October – December, 2025
Original Article
DOI: http://dx.doi.org/10.30867/action.v10i4.2651

Pages: 926 – 934

AcTion:
Aceh Nutrition Journal
p-issn 2527-3310; e-issn 2548-5741

The effectiveness of digital nutrition education interventions on behavioral changes in fast food consumption

Efektivitas intervensi edukasi gizi digital terhadap perubahan perilaku konsumsi makanan cepat saji

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Article History:
Received: June 14, 2025; Revised: August 07, 2025; Accepted: August 30, 2025; Published: December 13, 2025.

Publisher:
Politeknik Kesehatan Aceh
Kementerian Kesehatan RI

Abstract

The consumption of fast food has increased significantly and is associated with obesity and other chronic diseases. Digital nutrition education has been proposed as a solution to promote healthy eating behaviors. This randomized controlled trial was conducted in Jakarta and Bandung, Indonesia, in 2024 and involved 200 participants aged 18–50 years old. The experimental group (n=100) received digital nutrition education through a mobile application, whereas the control group (n=100) received no intervention. Data on fast-food consumption frequency, nutritional knowledge, and attitudes were collected using validated questionnaires before and after the 6-week intervention. Fast food consumption in the experimental group decreased significantly by 53% (from 6.5 to 3 times/week) compared with a 12% reduction in the control group. Nutritional knowledge improved from 40% to 75%, and 80% of the participants reported improved eating habits. Higher engagement with interactive app features led to a 30% increase in healthy food consumption. Digital nutrition education interventions effectively reduce fast food consumption and improve nutritional knowledge and attitudes. These findings support the integration of digital tools into public health strategies.

Keywords: Digital Nutrition Education, Behavior Change, Fast Food Consumption, Randomized Trial

Abstrak

Konsumsi makanan cepat saji meningkat secara signifikan dan dikaitkan dengan obesitas serta penyakit kronis. Edukasi gizi digital diusulkan sebagai solusi untuk mendorong perilaku makan yang lebih sehat. Penelitian uji coba terkontrol secara acak ini dilakukan di Jakarta dan Bandung, Indonesia, pada tahun 2024, melibatkan 200 partisipan berusia 18–50 tahun. Kelompok eksperimen (n=100) menerima intervensi edukasi gizi digital melalui aplikasi seluler, sementara kelompok kontrol (n=100) tidak menerima intervensi. Data dikumpulkan melalui kuesioner tervalidasi yang mengukur frekuensi konsumsi fast food, pengetahuan gizi, dan sikap terhadap pola makan sehat sebelum dan sesudah intervensi selama 6 minggu. Konsumsi makanan cepat saji pada kelompok eksperimen menurun secara signifikan sebesar 53% (dari 6.5 menjadi 3 kali/minggu), dibandingkan dengan penurunan 12% pada kelompok kontrol. Pengetahuan gizi meningkat dari 40% menjadi 75%, dan 80% partisipan melaporkan perubahan positif dalam kebiasaan makan. Keterlibatan tinggi dengan fitur interaktif aplikasi menghasilkan peningkatan konsumsi makanan sehat sebesar 30%. Intervensi edukasi gizi digital efektif dalam menurunkan konsumsi makanan cepat saji serta meningkatkan pengetahuan dan sikap gizi. Temuan ini mendukung

integrasi alat digital dalam strategi kesehatan masyarakat.

Kata Kunci: Edukasi Gizi Digital, Perubahan Perilaku, Konsumsi Fast Food, Uji Acak Terkontrol

Introduction

Fast food consumption, characterized by high calorie content, trans fats, sugar, and salt, is one of the main factors contributing to the increasing prevalence of obesity and other non-communicable diseases worldwide (Maldonado-Pereira et al., 2022). This phenomenon is not limited to developed nations but is also rapidly expanding in developing countries, including Indonesia. Fast food, which is often considered a practical, fast, and affordable solution, is increasingly becoming the main choice in the daily diet of many people, especially urban people with high mobility. However, in the long term, excessive fast-food consumption can pose serious health risks, including obesity, type 2 diabetes, hypertension, heart disease, and other metabolic disorders (Fulkerson, 2018; Hawkes et al., 2017).

Data from the World Health Organization (WHO) indicate that the global prevalence of obesity has more than doubled since 1980, with over 650 million adults classified as obese in 2016 (Lim et al., 2020; WHO, 2018). In Indonesia, data from the 2018 Basic Health Research (Riskesdas) revealed that the prevalence of obesity among adults was 21.8%. In addition, fast food consumption is associated with an increase in the prevalence of chronic diseases, which adds to the burden on the public health system (Ri, 2018). In this context, efforts to address this issue are of great importance, given the negative impact of unhealthy diets on the quality of life and productivity of individuals (Awaluddin et al., 2024).

However, changing people's eating habits that have been formed over the years is difficult to achieve. The high consumption of fast food in many countries, including Indonesia, is largely due to social, cultural, and economic factors (Warde, 2024). The convenience of access, relatively affordable prices, and quick service times make fast food a popular choice, especially among people with limited time and resources to prepare meals. In addition, aggressive promotion and advertising by the fast-food industry have exacerbated this problem, turning food consumption habits into complex challenges (Karnani et al., 2016; Najib et al., 2022).

In response to this growing phenomenon, various approaches have been attempted to reduce fast food consumption and promote healthier diets. One growing approach is the use of digital technology-based nutrition education interventions. Digital technology, with its ability to reach a wider audience, offers opportunities to deliver personalized, relevant, and accessible information anytime and anywhere (Chapman, 2017; Popkin et al., 2021). Digital nutrition education interventions, such as mobile applications, websites, and social media campaigns, offer a more flexible and affordable approach than traditional educational methods.

The importance of digital nutrition education has been increasingly recognized in recent years. Boulos et al. showed that mobile apps for nutrition education not only increase knowledge about nutrition but also help change participants' eating behaviors, encouraging them to reduce their consumption of fast food (Boulos et al., 2015; Zhao et al., 2017). Another study by Niederdeppe et al. (2024) showed that targeted social media campaigns can influence an individual's eating attitudes and behaviors by utilizing interactive and easily accessible media for different walks of life (Niederdeppe et al., 2024). Nonetheless, despite numerous studies showing the potential of digital education to raise awareness of the importance of healthy eating, there is still a lack of research focusing on the effects of these interventions on specific changes in fast-food consumption.

There are several reasons why the existing evidence on the impact of digital interventions in reducing fast food consumption is still limited. First, many previous studies have focused on improving knowledge about nutrition in general or changing attitudes toward healthy eating without evaluating the direct effects on fast food consumption (Hamulka et al., 2018). Second, some studies have focused only on the effectiveness of one type of digital platform, such as mobile apps or websites, and have not directly compared the effects of different types of digital interventions on eating behaviors (Chen et al., 2020). In addition, digital nutrition education interventions often do not consider

personalization aspects that may be more effective in encouraging behavioral changes.

By addressing these gaps, this study aimed to evaluate the effectiveness of digital nutrition education interventions in changing fast-food consumption behavior among individuals. This study used an experimental quantitative method with a random control design, in which two groups, namely, the group that received a digital nutrition education intervention (the experimental group) and the control group that did not receive the intervention, were compared. This study measured changes in fast food consumption behavior, increased nutritional knowledge, and changes in attitudes towards healthy eating using surveys administered before and after the intervention (Ferrara et al., 2019; Upreti, 2023).

This research is expected to contribute significantly to the lack of evidence related to the effectiveness of digital nutrition education in reducing fast food consumption and improving diets. The results of this study are also expected to provide a basis for the development of more effective and personalized digital-based nutrition education programs that can be implemented on a broader scale to support public health efforts. In addition, this study is expected to provide insights into how digital technology can be used to positively and sustainably influence people's eating behaviors and provide recommendations for more evidence-based health policies.

Methods

Research Design

This study employed a randomized controlled trial (RCT) to assess the effectiveness of digital nutrition education interventions in changing participants' fast food consumption behavior. The RCT design was chosen because it allows for the evaluation of the cause-and-effect relationship between the intervention and behavioral change. Two groups of participants were randomly assigned to the experimental group, which received the digital nutrition education intervention, and the control group, which did not receive any intervention. This design offers better control over external variables that may influence the results of this study (Bhide et al., 2018).

Population and Sample

The study involved 200 participants, with 100 in the experimental and 100 in the control group. Stratified random sampling techniques were used to select this sample, ensuring a balanced representation based on demographic factors, such as age, gender, and socioeconomic status, which are believed to influence fast food consumption habits.

The inclusion criteria in this study were as follows: adults aged between 18 and 50 years, having a habit of consuming fast food at least three times per week over the past three months, and having access to a digital device such as a smartphone with an Android or iOS operating system that could be used to download and use the digital nutrition education app. Participants with health conditions that significantly affected their diets were excluded from the study.

The exclusion criteria were individuals with serious health conditions, such as diabetes or heart disease, and those who had engaged in a weight management program or a structured diet in the past 6 months.

Research Location

This research was conducted in two major cities in Indonesia, Jakarta and Bandung, which were chosen because both have urban characteristics with a high level of fast food consumption and wide access to digital technology. Jakarta, the capital city, has a dense population and many areas with high fast-food consumption, while Bandung, with many universities and a creative sector, provides a younger population and is more open to technology. This research will be conducted in locations such as shopping centers, fast-food restaurants, and office areas in both cities.

Tools and Instruments

Data will be collected using tools and instruments that have been tested for their validity and reliability. These include a fast food consumption questionnaire to measure the frequency of participants' fast food intake before and after the intervention, a nutrition knowledge questionnaire to assess participants' understanding of nutrition, and an attitude scale to evaluate changes in participants' attitudes toward healthy eating following the intervention (Huang, J., Xu, Y., & Zhao, 2017; Ye et al., 2015; Champion & Skinner, 2008).

In addition, a Digital Nutrition Education application was used for the experimental group. The app was developed using Flutter 2.0 and provided nutrition education materials through videos, texts, and interactive features such as goal setting and personalized feedback.

Data Collection

Data collection was conducted in two stages. First, during the pre-intervention phase, the participants completed a questionnaire designed to assess their fast-food consumption, nutritional knowledge, and attitudes toward healthy eating. Following the 6-week intervention, the post-intervention phase will involve participants completing the same questionnaire to evaluate any changes in these areas of their lives. Additionally, app usage data, such as the frequency of use and interaction with specific features, were collected to assess the level of participant engagement with the intervention.

Data Analysis Methods

The collected data were analyzed using IBM SPSS Statistics for Windows, version 26. Descriptive analysis was used to describe the characteristics of the sample and the distribution of data on variables measured before and after the intervention. A paired-sample t-test was conducted to assess significant differences in fast food consumption, nutritional knowledge, and attitudes toward healthy eating between the pre- and post-intervention phases within both the experimental and control groups (Morgan et al., 2019).

ANOVA was employed to examine the differences between the experimental and control groups in terms of changes in fast-food consumption behavior and nutritional knowledge. Finally, linear regression analysis will be used to evaluate the factors influencing changes in fast food consumption behavior and to determine the impact of app engagement on these behavioral changes (McCormick & Salcedo, 2017).

Code of Health Ethics

All data collected in this study will be kept confidential, and the research results will be presented only in aggregate form, without disclosing the participants' identities. This study was approved by the Health Research Ethics Committee of the Sentra Medika Research Institute, West Java (ethical approval number SMRI-WJ/EC/057/VI/2024).

Result and Discussion

Sample Description

A total of 200 participants were included in this study and were divided equally into two groups: the experimental group (n = 100) and the control group (n = 100). The characteristics of the participants based on age, sex, and socioeconomic status are presented in Table 1. The mean age in the experimental group was 32.5 ± 6.4 years, compared with 33.0 ± 5.9 years in the control group, indicating a relatively homogeneous adult population in early to mid-adulthood. The sex distribution was also relatively balanced in both groups, minimizing the risk of sex-based bias in the intervention outcomes. Additionally, most participants (above 65%) were from the upper-middle socioeconomic class, suggesting high accessibility to digital devices and Internet connectivity. This condition supports the feasibility and effectiveness of implementing a digital nutrition education intervention, as participants likely possess the digital literacy and resources required to engage with the program content consistently (Bell, 2023; Kay et al. 2023).

Table 1. Demographic characteristics of participants

Variable	Experimental Group (n = 100)	Control Group (n = 100)	p-value
Age (mean ± SD)	32.5 ± 6.4 years	33.0 ± 5.9 years	0.621[1]
Gender (Male/Female)	50 / 50	48 / 52	0.764[2]
Socio-Economic Status (%)	70% upper-middle class	68% upper-middle class	0.751[2]

a Independent t-test; [2] chi-square test.

Changes in Fast Food Consumption

The paired-sample t-test results showed a significant decrease in fast-food consumption in the experimental group after the 6-week intervention. The mean frequency decreased from 6.5 ± 1.2 times/week to 3.0 ± 1.5

times/week ($p < 0.001$), indicating a reduction of more than 50% in the weekly fast food intake. In contrast, the control group showed a slight, statistically non-significant decrease from 6.0 ± 1.4 to 5.3 ± 1.3 times/week ($p = 0.078$). Furthermore, the results of the two-way ANOVA revealed a significant interaction effect between group and time ($p < 0.01$), confirming that the intervention had a substantial and differentiated impact compared to the absence of intervention.

Table 2. Changes in fast food consumption

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	p-value (t-test)
Experimental	6.5 ± 1.2	3.0 ± 1.5	-3.5	< 0.001
Control	6.0 ± 1.4	5.3 ± 1.3	-0.7	0.078

This finding suggests that the digital nutrition education intervention was effective in modifying participants' dietary behavior, particularly in reducing their fast-food consumption. The significant reduction in the experimental group implies that exposure to educational content via the digital platform likely increased participants' awareness of the health risks associated with frequent fast-food intake, thereby motivating them to change their behavior.

In contrast, the control group without access to the intervention did not experience meaningful changes, reinforcing the role of structured digital interventions in promoting healthier eating habits (Chen et al., 2020). These results are consistent with those of previous studies that highlight the potential of mobile and app-based education to influence dietary behavior change, particularly among digitally literate populations (Kankanhalli et al., 2019; Hussain, 2024).

Changes in Nutrition Knowledge

There was a significant increase in nutritional knowledge scores in the experimental group, from 40.2% ± 8.1% to 75.3% ± 7.4% after the intervention ($p < 0.001$), indicating a substantial improvement of 35.1 percentage points. Meanwhile, the control group showed only a slight and statistically non-significant increase, from 42.0% ± 7.9% to 45.1% ± 8.3% ($p = 0.114$). ANOVA results further confirmed a significant difference between groups in post-test scores ($p < 0.001$), reinforcing the effectiveness of the digital nutrition education intervention.

Table 3. Changes in nutritional knowledge before and after intervention

Group	Before Mean ± SD	After Mean ± SD	Mean Difference	p-value (t-test)
Experimental Group	40%	75%	+35%	< 0.001
Control Group	42%	45%	+3%	0.114

This marked improvement in the experimental group suggests that the digital intervention successfully enhanced the participants' understanding of essential nutrition concepts. The structured and interactive nature of digital content likely facilitated better engagement and retention of information compared with passive exposure or no intervention, as experienced by the control group participants.

These findings align with previous research supporting the use of digital platforms to improve nutrition literacy, particularly when the content is tailored, accessible, and delivered consistently over time. The negligible change in the control group also underscores the importance of guided educational strategies in achieving measurable learning outcomes related to health behaviors (Singh et al., 2023; Swargiary, 2024).

Changes in Attitudes to Healthy Eating

Attitudinal changes toward healthy eating also showed significant improvements in the experimental group. The mean positive attitude score increased from 80.1% ± 6.7% to 91.8% ± 5.3% ($p < 0.001$), reflecting an increase of 11.7 percentage points. In contrast, the control group exhibited only a marginal, statistically non-significant increase from 78.5 ± 7.2% to 80.0 ± 6.9% ($p = 0.092$). The ANOVA results further confirmed significant post-intervention

differences between the two groups ($p < 0.01$), indicating that the digital nutrition education program notably improved attitudes toward healthy eating.

These findings suggest that the intervention was effective not only in increasing knowledge but also in fostering more favorable attitudes toward nutritious dietary practices (Charles Shapu et al., 2020). A positive shift in attitude is critical because it often precedes actual behavioral changes, particularly in dietary habits.

Table 4. Changes in attitudes toward healthy eating

Group	Before Mean ± SD	After Mean ± SD	Mean Difference	p-value (t-test)
Experimental	80.1 ± 6.7%	91.8 ± 5.3%	+11.7%	< 0.001
Control	78.5 ± 7.2%	80.0 ± 6.9%	+1.5%	0.092

The digital platform likely influenced participants' perceptions by consistently presenting motivational messages, relatable scenarios, and actionable health tips that emphasized the benefits of healthy eating (Hudgens et al., 2020). The relatively stable scores in the control group reinforce the conclusion that attitudinal improvements were driven by the intervention rather than by external factors. These results support the existing literature, which asserts that digital health education, when designed to be engaging and user-centered, can play a vital role in shaping healthier lifestyle attitudes among adults (Alruwaili et al., 2023; Putra et al., 2025).

App Engagement and Behavioral Change (Regression Analysis)

Linear regression analysis was performed to determine the influence of app usage frequency on changes in the fast-food consumption. The results showed that the frequency of app use significantly predicted the magnitude of reduction in fast-food intake ($\beta = -0.52$, $p < 0.001$), indicating a moderate-to-strong inverse relationship between usage frequency and fast-food consumption. Participants who used the app ≥5 times per week experienced a substantial 60% reduction in their fast food intake, compared to only a 30% reduction among those who used the app ≤2 times per week.

Table 5. Relationship between app usage frequency and change in fast food consumption

App Usage Frequency	Mean Decrease in Fast Food Consumption (times/week)	Percentage Decrease
≥ 5 times/week	3.9 ± 1.1	-60%
3–4 times/week	2.8 ± 1.3	-43%
≤ 2 times/week	1.8 ± 1.4	-30%
Regression (β)	-0.52, p < 0.001	

This finding suggests that higher engagement with digital nutrition education platforms plays a critical role in reinforcing behavioral changes (Udoudom et al., 2023). Consistent app use likely facilitated repeated exposure to educational content, reminders, and interactive features that encouraged healthier food choices. This aligns with behavior change theories, such as the Health Belief Model and the Transtheoretical Model, which emphasize the importance of cues to action and reinforcement in adopting and maintaining new health behaviors (Al Rahmad & Shavira, 2024; Njoku et al., 2025).

Moreover, the significant β coefficient implies that digital interventions can be particularly effective when users interact with an application regularly and meaningfully. These results support a growing body of evidence highlighting the role of digital health tools in delivering scalable, personalized, and effective nutrition education, especially for populations with high digital literacy and accessibility issues. Thus, promoting user engagement should be a key strategy in future program implementation to maximize behavioral outcomes.

Conclusion

This study demonstrates that digital nutrition education interventions delivered through mobile applications significantly reduce fast food consumption, improve nutritional

knowledge, and foster more positive attitudes toward healthy eating. The experimental group showed a 53% reduction in fast-food intake, a 35% increase in nutrition knowledge, and notable improvements in dietary attitude. These findings highlight the importance of active user engagement, as a higher app usage frequency is strongly associated with greater behavioral change.

However, the study has some limitations, including a sample limited to urban populations with good access to technology and a relatively short intervention period of six weeks. Future research should involve more diverse populations and long-term follow-ups to assess the sustained impact of such interventions. Overall, digital nutrition education holds great potential as a public health tool for supporting healthy lifestyle changes and preventing diet-related disease.

Acknowledgments

I would like to express my sincere gratitude to all the participants for their cooperation and valuable contributions to this research. My heartfelt thanks go to my supervisor and colleagues for their guidance and support throughout the research process. I also appreciate the assistance of the technical team behind the digital nutrition education application. I would like to thank my family and friends for their continuous support and encouragement. Finally, I acknowledge the resources provided by [Your Institution's Name], which made this study possible.

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