16-week healthy lifestyle program to improve health literacy and physical fitness of elementary school students: a quasi-experimental approach

Programa de estilo de vida saludable de 16 semanas para mejorar la alfabetización en salud y la aptitud física de estudiantes de primaria: un enfoque cuasi-experimental

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Abstract

Objective. This study aimed to examine the effect of a 16-week healthy lifestyle program on improving health literacy and physical fitness among elementary school students.
Methodology. A quasi-experimental design involved 50 students divided into two groups: (1) the healthy lifestyle habituation program (EXP; n = 25) and (2) a control group without the program (CON; n = 25). Instruments used were a health literacy test and a physical fitness test (TKPN), administered at the pretest, post-test, and follow-up. Data were analyzed using MANOVA with normality (Shapiro-Wilk), and homogeneity (Levene's Test).
Results. The data were normally distributed and met the assumption of homogeneity of variance (Sig. > 0.05) across health literacy and physical fitness variables at all measurement stages. MANOVA results showed significant differences between the EXP and CON groups (Pillai's Trace = 0.945; $p < 0.001$), over time (Pillai's Trace = 1.387; $p < 0.001$), and for group × time interactions (Pillai's Trace = 1.348; $p < 0.001$), indicating that the program intervention had a significant and consistent effect on the EXP compared to the CON group. The effect sizes (η^2 = 0.65–0.72) were large, confirming that the intervention had a strong and meaningful impact on students' health literacy and physical fitness.
Discussion. The habituation program significantly enhanced students' health literacy and physical fitness, with sustained improvements observed over time.
Conclusions. This program effectively enhances health literacy and physical fitness and can be implemented in schools with the support of teachers, parents, and the broader community.

Keywords

Elementary school students; health literacy; healthy lifestyle, physical fitness.

Resumen

Objetivo. El objetivo de este estudio fue examinar el efecto de un programa de hábitos de vida saludable durante 16 semanas sobre la mejora de la alfabetización en salud y la condición física de los estudiantes de primaria.
Metodología. Se utilizó un diseño cuasi experimental con 50 estudiantes divididos en dos grupos: (1) el programa de habituación a un estilo de vida saludable (EXP; n = 25) y (2) un grupo de control sin el programa (CON; n = 25). Los instrumentos utilizados fueron una prueba de alfabetización en salud y una prueba de condición física (TKPN), aplicadas en el pretest, postest y seguimiento. Los datos se analizaron mediante MANOVA, junto con las pruebas de normalidad (Shapiro-Wilk) y homogeneidad (prueba de Levene).
Resultados. Los datos mostraron distribución normal y homogeneidad de varianza (Sig. >0,05) en las variables de alfabetización en salud y condición física en todas las etapas de medición. Los resultados del MANOVA indicaron diferencias significativas entre los grupos EXP y CON (Pillai's Trace = 0,945; $p < 0,001$), entre los momentos de medición (Pillai's Trace = 1,387; $p < 0,001$), así como en la interacción grupo × tiempo (Pillai's Trace = 1,348; $p < 0,001$), lo que indica que la intervención tuvo un efecto significativo y consistente en el grupo EXP en comparación con el grupo CON. Los tamaños del efecto (η^2 = 0.65–0.72) fueron grandes, lo que confirma que la intervención tuvo un impacto fuerte y significativo en la alfabetización en salud y la condición física de los estudiantes.
Discusión. El programa de habituación mejoró significativamente la alfabetización en salud y la condición física de los estudiantes, con mejoras sostenidas a lo largo del tiempo.
Conclusiones. Este programa es eficaz para mejorar la alfabetización en salud y la condición física, y puede ser implementado en las escuelas con el apoyo colaborativo de maestros, padres y la comunidad

Palabras clave

Alfabetización en salud; condición física; estudiantes de primaria; estilo de vida saludable.

Introduction

Over the past few years, the healthy lifestyle habit has become essential in physical education. A healthy lifestyle includes regular physical activity, a nutritious diet, maintaining personal hygiene,; therefore, it becomes a basic human need to be applied early through physical education learning (Friskawati et al., 2020). Physical education plays an important role in instilling healthy lifestyle habits so that students are aware of maintaining good habits and are motivated to live sustainably, actively, and healthily (Sari et al., 2024; Nevitaningrum et al., 2024).

The Association for Physical Education, Recreation, and Dance released a position statement recommending that all schools implement a Comprehensive School Physical Activity Program (CSPAP) or a comprehensive school physical activity program, this recommendation is in line with the recommendations of the Ministry of Health, which emphasizes the importance of integrating physical activity into school culture as part of efforts to maintain and improve students' overall physical fitness (Harvey et al., 2018). The World Health Organization (WHO) also recommends at least 60 minutes of moderate to vigorous physical activity daily for children aged 5–17 years (Hollis et al., 2016). Engaging children in structured and enjoyable physical activities such as circuit activity games can enhance both participation and physical fitness (Jago et al., 2017). However, physical activity alone is not sufficient to ensure children's overall health. A balanced approach that also addresses proper nutrition and dietary habits is equally important to support growth, prevent disease, and promote a sustainable healthy lifestyle from an early age.

Understanding balanced nutritional eating patterns is key in shaping healthy eating behavior and can reduce the prevalence of overweight and other diseases, especially in children (Doustmohammadian et al., 2022). Studies have shown that poor nutritional knowledge among students leads to unhealthy eating patterns, while effective school-based nutrition programs can increase understanding and improve overall health (Menor-Rodriguez et al., 2022). Thus, promoting balanced nutrition together with active lifestyles through schools becomes a strategic effort to improve children's health comprehensively. These global recommendations have also inspired various national policies, including those in Indonesia, which emphasize schools as strategic environments for promoting lifelong healthy habits.

Primary education is an essential foundation in shaping children's healthy lifestyles from an early age. Elementary school students are at a crucial stage of development because they begin to form habits, including personal hygiene, a balanced nutritional diet, physical activity, and overall lifestyle (Mulyana et al., 2024). Schools, where children spend most of their time, are the ideal setting for implementing health-related programs that not only develop academic abilities but also foster knowledge, skills, and healthy living habits (Taware et al., 2018; Guchetl et al., 2020). Therefore, integrating lifestyle learning through physical education can serve as an effective medium to shape students' physical, mental, and behavioral health. Effective physical education can increase students' physical activity, awareness of an active and healthy lifestyle (Villafaina et al., 2021). However, an active lifestyle and healthy eating habits also need to be supported by good personal hygiene as part of an overall healthy living behavior.

Personal hygiene is vital in preventing infectious diseases, especially in malnourished children (Taware et al., 2018). In elementary school-age children, personal hygiene is essential because they are in a period of growth and the formation of healthy living habits. This global and national concern is also evident at the local level. Strengthened by observations in private elementary schools in Yogyakarta, students still have the habit of not washing their hands before and after eating, not washing their food after using the toilet, and not maintaining other body hygiene. In addition, the habit of careless snacking without paying attention to the cleanliness of food and the environment in which to buy food is also a serious challenge. Research by Akbar et al. (2023) shows that children still have a low understanding of personal hygiene, which can increase cases of infection in schools (Akbar et al., 2023). Samsuni et al., (2019) reveal that the lack of information and awareness about maintaining personal hygiene makes a person more susceptible to hygiene-related diseases, such as pinworms, dental caries, skin diseases, and malnutrition. Basic Health Research (Riskesdas) data show that only 32.3% of the Indonesian population has met the behavioral indicators of clean and healthy living patterns (Samsuni et al., 2019). It shows that many people still have not implemented clean and healthy living habits in their daily lives. Therefore, hygiene promotion and health education not only improve knowledge but also change children's behavior toward better hygiene practices, contributing to overall better health (Nayoan & Kiling, 2021). In

addition to hygiene behavior, maintaining physical fitness is another crucial dimension of a healthy lifestyle that supports children's daily functioning and learning performance.

Physical fitness is essential for students to carry out daily activities both inside and outside school optimally and productively (Mashud et al., 2024). Elementary school students are often faced with various busy daily activities, ranging from learning activities at school, involvement in sports clubs, to taking additional lessons outside school hours. The density of student activities can be a challenge in maintaining the quality of student health and fitness. Therefore, students need good physical fitness to be healthy and carry out daily activities without excessive fatigue (Hidayana, R. (2023).For this reason, students must love sports, because sports are essential to being fit (González-Carrera et al., 2025). Students with good physical fitness tend to be more active, have good body immunity, and can participate optimally in learning and playing activities (Mulyana et al., 2024). However, to achieve optimal fitness, students also need proper guidance and structured interventions that combine knowledge and practice of healthy living.

Habitually adopting a sustainable, healthy lifestyle can improve students' health literacy. Health Literacy is the ability of an individual to understand, access health-related information, to make appropriate decisions to improve or maintain the quality of life. Health literacy is essential for children to understand healthy living behavior; therefore, it is crucial to implement healthy lifestyle education programs in primary schools (Nash et al. (2021). Children educated about healthy lifestyles, such as nutrition, hygiene, and physical activity, will tend to make the right choices in improving their long-term health (Bánfai-Csonka et al., 2022). When people understand health, they apply appropriate health behaviors to be healthy and produce a good quality of life (González-Carrera et al., 2025). Yet, despite existing national campaigns, there remains a significant gap between awareness and actual practice among students.

Although the Ministry of Health has carried out a healthy lifestyle campaign and promoted the educational program "Fill My Plate" and the Healthy Living Community Movement (GERMAS), the implementation in primary schools is limited to BMI surveys and immunization (Arif et al., 2020). Despite these national efforts, the challenge persists at the local level. This national situation is also reflected at the local level, as evidenced by findings from private elementary schools in Yogyakarta, where many students still struggle to practice healthy lifestyle habits in their daily routines. Strengthened by the results of a study at a private elementary school in Yogyakarta, it was revealed that many students had not fulfilled an optimal healthy lifestyle. Of about 200 students surveyed, more than 150 children routinely consumed less nutritious foods such as catfish rice, egg rice, nugget rice, chicken rice, fresh bread, and instant noodles. Only about 50 students consume vegetables and fruits regularly, and only 10 children meet the "Fill My Plate" rule in one meal, even with low consistency. In addition, many children still snack carelessly without paying attention to food and personal hygiene. This illustrates that awareness alone is not enough; consistent, structured education and habituation are needed to translate knowledge into healthy practices.

In addition, the low physical activity of students is also a concern, because most only exercise during physical education hours at school without exercising independently. This impacts their low physical fitness, essential for body health and immunity. Furthermore, based on the results of interviews with health workers in the Yogyakarta region, it was found that many children were obese, malnourished, and anemic. One of the causes is that children are given too much freedom in buying food or choosing food without looking at the nutritional content of the food. In addition, parents' understanding of feeding by the rules of balanced nutrition is still minimal. When students were asked questions related to physical activity, many preferred to play with gadgets rather than play outside strengthened by Bogataj et al (2021) found that children during the kiti period experience a lack of physical activity and a lot of sedentary activity (Bogataj et al., 2021). Therefore, schools play a strategic role in cultivating healthy lifestyle habits through physical education that integrates nutrition, hygiene, and fitness.

Many studies show a positive relationship between physical fitness and student health literacy in line with Setiawan et al. (2022), which shows that low health literacy and physical activity are correlated with low levels of physical fitness, which can increase the risk of non-communicable diseases and decrease children's endurance (Setiawan et al., 2022). Furthermore, research by Gumilang et al. (2023) adds that structured physical activity interventions can significantly improve students' physical fitness while strengthening awareness of the importance of fulfilling nutrition and increasing physical activity

in schools (Gumilang et al., 2023). Hence, designing an integrated intervention that fosters both health literacy and physical fitness becomes essential for sustainable behavior change.

Ulpi et al. (2021) highlighted that many students adopt inactive lifestyles, contributing to decreased physical fitness. This is supported by research by Gumilang et al. (2023), which shows that low physical activity among children is directly related to reduced student physical fitness (Gumilang et al., 2023). With this condition, it becomes increasingly urgent to design school-based interventions that are not only theoretical but also practical and enjoyable for students. As proposed by Kanduwi et al. (2024), adapting curricula that include elements of physical activity accompanied by healthy lifestyle education can significantly contribute to improving student well-being (Kanduwi et al., 2024).The combination of global recommendations, national programs, and local findings underscores the urgent need to integrate healthy lifestyle education into school curricula through physical education.

Based on the findings above, it is clear that the habituation of a healthy lifestyle, such as education on a balanced nutritional diet, personal hygiene, and comprehensive physical activity in physical education, has great potential in improving students' health literacy and physical fitness. If this program can be included in the curriculum, it is an advantage because it can be reached and accessed by all children from all different socio-economic backgrounds. By applying a personal hygiene educational approach, a balanced nutritional diet and a structured physical activity program that is fun in physical education learning, it is hoped that it will be an alternative for students to significantly improve their health literacy and physical fitness as well as an effective means in forming a healthy, active generation and be aware of the importance of a healthy lifestyle from an early age. Therefore, this study aims to analyze the implementation of healthy lifestyle habituation through physical education learning as an effort to improve students' health literacy and physical fitness in elementary schools.

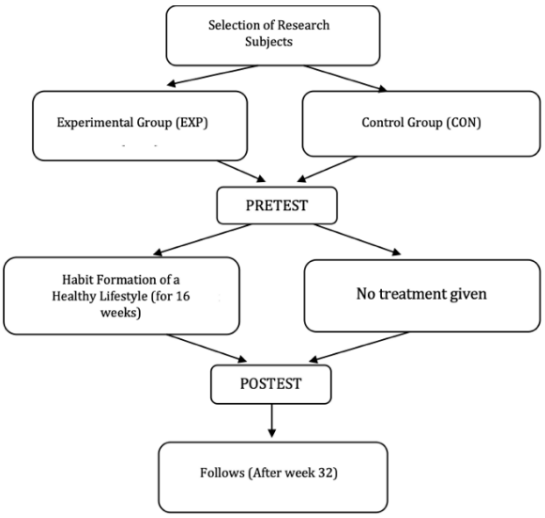
Method

Study Design

This research is a quasi-experimental study with a pretest-posttest control group design. Inclusion criteria are as follows: students aged 11 years, attending elementary school, not receiving a balanced nutritional eating program from government programs or institutions, and not participating in sports. Exclusion criteria are: students who have chronic diseases, are participating in nutrition programs, students with special needs, and who participate in projects for less than 80% of the specified period.

Furthermore, the research subjects were divided into two groups, namely the experimental group, who were given the treatment of a healthy lifestyle habituation program, and the control group, who did not receive treatment. The following is the research flow:

Figure 1. Research Flow



Participants

The research sample came from a private elementary school in Yogyakarta, Indonesia, without a balanced nutritional eating program. The research subjects were 5th-grade elementary school students with an age range of 11 years. Sample selection using a purposive sampling technique with criteria: students aged 11 years, good health (evidenced by a health certificate from a doctor), not athletes, or not participating in sports training. Of 75 students, as many as 50 met the inclusion and exclusion criteria. Furthermore, the 50 students were divided proportionally into two groups, namely 25 (13 women; 12 men) students as an experimental group who received treatment in the form of a healthy lifestyle habituation program, and 25(10 women; 15 men) students as a control group who did not receive treatment.

This research has obtained an official letter from the university, number 37/UN58.10/KM/2024, which will be given for approval from the school and parents. In addition, students have also received written approval from their parents.

Procedure

Experimental Group (EXP)

The EXP group received a physical activity training program through circuit games of moderate intensity, personal hygiene education, and a balanced nutritional diet. It was given lunch according to balanced dietary rules. The activities were carried out for 16 weeks gradually and systematically. The program is conducted in a school environment using physical education lesson hours. Structure of each 70-minute diving meeting with time division: 10 minutes (warm-up), 30 minutes (circuit game exercise +cooling down), 20 minutes (personal hygiene education), and 20 minutes (balanced nutrition education). Activities each week are as follows:

1. Week 1: Students are given socialization of the objectives of the healthy lifestyle habituation program, research procedures, benefits to be obtained, and the application of exercise results. Furthermore, the initial fitness test for Nusantara Student Fitness Test (TKPN) and health literacy test were carried out. Finally, students are given a strengthening commitment to participate in the research project.
2. Week 2: Students practice the Jump, Kick, and Zig-Zag Challenge circuit game program (Run zig-zag past the holahop, jump and jump past the cone, throw the ball to the target). Furthermore, students return to the classroom to be educated on the correct bathing method and understand the four pillars of balanced nutrition. Finally, the group discussion continued regarding the benefits of physical activity and personal goal setting.
3. Week 3: Students practice the Gallop Strike Race circuit game program (run past the cone, gallop, throw the ball at the target). Furthermore, the provision of education in maintaining nail cleanliness, carbohydrate, and protein functions in the classroom.
4. Week 4: Students practice the Hoop Challenge Adventure circuit game program (Run, jump, jump, throw a ball). Furthermore, they are educated on maintaining hair cleanliness and the types of staple foods and side dishes.
5. Week 5: Students practice the Balance Core Circuit game program (Knee hop, jumping jacks, ball sit-up, balance). Furthermore, providing education on the importance of changing clean clothes and vegetable and fruit consumption.
6. Week 6: Students practice the Jungle Jump Circuit game program (Lunges, deer jump, skipping). Furthermore, it provides education on how to clean personal tools and understand the function of vitamins and minerals.
7. Week 7: Students practice the Dynamic Duo Moves circuit game program (Light squat + jumping jack, light jogging on the spot). Furthermore, the practice of washing cutlery and drinking, and education on the importance of drinking mineral water.
8. Week 8: Students practice the Agility Adventure circuit game program (Bear walk, zig-zag jogging, jumping jacks).

9. Week 9-12: Students practice Strong Body Relay (Push-up, plank, kite, short-distance sprint), Balance Core Circuit (Knee hop, jumping jack, sit-up ball, balance), Jump, Kick, and Zig-Zag Challenge (Run zig-zag past holahops, jump and jump past cones, throw the ball to the target), Hoop Challenge Adventure (Run, jump, jump, throw the ball). Oral hygiene practices, keeping personal tools at school, washing hands as recommended, practice hygiene while playing at school. In the practice of balanced nutrition, namely making an orderly eating schedule, understanding healthy vs. unhealthy snacks, reading food labels, and determining the ideal daily meal portion.
10. Week 13-15: Students practice the Gallop Strike Race circuit game (run past the cone, gallop, throw the ball to the target), Move & Balance Mix (jump + squat), plank move (sideways), and Jungle Jump Circuit (Lunges, deer jump, skipping). Ethical practices in school toilets include recognizing and caring for yourself when sick. The practice of balanced nutrition is to prepare a lunch menu according to the rules of the contents of my plate by bringing produce.
11. Week 16: Students take the final fitness test for the Nusantara Student Fitness Test (TKPN) and health literacy test. The EXP group evaluated the program, discussed challenges, solutions for 16 weeks, and strengthened to maintain the habit of this healthy lifestyle program. In addition, awards were given to the EXP group who improved the level of fitness and health literacy significantly.

Control Group (CON)

The CON group conducted normal physical education learning activities without intervention. At the end of the study, students will receive the same exercise program as the EXP group.

Healthy Lifestyle Habituation Program

Researchers prepared a healthy lifestyle habituation program (Aiken V: 0.9 (accepted) ; reliability: 0.612 (reliable)). Five nutrition experts have validated the program in nutrition, health education, and physical training.

The implementation of this program consists of four circuit activity game posts that focus on improving fitness with moderate intensity, which is 50-70% of the maximum pulse rate (Hu et al., 2025). Each circuit exercise was performed for 40-50 seconds with 60 seconds of rest between posts, 90 seconds between circuits, performed twice. The circuit activity exercise program lasts 30 minutes, including warming up and cooling down. After the physical activity session, students followed personal hygiene education and practices and a balanced nutritional diet at school for 40 minutes. Thus, the total duration of this healthy lifestyle habituation program is 70 minutes/session, which is carried out 1 time/week for 16 weeks every Wednesday from 07.30 to 08.40.

Measurement

Health Literacy Test

The Health literacy test instrument is in the form of multiple-choice questions prepared by the researcher. The test includes understanding personal hygiene, a balanced nutritional diet, and physical activity. Experts in the field of question development have validated multiple-choice questions.

TKPN Fitness Test (Nusantara Student Fitness Test)

TKPN was developed to measure the level of physical fitness of students in Indonesia at the age of 9-17+ years, this fitness test has the following test items: body mass index (BMI) test, V Sit Reach Test, 60 Second Sit Up Test, 30 Second Thrust Squat Test, and Pacer Test (Kemenpora, 2022; Yudasmara et al., 2020)

Data analysis

Statistical calculations in this study used SPSS version 21 software (IBM Corp., IBM SPSS Statistics for Windows). The instrument validity test used Aiken's V formula, and the reliability test used Cronbach's Alpha coefficient. The prerequisite analysis consisted of a normality test with the Shapiro-Wilk method and a homogeneity test with Levene's Test. Hypothesis testing used Multivariate Analysis of Variance (MANOVA) analysis with a 2 × 3 factorial design, which included two groups (experimental group and

control group) and three measurement times (pretest, posttest after 16 weeks of intervention, and follow-up after 32 weeks).

Results

This study used data that included validity (Aiken's V, CFA) and reliability (Cronbach's Alpha, Composite Reliability) results of the Health Literacy Test Program instrument. Data were also obtained from pre-analysis tests and hypothesis tests based on the results of Health literacy tests and physical fitness tests. The research involved two groups, namely, the experimental and control groups, each consisting of 25 students. Measurements were carried out in three stages: pre-test, post-test after 16 weeks, and follow-up at week 32. The results of the study are described as follows:

Description of Research Results

Item validity test results

Validation tests are carried out to ensure that the healthy lifestyle habituation program and health literacy test instruments have accuracy and feasibility. Based on the assessment of five experts in nutrition, health education, and physical training. The instrument was validated using five raters with a 5-point rating scale. A statement item in the Healthy Lifestyle Habitat program and health literacy test instrument is declared valid if it gets a V value ≥ 0.80. The results of validity in detail are presented in the following table:

Table 1. Healthy Lifestyle Habituation Program Validation

No	Rated Aspect	Σs	V	Description
1	The suitability of the Program with the learning objectives of the Merdeka Curriculum	20	1	Accepted
2	The material in the program used is integrated with the Merdeka Curriculum.	16	0.8	Accepted
3	The program covers essential aspects of personal hygiene according to child development	19	0.95	Accepted
4	The conformity of the material in the personal hygiene program with basic health learning standards (hand washing practices, the importance of cleaning the body, the ethics of using the toilet, taking care of personal and body tools)	20	1	Accepted
5	The program covers the concept of comprehensive balanced nutrition according to the age of 10-11 years.	16	0.8	Accepted
6	The suitability of the material in the diet program with balanced nutritional standards for school-age children	16	0.8	Accepted
7	Physical activity programs include the introduction and practice of child-safe physical exercise.	19	0.95	Accepted
8	The conformity of the form of circuit physical exercise with the principles of children's physical development	17	0.85	Accepted
9	The material in the program is presented according to the needs of the daily life of children aged 10-11 years	18	0.9	Accepted
10	Materials in the program include a variety of topics and subtopics, from personal hygiene, balanced nutrition, and physical exercise	18	0.9	Accepted
	Average	18	0.9	Accepted

Based on Table 1, the analysis results of 10 items showed that all items successfully exceeded the coefficient of validity value V ≥ 0.8, so it was declared feasible. It could be used in the program to habituate healthy lifestyles of elementary school students. This finding shows that all items tested have met the validity of the contents. The average coefficient of validity of all healthy lifestyle habituation program instruments reached 0.9, indicating that the program instruments are valid and acceptable to apply.

Table 2. Health Literacy Instrument Validation

No	Rated Aspect	Σs	V	Description

1	The suitability of the questions with the indicators of the learning objectives of the Merdeka Curriculum	20	1	Accepted
2	The question covers aspects of personal hygiene, balanced nutrition, and physical exercise according to the needs of children aged 10-11 years.	18	0.9	Accepted
3	The cognitive level of the question is at the level of HOTS (Higher Order Thinking Skills) for children aged 10-11 years	16	0.8	Accepted
4	The question of being able to measure children's health literacy applicatively and contextually	18	0.9	Accepted
5	Answer choices are arranged logically and do not cause multiple interpretations	18	0.9	Accepted
6	Problems using language that is communicative and according to the level of understanding of elementary school students in grade 5	19	0.95	Accepted
7	No double use of terms or phrases	18	0.9	Accepted
8	Questions are arranged in a sentence structure that follows PUEBI rules	17	0.85	Accepted
9	The distribution of topics in the question includes proportionally: personal hygiene, balanced nutrition, and physical exercise.	16	0.8	Accepted
10	Questions are arranged in various aspects of knowledge, understanding, and application (C1-C3)	16	0.8	Accepted
	Average	18	0.9	Accepted

Based on Table 2, the analysis results of 10 items showed that all items successfully exceeded the coefficient of validity value V ≥ 0.8, so it was declared feasible. It could be used to measure the health literacy of elementary school students. This finding shows that all items tested have met the validity of the contents. The average coefficient of validity of all health literacy test instruments reached 0.9, indicating that the program instrument is valid and acceptable to apply.

Construct Validity of the Health Literacy Instrument

To ensure that the Health Literacy Test instrument accurately measures the intended construct dimensions, a Confirmatory Factor Analysis (CFA) was conducted. The analysis was based on three theoretical dimensions of health literacy, personal hygiene, balanced nutrition, and physical activity, derived from the theoretical framework and expert validation.

Table 3. Health Literacy Instrument Validation

Construct Dimension	Item Code	Standardized Loading	Description
Personal Hygiene	PH1	0.79	Accepted
	PH2	0.83	Accepted
	PH3	0.76	Accepted
Balanced Nutrition	BN1	0.81	Accepted
	BN2	0.77	Accepted
	BN3	0.82	Accepted
	BN4	0.75	Accepted
Physical Activity	PA1	0.84	Accepted
	PA2	0.78	Accepted
	PA3	0.80	Accepted

Model Fit Summary: $\chi^2/df = 1.874$ | CFI = 0.951 | TLI = 0.933 | RMSEA = 0.055 | SRMR = 0.047

Based on table 3, all standardized factor loadings ranged from 0.75 to 0.84, exceeding the minimum acceptable value of 0.50, which indicates that each item strongly represents its respective construct. The three-dimensional model (personal hygiene, balanced nutrition, and physical activity) demonstrated a good model fit, as shown by the fit indices (CFI = 0.951; TLI = 0.933; RMSEA = 0.055; SRMR = 0.047) that met the recommended thresholds (Cid et al., 2022)

These results confirm that the instrument's construct validity is well-established, with each dimension contributing meaningfully to the overall model of health literacy. The findings support the theoretical framework and expert validation, demonstrating that the Health Literacy Test accurately measures elementary school students' literacy across hygiene, nutrition, and physical activity domains.

Reliability Test Results

Reliability test ensures that the programs and instruments used are appropriate to the intended construct and consistent in generating data. Cronbach's Alpha value is declared acceptable (reliable) if it exceeds 0.600. The results of validity in detail are presented in the following table:

Table 4. Reliability Test Results of the Healthy Lifestyle Realization Program

Cronbach's Alpha	N of Items
0.612	10

Table 5. Health Literacy Test Instrument Reliability Test Results

Cronbach's Alpha	N of Items
0.783	10

Based on Table 4 and Table 5, from the results of the reliability test analysis using Cronbach's Alpha, the reliability of the Healthy Lifestyle Development Program obtained a value of 0.612, and the Health Literacy Test Instrument of 0.783, each with a total of 10 items. Both instruments can be declared reliable by referring to the minimum limit of 0.600 as the acceptance standard. This means the program and the test instrument have adequate and reliable internal consistency.

Following the initial reliability testing, a more detailed analysis was conducted specifically for the Health Literacy Test Instrument (multiple-choice format) to complement the construct validity findings. This analysis focused on evaluating the internal consistency of each construct dimensionpersonal hygiene, balanced nutrition, and physical activity using Cronbach's Alpha and Composite Reliability (CR) coefficients. The results are presented in Table 6.

Table 6. Reliability Results of Health Literacy Test Instrument

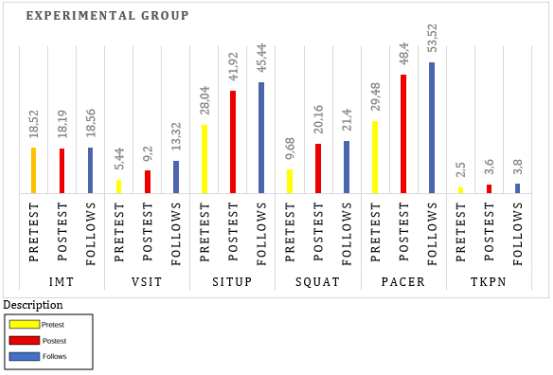
Construct Dimension	Cronbach's Alpha	Composite Reliability (CR)	Description
Personal Hygiene	0.82	0.85	Reliable
Balanced Nutrition	0.83	0.86	Reliable
Physical Activity	0.84	0.87	Reliable
Overall Instrument	0.88	0.86	Highly Reliable

Based on Table 6, the Cronbach's Alpha values ranged from 0.82 to 0.84, and the Composite Reliability values ranged from 0.85 to 0.87, both exceeding the commonly accepted threshold of 0.70 (Ghahremani et al., 2024; Martins et al., 2022). This indicates that all constructs demonstrate strong internal consistency and are reliable in measuring the intended aspects of health literacy.

Results of Physical Fitness Measurement (exp)

Figure The graph below presents the results of physical fitness measurements in the experimental group (exp) based on the components of the archipelago student fitness test (TKPN) which include: Body Mass Index (BMI), flexibility (V-Sit and Reach), abdominal muscle strength (Sit-Up), arm and shoulder muscle strength (Squat Thrust), and cardiorespiratory capacity (pacer). The total TKPN score is displayed as the result of the final fitness score. Measurements were carried out in three stages: pretest, post-test (after a 16-week intervention), and follow-up (week 32). The change data of each test stage can be seen in Figure 2.

Figure 2. Results of Physical Fitness Measurement (EXP)



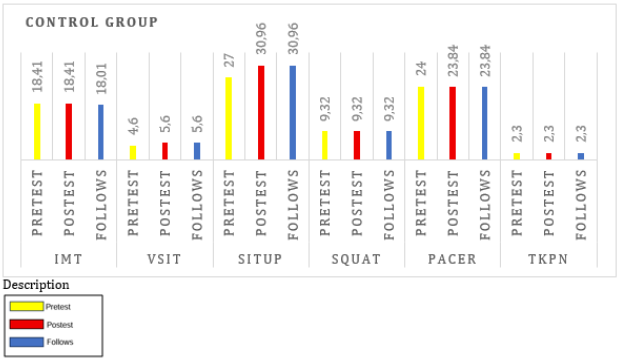
Based on Figure 2, the changes in the experimental group's physical fitness measurement test results in the pretest, post-test, and follow-up measurements can be seen. The Body Mass Index (BMI) component shows a relatively stable graph between pretest (18.52), posttest (18.19), and follow-up (18.56). Stability in the BMI component indicates that the intervention program is efficacious in improving the active physical fitness component and helps students maintain ideal body composition. Thus, it can be interpreted that a healthy lifestyle habituation program can minimize the risk of being overweight and underweight.

In other fitness components such as V-Sit and Reach, Sit-Up, Squat Thrust, and Pacer, there was a significant increase, even tending to continue to rise during the follow-up test (week 32). This shows that the intervention program has a sustained positive impact on students' flexibility, core muscle strength, leg muscles, upper muscles, and cardiorespiratory capacity. Meanwhile, the TKPN fitness test, the cumulative score of all physical test components, showed a consistent increase, from pretest 2.5 to 3.6 post-test, and again increased to 3.8 in follow-up. This increase indicates that the habituation program to a healthy lifestyle positively impacts the overall student fitness level.

Results of Physical Fitness Measurement (CON)

The graph below presents the results of physical fitness measurements of TKPN in the control (CON) group, who did not receive intervention. Measurement data at the pretest, post-test, and follow-up stages are presented as follows:

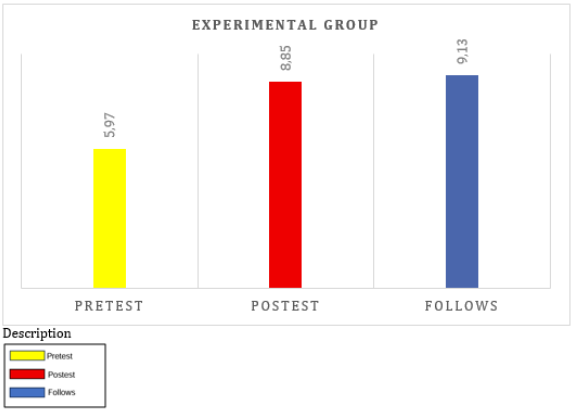
Figure 3. Results of Physical Fitness Measurement (CON)



In Figure 3, the graph results in the control group showed that most fitness components experienced relatively minor changes that tended to be stable between pre-test, post-test, and follow-up. The Body Mass Index (BMI) component shows a relatively stable graph between pretest (18.52), posttest (18.19), and follow-up (18.56). Other fitness components, such as V-Sit and Reach, Sit-Up, Squat Thrust, and pacer, tend to be stable, indicating no significant increase. Meanwhile, the TKPN fitness test, the cumulative score of all physical test components, showed no change with a score of 2.3 in the pretest, post-test, and follow-up stages, which showed no significant increase in the absence of intervention. Thus, it can be concluded that without a program to habituate a healthy lifestyle, physical fitness changes in the control group were relatively minimal.

Health Literacy Test (EXP) Results

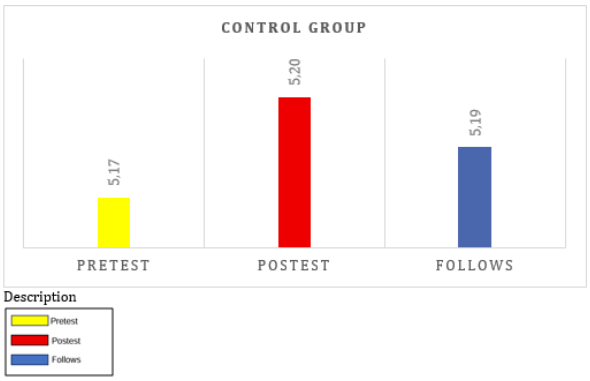
Figure 4. Health Literacy Test (exp) Results



Based on Figure 4, it can be seen that there was an increase in the health literacy score of students in the EXP group who received intervention on the healthy lifestyle habit program for 16 weeks. The improvement from the average pretest score of 5.97 increased significantly to 8.85 on the post-test. The improvement continued until the follow-up test stage at week 32 with an average score of 9.13. This shows that the program to habituate a healthy lifestyle has a sustainable, positive effect. Thus, it can be concluded that the program to develop healthy lifestyle habits, such as physical activity, education, personal hygiene practices, and a balanced nutritional diet for 16 weeks, can consistently improve and maintain students' health literacy.

Heallth Literacy Test Results (CON)

Figure 5. Health Literacy Test Results *(CON)*



In Figure 5, the health literacy test resilts in the CON group (who did not receive intervention for the healthy lifestyle habituation program) at the pretest, post-test, and follow-up stages showed minimal changes. Based on the pretest stage, the average score was 5.17, then slightly increased to 5.20 at the post-test stage, and then slightly decreased to 5.19 at the following stage. The results of test scores that did not experience a consistent increase and tended to fluctuate showed that, without specific interventions, understanding of health literacy tended not to develop.

Prerequisite Test Results

Normality Test

The normality test of this study was carried out on each of the research variables, namely physical fitness and health literacy in three stages of the test, namely pretest, potest, and follow for each exp and CON groups. The test used the Shapiro-Wilk method, with a significance value criterion (Sig.) greater than an alpha value of 0.05. The normality test results of physical fitness and health literacy variables are presented in Tables 7 and 8:

Table 7. Physical Fitness Variable Normality Results

Group	Time	Statistics	Sig.	Conclusion
Experiment	Follows	0.965	0.526	Normal
Experiment	Postest	0.975	0.771	Normal
Experiment	Pretest	0.954	0.314	Normal
Control	Follows	0.969	0.612	Normal
Control	Postest	0.972	0.694	Normal
Control	Pretest	0.950	0.256	Normal

Table 8. Normality Results of Health Literacy Variables

Group	Time	Statistics	Sig.	Conclusion
Experiment	Follows	0.932	0.098	Normal
Experiment	Postest	0.944	0.184	Normal
Experiment	Pretest	0.974	0.738	Normal
Control	Follows	0.948	0.222	Normal
Control	Postest	0.930	0.086	Normal
Control	Pretest	0.955	0.319	Normal

Based on Table 7 and Table 8, the results of the normality test of physical fitness variables and health literacy variables in the exp and CON groups showed that all significance values (Sig.) were above the alpha value of 0.05, indicating that all data were normally distributed. Normal distribution was achieved in physical fitness and health literacy variables, at all stages of pretest, potest, and follow-up measurements for each exp and CON groups.

Homogeneity Test

The homogeneity test of this study was carried out with Levene's Test method. This test aims to ensure that the data variation in each group compared is not significantly different. Homogeneity test results are presented in Table 9:

Table 9. Homogeneity Test Results

	F	df1	df2	Sig.
Health Literacy Test	6.669	5	144	0.132
Physical Fitness	12.817	5	144	0.221

a. Design: Intercept + group + time + group * time

Based on Table 9, the significance value of the health literacy variable is Sig. = 0.132, which is greater than the significance level of 0.05. This means there was no significant difference in the health literacy variance between the groups and the measurement time. Thus, the assumption of variance homogeneity is met in the health literacy variable. Furthermore, the significance value (Sig.) = 0.221 is also greater than 0.05 in the physical fitness variable. This shows that the physical fitness variance between the groups and the measurement time was not significantly different. Thus, the assumption of homogeneity of variance is also fulfilled for the physical culture variable. Levene's Test results show that both variables, namely health literacy and physical fitness, have homogeneous variances between groups and measurement time. It can be concluded that the prerequisites for homogeneity of variance are met.

Hypothesis Test Results

Hypótesis test was tested using Multivariate Analysis of Variance (MANOVA) analysis. The results of the MANOVA test showed that: the treatment or intervention given had a significant impact on improving health literacy and physical fitness, the difference in results was seen over time (from pretest to posttest and follow, and the interaction between treatment and time strengthened the findings that the experimental group showed a more significant development than the control group. The results of hypothesis testing are presented in Table 10:

Table 10. MANOVA Test Results

Variable	Pillai's Trace	Sig.	Partial η^2	Interpretation
Group	0.945	0.000	0.68	Large
Time	1.387	0.000	0.72	Large

Group x Time	1.348	0.000	0.65	Large

According to Cohen (1988), effect sizes are interpreted as small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$).

Based on Table 10, the Pillai's Trace value on the group influence was 0.945 with a significance of 0.000, indicating a significant difference between the experimental and control groups. This means that overall, the results of health literacy and physical fitness were substantial differences in the results of health literacy and physical fitness between students who received program intervention and those who did not receive program intervention. Furthermore, the Pillai's Trace value on the effect of time was 1,387 with a significance of 0.000, indicating a significant difference between measurement times, namely between pretest, posttest, and follow. This means the measurement results change over time in the experimental and control groups. Meanwhile, the Pillai's Trace value between the group and the time was 1,348 with a significance of 0.000, indicating a significant interaction between the group and the measurement time. The corresponding partial eta squared (η^2) values ranged from 0.65 to 0.72, which represent large effect sizes according to Cohen's criteria. This means that the intervention program had a strong and meaningful impact on improving students' physical fitness and health literacy levels.

These results indicate that the healthy lifestyle habituation program not only produced statistically significant differences but also large, practically meaningful effects. The consistent improvement from post-test to follow-up demonstrates the sustained positive influence of the intervention, showing that the program effectively promoted long-term enhancement in students' health literacy and physical fitness.

Discussion

The results showed that the habituation program to a healthy lifestyle (physical activity, personal hygiene education, and balanced nutritional diet) implemented for 16 weeks significantly improved elementary school students' health literacy and physical fitness. In addition to being statistically significant, the findings demonstrated large and practically meaningful effects ($\eta^2 = 0.65–0.72$), indicating that the intervention had a strong and substantial impact on both constructs. The difference in results between time and significant interactions reinforced the conclusion that the intervention of healthy lifestyle programs had a consistent and increasing effect, especially in the experimental group. This means that the program did not merely produce statistical differences but also brought real, sustained improvements in students' health-related behaviors and outcomes.

The success of this program was proven through MANOVA analysis which showed the results of differences between the experimental (exp) and control (CON) groups with Pillai's Trace value = 0.945, $p < 0.000$. The large effect size observed further supports the robustness of these differences, confirming that the healthy lifestyle habituation program effectively enhanced students' health literacy and physical fitness in a meaningful way. Huang & Haow's research shows that physical activity interventions combined with a positive attitude can improve health literacy and promote better student health outcomes (Huang & Xiao, 2025). Another finding by Reis et al. shows that physical activity intervention programs enhance physical fitness and students' ability to manage their overall health (Reis et al., 2024). Doustmohammadian et al. also revealed that nutrition-related understanding is a key factor in shaping healthy eating behaviors that affect health literacy (Doustmohammadian et al., 2020). In addition, Jung et al. showed that curriculum-based interventions through healthy eating habits programs significantly improved healthy eating literacy, affecting elementary school students' health (Jung et al., 2019). Furthermore, Samsuni et al., in their research, show that personal hygiene interventions provided through an educational approach are proven to improve health literacy, especially in the aspect of knowledge (Samsuni et al., 2019). in addition, Taware et al. showed that school-based intervention programs in promoting personal hygiene proved effective in improving elementary school children's learning, attitudes, and hygiene practices (Taware, et al., 2018).

In addition, the results of 1,387, $p < 0,000$, showed a significant difference between the measurement time, indicating that students' health literacy and physical fitness changed from pretest to post-test to follow both the exp and CON groups. However, the large effect size across time underscores that these changes were not only statistically meaningful but also practically significant, reflecting sustained improvements in the EXP group.The most significant and consistent changes were found in the EXP group

that received the 16-week intervention program. This finding was significantly improved by Raksilp et al., who showed that the EXP group followed a 12-week physical exercise program, considerably improving body outcomes. These results highlighted that the sufficient duration of the intervention, accompanied by a structured and sustainable approach, provided positive changes in physical and behavioral aspects of health. (Raksilp et al., 2025)

Furthermore, the results of Pillai's Trace between the group and the time amounted to 1,348, $p < 0.000$, showing a significant interaction. This indicates that the intervention's effect differed at each measurement time, and more substantial and positive changes occurred in the EXP group compared to the CON group. The presence of a large interaction effect suggests that the intervention maintained its impact even beyond the program period, demonstrating the sustainability of behavioral improvement.,This change not only happens when the program is completed, but also continues until the follow-up period. The presence of a large interaction effect suggests that the intervention maintained its impact even beyond the program period, demonstrating the sustainability of behavioral improvement. These findings reinforce that an integrative approach that combines physical activity programs, personal hygiene education, and balanced nutrition education can form a sustainable, healthy lifestyle, proving the effectiveness of such programs.

In the EXP group, the health literacy score continued to increase from the pretest of 5.97 to 8.85 in the posttest, and the improvement continued until the test was followed at week 32 with a score of 9.13. Meanwhile, in the CON group, the results of pretest 5.17 increased slightly to 5.20 at the post-test stage, then slightly decreased to 5.19 at the follow-up stage, which showed no change without intervention.

Similar improvements in the physical fitness of the EXP group. The Body Mass Index (BMI) component showed pretest (18.52), posttest (18.19), and follow-up (18.56) scores. Results of V-Sit and Reach, Sit-Up, Squat Thrust, and Pacer showed a significant improvement, even tending to increase during the follow-up test (week 32). The final score of TKPN, which is the cumulative score of all physical test components (V-Sit and Reach, Sit-Up, Squat Thrust, and pacer), shows a consistent improvement from pretest 2.5 to 3.6 posttest and increased again to 3.8 in follow-up, illustrating the overall improvement of physical fitness. The Body Mass Index (BMI) component shows a relatively stable graph between pretest (18.52), posttest (18.19), and follow-up (18.56). Other fitness components, such as V-Sit and Reach, Sit-Up, Squat Thrust, and pacer, tend to be stable, indicating no significant increase. Meanwhile, the TKPN fitness test, the cumulative score of all physical test components, showed no change with a score of 2.3 in the pretest, post-test, and follow-up stages, which showed no significant increase in the absence of intervention.

The significant difference between the EXP and CON groups reinforces the conclusion that the intervention of healthy lifestyle habits improves health literacy and physical fitness measurably and sustainably. This finding aligns with research conducted by Caldwell et al., which shows that physical literacy and physical activity interventions significantly correlate with physical fitness and quality of life of children (Caldwell et al., 2020). In addition, these results are also reinforced by the study of Chu Ko et al, which revealed that health literacy is closely related to a healthy lifestyle, including physical activity, personal hygiene, and eating patterns that support the creation of healthy behavior in a sustainable manner(Chu-Ko et al., 2021).

The effectiveness of this healthy lifestyle habituation program was planned and structured, which included 30 minutes of moderate-intensity circuit game physical activity, personal hygiene education, and balanced nutrition diet education (given lunch according to balanced nutrition rules) for 40 minutes for 16 weeks. This consistent combination of physical activity and health education supports changes in students' health literacy and physical fitness on an ongoing basis. In addition, implementing the 16-week program can allow students to form healthy lifestyle habits without excessive saturation and fatigue. On the other hand, the results in the CON group that did not show significant changes in health literacy and physical fitness results strengthen the evidence that a healthy lifestyle habitualization program is needed to support the improvement of students' understanding and healthy living practices. Without a comprehensive approach to students regarding the habituation of a healthy lifestyle, students will be unaware of their health and remain at the literacy level. Fitness levels can even decrease due to a poor lifestyle.

The results of this study provide significant implications for the practice of health education at the primary school level. An integrative approach to habituating a healthy lifestyle that includes physical activity, personal hygiene education, and a balanced nutritional diet effectively improves students' health literacy and physical fitness. This program is in line with Sustainable Development Goals (SDGs) point 3 which focuses on good health and well-being, It emphasizes that the importance of health education at the primary school level cannot be underestimated, given that children are a vulnerable group who need support in ensuring a healthy lifestyle (Küfeoğlu, 2022). The habituation of healthy lifestyles can also be an alternative for various countries, especially in facing global challenges such as childhood obesity, low health literacy, and lack of physical activity among children (Turner, 2020). The study by Hamulka et al. also confirms that the school environment has great potential in promoting healthy lifestyles. Adequate education about healthy lifestyles in schools will help achieve a better and sustainable level of health (Hamulka et al., 2024).

Although the results of this study have a significant positive impact, this study has limitations, such as not considering gender differences, so it cannot conclude whether there are variations in influence changes between female and male students. In addition, the duration of the following only reaches the 32nd week of measurement, so the program's long-term impact cannot be fully ascertained. Furthermore, health literacy measurement is still cognitive and has not directly touched the affective and behavioral aspects. Further research is expected to include gender analysis, using a longitudinal design, and developing instruments to measure changes in healthy behavior to provide more comprehensive results and descriptions.

Conclusions

The findings of this study indicate that the habituation program to a healthy lifestyle carried out for 16 weeks significantly affects the improvement of elementary school students' health literacy and physical fitness. A program of habituation that combines physical activity through circuit games with moderate intensity, education and personal hygiene practices, as well as education on a balanced nutrition diet and lunch feeding according to balanced nutrition rules, is efficacious in improving nutritional literacy and physical fitness of elementary school students.

The consistent improvement of the experimental group (EXP) in the post-test to follow results shows that the impact of the healthy lifestyle habituation program is sustainable. The stability of the Body Mass Index (BMI) value also indicates that this program not only improves physical aspects such as V-Sit and Reach, Sit-Up, Squat Thrust, and pacer components, but also plays a role in maintaining body composition, losing weight, and directing students' nutritional status towards standard categories to support ideal body proportions. In addition to the physical fitness aspect, a significant increase in health literacy also occurs continuously. This positive change can be seen from the rise in nutritional literacy from pre-test to post-test to the follow-up stage. This shows that the habituation program to a healthy lifestyle has a direct influence not only, but also persists for a specific period, so that it can form the foundation of healthy living behavior of elementary school students.

Therefore, elementary schools must integrate programs to habituate healthy lifestyles as part of routine activities and school culture, not limited to physical education learning. This program can be a long-term strategy to form healthy habits that can improve students' quality of life early on. In addition, teachers and educators must be given continuous training to deliver material that supports contextual, applicative, and interactive healthy lifestyle habituation programs according to the development of the child's age and the development of the times. The implementation of this program also requires support from various parties, including parents and the school community, to create an environment that supports overall healthy behavior patterns. With a collaborative and sustainable approach, schools strategically shape young people who are academically intelligent, physically, mentally, and socially healthy.

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