



Comparison of the Effectiveness of Circuit Training and Interval Training on The Physical Fitness of Students at Primary School

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Abstract

Physical fitness is an important indicator in supporting the physical and motor development and learning readiness of primary school students in physical education, sports and health (PE) lessons. However, the level of physical fitness of primary school students still tends to be in the moderate to low category due to limitations in the variety and systematics of training methods. This study aims to analyse the effect of circuit training and interval training on improving the physical fitness of primary school students and to compare the effectiveness of the two training methods. The study used a quasi-experimental method with a pretest-posttest two-group design. The research subjects consisted of 20 primary school students divided into two groups, namely the circuit training group and the interval training group. The physical fitness measurement instrument was based on the Indonesian Physical Fitness Test (TKJI). Data analysis included descriptive statistics, normality tests, homogeneity tests, paired sample t-tests, and independent sample t-tests. The results showed that both circuit training and interval training significantly improved physical fitness in each group ($p < 0.05$). However, the results of the intergroup comparison test showed no statistically significant difference ($p > 0.05$), although descriptively, circuit training showed a higher increase. In conclusion, both training methods are effective in improving the physical fitness of primary school students, with circuit training having the potential to provide more comprehensive physical fitness development in physical education learning.

How to Cite

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INTRODUCTION

Physical fitness is one of the main components that supports the growth and development of primary school students, both in terms of physical and motor skills, as well as their readiness to participate in the learning process. In physical education, sports, and health (PE) (Helme et al., 2025), physical fitness is understood as the body's ability to perform daily physical activities without experiencing excessive fatigue and still having energy reserves for subsequent activities (Wang & Zhou, 2024). Therefore, physical fitness is an important indicator of the success of PE learning in primary schools (Depdiknas, 1984).

At primary school age, children are in a phase of rapid basic motor development. If they are not given appropriate and structured physical activity stimuli during this phase, their potential for physical fitness development will not be optimally developed (Ortega et al., 2022; Telama et al., 2014). Several studies show that the level of physical fitness of primary school students in Indonesia is still in the moderate to low category, which is caused by a lack of variety in exercises, low intensity of physical activity, and limited application of systematic exercise models in PE learning (Li et al., 2023; Rohmah & Muhammad, 2021; Zulfaini et al., 2023). The Indonesian Physical Fitness Test (TKJI) developed by the Ministry of National Education emphasises that the physical fitness of primary school students includes several key components, such as muscle strength and endurance, speed, agility, and cardiorespiratory endurance. These components cannot develop optimally if PE lessons only focus on routine activities without programmed and measurable training plans (Depdiknas, 1984). Therefore, PE teachers are required to be able to select and apply training methods that are appropriate for the characteristics of their students (Duncombe et al., 2022).

One form of exercise that is often recommended in PE learning is circuit training (Reigal et al., 2020). Circuit training is a training method that combines several forms of movement in a series of exercise stations performed sequentially with relatively short rest periods (Sanchez-Sanchez & Rodríguez-Fernández, 2025). This method is considered effective because it can train several components of physical fitness simultaneously, such as muscle strength, endurance, speed, and movement coordination. Research conducted by (Maghfirah et al., 2024), shows that circuit training has a significant effect on improving the physical fitness of primary

school students because of its varied nature and ability to adapt to children's abilities. In addition to circuit training, interval training is also widely used as a method to improve physical fitness. Interval training emphasises the regulation of work and rest periods at a certain intensity, thereby improving the efficiency of the cardiorespiratory system. Several studies indicate that interval training effectively improves cardiorespiratory endurance and physical performance in children and adolescents, especially when applied in a structured and continuous manner (Jamaludin et al., 2023; Wu et al., 2023).

Although circuit training and interval training both aim to improve physical fitness, the characteristics of the stimuli provided by the two methods are different (da Silva Bento et al., 2021). Circuit training tends to provide comprehensive stimuli to various components of physical fitness, while interval training is more dominant in increasing aerobic capacity and endurance. These differences in characteristics allow for differences in physical fitness improvement results when applied to primary school students (Buccheit & Laursen, 2019; Faigenbaum et al., 2020). However, studies that directly compare the effectiveness of circuit training and interval training in the context of physical education in primary schools are still relatively limited, especially in primary school settings in Indonesia. Based on preliminary observations at State Primary School Wonobodro 01, Blado District, Batang Regency, it was found that the students' physical fitness levels were still in the moderate category based on the initial physical fitness test results. In addition, the variety of training methods in physical education lessons had not been optimally implemented and tended to be monotonous. This condition indicated the need to implement more structured and evidence-based training methods to improve students' physical fitness.

Therefore, this study examines the effects of circuit training and interval training on the physical fitness of primary school pupils, whilst analysing the comparative effectiveness of these two methods in the context of physical education. Although various training methods have been extensively studied in previous research, most studies tend to focus on adolescent athletes or structured sports training environments. Research specifically exploring the application of these training methods within the physical education learning process at primary school level remains relatively limited, particularly studies evaluating improvements using components of the

Indonesian Physical Fitness Test (TKJI).

The uniqueness of this study lies in the effort to integrate two widely recognised training methods into a learning-based physical activity programme specifically designed for primary school pupils. In this context, circuit training and interval training are positioned not only as training models but also as pedagogical strategies that can enrich the implementation of physical education in schools. Furthermore, this study examines how the characteristics of different exercise stimuli comprehensive movement patterns in circuit training and work-rest regulation in interval training influence the development of various components of pupils' physical fitness as measured by TKJI indicators.

By employing a pretest-posttest quasi-experimental design, this study provides empirical evidence regarding the effectiveness of both training methods when applied within a real-world school learning environment. These findings are expected to offer practical insights for PE teachers in designing physical activity programmes that are more structured, varied, and developmentally appropriate, thereby effectively enhancing the physical fitness of primary school pupils.

METHOD

This study used a quasi-experimental research method with a pretest-posttest two-group design. This design was used because the researcher did not fully randomise the subjects but used existing groups. In this design, two groups were given different treatments, and the results were then compared based on the change in scores from the pretest to the posttest. The first group was given circuit training, while the second group was given interval training. Before and after the treatment, both groups were given physical fitness tests to determine changes in students' physical fitness levels. This research design was chosen because it was suitable for examining the effects and comparisons of two training methods on physical fitness variables.

Participants All participants were in normal physical condition, had no injuries, and obtained permission from the school to participate in the entire research process. The research subjects were selected using purposive sampling, considering that fifth and sixth grade students have relatively homogeneous physical characteristics and are able to follow a structured physical training programme in physical education classes. The division of groups based on grade level was done to maintain the integrity of existing classes and to

adjust to the learning conditions at the school, so that the research design was classified as a quasi-experiment.

Table 1. Distribution of Students in the Circuit Training and Interval Training Groups

Group	Pretest	Treatment	Posttest
A (Sirkuit Training)	O ₁	X ₁	O ₂
B (Interval Training)	O ₁	X ₂	O ₂

Explanation:

O₁ = Initial physical fitness test (pretest)

X₁ = Circuit training treatment

X₂ = Interval training treatment

O₂ = Final physical fitness test (post-test)

This design allows researchers to determine the effect of (X₁ and X₂) on changes in physical fitness (Y) and the differences in effectiveness between training methods. After that, the sample was divided into two treatment groups using random assignment techniques. The following is a table of group divisions in ABBA format:

Table 2. Group Division Design Using the ABBA Technique

Student Name	Code	Description
Group I		
AB	A	Sirkuit Training
CD	B	Sirkuit Training
EF	B	Sirkuit Training
GH	A	Sirkuit Training
IJ	A	Sirkuit Training
KL	B	Sirkuit Training
MN	B	Sirkuit Training
OP	A	Sirkuit Training
QR	A	Sirkuit Training
ST	B	Sirkuit Training
Group II		
BC	B	Interval Training
DE	A	Interval Training
FG	A	Interval Training
GI	B	Interval Training
JK	B	Interval Training
LM	A	Interval Training
NO	A	Interval Training
PQ	B	Interval Training
RS	B	Interval Training
TU	A	Interval Training

Data collection techniques in this study used tests and measurements, which were divided

into physical fitness tests as measurement instruments and exercise programmes as treatments.

a) Physical Fitness Measurement Instruments

The instruments used to measure students' physical fitness refer to the Indonesian Physical Fitness Test (TKJI) for primary school age. TKJI was chosen because it has been standardised and is commonly used in physical education research in Indonesia. The components of physical fitness measured include:

Table 3. Physical Fitness Test Instrument Grid Table

Component	Test Form	Unit	Purpose
Abdominal muscle strength	Sit-ups for 60 seconds	Number of repetitions	To measure abdominal muscle strength
Arm muscle strength	Push-ups for 60 seconds	Number of repetitions	To measure arm muscle strength
Agility	Shuttle Run (10×5 m)	Time (seconds)	To measure agility and coordination
Speed	40 metre Sprint	Time (seconds)	To measure linear movement speed
Endurance	1.000 metre Run	Time (minutes)	To measure cardiorespiratory endurance

The results of each test item are converted into a standard score with a value interval of 1-5 according to TKJI guidelines, then the average score is calculated to obtain the student's physical fitness score.

b) Physical Fitness Scoring System (TKJI)

The results of students' physical fitness measurements for each test item are converted into standard scores with a range of 1-5 in accordance with the Indonesian Physical Fitness Test (TKJI) guidelines for primary school children. This scoring system is used to standardise different measurement units so that they can be processed quantitatively.

Table 4. Scoring Criteria for Primary School Student Physical Fitness Tests

Skore	Score 60-second	Sit-ups 60 seconds (reps)	Shuttle Run 10×5 m (seconds)	40 m Run (seconds)	1,000 m Run (minutes)
5	≥ 30	≥ 30	≤ 18,5	≤ 5,9	≤ 4,30
4	25 - 29	25 - 29	18,6 - 19,5	6,0 - 6,3	4,31 - 4,59
3	20 - 24	20 - 24	19,6 - 20,5	6,4 - 6,7	5,00 - 5,29
2	15 - 19	15 - 19	20,6 - 21,5	6,8 - 7,1	5,30 - 5,59
1	< 15	< 15	> 21,5	≥ 7,2	≥ 6,00

Source: Ministry of Education and Culture (2010). Indonesian Physical Fitness Test (TKJI) for Primary School Children. Jakarta.

Next, the scores from all test items were added up and the average value was calculated to obtain the overall physical fitness score of the students, which was used as the basis for statistical analysis in the next stage. Below is the physical fitness scoring **Table 5**.

Table 5. Physical Fitness Scoring

Average Score	Fitness Category
4,20 - 5,00	Very Good
3,40 - 4,19	Good
2,60 - 3,39	Moderate
1,80 - 2,59	Poor
1,00 - 1,79	Very Poor

Source: (Tes, 1984)

c) Circuit Training Exercise Treatment

Circuit training exercise was used as the treatment for the first group. Circuit training is a form of exercise consisting of several exercise stations performed sequentially with limited rest time between stations. In this study, circuit training exercise consisted of the following forms of exercise:

- 1) Push-ups
- 2) Sit-ups
- 3) Squat jumps
- 4) Step-ups
- 5) Jumping jacks
- 6) Shuttle runs

Each student performed the entire series of exercises sequentially in one training session. Circuit training is designed to stimulate various components of physical fitness, especially muscle strength, muscle endurance, speed, and agility. These exercises are given in a structured manner in PE lessons according to the abilities and characteristics of primary school students.

d) Interval Training Exercise Treatment

Interval training exercises were used as treatment for the second group. Interval training is a form of exercise performed with alternating work and rest patterns at a certain intensity. In this study, interval training was conducted with the following conditions:

1. Training pattern: 30 seconds of work and 60 seconds of rest.
2. Training intensity: 70-85% of maximum heart rate.
3. Training form: 40-metre shuttle run.
4. Number of sets: 3-4 sets per training session.
5. Duration of one training session: ±60 minutes, including warm-up and cool-down.

Interval training aims to improve cardiorespiratory endurance and the efficiency of the heart and lungs, thereby significantly improving students' physical fitness.

The research procedure was carried out in several stages as follows:

Preparation stage

The researcher coordinated with the school, prepared the research schedule, and prepared the instruments and equipment for the physical fitness test.

Pretest

All participants were given a preliminary physical fitness test (pretest) to determine their physical fitness condition before being given the treatment.

Treatment

The circuit training group was given exercises consisting of a series of movements such as push-ups, sit-ups, squat jumps, step-ups, jumping jacks, and shuttle runs, which were performed sequentially in one training session. The interval training group was given interval training in the form of shuttle runs with specific work and rest patterns, at an intensity of approximately 70-85% of maximum heart rate. The treatment was given over several sessions in accordance with the PE learning schedule.

Posttest Implementation

After all treatments were completed, participants underwent a physical fitness test (posttest) using the same instrument as the pretest.

The collected data were processed and analysed using Statistical Package for the Social Sciences (SPSS) software through several stages of statistical analysis as follows:

Descriptive statistical tests were used to describe the characteristics of students' physical fitness data in each treatment group, both at the pretest and posttest stages. This analysis included the mean, standard deviation, minimum, and maximum values of physical fitness scores in the circuit training group and the interval training group. The results of the descriptive statistical test were used to provide an initial overview of the students' physical fitness conditions before and after the treatment, as well as to observe the trends in changes in physical fitness scores in each group.

A normality test was conducted to determine whether the physical fitness scores were normally distributed as a prerequisite for using parametric statistical tests. The normality test in this study used the Shapiro-Wilk test because the number of subjects in each group was relatively small ($n < 50$). The normality test was applied to the pretest and posttest physical fitness scores in the circuit training and interval training groups. The data was declared to be normally distributed

if the significance value (p) > 0.05 .

The homogeneity test was conducted to determine the similarity of data variance between the circuit training group and the interval training group. The homogeneity of variance test used the Levene test by entering the students' physical fitness scores. The data was declared to have a homogeneous variance if the significance value (p) > 0.05 . The results of this homogeneity test were used as a basis for determining the use of the equal variances assumed or equal variances not assumed options in the unpaired t-test.

The paired t-test was used to determine the effect of circuit training and interval training on students' physical fitness. This test was conducted by comparing the pretest and posttest scores in the same group. The test was conducted separately on:

- Circuit training group
- Interval training group

The data used in this test were the students' physical fitness scores at the pretest and posttest stages. This test aims to determine whether there is a significant increase in physical fitness after treatment in each group.

The independent sample t-test is used to determine the difference in physical fitness results between the circuit training group and the interval training group after treatment. The test was conducted by comparing the post-test physical fitness scores of both groups. The selection of the equal variances assumed or equal variances not assumed option was adjusted to the results of the variance homogeneity test. This test aims to determine whether one training method is more effective than the other in improving students' physical fitness.

All statistical tests in this study were conducted at a significance level of $\alpha = 0.05$. The test results were declared significant if the significance value (p) < 0.05 , indicating a statistically significant effect or difference. Conversely, if the significance value (p) ≥ 0.05 , the test results were declared insignificant.

RESULTS AND DISCUSSION

This section of the research results presents the findings systematically based on the stages of data analysis that have been carried out. The presentation of the results begins with descriptive statistics to provide an overview of the students' physical fitness, followed by a prerequisite analysis test, and concludes with hypothesis testing using parametric statistical tests. All analysis results are presented in tabular form for ease of understanding, then interpreted narratively in accordance with the research objectives.

Descriptive statistics are used to describe the initial and final physical fitness conditions of students in the circuit training and interval training groups. This analysis includes the minimum, maximum, mean, and standard deviation of physical fitness scores at the pretest and posttest stages. The presentation of descriptive statistics aims to provide an overview of data trends and changes in physical fitness scores after treatment. The results of the descriptive statistical analysis of students' physical fitness are presented in **Table 6**.

Table 6. Descriptive Statistics

	Min	Max	Mean	Std. Deviation
Pretest Circuit Training	2.0	4.0	3.020	0.6828
Pretest Interval Training	1.8	3.0	2.460	0.4812
Posttest Circuit Training	2.8	4.8	3.780	0.6215
Posttest Interval Training	2.8	4.0	3.340	0.4624
Valid N (listwise)			10	

Based on the descriptive statistics results, there was an increase in physical fitness scores in both treatment groups after the training, both in the circuit training and interval training groups. At the pretest stage, the average physical fitness score of the circuit training group was in the moderate to good category, while the interval training group tended to be in the moderate to poor category. This condition indicates that before the treatment was given, the physical fitness levels of students in both groups were relatively comparable, although there were variations in individual abilities.

Physical Fitness Assessment Results

Table 7. Distribution of Pretest Results for Physical Fitness of the Treatment Group

Circuit Training			
Name	Code	Score Result	Category
AB	A	2.8	Moderate
CD	B	3.4	Good
EF	B	2.6	Moderate
GH	A	4	Good
IJ	A	3	Moderate
KL	B	2.2	Moderate
MN	B	3.4	Good
OP	A	4	Good
QR	A	2.8	Moderate
ST	B	2	Poor

Interval Training			
Name	Code	Score Result	Category
BC	B	1.8	Moderate
DE	A	2.4	Poor
FG	A	2	Poor
GI	B	2.8	Moderate
JK	B	2.8	Moderate
LM	A	3	Moderate
NO	A	3	Moderate
PQ	B	2.2	Poor
RS	B	1.8	Poor
TU	A	2.8	Moderate

Table 8. Distribution of Posttest Results for Physical Fitness of the Treatment Group

Circuit Training			
Name	Code	Score Result	Category
AB	A	3.8	Good
CD	B	4	Very Good
EF	B	3.6	Good
GH	A	4.8	Very Good
IJ	A	3.8	Good
KL	B	2.8	Moderate
MN	B	4	Very Good
OP	A	4.4	Very Good
QR	A	3.8	Good
ST	B	2.8	Moderate

Interval Training			
Name	Code	Score Result	Category
BC	B	2.8	Moderate
DE	A	3	Moderate
FG	A	2.8	Moderate
GI	B	3.8	Good
JK	B	3.6	Good
LM	A	3.8	Good
NO	A	4	Good
PQ	B	3	Moderate
RS	B	3	Moderate
TU	A	3.6	Good

Based on the pretest results, the physical fitness of students in the circuit training and interval training groups was generally in the poor to moderate category, with a small number of students reaching the good category. This condition shows that before the treatment was given, the physical fitness level of students in both groups was still not optimal and relatively comparable. After the treatment (post-test), all students in both groups experienced an increase in their physical fitness scores. In the circuit training group, most students improved to the good and very good ca-

tegrities, while in the interval training group, the dominant improvement occurred in the moderate and good categories.

Descriptively, the increase in physical fitness scores in the circuit training group was higher than in the interval training group, although both training methods showed an improvement in students' physical fitness.

Before testing the hypothesis, prerequisite analysis testing is carried out, which includes normality testing and variance homogeneity testing. This prerequisite testing aims to ensure that the data meets the assumptions for the use of parametric statistical testing.

The normality test is conducted to determine whether the physical fitness score data is normally distributed. The normality test in this study uses the Shapiro-Wilk test because the sample size in each group is less than 50. The results of the normality test for the pretest and posttest physical fitness data are presented in **Table 9**.

Table 9. Results of the Normality Test for Pretest and Posttest Data

	Statistic	df	Sig.	Conclusion
Pretest Circuit Training	0.946	10	0.626	Normal
Pretest Interval Training	0.867	10	0.093	Normal
Posttest Circuit Training	0.916	10	0.322	Normal
Posttest Interval Training	0.86	10	0.077	Normal

Based on the Shapiro-Wilk test results, all pretest and posttest data in the circuit training and interval training groups had a significance value greater than 0.05. Thus, the students' physical fitness data was declared to be normally distributed and met the prerequisites for parametric statistical analysis.

Based on the results of the Shapiro-Wilk test, all pre-test and post-test data for the circuit training and interval training groups had p-values greater than 0.05 ($p > 0.05$). Therefore, the physical fitness data are normally distributed and satisfy the assumptions required for parametric statistical analysis.

The variance homogeneity test was conducted to determine the similarity of physical fitness data between the circuit training and interval training groups. The homogeneity test in this study used Levene's Test. The results of the physical fitness variance homogeneity test are presented in **Table 10**.

Table 10. Results of the Homogeneity Test

		Levene Statistic	Sig.	Conclusion
Physical Fitness Pretest	Based on Mean	1.760	0.632	Homogen
Physical Fitness Posttest	Based on Mean	1.796	0.615	Homogen

The homogeneity test results show a significance value of 0.632 for the pretest and 0.615 for the posttest ($p > 0.05$). This indicates that the variance of physical fitness data between groups is homogeneous, so that intergroup comparisons can be performed using an independent samples t-test with the equal variances assumed option.

After all analysis prerequisites were met, hypothesis testing was conducted to determine the effect and comparison of training methods on students' physical fitness. Hypothesis testing was conducted using paired t-tests and unpaired t-tests.

The paired t-test was used to determine the effect of training on students' physical fitness by comparing pretest and posttest scores within the same group. The results of the paired sample t-test are presented in **Table 11**.

Table 11. Results of the Paired Sample t-test

Group	Mean Difference	t	df	Sig. (p)	Conclusion
Circuit Training	-0.76	-11.6	9	0	Significant improvement
Interval Training	-0.88	-16.5	9	0	Significant improvement

The results of the paired sample t-test show that in the circuit training group, a t-value of -11.635 with $p = 0.000$ ($p < 0.05$) was obtained, indicating a significant increase in physical fitness after circuit training. In the interval training group, a t-value of -16.500 was obtained with $p = 0.000$ ($p < 0.05$), indicating that interval training also resulted in a significant improvement in physical fitness.

The paired sample t-test results indicate that both the circuit training and interval training groups experienced improvements in physical fitness scores after the treatment period.

The independent sample t-test was used to determine the difference in physical fitness between the circuit training and interval training groups. The results of the independent samples t-test are presented in **Table 12**.

Table 12. Results of the Independent Sample t-test

	t	df	Sig. (2-tailed)	Conclu- sion	Conclusion
Physical Fitness Pretest	Equal variances assumed	1.760	18	0.095	Not significant difference
Physical Fitness Posttest	Equal variances assumed	1.796	18	0.089	Not significant difference

The test results show that at the pretest stage, there was no significant difference between the circuit training and interval training groups ($p = 0.095 > 0.05$). This indicates that the initial physical fitness conditions of the two groups were at a relatively equal level.

The results of this study indicate that the implementation of circuit training and interval training has a significant effect on improving the physical fitness of primary school students. These findings confirm that physical activities that are structured, systematic, and tailored to the developmental characteristics of students can significantly improve physical fitness. In the context of physical education, sports, and health (PE), these results reinforce the role of activity-based learning as the primary means of optimising the physical development of primary school students who are in a phase of rapid growth and motor development (Arida & Abdulaziz, 2025).

At the pretest stage, the physical fitness of students in the circuit training and interval training groups was relatively comparable and dominated by the low to moderate categories. This condition indicates that, in general, the initial level of physical fitness of students was not optimal. These findings are in line with previous research reports which revealed that low intensity of structured physical activity, limited time for physical education, and a lack of variety in training methods can have an impact on the low level of physical fitness of primary school students (Permana, 2024). The initial conditions between the groups were also reinforced by the results of the independent samples t-test on the pretest, which showed no significant differences, so that the two groups had an equal basis for comparison in terms of the effectiveness of the treatment. After the treatment was administered, the results showed a significant improvement in physical fitness in both groups. In the circuit training group, the improvement in physical fitness was more pronounced, with students shifting from the moderate to good and very good categories. This indicates that circuit training is effective in providing comprehensive exercise stimuli. Circuit training invol-

ves a series of varied and sequential movements, enabling it to stimulate various components of physical fitness simultaneously, such as muscle strength, muscle endurance, speed, agility, and cardiorespiratory endurance. The characteristic of this exercise, which involves minimal passive rest periods, also allows students to remain active throughout the training session, thereby optimising the training load received. These findings are consistent with the results of studies (Lubans et al., 2021) and (Islam et al., 2025; Permana, 2024), which state that circuit training is an effective training method for improving children's physical fitness because it is comprehensive and adaptive to the abilities of the students.

The interval training group also showed a significant increase in physical fitness between the pretest and posttest. Interval training with a structured work and rest pattern has been proven to increase students' cardiorespiratory capacity and cardiovascular system efficiency. Although descriptively the increase was slightly lower than circuit training, interval training still had a positive impact on physical fitness. This is in line with the findings of (Baquet et al., 2003) and (Raghuvveer et al., 2020), which explain that moderate to high-intensity interval training, when applied in a controlled manner and in accordance with the characteristics of school-age children, is effective in increasing VO_{2max} and cardiovascular endurance.

The results of the independent samples t-test at the posttest stage showed that the difference in physical fitness between the circuit training and interval training groups was not statistically significant. These findings indicate that both training methods have relatively equivalent levels of effectiveness in improving the physical fitness of primary school students. However, when viewed descriptively, the circuit training group showed a higher average post-test physical fitness score and a higher proportion of students achieving good and very good categories compared to the interval training group. This difference in tendency indicates that circuit training provides a more balanced training stimulus across various components of physical fitness, while interval training tends to emphasise the aspect of cardiorespiratory endurance. These findings are in line with the results of studies by (Yuliawan et al., 2025) and (Hamdi, 2026), which reported that differences in the effectiveness of training methods are often insignificant when applied to groups of relatively homogeneous age and physical condition. Although the differences in physical fitness improvement between the treatment groups did

not show statistical significance, these findings still have practical implications in the context of physical education learning. The higher increase in the circuit training group indicates that this training model has the potential to provide relatively more optimal results in overall physical fitness development when applied continuously over a longer period of time. This finding is in line with research showing that the implementation of circuit training in primary school students can improve physical fitness components, even when conducted in a limited number of sessions (Majdin Majdin, Rostati Rostati, 2025; Muhafis Ikbil Hassan, 2022). Additionally, other studies also confirm that longer training durations have a stronger impact on improving physical fitness parameters (Toprak Celenay et al., 2024). Therefore, the insignificant differences in this study may have been influenced by the relatively short treatment duration, limited sample size, and homogeneity of the research subjects in terms of age and physical development level (At et al., 2025).

Overall, the results of this study confirm that both circuit training and interval training are effective exercise methods for improving the physical fitness of primary school students in PE learning. Both methods can be used as alternative learning strategies that are applicable and relevant to school conditions. However, based on the trends in the results obtained, circuit training can be considered as an exercise method that emphasises comprehensive physical fitness development, while interval training is more suitable for the purpose of improving cardiorespiratory endurance. With the implementation of planned, structured, and continuous training, improvements in students' physical fitness can be achieved optimally and contribute to their physical readiness in participating in the learning process and daily activities.

An additional finding beyond the initial expectations of this study was that both training methods produced relatively comparable improvements in overall physical fitness despite having different training characteristics. This suggests that various models of structured physical activity can be effectively implemented in school-based PE when appropriately tailored to students' abilities and learning conditions. However, this study has several limitations. The number of participants involved was relatively small and drawn from a single primary school, which may limit the generalisation of the findings to a wider population. Furthermore, the duration of the exercise intervention was relatively short, which may have influenced the magnitude of the observed improvements.

Therefore, future research is recommended to involve a larger sample size, a longer intervention period, and a wider variety of schools in order to obtain more comprehensive evidence regarding the effectiveness of different exercise methods in improving pupils' physical fitness.

CONCLUSION

Based on the results of the data analysis and discussion, it can be concluded that the implementation of circuit training and interval training makes a positive contribution to improving the physical fitness of primary school pupils. Both training methods resulted in measurable improvements in pupils' physical fitness scores, as demonstrated by the increase in post-test scores compared with the pre-test results in each group. These findings suggest that structured and systematic physical activity tailored to pupils' developmental characteristics can support improvements in physical fitness within the context of Physical Education (PE) lessons. Although the between-group comparison did not reveal clear statistical differences in the final results, descriptively, the circuit training group showed a greater increase in average scores and a higher proportion of pupils achieving the 'good' and 'very good' categories compared to the interval training group. This pattern suggests that circuit training tends to provide broader stimulation across several components of physical fitness, whereas interval training primarily emphasises the development of cardiovascular endurance. Overall, both circuit training and interval training can be considered practical and relevant approaches for improving pupils' physical fitness in Physical Education lessons. The choice of training method should therefore be tailored to learning objectives, pupil characteristics, and the availability of facilities and learning resources within the school.

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