

Research Article

Digital Educational Media for Obesity and Menstrual Health Prevention in Adolescent Girls

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Abstract

Objective: To evaluate the effectiveness of digital educational media based on an integrated Health Belief Model (HBM), Social Cognitive Theory (SCT), and Technology Acceptance Model (TAM) framework in improving knowledge, health beliefs, self-efficacy, healthy behaviors, and menstrual health outcomes among adolescent girls.

Methods: A quasi-experimental pretest–posttest study was conducted among 105 adolescent girls aged 12–18 years in Pasir Putih Subdistrict, Jambi City, Indonesia, in 2025. Participants received interactive video-based education delivered through digital platforms over a four-week period. Data were collected using validated questionnaires and anthropometric measurements. Changes before and after the intervention were analyzed using paired statistical tests with a significance level of $\alpha = 0.05$.

Results: Significant improvements were observed in knowledge scores (62.4 ± 9.7 to 84.6 ± 7.3 ; $p < 0.001$), perceived susceptibility (2.8 to 3.9 ; $p = 0.002$), perceived severity (3.1 to 4.2 ; $p < 0.001$), and self-efficacy (68.2 ± 10.5 to 86.9 ± 8.1 ; $p < 0.001$). Healthy lifestyle behaviors also improved, as reflected by reduced fast-food consumption (4.2 to 2.1 times/week) and increased physical activity (2.3 to 4.5 days/week). Body mass index demonstrated a modest but significant reduction (24.8 ± 3.2 to 24.3 ± 3.0 ; $p = 0.032$). The prevalence of menstrual disorders decreased from 63.8% to 42.9% ($p < 0.001$), with the greatest reduction observed in irregular menstrual cycles (48.6% to 29.5%). Participants reported high levels of technology acceptance, with mean scores of $4.3/5$ for perceived usefulness and $4.5/5$ for perceived ease of use.

Conclusion: Digital educational media based on an integrated HBM–SCT–TAM framework effectively improved health knowledge, risk perception, self-efficacy, and healthy lifestyle behaviors among adolescent girls. The intervention was also associated with a reduction in body mass index and the prevalence of menstrual disorders. These findings suggest that digital health education is a promising strategy for the primary prevention of obesity-related reproductive health problems in adolescent populations.

Keywords: adolescent girls; digital education media; Health Belief Model; menstrual disorders; obesity.

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INTRODUCTION

Obesity among adolescent girls has emerged as a major public health concern worldwide, with substantial implications for reproductive health. According to the 2018 Indonesian Basic Health Research (Riskesdas), the prevalence of obesity among Indonesian adults increased from 11.7% in 2010 to 15.4% in 2018.¹ More recently, the 2023 Indonesian Health Survey (SKI) reported

that 34.7% of women aged over 18 years in Jambi Province were overweight or obese, with the highest prevalence observed in Jambi City (41.1%).² Obesity is defined as an excessive accumulation of body fat that may impair health and is commonly assessed using Body Mass Index (BMI).³ It results from a chronic imbalance between energy intake and energy expenditure and is associated with numerous metabolic and reproductive health consequences.⁴

Obesity during adolescence is strongly associated with menstrual disorders, including irregular menstrual cycles, oligomenorrhea, amenorrhea, and dysmenorrhea, all of which may negatively affect quality of life and future reproductive outcomes.^{5,17} The underlying mechanisms involve hormonal and metabolic disturbances caused by excess adipose tissue, including increased leptin secretion, insulin resistance, and hyperandrogenism, which disrupt the hypothalamic-pituitary-ovarian axis.⁶ Consequently, obese adolescents are at increased risk of developing Polycystic Ovary Syndrome (PCOS) and experiencing subfertility later in life.^{7,18}

The development of health-related behaviors during adolescence is influenced by multiple factors, including knowledge, risk perception, social influences, and self-regulatory abilities.⁸ However, previous studies have shown that many adolescent girls possess limited knowledge regarding the relationship between obesity and menstrual health, resulting in inadequate preventive behaviors and delayed health-seeking practices.⁹ Therefore, innovative, effective, and age-appropriate health education strategies are needed to promote healthy lifestyles and improve reproductive health awareness among adolescents.

Digital educational media offer a promising approach for health promotion because adolescents are highly engaged with digital technologies and online learning platforms.^{10,11} Evidence suggests that digital health interventions can effectively improve health knowledge, promote healthy behaviors, and support reproductive health outcomes among adolescents.^{12,13} Nevertheless, the effectiveness of such interventions depends on the integration of appropriate behavioral theories that can address cognitive, social, and technological determinants of behavior change.

To provide a comprehensive theoretical foundation, this study integrates the Health Belief Model (HBM), Social Cognitive Theory (SCT), and Technology Acceptance Model (TAM).¹⁴⁻¹⁶ The HBM explains how individuals' perceptions of susceptibility to health problems and the severity of potential consequences influence preventive health behaviors.¹⁴ SCT emphasizes the importance of self-efficacy, observational learning, and environmental reinforcement in facilitating and maintaining behavior change.¹⁵ Meanwhile, TAM proposes that the adoption of

digital technologies is primarily influenced by perceived usefulness and perceived ease of use.¹⁶

Therefore, this study aimed to evaluate the effectiveness of SILVI (Smart Interactive Learning Video), a digital educational media intervention based on an integrated HBM-SCT-TAM framework, in improving knowledge, health beliefs, self-efficacy, healthy lifestyle behaviors, and menstrual health outcomes among adolescent girls in Jambi City, Indonesia. The findings are expected to contribute to the development of evidence-based digital health promotion strategies for adolescent reproductive health and support current recommendations for the prevention and management of menstrual disorders among adolescents.^{5,17}

METHODS

Study Design and Participants

A quasi-experimental study employing a pretest–posttest design was conducted among 105 adolescent girls in Pasir Putih Subdistrict, Jambi City, Indonesia. Participants were selected using purposive sampling. The study evaluated the effects of a digital educational intervention delivered through interactive audiovisual modules over a four-week period. Outcomes were assessed using validated questionnaires and anthropometric measurements, followed by statistical analyses to determine changes in behavioral and physiological indicators after the intervention.

Participants were adolescent girls aged 12–18 years who met the following inclusion criteria: having experienced menarche, possessing regular access to a digital device (smartphone, tablet, or computer), and providing informed consent to participate throughout the study period. Exclusion criteria included a history of chronic diseases affecting body weight or menstrual function (e.g., diabetes mellitus or hypothyroidism) and previously diagnosed hormonal disorders such as Polycystic Ovary Syndrome (PCOS) or hyperprolactinemia.

Initial screening identified 120 eligible participants. Fifteen participants were excluded due to inconsistent access to digital devices ($n = 9$) or suspected hormonal disorders identified during screening ($n = 6$). Consequently, 105 participants completed both pretest and posttest assessments and were included in the final analysis. The sample size was determined

using power analysis with a significance level of 0.05 and statistical power of 80%, based on the expected effect size reported in previous studies.

Intervention

The intervention consisted of **SILVI (Smart Interactive Learning Video)**, a 10–12-minute interactive educational video delivered over four weeks with a minimum frequency of three sessions per week through WhatsApp and curated YouTube channels. The educational content was developed based on an integrated framework incorporating the Health Belief Model (HBM), Social Cognitive Theory (SCT), and Technology Acceptance Model (TAM).

HBM components included information on the relationship between obesity and menstrual disorders, perceived susceptibility to reproductive health risks, perceived severity of long-term consequences, perceived benefits of preventive behaviors, and strategies to overcome barriers to healthy lifestyle practices.

SCT components included peer role modeling of healthy behaviors, motivational messages, enhancement of self-efficacy through realistic goal setting, and positive reinforcement strategies.

TAM components emphasized user-friendly design features to enhance perceived ease of use and practical, relevant content to strengthen perceived usefulness. Content validity was evaluated by three experts, including an obstetrician–gynecologist, an adolescent health nurse, and a health education specialist. The content validity index (CVI) was 0.92. The videos incorporated adolescent-friendly visual elements, simple narration, and real-life scenarios relevant to Indonesian adolescent girls.

Variables and Instruments

The independent variable was participation in the SILVI digital educational intervention based on the integrated HBM–SCT–TAM framework. The dependent variables included;

Knowledge regarding obesity and menstrual disorders, assessed using a 20-item questionnaire (score range: 0–100; item validity coefficients $r = 0.78$ – 0.89 ; Cronbach's $\alpha = 0.84$).

Health beliefs based on the HBM, including perceived susceptibility, perceived severity, perceived benefits, and perceived barriers, measured using a five-point Likert scale (Cronbach's $\alpha = 0.79$).

Self-efficacy and healthy lifestyle behaviors based on SCT, measured using a standardized scale ranging from 0 to 100 (Cronbach's $\alpha = 0.82$).

Technology acceptance based on TAM, including perceived usefulness and perceived ease of use, assessed using a five-point Likert scale (Cronbach's $\alpha = 0.87$).

Nutritional status, determined using body mass index (BMI), calculated from body weight measured with a calibrated digital scale and height measured with a stadiometer.

Menstrual disorders, including irregular menstrual cycles, oligomenorrhea, amenorrhea, and dysmenorrhea, assessed according to established adolescent gynecological criteria and relevant clinical practice guidelines.

Data Collection and Statistical Analysis

Data were collected at two time points: baseline (pretest) and immediately after completion of the four-week intervention (posttest). Data distribution was assessed using the Shapiro–Wilk test. Normally distributed variables were analyzed using paired t-tests, whereas non-normally distributed variables were analyzed using the Wilcoxon signed-rank test. Pearson or Spearman correlation analyses were performed as appropriate to examine relationships between variables. Multiple linear regression analysis was used to identify predictors of behavioral change following the intervention. All statistical analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Statistical significance was established at $p < 0.05$.

Ethical Considerations

This study was approved by the Health Research Ethics Committee of the University of Jambi (No. 045/KEPK/UNJA/I/2025). Written informed consent was obtained from all participants, with additional parental assent for minors. Data confidentiality was ensured through anonymized coding.

RESULTS

Participant Characteristics

A total of 105 adolescent girls completed the study and were included in the final analysis. The mean age of participants was 15.2 ± 1.8 years. At baseline, 28.6% of participants were classified as obese ($\text{BMI} \geq 25 \text{ kg/m}^2$), 29.5% as overweight ($\text{BMI} 23.0\text{--}24.9 \text{ kg/m}^2$), and 41.9% had normal nutritional status ($\text{BMI} 18.5\text{--}22.9 \text{ kg/m}^2$). The overall prevalence of menstrual disorders at baseline was 63.8%, with irregular menstrual cycles being the most commonly reported condition (48.6%).

Changes in Knowledge and Health Perceptions (HBM)

Knowledge scores increased significantly following the intervention, rising from 62.4 ± 9.7 at baseline to 84.6 ± 7.3 after four weeks ($p < 0.001$). The greatest improvement was observed in participants' understanding of the relationship between obesity and menstrual disorders, with correct responses increasing from 42.1% to 86.7%. Significant improvements were also observed across all Health Belief Model (HBM) constructs (Table 1). Mean perceived susceptibility scores increased from 2.8 ± 0.9 to 3.9 ± 0.7 ($p = 0.002$), while perceived severity increased from 3.1 ± 0.8 to 4.2 ± 0.6 ($p < 0.001$). Perceived benefits increased from 3.4 ± 0.7 to 4.5 ± 0.5 ($p < 0.001$), whereas perceived barriers decreased from 3.7 ± 0.8 to 2.6 ± 0.7 ($p < 0.001$).

Table 1. Changes in Health Perceptions Based on Health Belief Model (n=105)

HBM Component	Pretest (mean $\pm$ SD)	Posttest (mean $\pm$ SD)	P-value
Perceived susceptibility	2.8 $\pm$ 0.9	3.9 $\pm$ 0.7	0.002
Perceived severity	3.1 $\pm$ 0.8	4.2 $\pm$ 0.6	<0.001
Perceived benefits	3.4 $\pm$ 0.7	4.5 $\pm$ 0.5	<0.001
Perceived barriers	3.7 $\pm$ 0.8	2.6 $\pm$ 0.7	<0.001

Self-Efficacy and Healthy Behaviors (SCT)

Self-efficacy scores increased significantly from 68.2 ± 10.5 at baseline to 86.9 ± 8.1 after the intervention ($p < 0.001$). Significant improvements were also observed in healthy lifestyle behaviors. Mean fast-food consumption decreased from 4.2 ± 1.3 to 2.1 ± 0.9 times per week ($p < 0.001$), while the frequency of physical activity increased from 2.3 ± 1.1 to 4.5 ± 1.4 days per week ($p < 0.001$).

Technology Acceptance (TAM)

Participants demonstrated high acceptance of the digital educational media. The mean perceived usefulness score was 4.3 ± 0.6 , while the mean perceived ease-of-use score was 4.5 ± 0.5 on a five-point scale. Overall, 92.4% of participants reported that the educational media were easy to understand, relevant to their daily lives, and helpful in improving their understanding of obesity-related reproductive health risks. Overall user satisfaction reached 89.5%.

Changes in Menstrual Disorders

Before the intervention, 63.8% of participants reported experiencing at least one menstrual disorder. Following the four-week intervention,

the prevalence decreased significantly to 42.9% ($p < 0.001$). The greatest reduction was observed in irregular menstrual cycles, which declined from 48.6% to 29.5% ($p < 0.001$). The prevalence of severe dysmenorrhea decreased from 22.9% to 14.3% ($p = 0.008$), while oligomenorrhea decreased from 18.1% to 11.4% ($p = 0.021$).

Because the intervention period was relatively short and no hormonal biomarkers were assessed, these findings should be interpreted as improvements in self-reported menstrual health outcomes rather than direct evidence of physiological or endocrine changes.

Changes in Nutritional Status

Although modest, a statistically significant reduction in BMI was observed during the four-week intervention period. Mean BMI decreased from $24.8 \pm 3.2 \text{ kg/m}^2$ at baseline to $24.3 \pm 3.0 \text{ kg/m}^2$ at posttest ($p = 0.032$). Categorically, the prevalence of obesity decreased from 28.6% to 22.9%, while the proportion of participants with normal BMI increased from 41.9% to 47.6%.

Patterns of Change during the Intervention

Progressive improvements were observed throughout the four-week intervention period.

The proportion of participants reporting menstrual complaints decreased from 63.8% at baseline to approximately 60% in week 1, 55% in week 2, 48% in week 3, and 42.9% by week 4. Similarly, the average frequency of physical activity increased from approximately two days per week at baseline to nearly three days in week 1, four days in week 2, and 4.5 days per week by weeks 3 and 4. Mean BMI showed a gradual downward trend over the intervention period, decreasing from 24.8 kg/m² at baseline to 24.3 kg/m² at week 4.

Correlation and Regression Analysis

Linear regression analysis demonstrated that improvements in knowledge ($\beta = 0.42$, $p < 0.01$) and self-efficacy ($\beta = 0.38$, $p < 0.01$) were significant predictors of healthy behavior change. Technology acceptance was strongly correlated with media utilization frequency and information retention ($r = 0.71$, $p < 0.001$). In addition, BMI reduction showed a moderate inverse correlation with menstrual disorder prevalence ($r = -0.48$, $p = 0.008$).

DISCUSSION

This study demonstrated that the SILVI digital educational intervention significantly improved knowledge, health beliefs, self-efficacy, healthy lifestyle behaviors, and menstrual health outcomes among adolescent girls. These findings support previous evidence that digital health education can effectively promote reproductive health awareness and healthy behaviors in adolescent populations.^{12,13}

A substantial increase in knowledge scores was observed following the intervention, particularly regarding the relationship between obesity and menstrual disorders. Significant improvements were also found across all Health Belief Model (HBM) constructs, including perceived susceptibility, severity, benefits, and barriers. According to the HBM, these changes are important determinants of preventive health behavior and may explain the observed improvements in participants' lifestyle practices.¹⁴

Self-efficacy increased significantly after the intervention, consistent with Social Cognitive Theory, which identifies self-efficacy as a key factor influencing behavior change.¹⁵ This improvement was accompanied by reduced fast-food consumption and increased physical activity, suggesting that the intervention

successfully translated knowledge into healthier behaviors. Regression analysis further confirmed that knowledge and self-efficacy were significant predictors of behavior change.

Participants reported high levels of technology acceptance, with favorable ratings for both perceived usefulness and perceived ease of use. These findings are consistent with the Technology Acceptance Model, which suggests that user engagement with digital interventions is influenced by their perceived utility and accessibility.¹⁶ The strong association between technology acceptance and information retention highlights the importance of developing adolescent-friendly educational media.

A significant reduction in self-reported menstrual disorders was also observed after the intervention, particularly in irregular menstrual cycles and dysmenorrhea. In addition, a modest reduction in BMI was identified during the study period. Although relatively small, this finding may be clinically relevant because obesity is a well-established contributor to menstrual dysfunction and PCOS development.^{7,18} However, because the intervention period was limited to four weeks and no hormonal biomarkers were assessed, these findings should be interpreted cautiously. The observed improvements may reflect enhanced menstrual health awareness, improved symptom management, and healthier lifestyle behaviors rather than direct physiological or endocrine changes.

This study has several limitations. The quasi-experimental design limits causal inference, the intervention period was relatively short, and menstrual outcomes were assessed through self-report rather than clinical evaluation. Despite these limitations, the findings suggest that theory-based digital educational media represent a promising approach for promoting healthy lifestyles and reproductive health among adolescent girls. Future studies should include longer follow-up periods and objective clinical measures to evaluate long-term effectiveness.

CONCLUSION

The SILVI digital educational intervention, developed using an integrated Health Belief Model (HBM), Social Cognitive Theory (SCT), and Technology Acceptance Model (TAM) framework, effectively improved knowledge, health beliefs, self-efficacy, and healthy lifestyle behaviors among adolescent girls. The intervention was

also associated with a modest reduction in body mass index and improved self-reported menstrual health outcomes. However, because hormonal parameters were not assessed and the follow-up period was relatively short, these findings should not be interpreted as evidence of hormonal regulation or physiological changes. Overall, digital educational media represent a feasible and promising strategy for promoting healthy lifestyles and reproductive health among adolescent girls. Future studies with longer follow-up periods and objective clinical assessments are needed to confirm their long-term effectiveness.

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