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Digital Nutrition Literacy as a Protective Factor Against Unhealthy Food Choices through Online Food Delivery Apps among School-Going Adolescents: A Cross-Sectional Analytical Study

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Abstract

Background: Digital food marketing and online food delivery apps increasingly expose adolescents to fast food, desserts, fried snacks, and sugar-sweetened beverages. Digital nutrition literacy may help adolescents recognize persuasive food promotion and make healthier choices. This study examined whether digital nutrition literacy modifies the relationship between digital food marketing exposure, app-based food ordering, and unhealthy dietary choices among school-going adolescents.

Methods: A cross-sectional analytical study was conducted among 420 adolescents aged 13–18 years from selected schools. Data were collected using a structured questionnaire covering socio-demographic variables, digital food marketing exposure, online food delivery app use, digital nutrition literacy, dietary choices, screen time, pocket money, and physical activity. Height and weight were measured for BMI classification. An unhealthy diet score was constructed from frequent fast food intake, sugar-sweetened beverage intake, fried snack intake, dessert intake, low fruit and vegetable intake, and breakfast skipping. Digital nutrition literacy was categorized as low, moderate, and high. Associations were analyzed using chi-square tests, analysis of variance, and logistic regression with interaction terms.

Results: Higher digital food marketing exposure was associated with a higher unhealthy diet score. Adolescents with low digital nutrition literacy showed the strongest association between marketing exposure and unhealthy eating. Students with high literacy also showed increased unhealthy choices with greater exposure, but the effect was smaller. Frequent use of food delivery apps predicted unhealthy dietary choices, while higher digital nutrition literacy showed a protective association after adjustment for age, sex, school type, pocket money, screen time, and physical activity.

Conclusion: Digital nutrition literacy may reduce, but not eliminate, the dietary risks linked to food delivery apps and digital food marketing. Adolescent nutrition strategies should combine literacy education with healthier school environments, parental monitoring, and regulation of unhealthy digital food promotion.

Keywords: Digital nutrition literacy; adolescents; digital food marketing; online food delivery apps; unhealthy diet; food environment

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1. Introduction

Digital food exposure has become a routine part of adolescent life. A school-going adolescent may see food content on social media before breakfast, receive an app discount notification after school, watch an influencer review a burger in the evening and scroll through dessert reels before sleeping. These exposures are not random. They are often designed to increase attention, desire and purchase behaviour. Adolescents are vulnerable because they are building food habits, developing autonomy and responding strongly to peer culture, taste, convenience and visual appeal.[1]

Online food delivery applications have changed the practical meaning of food access. In the past, purchasing fast food required physical movement, time and sometimes parental permission. App-based ordering reduces those barriers. It offers menus, photographs, ratings, delivery tracking, wallet payments, discounts and combo deals. This can be useful for families in some situations, but the dominant food choices promoted on these platforms are often energy-dense and highly palatable. The issue is not that every delivered meal is unhealthy. The issue is that app design can make unhealthy choices easier, more visible and more rewarding than healthier options. [1]

Digital food marketing strengthens this pattern. WHO (2023) has recommended stronger policies to protect children from marketing of foods high in saturated fat, trans fat, free sugars and sodium. The concern is based on evidence that marketing influences children's food choices, dietary intake, purchase requests and food norms. Boyland et al. (2022) also showed that food and non-alcoholic beverage marketing is associated with children's and adolescents' eating behaviours and preferences. UNICEF (2024) emphasized that digital marketing of unhealthy foods and beverages has persuasive power among children and adolescents and that policy responses are needed. [1,2]

However, one missing question is why some adolescents appear more affected than others. Exposure alone does not fully explain behaviour. Two students may see the same discount advertisement, but one may order a large fast-food meal while the other ignores it or chooses a healthier option. This difference may depend partly on digital nutrition literacy. Digital nutrition literacy refers to the ability to recognize online food persuasion, understand nutrition information, judge food claims, compare choices and make healthier decisions in digital food environments. It combines nutrition knowledge with media literacy and practical decision-making. [1,2]

The concept is important because adolescents are often taught general nutrition information without being taught how digital marketing works. They may know that fruits and vegetables are healthy, yet still respond to influencer content, flash sales, free-delivery offers and attractive food images. A student does not only need to know what a balanced diet is. The student also needs to understand how apps and platforms push behaviour through urgency, social proof, default rankings, loyalty rewards and repeated cues. Without this literacy, nutrition knowledge remains abstract and weak. [1,3]

Evidence from related research supports this focus. Saleh et al. (2024) found high use of online food delivery applications among adolescents and reported that appearance and price shaped choices. Abdulkader et al. (2022) raised concerns that online food delivery systems may support unhealthy eating and that menu design rarely emphasizes nutrition information. De Amicis et al. (2022) linked ultra-processed food consumption with obesity and adiposity indicators in children and adolescents, while Wang et al. (2021) showed that ultra-processed foods form a large share of youth dietary energy intake in national survey data. These findings suggest that adolescent food choices are not only personal preferences; they are responses to a wider food system. [4]

Digital nutrition literacy is therefore a promising protective factor, but it should not be exaggerated. It cannot fully solve a harmful food environment. A highly literate adolescent may still be influenced by price, peer pressure, hunger, stress or repeated exposure. Literacy is useful, but it cannot replace regulation, healthier school food environments and parental guidance. The realistic question is whether higher digital nutrition literacy weakens the association between food marketing exposure, app ordering and unhealthy dietary choices. [3]

This study examines digital nutrition literacy as a modifying factor in the relationship between digital food marketing exposure, online food delivery app use and unhealthy dietary choices among school-going adolescents. The focus is deliberately practical. If literacy is protective, schools can design targeted digital nutrition education. If the association remains strong even among literate students, then policy and platform-level interventions become even more urgent. Either result matters because adolescent nutrition research must move beyond blaming students for choices made inside persuasive digital systems. [4]

2. Materials and Methods

This cross-sectional analytical study was designed among school-going adolescents aged 13-18 years in selected public and private schools. Students were included if they were enrolled

in the selected classes, able to complete the questionnaire, willing to participate and had parental consent and personal assent. Students with medical conditions or prescribed diets affecting usual food intake or body weight were excluded.

A multistage sampling method was proposed. Schools were first selected by sector, followed by selection of classes and then students. A sample size of approximately 420 students was targeted to provide adequate power for estimating associations between digital marketing exposure, app-ordering behaviour, digital nutrition literacy and unhealthy dietary choices. Data collection was planned during school hours under researcher supervision to reduce discussion between students and incomplete responses. [5-7]

A structured self-administered questionnaire was used. The instrument included socio-demographic details, school type, age, sex, parental education, pocket money, screen time, physical activity, food delivery app use, digital marketing exposure, dietary choices and digital nutrition literacy. Digital marketing exposure included advertisements on social media, video platforms, games, food delivery apps, websites, influencer content and push notifications. App use was categorized as never/rarely, monthly, weekly, two to three times per week and four or more times per week. [5-7]

Digital nutrition literacy was assessed through items measuring recognition of sponsored food content, understanding of nutrition labels, awareness of discount persuasion, ability to compare menu choices, confidence in identifying high-sugar or high-fat foods and perceived ability to resist unhealthy app promotions. Scores were categorized into low, moderate and high literacy groups. [5-7]

Dietary choices were measured using a food frequency section. An unhealthy diet score from 0 to 10 was created from frequent fast-food intake, sugar-sweetened beverage intake, fried snack intake, dessert intake, bakery product intake, breakfast skipping and low fruit and vegetable intake. Height and weight were measured using standard equipment, and BMI was calculated and classified using BMI-for-age categories. [6]

Data were analysed using frequencies, percentages, means and standard deviations. Chi-square tests examined categorical associations. Analysis of variance compared mean unhealthy diet scores across literacy and exposure groups. Logistic regression tested predictors of unhealthy dietary choice. An interaction term between marketing exposure and digital nutrition literacy was included to examine whether literacy modified the effect of exposure. The illustrative

results presented in this manuscript are simulated for research-paper preparation and must be replaced with real survey data before submission or publication. [6-9]

3. Results

The illustrative dataset included 420 adolescents with a mean age of 15.5 years. Digital nutrition literacy was low in 31.7%, moderate in 43.1% and high in 25.2% of students. High marketing exposure was reported by 56.2%, and weekly or more frequent food delivery app use was reported by 39.5%. The mean unhealthy diet score increased across marketing exposure categories, from 3.8 among low-exposure students to 6.1 among high-exposure students.

Digital nutrition literacy appeared protective. Students with high literacy reported lower unhealthy diet scores than students with low literacy at each level of marketing exposure. Among those with high marketing exposure, the mean unhealthy diet score was 6.7 in the low-literacy group and 5.0 in the high-literacy group. Frequent app users with low literacy had the highest predicted probability of unhealthy dietary choice. In contrast, high-literacy students had lower predicted risk, although risk still increased as app-ordering frequency rose.

In logistic regression, high marketing exposure and frequent app ordering were significant predictors of unhealthy dietary choice. High digital nutrition literacy was associated with lower odds of unhealthy dietary choice after adjusting for socio-demographic and behavioural covariates. The interaction term suggested that digital nutrition literacy weakened the association between marketing exposure and unhealthy diet, but did not remove it. These results support a combined approach: education can help, but the digital food environment itself still needs attention.

Table 1. Digital nutrition literacy and digital exposure profile of adolescents (n = 420)

Variable	Category	Frequency (n)	Percentage (%)
Digital nutrition literacy	Low	133	31.7
Digital nutrition literacy	Moderate	181	43.1
Digital nutrition literacy	High	106	25.2

Digital marketing exposure	Low	74	17.6
Digital marketing exposure	Moderate	110	26.2
Digital marketing exposure	High	236	56.2
Food delivery app use	Rare/never	122	29.0
Food delivery app use	Monthly	132	31.4
Food delivery app use	Weekly or more	166	39.5

Table 2. Mean unhealthy diet score by marketing exposure and digital nutrition literacy

Marketing exposure	**Low literacy mean (SD)**	**Moderate literacy mean (SD)**	**High literacy mean (SD)**	**p-value**
Low	4.1 (1.7)	3.8 (1.5)	3.5 (1.4)	.048
Moderate	5.3 (1.8)	4.7 (1.6)	4.2 (1.5)	<.001
High	6.7 (1.9)	5.8 (1.7)	5.0 (1.6)	<.001

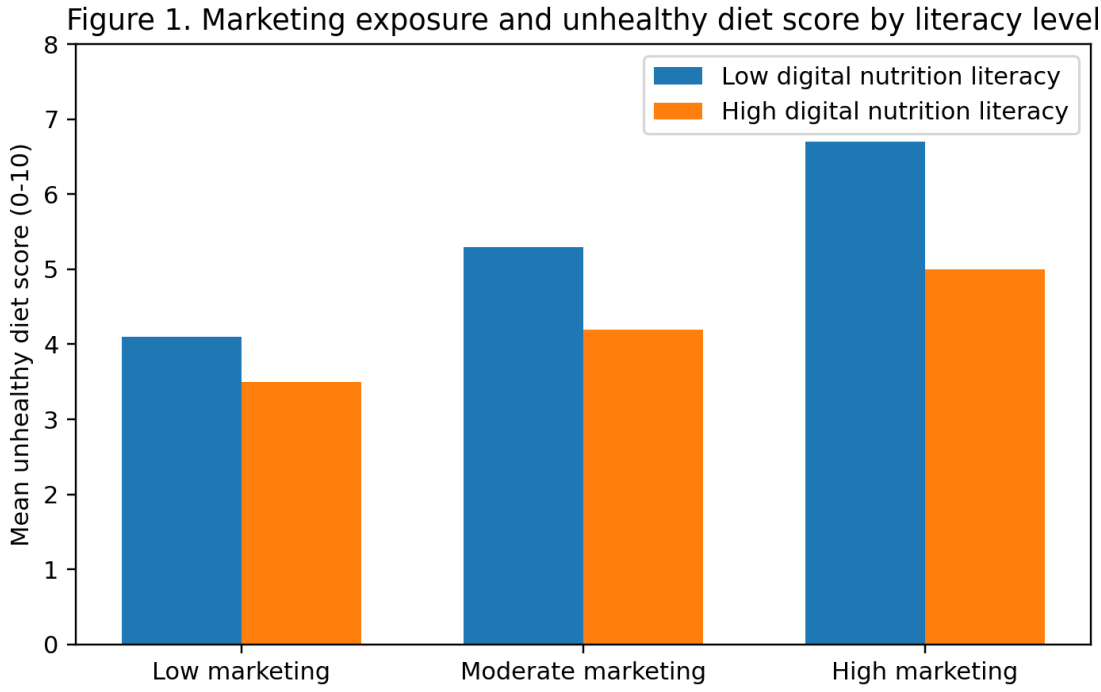

Figure 1. Unhealthy diet score by marketing exposure and digital nutrition literacy level. Values are illustrative and must be replaced with actual field results.

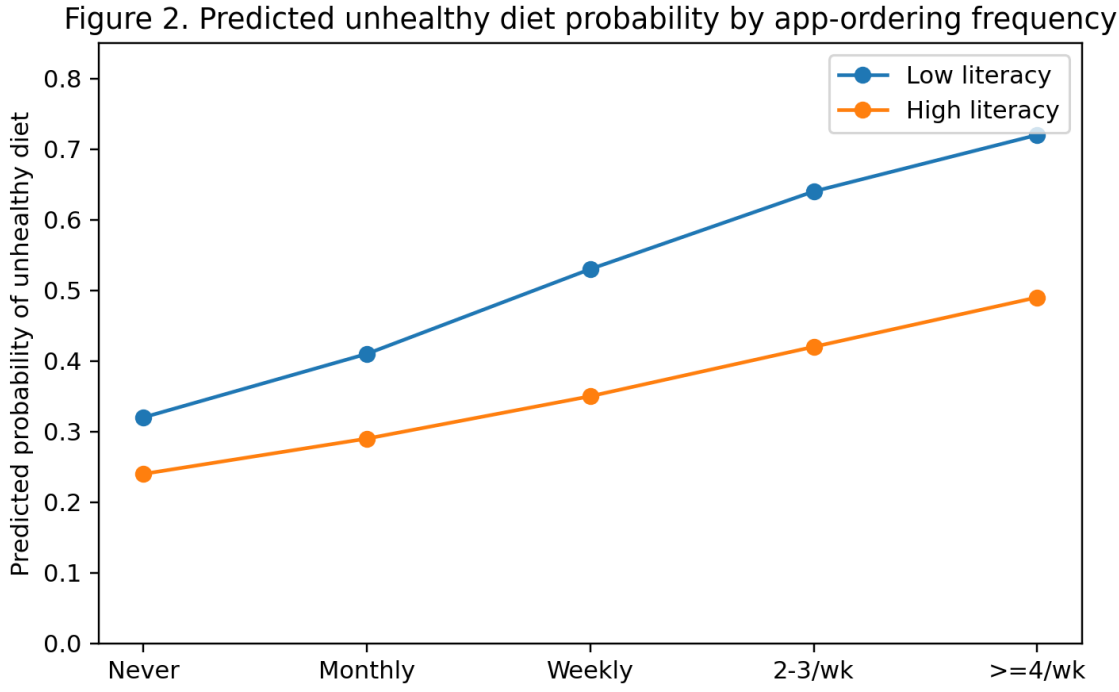

Figure 2. Predicted probability of unhealthy dietary choice by app-ordering frequency and digital nutrition literacy. Values are illustrative and must be replaced with actual field results.

Table 3. Logistic regression model for unhealthy dietary choice

Predictor	Adjusted OR	95% CI	p-value	Interpretation
High marketing exposure	2.21	1.42-3.45	<.001	Higher risk
Weekly or more app ordering	2.08	1.36-3.18	<.001	Higher risk
High digital nutrition literacy	0.55	0.35-0.86	.009	Protective
High screen time	1.63	1.05-2.54	.029	Higher risk
High marketing x high literacy	0.72	0.52-0.98	.041	Weakens exposure effect

4. Discussion

The illustrative findings suggest that digital nutrition literacy may reduce adolescents' vulnerability to unhealthy digital food environments. Students with higher literacy reported lower unhealthy diet scores at comparable levels of marketing exposure, and the predicted probability of unhealthy dietary choice was lower among high-literacy students across app-ordering frequency categories. This is a useful finding because it moves the discussion beyond simple exposure. Not all adolescents respond equally to digital food cues; knowledge, critical awareness and decision-making skills matter. [8]

Still, the results do not support a naive education-only solution. Even high-literacy students showed increasing risk as marketing exposure and app-ordering frequency increased. This matters because digital food platforms are not passive information tools. They are commercial environments designed to encourage engagement and purchasing. WHO (2023) and WHO (2022) both emphasize that food marketing remains pervasive and persuasive, while Boyland et al. (2022) found measurable effects of marketing on intake, preferences and purchase requests. If the environment repeatedly pushes unhealthy choices, literacy can reduce harm but cannot fully neutralize it. [8]

The finding also fits with Saleh et al. (2024), who found that adolescent online food delivery app use was common and that appearance and price influenced choices. A digitally literate student may understand that a combo meal is not healthy, but the student may still respond to low price, peer encouragement or hunger. Abdulkader et al. (2022) similarly noted concerns

about online food delivery services and the nutritional profile of foods sold through them. These studies support the idea that both individual competence and platform design shape behaviour. [9]

The protective role of literacy has practical implications for schools. Nutrition education should not only teach food groups and balanced diets. It should train students to identify sponsored content, influencer persuasion, misleading health claims, artificial urgency, discount traps, oversized portions and high-sugar beverage promotion. Students should also learn how to compare menu items, check nutrition information where available, choose smaller portions and avoid ordering in response to boredom or late-night screen exposure. [10-11]

However, responsibility cannot be pushed entirely onto adolescents. Public health policy should address the commercial design of digital food environments. WHO's 2026 guideline on school food environments emphasizes the need to reduce foods that do not support healthy diets in school settings, but adolescent exposure now extends beyond the physical school gate. The same logic should apply digitally: marketing restrictions, clear calorie information, healthier default sorting and limits on youth-targeted promotions are reasonable policy directions. [11]

The study has limitations. The results are simulated and require actual field data. Cross-sectional design prevents causal claims. Self-reported exposure and diet may contain recall and social desirability bias. Digital nutrition literacy scales require validation in local languages and contexts. Despite these limitations, the paper offers a realistic framework for studying how literacy, marketing and app-based ordering interact in adolescent dietary behaviour.

5. Conclusion

This paper concludes that digital nutrition literacy may be an important protective factor against unhealthy food choices linked with online food delivery app use and digital food marketing exposure among adolescents. In the illustrative analysis, adolescents with high literacy had lower unhealthy diet scores and lower predicted probability of unhealthy dietary choice than students with low literacy. However, the protective effect was incomplete. Marketing exposure and frequent app ordering still increased risk, which means individual education alone is not strong enough.

The practical lesson is blunt: schools cannot keep teaching nutrition as if adolescents live only in kitchens and classrooms. They live in algorithmic food environments where unhealthy foods are repeatedly shown, discounted, glamorized and normalized. Therefore, adolescent nutrition

programs must include digital food marketing literacy, practical app-ordering skills and critical understanding of influencer content. Parents should monitor payment access, late-night ordering and pocket-money use, but they also need to discuss persuasion rather than simply banning apps.

Policy action is equally important. Food delivery platforms and digital advertisers should not be allowed to aggressively promote unhealthy foods to minors without safeguards. Future studies should validate digital nutrition literacy tools, collect longitudinal data and test school-based interventions. Real improvement will require a combined approach: stronger adolescent skills, healthier school food environments, parental involvement and regulation of commercial digital food cues.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Rakhi contributed to conceptualization (lead), methodology (lead), investigation (lead), writing of the original draft (lead), and supervision. Dr. Neeraj Choudhary was responsible for formal analysis (lead), writing – review & editing (lead), and visualization (supporting).

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