

## EFFECTIVENESS OF DIGITAL-BASED NUTRITION EDUCATION ON CHANGING CONSUMPTION PATTERNS OF ADOLESCENTS

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### *Abstract*

This study investigates the impact of digital-based nutrition education on the dietary behaviors of adolescents. With the increasing prevalence of unhealthy eating patterns among teenagers, exacerbated by digital influences, a targeted intervention utilizing mobile applications, social media, and online modules was implemented. Using a quasi-experimental design with pre- and post-test measures across two groups (intervention and control), the research involved 300 students aged 13–17 in urban schools. Results demonstrated a significant improvement in the dietary habits of the intervention group, including increased fruit and vegetable intake and reduced consumption of sugary beverages and ultra-processed foods. These findings affirm the potential of digital platforms as scalable and effective tools in promoting adolescent nutritional literacy and behavioral change.

**Keyword:** Adolescents, Dietary Behavior, Health Intervention, Digital Health Literacy

### Introduction

The global increase in non-communicable diseases is closely linked to poor dietary habits developed during adolescence (World Health Organization, 2020). Adolescents are particularly vulnerable to the influence of social media, marketing, and peer culture, which often promote unhealthy food choices. Concurrently, digital technologies have permeated every aspect of young people's lives, offering both a challenge and an opportunity for health educators.

The advent of mobile applications and digital platforms presents a promising avenue for health interventions targeting youth. Previous studies (Chen et al., 2021; Nour et al., 2019) suggest that digital health education can be as effective—if not more—than traditional methods. However, evidence on the impact of such tools specifically on adolescents' nutritional behaviors remains fragmented, particularly in non-Western contexts.

This study aims to evaluate the effectiveness of a structured, digital-based nutrition education program in altering dietary behaviors among adolescents. The research focuses on measurable changes in food consumption patterns, digital engagement levels, and knowledge retention. In recent decades, the global burden of diet-related non-communicable diseases (NCDs) has risen dramatically, with poor dietary habits established during adolescence playing a substantial contributory role (World Health Organization, 2020). Adolescents represent a nutritionally vulnerable demographic, not only due to their increased physiological demands during growth spurts but also because of their evolving autonomy, cognitive development, and increasing exposure to environmental and sociocultural influences, including digital media.

Current dietary trends among adolescents in both developed and developing countries reveal a concerning shift toward high-energy, low-nutrient foods—characterized by excessive intake of sugar-sweetened beverages, processed snacks, fast foods, and insufficient consumption of fruits, vegetables, and fiber-rich foods (Nour et al., 2019). These consumption patterns have been linked to early onset obesity, insulin resistance, micronutrient deficiencies, and the development of unhealthy dietary preferences that often persist into adulthood (Sahoo et al., 2015).

Simultaneously, the digital landscape has become a dominant part of adolescents' daily lives, with studies indicating that youth spend an average of 7 to 10 hours daily on screens, including smartphones, tablets, and computers (Stephens et al., 2020). While excessive screen time has been associated with sedentary behavior and exposure to unhealthy food marketing, digital platforms also present unique opportunities to disseminate health information in engaging, personalized, and scalable formats.

Digital-based nutrition education—encompassing mobile health (mHealth) applications, social media campaigns, gamified learning, and interactive e-learning platforms—has gained traction as a potential tool to influence youth health behaviors positively. Unlike traditional classroom-based interventions, digital tools can be adapted to individual preferences, delivered at scale with lower cost, and accessed asynchronously, thus overcoming many logistical barriers in school or community-based health education (Chen et al., 2021; Hamm et al., 2014).

Despite these advantages, empirical evidence on the actual effectiveness of digital interventions specifically targeting adolescent dietary behaviors remains limited and methodologically heterogeneous. Moreover, questions remain regarding which components

of digital education (e.g., interactivity, visual appeal, feedback loops, or peer engagement) are most impactful, and how these tools can be integrated effectively into broader public health strategies.

Grounded in the Social Cognitive Theory (Bandura, 1986), which emphasizes the role of observational learning, self-regulation, and social influence in behavior change, this study aims to investigate the effect of a structured, digital-based nutrition education program on the consumption patterns of adolescents in urban school settings. By evaluating both behavioral outcomes and engagement metrics, this research seeks to contribute rigorous evidence to the discourse on digital health literacy and adolescent nutrition, with implications for policy, practice, and future program development.

## **Research methods**

This study uses a cross-sectional design with a quantitative approach. The research location is three sub-districts in City X, known for high population density and diverse environmental conditions. The population in this study is all household heads in the area. The sample was selected using purposive sampling, involving 150 respondents. The research instrument was a structured questionnaire tested for validity and reliability. Data were analyzed using logistic regression to identify the relationship between independent variables (education, PHBS knowledge, access to clean water, role of health cadres, family income) and the dependent variable (PHBS practice level).

## **Results and Discussion**

The findings of this study provide compelling evidence that digital-based nutrition education can effectively influence adolescents' dietary behaviors. The intervention group demonstrated significant improvements in multiple domains, including increased consumption of fruits and vegetables, and reduced intake of sugar-sweetened beverages and fast foods. These outcomes are consistent with previous literature, affirming the efficacy of digital health interventions among young populations (Nour et al., 2019; Chen et al., 2021).

One of the most notable aspects of the intervention's success lies in its integration of interactivity, gamification, and real-time feedback, which align closely with behavioral principles derived from Bandura's Social Cognitive Theory. According to Bandura (1986), behavior change is best facilitated when individuals are exposed to modeling, self-regulation

opportunities, and social reinforcement—all of which were embedded in the mobile application used in this study. The inclusion of weekly interactive content and a point-based reward system likely served as **positive reinforcement**, motivating participants to adopt and maintain healthier eating patterns.

Furthermore, the increase in nutrition knowledge and self-reported confidence in making healthier food choices supports the role of **digital health literacy** as a mediator of behavioral change. As suggested by Nutbeam (2000), health literacy is not limited to the acquisition of knowledge but also involves critical thinking and decision-making skills, particularly important during adolescence when autonomy in food selection begins to emerge. The intervention's ability to enhance digital health literacy likely contributed to sustained changes in behavior observed during the post-test phase. The importance of **peer influence** and social engagement in digital environments was also observed qualitatively. Many participants reported discussing the content of the modules with peers and family members, suggesting that the program had a ripple effect beyond individual users. This supports findings from previous studies that emphasize the value of **social learning and group norms** in adolescent behavior change (Chau et al., 2018). Despite these encouraging results, several challenges must be acknowledged. First, while the digital approach effectively engaged the majority of participants, **digital inequality** remains a critical issue. Access to smartphones, reliable internet, and digital fluency varied among students, potentially limiting the intervention's universal applicability. As argued by van Dijk (2020), the digital divide is not merely a matter of access but of usage and outcome disparities—an essential consideration for future program scaling and policy integration. Second, the **short duration** of the study—six weeks—limits the ability to assess the long-term sustainability of behavior change. While positive trends were evident, longer-term follow-up is necessary to determine whether adolescents maintain these healthier habits or revert to previous consumption patterns. Longitudinal research would also help evaluate whether improved adolescent dietary practices translate into measurable health outcomes such as BMI reduction, metabolic improvements, or cognitive performance enhancement (Sahoo et al., 2015).

Third, it is important to consider **content fatigue** and declining engagement, which are common challenges in digital interventions. Stephens et al. (2020) found that adolescent engagement often declines after the novelty of an app wears off, unless content is regularly updated and personalized. Future iterations of the program should include adaptive algorithms, peer-driven challenges, or integration with existing social media platforms to sustain interest. Finally, this study reinforces the **policy relevance** of integrating digital nutrition education into national adolescent health strategies. Given the scalability and cost-efficiency of digital platforms, they can complement existing school-based or community-based interventions. However, such integration requires **multi-sectoral collaboration**—involving ministries of education, health, communication, and private tech sectors—to ensure content quality, data privacy, and equitable access (World Health Organization, 2020).

## Discussion

### Participant Characteristics

A total of **300 adolescents** aged between 13 and 17 years participated in this study, with an equal distribution between the intervention ( $n = 150$ ) and control groups ( $n = 150$ ). The mean age was **15.2 years (SD = 1.3)**. The gender distribution was approximately equal (51.7% female, 48.3% male), and no statistically significant differences were observed between the two groups at baseline in terms of demographic characteristics ( $p > 0.05$ ).

### Changes in Food Consumption Patterns

Post-intervention analysis revealed significant improvements in the dietary habits of the intervention group compared to the control group. The following table summarizes the key changes in selected dietary behaviors:<br>

**Table 1. Changes in Dietary Habits Pre- and Post-Intervention (Mean Servings per Day)**

Food Category	Intervention (Pre)	Intervention (Post)	Control (Pre)	Control (Post)	p-value (Group × Time)

Fruits	1.2	<b>2.0</b>	1.3	1.4	<b>0.0 01</b>
Vegetables	1.0	<b>1.8</b>	1.1	1.2	<b>&lt;0 .001</b>
Sugar-sweetened beverages	2.1	<b>1.4</b>	2.0	2.0	<b>0.0 02</b>
Fast food (times/week)	2.5	<b>1.9</b>	2.4	2.3	<b>0.0 04</b>

*Statistical test: Two-way repeated measures ANOVA.*

The intervention group showed:

- A 67% increase in fruit intake ( $p = 0.001$ ),
- An 80% increase in vegetable consumption ( $p < 0.001$ ),
- A 33% decrease in sugary drink consumption ( $p = 0.002$ ),
- A 24% reduction in fast-food intake ( $p = 0.004$ ).

In contrast, the control group exhibited no statistically significant change across all dietary variables.

### Improvement in Nutrition Knowledge

Nutrition knowledge scores improved significantly in the intervention group, with average scores rising from 58.4% to 74.2% ( $p < 0.001$ ), while the control group remained stable at around 59%.

*Statistical test: Paired sample t-test for within-group comparison, and ANCOVA for between-group comparison controlling for baseline.*

### Digital Engagement and Correlation with Outcomes

Data from the app's backend indicated that 83% of participants in the intervention group completed at least 80% of the modules. A positive correlation ( $r = 0.46$ ,  $p < 0.01$ ) was found between module completion rate and the magnitude of dietary improvement, particularly in fruit and vegetable intake.

### Qualitative Insights

Focus group discussions revealed that adolescents appreciated the gamified features, short educational videos, and weekly goal setting. Participants also reported discussing

dietary topics with family members, indicating potential spill-over effects of the intervention beyond individual behavior.

## Closing

Digital-based nutrition education presents an effective, scalable approach to modifying adolescent dietary behaviors. Given the ubiquity of mobile technology, especially among youth, such interventions should be integrated into national health education strategies. To enhance long-term effectiveness, ongoing updates, user feedback loops, and community support systems are essential.

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