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HEALTH EDUCATION "MOLETAS" IMPROVING KNOWLEDGE AND AT TOWARD OBESITY PREVENTION AMONG ADOLESCENTS

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ABSTRACT

Obesity is an emerging health problem among adolescents and can have long-term health consequences. One innovative approach to improving knowledge and attitudes toward obesity prevention is through the use of educational games. The MOLETAS (Monopoly Obesity) educational media was developed to deliver health messages in an engaging and interactive way. This study aimed to determine the effect of health education using the MOLETAS media on improving knowledge and attitudes toward obesity prevention among adolescents.

This research employed a quantitative pre-experimental design with a one-group pretest–posttest approach. A total of 70 students were selected using random sampling in Senior High School 10, Jambi City. Data were collected using validated questionnaires on knowledge and attitudes. The data were analyzed using the Wilcoxon test, as the distribution was non-normal according to the Kolmogorov–Smirnov test.

The results showed a significant increase in the mean knowledge score ($P < 0.001$; MD = 1.7) and mean attitude score ($P < 0.001$; MD = 14.09) after the intervention. These findings indicate that the MOLETAS educational media effectively improves students' knowledge and attitudes toward obesity prevention.

Keywords: Adolescents; Education; Media; MOLETAS.

INTRODUCTION

Adolescent obesity is an escalating global health problem and has become a major public health priority in both high-income and low–middle-income countries. In Indonesia, findings from the 2023 Indonesian Health Survey (SKI) reported that 12.1% of adolescents aged 13–15 years and 8.8% of those aged 16–18 years were categorized as overweight, with an additional 4.1% and 3.3% classified as obese, respectively. These figures indicate a worrying upward trend in adolescent obesity and underscore the need for early, sustained intervention. Although genetic predisposition contributes to obesity risk, environmental and lifestyle determinants—particularly unhealthy dietary patterns and low physical activity levels continue to be the most influential factors shaping obesity development during adolescence (World Health Organization, 2022).

Extensive evidence shows that poor diet quality and physical inactivity are major contributors to excess weight gain among adolescents. Diets characterized by high intake of energy-dense, nutrient-poor foods coupled with sedentary lifestyles significantly increase the risk of obesity by disrupting the balance between caloric intake and expenditure (Nittari et al., 2020). Moreover, numerous studies indicate that adolescents often lack adequate nutritional knowledge, leading to unhealthy food choices, poor eating behaviors, and an inability to recognize long-term health consequences (Story et al., 2012). Improving adolescents' nutrition literacy is therefore essential for supporting healthier dietary behaviors and preventing obesity across the lifespan.

Health education has been widely recognized as a fundamental strategy for reducing obesity risk by improving knowledge, attitudes, and behavioral intentions related to nutrition and physical activity. School-based health education programs are particularly effective because they reach adolescents during critical developmental stages when lifelong health behaviors are formed (Silva et al., 2022). However, traditional lecture-based methods are often perceived as monotonous and do not engage adolescents adequately, which limits their impact on behavioral change. To address this limitation, innovative and interactive learning

approaches are increasingly recommended, particularly those that integrate participatory, experiential, and technology-assisted learning (Backlund & Engström, 2020).

Game-based learning also known as serious games has emerged as an effective educational strategy capable of increasing student engagement, motivation, and retention of health information. Research demonstrates that game-based interventions can improve knowledge and promote positive health behaviors related to nutrition and obesity prevention (DeSmet et al., 2018; Kato & Beale, 2021). Adolescents respond particularly well to games because they incorporate challenge, reward systems, collaboration, and real-time feedback, all of which enhance learning outcomes. Board games such as Monopoly offer structured decision-making, rule-based engagement, and repeated exposure to educational messages, making them a suitable foundation for health-promotion tools.

Building on these principles, the MOLETAS (Monopoly Obesity) game was developed as an innovative educational medium to deliver key health messages related to obesity in a playful, interactive format. The game incorporates essential concepts of obesity—including its causes, consequences, and preventive behaviors within a structured gameplay environment designed to enhance learning motivation and cognitive engagement. Through simulation-based problem-solving and reward mechanics, MOLETAS aims to strengthen adolescents' knowledge and foster more positive attitudes toward obesity prevention. Given the increasing incidence of adolescent obesity in Indonesia and the need for culturally relevant health education tools, MOLETAS may offer an effective and scalable intervention for school-based obesity prevention.

This study therefore aims to evaluate the effectiveness of the MOLETAS game in improving adolescents' knowledge and attitudes toward obesity prevention using a pretest–posttest experimental approach.

MATERIALS AND METHODS

This study employed a quantitative pre–experimental design using a one-group pretest–posttest approach to evaluate the effect of the MOLETAS (Monopoly Obesity) educational game on adolescents' knowledge and attitudes regarding obesity prevention. The intervention was conducted over one week and included a single structured gameplay session. Ethical clearance for this research was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Jambi (Approval Number: LB/02.06/2/271/2025). Written informed consent was obtained from all participants and school authorities prior to data collection. All procedures complied with the ethical principles outlined in the Declaration of Helsinki.

The study was conducted in Jambi City, Indonesia. The selection of the research site was carried out using simple random sampling from 13 public senior high schools. SMA Negeri 10 Kota Jambi was randomly selected as the study location. The sample consisted of 70 students, recruited through simple random sampling from enrolled class groups that met the inclusion criteria: (1) adolescents aged 15–18 years, (2) able to participate in the entire intervention process, and (3) willing to provide informed consent. Students with cognitive or learning disabilities that interfered with comprehension were excluded.

Knowledge and attitude toward obesity prevention were measured using standardized questionnaires previously adapted for use in Indonesian adolescents. Content validity was established by a panel of three public health and nutrition experts through an Item-Content Validity Index (I-CVI) review, resulting in a scale-level validity index exceeding 0.80. Reliability testing conducted during pilot assessment yielded Cronbach's alpha values of 0.704 for the knowledge scale and 0.763 for the attitude scale, indicating acceptable internal consistency for research use. All items were assessed for clarity, cultural appropriateness, and comprehension prior to implementation.

The MOLETAS game is a structured educational board game adapted from the Monopoly format, specifically designed to strengthen adolescents' understanding of obesity, its causes, prevention strategies, and lifestyle implications. The game consists of three sequential levels that progressively increase cognitive load: Problem Recognition Level – focuses on identifying behavioral determinants and situational cues influencing obesity risk. Strategic Planning Level – requires players to select and justify evidence-based health-promotion strategies aligned with established public health frameworks. Communication and Advocacy Level – engages players in structured argumentation, defense of selected solutions, and peer deliberation. Each level incorporates embedded narrative vignettes derived from authentic community health-promotion scenarios, designed to stimulate higher-order thinking based on the revised Bloom's Taxonomy. Game mechanics include point-based progression, chance/risk cards, reward–penalty sequences, and time-limited decision-making rounds to simulate real-world public-health constraints.

The intervention was delivered face-to-face in small groups of 4–6 participants in a controlled classroom setting. Each session lasted approximately 45–60 minutes. All participants received an initial orientation session explaining the rules, scoring rubric, and expected behaviors. Gameplay proceeded sequentially from Level 1 to Level 3, with no skipping or revisiting of stages permitted. Participants

collaboratively analyzed vignette tasks, formulated solutions, and recorded responses on standardized answer sheets.

A trained facilitator oversaw each group using a fidelity checklist to ensure consistent implementation, maintain intervention integrity, and prevent procedural bias. Facilitators were not involved in scoring to avoid observer-expectancy effects. Upon completion of all game levels, a 10–15-minute structured debriefing session was conducted using a protocol adapted from the Debriefing for Meaningful Learning (DfML) model. The debriefing emphasized reflection, conceptual integration, justification of decisions, and reinforcement of real-world applicability to adolescent health-promotion behaviors.

Knowledge outcomes were measured using a 10-item questionnaire assessing understanding of obesity definitions, risk factors, dietary practices, physical activity, and prevention strategies. Attitude outcomes were measured using a 10-item Likert-scale instrument evaluating perceptions, motivation, and behavioral intentions related to healthy lifestyles. Pretest assessments were administered immediately before the intervention, and posttest assessments were conducted immediately after the gameplay and debriefing session.

Data analysis was conducted using SPSS. Normality testing using the Kolmogorov–Smirnov test indicated that the data were not normally distributed; therefore, the Wilcoxon signed-rank test was used to evaluate changes in pretest and posttest scores for knowledge and attitudes. Statistical significance was set at $p < 0.05$. Descriptive statistics (means, medians, standard deviations, and interquartile ranges) were generated to characterize the distribution of outcome measures.

RESULTS AND DISCUSSION

The findings presented in Table 1 demonstrate that all 70 participants successfully completed both the pre-test and post-test assessments, resulting in a 100% completion and retention rate. This high level of participation reflects both the feasibility of conducting game-based educational interventions within a school setting and the acceptability of the MOLETAS application among adolescents. Such retention is essential to ensure internal validity and suggests that the learning platform was sufficiently engaging to maintain participants' involvement throughout the study period.

A significant increase in obesity-related knowledge was observed following exposure to the MOLETAS game. The mean post-intervention knowledge score increased markedly compared with the baseline measurement, indicating that the educational content embedded within the game mechanics was effectively delivered and comprehended by the students. This result is aligned with prior evidence indicating that interactive digital tools can enhance cognitive engagement, facilitate deeper information processing, and improve comprehension of health-related concepts in young populations.

In addition to cognitive improvements, the intervention produced a statistically significant enhancement in adolescents' attitudes toward obesity prevention. Participants demonstrated a more favorable disposition toward adopting healthy behaviors, such as regulating portion size, increasing physical activity, and reducing consumption of energy-dense foods. The post-test results suggest a shift from neutral or inconsistent attitudes to more positive and proactive perspectives. This attitudinal shift is especially important, as attitudes are considered primary determinants of future behavior adoption in many behavior change models, including the Theory of Planned Behavior and the Health Belief Model.

The positive outcomes observed in this study underscore the potential of gamified educational strategies as an effective medium for promoting health literacy and preventing lifestyle-related diseases in adolescents. Game-based interventions provide multisensory learning, immediate feedback loops, and reward-based reinforcement, all of which can enhance motivation and sustain engagement more effectively than traditional lecture-based methods. Considering that adolescents are digital natives, integrating health education into interactive digital platforms can bridge the gap between knowledge acquisition and behavior intention.

Furthermore, the success of the MOLETAS game supports the notion that culturally adapted, context-specific health promotion tools may yield better outcomes compared to generic health education materials. The game's storyline and activities were designed to align with local dietary patterns and lifestyle behaviors, making the learning experience more relatable and personally meaningful to the participants. This contextual alignment likely contributed to the high retention rate and strong post-test performance.

Overall, the improvement in both knowledge and attitudes highlights the dual impact of digital game-based learning approaches not only reinforcing cognitive understanding but also shaping affective components of health behavior. Such findings emphasize the value of integrating gamification into school-based health programs as a scalable, feasible, and adolescent-friendly strategy for obesity prevention.

Tabel 1. Effect of MOLETAS to Knowledge and Attitude

Variable	Pre-test Mean ± SD	Post-test Mean ± SD	Median Pre (IQR)	Median Post (IQR)	MD	Z-value	p-value	Effect Size (r)
Knowledge	33.54 ± 6.82	47.63 ± 7.15	33 (29–38)	48 (43–53)	14.09	–7.38	<0.001	0.86
Attitude	8.01 ± 1.49	9.71 ± 1.36	8 (7–9)	10 (9–11)	1.70	–6.41	<0.001	0.75

There was a substantial increase in students' nutritional knowledge after the intervention. The mean pre-test knowledge score was 33.54, increasing to 47.63 after the intervention, with a mean difference (MD) of 14.09 points. The Wilcoxon signed-rank test indicated a statistically significant improvement in knowledge ($p < 0.001$). Students' attitudes toward obesity prevention also improved significantly following the intervention. The mean pre-test attitude score was 8.01, increasing to 9.71 in the post-test, with a mean difference of 1.70 points. The Wilcoxon signed-rank test demonstrated that this improvement was statistically significant ($p < 0.001$). These results indicate that participation in the game-based learning experience positively shifted students' perceptions and motivation toward adopting healthier behaviors.

The present study demonstrated that the MOLETAS game a board-based serious game designed to enhance obesity-related knowledge and attitudes produced significant improvements among Indonesian adolescents. Knowledge scores increased substantially after the intervention, accompanied by more positive attitudes toward the importance of obesity prevention and healthy lifestyle practices. These findings align with emerging evidence showing that serious games and game-based learning strategies are promising tools for modifying health behaviors among adolescents (Liu et al., 2024; Limone et al., 2022). The high retention rate (100%) also underscores the acceptability and feasibility of this medium in school settings.

The effectiveness of MOLETAS in improving knowledge is consistent with previous school-based interventions incorporating structured educational content. Systematic reviews indicate that health education programs particularly those that integrate interactive, student-centered approaches are associated with significant increases in obesity-related knowledge and behavioral intentions (Jacob et al., 2021; Silva et al., 2022). Randomized controlled trials in adolescent populations similarly highlight improvements in nutritional literacy following exposure to gamified media or digital serious games (Mack et al., 2020; Folkvord et al., 2021; Thompson et al., 2022). Our findings thus reinforce the global trend emphasizing the utility of game-based learning in addressing modifiable lifestyle factors.

Comparable results have also been documented in Indonesia. Rachman and Lestari (2025) found that a nutrition-specific board game significantly improved students' understanding of "Pedoman Gizi Seimbang" and "Isi Piringku," suggesting that well-designed analog games can facilitate learning even in settings with limited digital infrastructure. Similarly, Kusumah and Kurniawan (2024) developed a serious game for obesity prevention and reported improved engagement and nutritional awareness among junior high school students. These parallels support the cultural and pedagogical suitability of game-based methods within the Indonesian education system.

Several mechanisms may explain the effectiveness of the MOLETAS game. First, from the perspective of educational psychology, gamification enhances motivation and learning retention by incorporating elements such as challenge, reward, role play, and immediate feedback (Mayer, 2020; Parong & Mayer, 2021). These features strengthen cognitive engagement and intrinsic motivation two critical factors known to enhance memory consolidation.

Second, theories of health behavior also provide explanatory frameworks. The Health Belief Model suggests that improved knowledge may influence perceived susceptibility, perceived severity, and perceived benefits related to obesity prevention (Rosenstock, 1990). The Theory of Planned Behavior likewise posits that attitudes shape intentions and behaviors, implying that improved attitudes following the intervention may contribute to healthier future choices (Ajzen, 1991). Our results support these theoretical pathways, as increased knowledge was paralleled by more positive attitudes.

Third, serious games encourage experiential learning allowing students to "experience" health consequences and make decisions within simulated environments. Evidence indicates that experiential or scenario-based learning improves behavioral decision-making by providing a safe, engaging context where learners can experiment with choices (Backlund & Engström, 2020). This is consistent with findings from other adolescent-oriented serious games such as KOP (Mack et al., 2020) and other international programs (DeSmet et al., 2018; Gentry et al., 2019).

The improvement in obesity-related knowledge and attitudes is particularly relevant given the growing prevalence of overweight and obesity among Indonesian adolescents. The Indonesian Health Survey (Kemenkes RI, 2023) reported that over 12% of adolescents aged 13–15 years are overweight and more than 4% are obese—figures that continue to rise annually. Environmental and behavioral factors, including

inadequate physical activity and consumption of calorie-dense foods, have been consistently implicated in this trend (WHO, 2022, 2023). Most adolescents also have limited access to structured nutrition education, especially in regions where health promotion programs are inconsistently implemented.

Game-based learning offers a unique advantage in such contexts. Board games, unlike digital formats, do not require high technology or internet access, making them more equitable and scalable. They also align well with Indonesian classroom culture, which favors group-based and teacher-facilitated learning. The MOLETAS game supports active learning principles while addressing local dietary patterns and obesity risk factors relevant to Indonesian adolescents.

Globally, serious games have become increasingly recognized as effective strategies for behavior modification. Multiple meta-analyses have shown that such interventions can improve dietary behaviors, physical activity, and body composition outcomes (Liu et al., 2024; Limone et al., 2022). Although our study did not assess physical activity or anthropometric changes, the significant improvements in knowledge and attitudes are consistent with early proximal changes expected in behavior change processes. Previous trials indicate that knowledge improvements are often the first step toward sustainable behavioral shifts (Nonguierma et al., 2022; Rojas-Farías et al., 2023).

Furthermore, educational games have demonstrated effectiveness even across diverse cultural and socioeconomic contexts. For instance, a trial in Chile (Rojas-Farías et al., 2023) showed that interactive game-based learning significantly improved healthy eating attitudes among adolescents from low-resource communities. In Europe, Folkvord et al. (2021) reported that a health-focused game improved children's snacking decisions, while in the United States, Thompson et al. (2022) showed improved dietary choices among adolescents following a gamified nutrition module.

These international parallels reinforce MOLETAS's potential as a culturally adaptable and scalable intervention model. Several aspects make MOLETAS an effective educational tool: (1) Contextual relevance. Content was specifically tailored to Indonesian dietary patterns, local obesity determinants, and adolescent lifestyle realities; (2) High engagement. The game mechanics (chance cards, progress tracking, challenge tasks) enhanced enjoyment and sustained participation, consistent with motivational dynamics described by Sundar et al. (2021); (3) Feasibility in low-resource schools The analog format removes barriers related to electricity, internet, or device availability; (4) Alignment with curriculum. MOLETAS mapped directly onto themes required by national adolescent health promotion standards; (1) These strengths place the intervention within the broader educational innovation framework advocated by WHO and recent Indonesian health policy reforms.

Integration into school curricula: Schools may incorporate board game educational tools in regular health education sessions. Support for national obesity prevention programs: (1) MOLETAS aligns with Indonesia's "Gerakan Masyarakat Hidup Sehat (GERMAS)" and can enhance community-level learning; (2) Cost-effective scaling: The low production cost enables broad implementation, especially in rural or low-resource regions.

Complement to digital interventions: While serious digital games are effective, analog games provide inclusive alternatives. At the policy level, the Ministry of Health and Ministry of Education can consider adopting game-based learning tools as part of standardized adolescent nutrition education.

Although the findings are promising, several avenues warrant further exploration: (1) Conducting randomized controlled trials comparing MOLETAS with other educational modalities; (2) Assessing long-term retention and behavioral change outcomes (dietary intake, physical activity patterns, BMI trajectories); (3) Exploring implementation science aspects, including teacher training, fidelity, and scalability; (4) Adapting the game for younger children or digital formats for hybrid learning; (5) Incorporating psychometric analysis linking game engagement with cognitive gains.

CONCLUSION

This study demonstrated that the MOLETAS game-based learning intervention produced a substantial and statistically significant improvement in both knowledge and attitudes related to obesity prevention among adolescents. The 100% retention rate underscores the acceptability, feasibility, and engaging nature of the intervention within the school context. Improvements in knowledge scores highlight that interactive digital platforms can serve as effective tools for enhancing students' understanding of key nutrition and obesity-related concepts, while the positive shift in attitudes indicates the potential of game-based learning to influence cognitive and affective determinants of health behavior. Collectively, these findings provide compelling evidence that culturally adapted, contextually relevant gamified educational tools represent a promising strategy for strengthening obesity-prevention efforts among youth populations. The MOLETAS intervention may therefore serve as a viable complement to conventional school-based health education programs, contributing to a more comprehensive approach to adolescent health promotion.

Despite the encouraging results, several limitations should be acknowledged. First, the study employed a quasi-experimental pre–post design without a control group, which limits the ability to infer causality and increases the potential for confounding factors to influence outcomes. Future studies should consider randomized controlled trials to strengthen causal claims. Second, the assessment relied on self-reported measures of attitudes, which may be subject to response bias, including social desirability effects. Including objective or behavioral indicators such as dietary logs, step counts, or in-game analytics could provide a more comprehensive evaluation of intervention impact. Third, the study was conducted in a single school setting with a relatively homogenous sample, potentially limiting generalizability to other populations with different cultural, socioeconomic, or educational backgrounds. Future research should replicate this intervention across diverse contexts to assess external validity. Finally, the short follow-up period prevented evaluation of the sustainability of improvements; long-term monitoring is needed to determine whether gains in knowledge and attitudes translate into lasting behavior change.

The findings of this study carry several important implications for both practice and policy. For health practitioners and educators, the MOLETAS game highlights the utility of incorporating interactive, gamified learning platforms into school curricula to enhance engagement and foster meaningful learning experiences related to obesity prevention. Educators may consider integrating similar digital tools into routine health education sessions to complement traditional didactic approaches. At the policy level, the results support the incorporation of digital health literacy initiatives within national school-based health programs, particularly in regions facing rising rates of childhood and adolescent obesity. Development of standardized, culturally appropriate digital learning modules could enhance scalability and ensure consistent delivery across educational institutions. Furthermore, policymakers may explore partnerships with technology developers to create innovative health promotion tools tailored to local needs. Investing in gamified interventions such as MOLETAS aligns with global efforts to leverage digital health technologies to improve preventive health behaviors among youth, ultimately contributing to long-term strategies aimed at reducing the burden of non-communicable diseases in future generations.

CONFLICT OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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