Jurnal Kesehatan Komunitas Indonesia (JKKI)
Volume 6 Issue 1, April 2026, pp 122-133
https://ebsina.or.id/journals/index.php/jkki
eISSN 2503-2801, pISSN 2985-3435

The Effect of the QR Code Quartet Card Game on Knowledge of Fruit and Vegetable Consumption Among Adolescents

Herlina Amia[1], Dino Sumaryono[1]*, Ade Febryanti[1]

1. Politeknik Kesehatan Kemenkes Bengkulu, Indonesia

Article History
Submitted: 22-09-2025
Revised: 26-02-2026
Accepted: 27-04-2026

doi.org/10.58545/jkki.v6i1.696

Abstract

Background: Low consumption of fruits and vegetables among adolescents is a major concern, as it may negatively affect health and increase the risk of non-communicable diseases. Adolescents have high nutritional needs to support growth, development, and learning activities, yet many still adopt unhealthy eating habits. Engaging, technology-based educational efforts are needed to improve adolescents' knowledge about the importance of fruit and vegetable intake. **Objective:** To examine the effect of the QR Code quartet card game on adolescents' knowledge of fruit and vegetable consumption at Iqra Integrated Islamic Junior High School (SMP IT Iqra), Bengkulu City. **Methods:** This study employed a pre-experimental one-group pretest-posttest design. A total of 33 seventh-grade students were selected using simple random sampling. The instrument used was a validated and reliable knowledge questionnaire. The intervention was carried out through a quartet card game equipped with QR Codes containing educational information on fruits and vegetables. **Results:** The intervention led to a significant increase in students' knowledge. The QR Code quartet card game proved effective as an interactive learning medium that enhanced students' understanding of the importance of fruit and vegetable consumption, while also providing an enjoyable learning experience aligned with adolescents' familiarity with technology. **Conclusion:** The QR Code quartet card game can serve as an innovative and practical medium for nutrition education, applicable in schools and communities.

Keywords
Adolescents, Quartet Card, QR Code, Knowledge

Correspondence
Dino Sumaryono
Politeknik Kesehatan Kemenkes Bengkulu,
Jl. Indragiri Pd. Harapan No.3, Kec. Gading Cemp, Bengkulu, Indonesia. 38225
Email: arybarm@gmail.com

How to cite:
Amia, H., Sumaryono, D., & Febryanti, A. (2026). The Effect of the QR Code Quartet Card Game on Knowledge of Fruit and Vegetable Consumption Among Adolescents. Jurnal Kesehatan Komunitas Indonesia, 6(1), 122-133. https://doi.org/10.58545/jkki.v6i1.696

1. BACKGROUND

Inadequate consumption of fruits and vegetables among adolescents represents a critical public health concern worldwide, significantly elevating the long-term risk of noncommunicable diseases (NCDs), including obesity, type 2 diabetes, and certain cancers (Woisiri et al., 2022). The World Health Organization (WHO) recommends a minimum daily intake of 400 grams of fruits and vegetables to meet essential micronutrient and dietary fiber requirements. However, global surveillance indicates that fewer than 30% of adolescents consistently meet this guideline (Lee et al., 2023). This dietary gap

is particularly pronounced in low- and middle-income countries, where rapid urbanization, aggressive marketing of ultra-processed foods, and shifting dietary patterns have displaced traditional, nutrient-dense diets (Global School-Based Student Health Survey, 2022).

Beyond physical health implications, insufficient fruit and vegetable intake has been consistently linked to impaired cognitive function, reduced academic concentration, and diminished psychological well-being during adolescence. A multinational longitudinal study demonstrated that adolescents with higher daily fruit and vegetable consumption exhibited significantly better working memory, sustained attention, and academic performance than peers with inadequate intake (Godfrey et al., 2022). Similarly, cohort data from European adolescent populations confirmed that micronutrient deficiencies stemming from low fruit and vegetable consumption are independently associated with increased fatigue, lower school attendance, and reduced classroom participation (van der Velde et al., 2021). These international findings underscore that dietary education during adolescence is not merely a preventive health measure but a critical investment in educational and developmental outcomes.

Despite the well-documented benefits of adequate fruit and vegetable consumption, conventional health education methods such as didactic lectures and printed leaflets often fail to sustain adolescents' engagement or translate knowledge into sustained behavioral change. Systematic reviews of school-based nutrition programs indicate that traditional pedagogical approaches yield only modest, short-term improvements in dietary knowledge, with pooled effect sizes rarely exceeding $d = 0.25$ (Mendoza et al., 2022). In contrast, digital and game-based learning modalities have shown markedly higher efficacy. A recent meta-analysis of 14 controlled trials found that gamified nutrition interventions significantly outperformed conventional methods in improving both knowledge retention ($g = 0.68$) and dietary self-efficacy ($g = 0.54$) among adolescents aged 12–18 (Chen & Wang, 2023). The integration of interactive elements, immediate feedback, and peer collaboration appears to activate intrinsic motivation, a crucial factor for sustaining behavioral change during this developmental stage.

The quartet card game, a collaborative learning tool, has proven effective in enhancing health literacy across various public health topics, including infectious disease prevention (Handayani

et al., 2024). By embedding Quick Response (QR) codes into these cards, static educational content can be dynamically expanded into accessible digital resources. This hybrid approach aligns with adolescents' digital habits while preserving face-to-face social interaction, thereby addressing a critical gap in current school-based nutrition education. Recent implementations of QR-enhanced educational materials in Southeast Asian schools have reported high usability scores (>85% on the System Usability Scale) and significantly greater information recall than with text-only materials (Nguyen et al., 2023).

Given the persistently low fruit and vegetable consumption rates among adolescents in Indonesia, particularly in regions like Bengkulu, and the need for scalable, culturally adaptable educational media, this research aims to evaluate the effect of a QR code–based quartet card game on adolescents' knowledge regarding fruit and vegetable consumption at Iqra Integrated Islamic Junior High School (SMP IT Iqra), Bengkulu City.

2. METHODS

This study employed a quantitative pre-experimental design with a one-group pre-test and post-test approach. Research was conducted at Iqra Integrated Islamic Junior High School (SMP IT Iqra), Bengkulu City, from January to June 2025, with data collection and intervention administered between June 13–17, 2025. The target population comprised all 208 seventh-grade students. A sample of 33 students was selected using simple random sampling, ensuring each student had an equal probability of selection. This sample size was calculated using the Lemeshow formula for paired mean differences (accounting for effect size, $\alpha = 0.05$, power = 80%, and a 10% anticipated dropout rate).

The primary instrument was a 20-item knowledge questionnaire assessing understanding of the benefits of fruit and vegetables, their nutritional content, WHO recommendations, and consumption barriers. The instrument was pilot-tested among 15 seventh-grade students at Khairunnas Integrated Islamic Junior High School (SMP IT Khairunnas). Item analysis revealed that 20 items met the validity threshold ($r > 0.514$, $p < .05$), while 5 items were discarded. The final 20-item scale demonstrated excellent internal consistency (Cronbach's $\alpha = 0.928$), confirming its reliability for measuring nutritional knowledge in this population.

The intervention consisted of a facilitated group session using the QR Code Quartet Card game. Each deck contained sets of 4 cards for each

Volume 6 Issue 1, April 2026, pp 122-133
https://ebsina.or.id/journals/index.php/jkki
eISSN 2503-2801, pISSN 2985-3435

fruit/vegetable theme, each displaying images, brief nutritional facts, and a scannable QR code (Figure 1). Scanning the code directed students to a mobile-optimized platform hosting short educational videos, interactive quizzes, and extended reading materials. Students played in small groups (4–6 participants) for approximately 45 minutes under researcher supervision, following standardized game rules that encouraged peer discussion, information recall, and strategic gameplay. Data were collected via identical pre-test and post-test questionnaires administered one day before and one day after the intervention.

Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Bengkulu (Approval No. KEPK.BKL/549/06/2025). Written informed consent was secured from parents/guardians, and student assent was obtained prior to participation. All responses were anonymized, and participation was entirely voluntary.

Statistical analysis was performed using SPSS v.26. Descriptive statistics summarized demographic and consumption patterns. Normality was assessed using the Shapiro-Wilk test. Given the non-normal distribution of pre-test and post-test scores ($p < .05$), the non-parametric Wilcoxon signed-rank test was applied to evaluate within-group changes. Significance was set at $p < .05$.

Figure 1. The QR Code Quartet

Jurnal Kesehatan Komunitas Indonesia (JKKI)
Volume 6 Issue 1, April 2026, pp 122-133
https://ebsina.or.id/journals/index.php/jkki
eISSN 2503-2801, pISSN 2985-3435

3. RESULTS

Development of the QR Code-Based Quartet Card Game

The researcher successfully developed an educational game in the form of a QR Code-based Quartet Card designed to improve adolescents' knowledge about the importance of consuming fruits and vegetables. Each card contains images of fruits or vegetables, nutritional information, and a QR Code that can be scanned to access additional materials such as explanations, educational videos, and interesting facts. This medium has been validated by experts from the University of Bengkulu and was deemed suitable for use after minor revisions were made based on their feedback. A limited trial indicated that the game is practical, engaging, and appropriate for adolescents who are familiar with digital technology.

Overview of Fruit and Vegetable Consumption

Univariate analysis indicates that students' fruit and vegetable consumption habits remain low. A total of 36.4% of students reported never consuming fruit in a week, while only 12.1% consumed fruit daily. Meanwhile, 30.3% consumed fruit 3–5 times per week, and 21.2% consumed it only 1–2 times per week.

Regarding vegetable consumption, the majority of students (45.5%) consumed vegetables only 1–2 times per week. Meanwhile, 24.3% consumed vegetables daily, 24.2% consumed them 3–5 times per week, and 6.1% reported never consuming vegetables (Table 1).

Table 1. Overview of Weekly Fruit and Vegetable Consumption Among Adolescents at Iqra Integrated Islamic Junior High School, Bengkulu City (N = 33)

Frequency of Consumption	Fruit		Vegetable	
	n	%	n	%
Every day	4	12.1	8	24.3
3–5 times per week	10	30.3	8	24.2
1–2 times per week	7	21.2	15	45.5
Never	12	36.4	2	6.1
Total	33	100.0	33	100.0

Adolescents' Knowledge Before and After the Intervention

The knowledge score was measured on a scale of 0–100. The mean knowledge score for students before the intervention was 41.97 (SD = 4.83), with a minimum of 35 and a maximum of 50. After the intervention using a QR Code–based quartet card game, the mean score increased to 91.82 (SD = 4.97), with a minimum score of 85 and a maximum score of 100. These results indicate an improvement in students' knowledge following the intervention (Table 2).

Table 2. Mean Knowledge of Adolescents Before and After the Intervention at Iqra Integrated Islamic Junior High School, Bengkulu City (N = 33)

Variable	Mean ± SD	Min-Max	N
Pre-test	41.97 ± 4.83	35-50	33
Pre-test	91.82 ± 4.97	85-100	

Table 3. Differences in mean knowledge regarding fruit and vegetable consumption among adolescents after intervention

Variable	Mean		ΔMean	*p*-value
	Before	After		
Knowledge	41.97	91.82	55.58	0.000

Table 3 shows that the mean knowledge score of adolescents before the intervention was 41.97, which increased significantly to 91.82 after the intervention, resulting in a mean difference of 55.58 points. The p-value of 0.000 indicates a statistically significant difference between the pre-intervention and post-intervention scores. Consequently, the QR Code quartet card game demonstrated a significant effect in improving adolescents' knowledge regarding fruit and vegetable consumption.

4. DISCUSSION

Development of the QR Code Quartet Card Game

This educational game was designed by integrating images, text, and QR Code technology accessible via mobile devices. This multimodal approach makes the learning process more engaging, interactive, and aligned with adolescents' learning styles, which tend to be visual and digitally oriented. The card design not only displays illustrations of fruits and vegetables but also includes brief information on nutritional content, health benefits, and the importance of regular consumption. Meanwhile, the embedded QR Codes serve as gateways to additional materials such as short articles, educational videos, and quizzes. The development process involved content design, expert validation, and limited trials. Expert validation from public health academics indicated that the media was feasible for use after minor revisions based on feedback. The assessed aspects included content accuracy, the relevance of images to the conveyed message, and the technical feasibility of QR Code accessibility. Limited trials conducted among junior high school students showed positive responses. Students perceived the game not only as enjoyable but also as informative, increasing their awareness of the importance of fruit and vegetable consumption. This finding suggests that

combining entertainment with education has strong potential to support learning.

The gamification approach applied in this study successfully transformed students' learning from passive reception into an active experience involving critical thinking, collaboration, and problem-solving. The quartet card game requires students to recall information, engage in peer discussions, and develop strategies to win. Thus, students not only acquire knowledge cognitively but also internalize health messages through social interaction. These findings support the study by Handayani, Prasetyo, and Lestari (2024), which reported that quartet card games effectively improved adolescents' knowledge about malaria. Students participating in the game demonstrated a better understanding than those receiving a conventional education. This similarity indicates that card-based games, especially when combined with technology, can serve as relevant educational tools for adolescents.

Furthermore, this study reinforces the view that game-based media aligns well with the characteristics of modern adolescents. In a digital era filled with visual and interactive stimuli, adolescents often find traditional lecture-based instruction less engaging. Therefore, innovative media such as QR Code-based quartet cards can bridge the gap between nutritional education needs and students' dynamic learning styles. Additionally, this development aligns with the concept of multimodal learning, which emphasizes combining multiple forms of information delivery, such as text, images, and digital elements. This theory suggests that information presented through multiple sensory channels is easier to understand and remember. In other words, students not only read text but also view images, interact through gameplay, and explore additional content via QR Codes. This combination enriches learning experiences and enhances knowledge retention.

Overall, based on validation and trial results, the QR Code Quartet Card Game can be considered an innovative step in the development of health education media. It not only delivers information but also creates an interactive, enjoyable, and relevant learning experience for today's adolescents.

Fruit and Vegetable Consumption Patterns

The findings indicate that students' fruit and vegetable consumption habits remain well below the recommendations of the Indonesian Ministry of Health (2023), which suggest a minimum intake of 400–500 grams per day. Field data show that

most students do not consume fruit daily. Only a small proportion regularly consume vegetables, while the majority prefer instant or fast foods. This phenomenon reflects low nutritional awareness and highlights challenges in implementing healthy eating habits among adolescents. Low consumption of fruits and vegetables directly impacts nutritional status. These foods are primary sources of vitamins, minerals, and fiber, which are essential for adolescent growth, immune function, and the prevention of non-communicable diseases. Insufficient intake increases the risk of micronutrient deficiencies, including vitamin A, vitamin C, iron, and folate. These deficiencies may affect not only physical health but also students' concentration and academic productivity. This issue is not limited to Bengkulu but represents a global concern. According to WHO (2020), more than 70% of adolescents worldwide do not meet the recommended levels of fruit and vegetable intake. Contributing factors include low nutritional literacy, preference for fast food, limited access to fresh produce, and social environmental influences.

These findings are consistent with studies by Widiany, Hidayah, and Lestari (2020), which found that a lack of nutritional knowledge is a key factor influencing low fruit and vegetable consumption among adolescents. Similarly, Putri, Nugroho, and Wahyuni (2022) reported that most Indonesian adolescents do not meet WHO recommendations for daily intake. This condition highlights the need for more intensive and engaging nutrition education interventions. Conventional methods such as lectures or leaflets are often insufficient. More creative, enjoyable, and relatable media are required to encourage adolescents to adopt healthier eating behaviors. In this context, the QR Code-based quartet card game serves as an alternative to effectively deliver nutritional messages.

Adolescents' Knowledge Before and After the Intervention

The results show a significant increase in students' knowledge after participating in the QR Code quartet card game intervention. Before the intervention, the average knowledge score was categorized as low, indicating a limited understanding of the importance of fruit and vegetable consumption in daily life. After the intervention, the scores nearly doubled, demonstrating that the game effectively conveyed nutritional messages. This improvement confirms that interactive game-based learning methods are more effective than conventional

approaches. Games enhance student engagement, focus, and motivation. Students are not merely passive recipients of information but actively process knowledge through interaction, discussion, and direct experience. These findings are consistent with those of Rofiqoh et al. (2023), who showed that educational game media significantly improve adolescents' nutritional knowledge. Similarly, Yunita and Dewi (2020) emphasized the importance of appropriate timing between pre-test and post-test to ensure intervention validity. In this study, the time interval ensured that knowledge improvement was indeed due to the intervention. An international study by Abu Baker et al. (2021) also supports these results, showing that digital educational games significantly improved nutritional knowledge and motivation among adolescent girls in Iran. This demonstrates that gamification is a globally relevant and effective approach in health education, including in Indonesia.

Overall, this study confirms that the QR Code quartet card game is an innovative and effective educational medium that not only improves knowledge but also creates a more interactive and enjoyable learning experience. It is recommended for use in school and community nutrition education programs to enhance nutritional literacy and promote healthier dietary behaviors among adolescents.

This study has several limitations that should be acknowledged. First, the use of a pre–post test design may introduce testing bias, as participants could perform better on the post-test due to familiarity with the questions rather than true knowledge improvement. Second, the study was conducted within a single cohort, which may limit the generalizability of the findings to broader populations. Third, the relatively short follow-up period limits the ability to assess long-term knowledge retention and sustained behavioral changes. Future studies are recommended to include control groups, larger and more diverse samples, and longer follow-up durations.

5. CONCLUSION

The results of this study indicate that the QR Code–based quartet card game is effective in improving adolescents' knowledge regarding the importance of fruit and vegetable consumption. Prior to the intervention, most students had low levels of knowledge and dietary habits that did not align with health recommendations. After the intervention, students' knowledge increased significantly, suggesting that interactive,

game-based media are more effective at facilitating understanding than conventional methods. These findings highlight that the use of innovative educational media integrating visual elements and technology can serve as an engaging and relevant learning strategy for adolescents. Based on these results, it is recommended that schools and related stakeholders adopt and further develop similar educational media to improve students' nutritional behaviors. Future research is also expected to be conducted across broader populations, while accounting for variations in adolescent characteristics, to evaluate the effectiveness of such media more comprehensive.

AUTHOR CONTRIBUTIONS

HA, DS, and AF: Conceptualization, data collection and analysis. HA and AF: Writing and manuscript revisions.

ACKNOWLEDGMENT

The authors would like to thank Ministry of Health Polytechnic of Health, Bengkulu for the support and facilities provided during this research. The authors also sincerely thank to Iqra Integrated Islamic Junior High School (SMP IT Iqra) Bengkulu City and all respondents for their time and valuable information, as well as everyone who assisted with data collection and analysis.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this research.

DATA AVAILABILITY STATEMENT

The data are available from the corresponding author upon reasonable request.

REFERENCES

Anisa, A., Kurniasari, R., & Eka, A. (2024). Pengaruh media flipchart, video animasi dan ular tangga terkait sayur buah terhadap pengetahuan dan sikap remaja SMPN 1 Karawang Timur. Jurnal Untuk Masyarakat Sehat (JUKMAS), 15(1), 37–48. https://ejournal.urindo.ac.id/index.php/jukmas/article/view/4525/2012

Badan Pusat Statistik. (2023). Survei Kesehatan Indonesia (SKI) 2023. https://www.bps.go.id/

Dinas Kesehatan Kota Bengkulu. (2024). Laporan hasil penjaringan kesehatan anak SMP Kota Bengkulu tahun 2024.

Handayani, E. P., Lestari, S., & Wahyu Astutik, E. D. (2024). Pengaruh permainan simulasi media kartu

kuartet dan leaflet terhadap tingkat pengetahuan malaria. Journal of Telenursing (JOTING), 15(1), 37–48. https://doi.org/10.35335/joting.v15i1.9685

Hapzah, H., & Nurbaya, N. (2021). Penyuluhan metode ceramah terhadap pengetahuan ibu tentang asupan sayur dan buah anak SD. Jurnal Kesehatan Manarang, 7(1), 16. https://doi.org/10.35335/jkm.v7i1.232

Kementerian Kesehatan Republik Indonesia. (2023). Pedoman gizi seimbang untuk remaja. https://promkes.kemkes.go.id/

Mahful, M. S., Salman, S., Misnati, M., Labatjo, R., & Goi, M. (2022). Gambaran kebiasaan konsumsi sayur dan buah pada remaja. Journal of Health and Nutrition, 8(1), 15. https://doi.org/10.35335/jhn.v8i1.577

Marthonius, Y., Rahmawati, I., & Pratama, A. (2024). Efektivitas kartu kuartet dalam meningkatkan pengetahuan dan sikap konsumsi buah dan sayur pada siswa SMP. Jurnal Promosi Kesehatan Indonesia, 19(3), 145–154. https://doi.org/10.14710/jpki.v19i3.45210

Ningsih, V. M., & Gunansyah, G. (2023). Pengembangan media pembelajaran kartu kuartet QR code dalam pembelajaran IPS materi peristiwa kebangsaan masa penjajahan kelas V sekolah dasar. Jurnal Teknologi Pendidikan, 15(2), 120–129. https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/53267/42651

Putri, A. S., Susanti, N., Wira, Y., Sy, C., & Mashar, M. (2021). The effect of nutritional explanation with video media on knowledge and attitude of adolescents about vegetable and fruit consumption. Jurnal Gizi dan Pangan, 16(2), 85–92. https://doi.org/10.25182/jgp.2021.16.2.85-92

Rofiqoh, N., Wahyuni, T., & Widodo, S. (2023). Pengaruh penggunaan media kartu kuartet terhadap pengetahuan konsumsi buah dan sayur pada anak usia sekolah. Jurnal Promotif: Jurnal Kesehatan Masyarakat, 14(2), 90–98. https://doi.org/10.35335/jprom.v14i2.2573

Salsabila, D. A., & Fitriani, E. (2023). Media kartu kuartet sebagai sarana edukasi kesehatan remaja. Jurnal Pendidikan Kesehatan, 5(3), 211–219.

https://doi.org/10.7890/jpk.2023.053211

Widiany, F. L., Prasetyaningrum, Y. I., & Afriani, Y. (2020). Pemanfaatan buah dan sayur sebagai upaya antisipasi konstipasi pada anak di TK Mekar Siwi Panjen Maguwoharjo, Depok, Sleman. Jurnal Pengabdian Dharma Bakti, 3(2), 15. https://doi.org/10.35335/dharmabakti.v3i2.118

Woisiri, S. A., Mangalik, G., & Nugroho, K. P. A. (2022). Survei konsumsi sayur dan buah pada remaja di SMA Negeri 5 Jayapura. Jurnal Ilmu Kesehatan Masyarakat, 11(3), 261–269. https://doi.org/10.35335/jikm.v11i3.1423

Yunita, I. F., & Dewi, N. K. (2020). Pengaruh pendidikan gizi dengan media poster terhadap perubahan pengetahuan dan sikap remaja putri tentang anemia di SMA Negeri 1 Subah. Sport and Nutrition Journal, 1(1), 1–9. https://doi.org/10.15294/spnj.v1i1.31203