimes reduces persuasion and sometimes increases engagement, and in child samples disclosure has failed to attenuate intake effects at all [18]. Fifth, the intention–behavior gap documented in TPB meta-analyses [5] means that a model resting on intention as the proximal mediator will systematically over-predict behavior, and habit and automaticity may be doing work the model assigns to deliberation [44]. These are not marginal caveats: taken together they imply the model's central three-way interaction may prove smaller and more context-dependent than its theoretical prominence suggests.

❖ Why nutrition education campaigns often fail

The model offers a mechanistic account of a well-documented disappointment. Mass-media health campaigns produce measurable but small behavioral effects, generally requiring sustained exposure, supportive environments, and complementary structural measures [74]. Four failure mechanisms follow from the framework developed here. First, asymmetry of resources and repetition: commercial food marketing outspends nutrition promotion by orders of magnitude and reaches consumers with far greater frequency and precision. Second, route mismatch: nutrition education is characteristically delivered as central-route informational content into environments engineered for peripheral processing, so it is not competing on the same channel. Third, motivational insufficiency: consistent with meta-analytic HBM findings, campaigns that raise perceived susceptibility without lowering perceived barriers or raising self-efficacy generate awareness without action [14]. Fourth, differential uptake: information-based interventions are preferentially adopted by higher-literacy, higher-resource groups, which can widen dietary inequalities even where average effects are positive [1]. The practical corollary is that the failure is not primarily one of message quality but of channel, motivation, and structural context.

❖ Implementation challenges

The recommendations in Section 9 face substantial barriers, and it would be misleading to present them as straightforward. Media literacy components require curriculum time and trained educators, and meta-analytic evidence indicates that media literacy interventions shift knowledge and attitudes reliably but behavior less so, with effects that decay without reinforcement [37]. Influencer disclosure regimes depend on the detectability of undisclosed sponsorship across millions of accounts and on enforcement capacity that most regulators lack; disclosure also assumes an audience able to act on it, which the child evidence contradicts. Platform-level advertising restrictions confront jurisdictional limits, definitional disputes over which products count as unhealthy, and the ready migration of marketing to formats and territories outside the restriction's scope. Algorithmic transparency requirements encounter commercial confidentiality claims and the practical difficulty of auditing

systems that are personalized by construction. Structural measures such as reformulation incentives and pricing policy have the strongest evidence but the greatest political cost [31, 55]. Recognizing these constraints is a precondition for prioritization rather than an argument against action.

❖ Possible unintended consequences

Raising nutritional awareness is not costless, and the literature identifies several potential adverse consequences that intervention designers should anticipate. Intensive self-monitoring through calorie-tracking applications has been associated in observational research with heightened dietary preoccupation and, in some samples, with disordered eating symptomatology, with the direction of causation unresolved and self-selection a serious confound [59, 43]. Strongly moralized nutrition messaging risks stigma and, for individuals with existing vulnerability, may reinforce rigid rule-based eating. Information-based approaches can also individualize responsibility for a problem that is substantially environmental, providing rhetorical cover for inaction on structural determinants, and — as noted above — may widen inequalities through differential uptake. Practical mitigation includes designing literacy interventions around flexible rather than restrictive rules, avoiding fear-based framing without efficacy support, monitoring adverse outcomes as a matter of course in nutrition-app trials, and pairing individual-level measures with environmental ones. The purpose of raising these possibilities is not to argue against nutrition education but to specify what responsible implementation entails.

Practical and Policy Implications

❖ For health communicators

Nutrition education campaigns are unlikely to succeed if delivered purely as informational content without addressing the peripheral-route persuasive techniques used in commercial food marketing. Concretely, this suggests: embedding advertising-literacy modules that teach recognition of native advertising, influencer sponsorship, and health-halo claims alongside nutrient content; delivering content in the formats and on the platforms where food marketing occurs, in short-form video rather than long-form text; pairing threat information with explicit barrier-reduction and efficacy content, consistent with HBM evidence; and using interpretive rather than numerical presentation to lower the literacy threshold. Evaluation should be specified in advance and should include behavioral or purchase endpoints, retention measures at three and six months given documented decay of media-literacy effects, and stratified analysis by socioeconomic position to detect inequitable uptake.

❖ For marketers of healthier products

For marketers of healthier food products, the findings suggest that pairing credible, verifiable nutritional claims with the

same peripheral cues — social proof, relatable messaging, aspirational framing — used by less healthy competitors may improve competitiveness without misleading consumers. Specific strategies indicated by the reviewed evidence include leading with taste and identity appeals rather than health warnings, since health-framed positioning can depress expected palatability; using credible micro-influencers with transparent disclosure, which sustains persuasion while preserving trust; reducing friction at the point of purchase, which acts on perceived behavioral control rather than attitudes; and avoiding isolated single-nutrient claims, which invite health-halo effects and, once recognized, damage credibility among the most nutritionally literate consumers.

❖ For policymakers

The review supports continued attention to the regulation of health claims and to disclosure requirements for influencer-sponsored food content, given the demonstrated susceptibility of low-literacy consumers to health-halo and peripheral marketing effects. Specific regulatory approaches indicated by the evidence include: restrictions on the targeting of food advertising to children and adolescents on digital platforms, aligned with current WHO guidance [78]; standardized, machine-readable, and prominently placed sponsorship disclosure, coupled with enforcement resourcing rather than voluntary codes; advertising-content restrictions defined by a validated nutrient profiling model to avoid definitional disputes; algorithmic transparency and researcher data-access obligations, without which independent assessment of exposure is impossible; mandatory interpretive front-of-pack labelling, for which the evidence base is comparatively strong; and evaluation clauses attached to new measures so that natural-experiment evidence accumulates.

❖ Prioritization

Because these recommendations are not equally feasible or equally supported, Table 5 offers an indicative prioritization on three criteria: feasibility given current institutional capacity, cost-effectiveness, and likely magnitude of population impact. The assessment is the author's judgement based on the reviewed evidence and is offered as a framework for deliberation rather than as a quantified appraisal.

Table 5. Indicative prioritization of recommended interventions

Intervention	Feasibility	Cost-effectiveness	Likely population impact	Priority
Mandatory interpretive front-of-pack labelling	Moderate-high (precedents exist)	High (one-off regulatory cost)	Moderate	High
Restrictions on targeted digital food advertising to minors	Moderate (jurisdictional limits)	High	High	High
Standardized, enforced influencer sponsorship disclosure	High	High	Low-moderate (weak in children)	High

Advertising-literacy modules in school curricula	Moderate (curriculum time)	Moderate	Moderate, decays without reinforcement	Moderate
Platform algorithmic transparency and researcher data access	Low-moderate (commercial resistance)	Moderate	Indirect but enabling	Moderate
Mass-media nutrition campaigns without literacy components	High	Low	Low	Low
Reformulation incentives and fiscal measures	Low (political cost)	High	High	High, longer horizon

Limitations

The limitations of this paper are substantial and fall into two groups: limitations of the review itself, and limitations of the evidence base it synthesizes.

❖ Limitations of this review

Non-systematic synthesis. Although the search strategy and inclusion criteria are reported, this is an integrative conceptual review rather than a systematic review. It does not claim exhaustive coverage, no formal risk-of-bias appraisal was conducted, and no pooled effect estimates are offered.

Single-reviewer screening. Screening and charting were performed by one author without duplicate independent assessment, so selection bias cannot be excluded and inter-rater reliability cannot be reported.

Language and database restriction. The restriction to English-language sources and to four databases will have under-represented research from non-Anglophone and lower-income settings — precisely the contexts the paper identifies as under-studied.

Untested model. The integrative model and its propositions are derived analytically and have not been empirically validated. They require testing across product categories, platforms, and populations before any confidence in the specified interactions is warranted.

❖ Limitations of the evidence base

Construct operationalization. As set out in Measurement and operationalization problems, ‘digital marketing exposure’ and ‘nutritional awareness’ are measured heterogeneously across studies — exposure via self-report, content analysis, or platform logs; awareness via at least five distinct instruments — with correspondingly variable validity and reliability, which limits comparability and makes apparent inconsistencies difficult to interpret.

Causality. Most non-experimental evidence is cross-sectional and correlational, while most experimental evidence measures short-term intake in laboratory settings. Neither design supports inference about effects on habitual diet, and the

reciprocal relationship posited in P5 means cross-sectional moderator estimates are likely biased.

Contextual specificity. The evidence is drawn predominantly from Western, high-income countries with particular regulatory regimes and food environments, limiting generalizability to the settings where digital penetration is growing fastest.

Rapid technological change. The digital marketing landscape evolves faster than the publication cycle. Generative AI content, increasingly personalized algorithmic targeting, and quick-commerce interfaces may introduce persuasive mechanisms not captured by frameworks developed before these technologies, so parts of the reviewed evidence may already describe a superseded environment.

Publication and small-study bias. Positive findings are likely over-represented in both the marketing-effects and the app-intervention literatures, and several relevant meta-analyses rest on small trials.

Self-report bias. Most dietary intake and marketing exposure measures are self-reported and subject to recall error and social desirability, with well-documented systematic under-reporting of energy intake [63]; common-method variance is a further threat where all constructs share a single instrument [52].

Conclusion

Digital marketing and nutritional awareness jointly shape consumer behavior toward healthy food choices, often in interacting and sometimes counteracting ways. Rather than treating digital marketing as uniformly detrimental to healthy eating, this review argues that its effects are contingent on message content, platform-driven processing mode, and the nutritional literacy of the audience it reaches. The integrative model developed here makes that contingency explicit: nutritional awareness supplies the capacity to evaluate marketing claims, elaboration likelihood determines whether that capacity is deployed, and the psychological pathways specified by the Theory of Planned behavior carry the resulting effects through choice. The model's most consequential implication is also its most testable: interventions that raise nutritional awareness should be expected to fail in environments engineered to suppress deliberation, however successfully they raise knowledge. If that prediction holds, the policy inference is not that consumer literacy is worthless but that it must be paired with measures that either restore the opportunity to deliberate or restrict exposure where deliberation is not possible — and, for young children, with exposure restriction alone. A social science approach integrating consumer psychology, marketing science, and public health nutrition offers the most complete account of this dynamic, and provides a foundation for interventions — educational, regulatory, and commercial — that support healthier food choice in an increasingly algorithmically

mediated food environment. The empirical validation of the propositions advanced here is the necessary next step.

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Declarations:

Author's Contribution:

- Conceptualization, data collection, interpretation, drafting of the manuscript and intellectual revisions
- The author agrees to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed

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