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Effect of circuit training on physical fitness among fifth-grade male elementary school students

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Abstract: This study was motivated by the low level of physical fitness among elementary school students, which impacts their learning ability and participation in physical activities; therefore, a teaching method capable of systematically improving physical fitness is needed, one of which is circuit training. This study aims to analyze changes in the physical fitness levels of fifth-grade male students at SDN Inpres Sampungu after participating in a circuit training program. The study employed a quantitative approach using a quasi-experimental method with a one-group pretest–posttest design. The sample consisted of 15 male students selected through purposive sampling. The research instrument used was the Indonesian Physical Fitness Test, which included a 40-meter run, bent-arm hang, sit-ups, vertical jump, and a 600-meter run. The intervention, in the form of a circuit training program, was conducted over eight sessions. The results showed an increase in the average physical fitness score from 10.7 on the pretest to 20.1 on the posttest. The results of the paired-sample t-test showed a t-value of -36.9 with a significance level of $p < 0.001$, indicating a significant improvement in physical fitness following the intervention. These findings indicate that circuit training can significantly improve students' physical fitness and has the potential to serve as an alternative teaching strategy for Physical Education, Sports, and Health teachers. However, the research results should be interpreted with caution because this study used a design without a control group and involved a relatively small sample size, so the generalizability of the findings remains limited.

Keywords: circuit training; physical fitness; elementary school

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INTRODUCTION

Physical education in elementary school plays a strategic role in shaping the quality of human resources from an early age, particularly in developing physical fitness as the primary foundation for students' health and readiness to learn. Through Physical Education, Sports, and Health instruction, students are not only guided to master basic motor skills but are also nurtured to achieve optimal physical fitness through structured and sustained physical activity (Sina, 2026). In the 21st-century educational paradigm, schools are no longer solely focused on academic achievement but also on the balanced development of physical, cognitive, and social-emotional aspects.

Physical fitness is an important indicator because it is directly related to students' ability to actively participate in the learning process, improve their concentration, and develop positive attitudes in social interactions. According to Pratama et al. (2025), students with good physical fitness tend to have optimal stamina and can participate in various learning activities without experiencing excessive fatigue. Students with good physical fitness levels tend to have higher learning readiness compared to students with low fitness levels (Rusdin & Irawan, 2020). Conversely, low physical fitness levels can lead to decreased learning motivation, low participation in physical activities, and an increased risk of health problems.

Physical fitness in elementary school-aged children is not only related to the ability to perform physical activities, but is also closely linked to cognitive development, concentration, and academic achievement. Children with good physical fitness tend to have better attention spans and greater stamina for learning compared to students with low fitness levels. Regular physical activity can improve the body's physiological functions, enhance oxygen circulation to the brain, and support children's overall motor and psychological development.

The issue of low physical fitness levels among elementary school students remains a serious concern. Research findings (Dwijayanti et al., 2025) indicate that most students have not yet achieved optimal fitness standards, particularly in the areas of cardiorespiratory endurance, muscle strength, and agility. Furthermore, globally, more than 80% of school-aged children do not meet the World Health Organization's recommendation of at least 60 minutes of physical activity per day (Fauzan, 2025). Furthermore, physical fitness is inseparable from physical condition components such as strength, endurance, speed, agility, coordination, and flexibility, which are interrelated in supporting students' motor activities. These components are critical factors that must be systematically developed in physical education instruction, as

without good physical condition, motor skills cannot be performed optimally (Irawan, 2019). This highlights a gap between the ideal need for physical activity and the implementation of physical education instruction in schools.

Preliminary observations at SDN Inpres Sampungu indicate that the physical fitness levels of fifth-grade students remain in the moderate to poor range based on the results of the Indonesian Physical Fitness Test. Most students struggle to maintain endurance, strength, and agility during physical activities. Additionally, student participation and enthusiasm in physical education classes are relatively low. This situation indicates that the exercise stimuli provided have not been optimal in improving students' overall physical fitness. This aligns with the findings of Safriadi et al. (2025), who state that low levels of physical activity and limited exercise frequency are among the causes of low physical fitness among elementary school students.

This situation is a major concern because SDN Inpres Sampungu is an elementary school located in an area where physical education facilities remain limited. Physical education generally still relies on conventional training methods and has not yet adopted structured and varied training models. This situation reflects the challenges still commonly encountered in rural elementary schools, making it necessary to adopt a teaching approach that is simple and easy to implement, yet still capable of optimally improving students' physical fitness.

This issue is closely tied to the Physical Education (PJOK) learning process, which remains dominated by conventional methods that tend to be monotonous and lack variety. Learning that has not been systematically designed results in suboptimal development of all components of physical fitness. According to Wicaksana et al. (2025), Physical Education instruction that lacks innovation tends to be ineffective in improving students' physical fitness. Furthermore, changes in students' lifestyles—which have become increasingly sedentary due to the use of digital technology—have further worsened their physical fitness, as children are now more frequently engaged in sedentary activities (Maulana et al., 2026).

Given these issues, a learning method is needed that can provide comprehensive, systematic, and engaging exercise stimuli. One such method is circuit training, which combines various forms of physical activity into several exercise stations performed sequentially at a specific intensity (Sukron & Firjatulloh, 2025). This method allows students to train various components of physical fitness simultaneously within a single sequence of activities. Previous studies have shown that circuit training has the potential to improve various components of

physical fitness in school-aged children. A study by Marinho et al. (2022) demonstrated that the implementation of high-intensity circuit training in physical education not only increases students' physical activity but also contributes to improvements in body composition indicators. Furthermore, a study by Stojanovic et al. (2023) showed that a school-based circuit training intervention effectively improves local muscle endurance in elementary school students.

The findings of Khomariyah et al. (2026) also indicate that circuit training is effective in improving cardiorespiratory fitness, muscle strength, and motor coordination in school-aged children. Furthermore, this method can also enhance students' motivation and engagement in learning because it is varied and enjoyable. However, most of these studies were conducted with different student characteristics, intervention designs, and school contexts, so the results cannot yet be generalized to elementary schools in areas with limited learning resources. Furthermore, there is still a limited number of studies that integrate circuit training programs with the Indonesian Physical Fitness Test indicators as an instrument for evaluating the fitness of elementary school students. Therefore, research is needed to examine the application of circuit training in this context.

The novelty of this study lies not only in its implementation at SDN Inpres Sampungu but also in the application of a circuit training program systematically designed based on the components of the Indonesian Physical Fitness Test, such that each exercise station is tailored to train the fitness aspects measured by that test. Furthermore, this study provides empirical evidence regarding the application of circuit training among elementary school students in an area with limited innovations in physical education instruction. Thus, this study is expected to enrich the body of evidence regarding the contextual and practical implementation of circuit training as an alternative approach to physical education in elementary schools.

Based on the above description, this study aims to examine changes in the physical fitness levels of fifth-grade male students at SDN Inpres Sampungu after participating in a circuit training program. This study is expected to provide empirical evidence regarding the application of circuit training as an alternative for physical education to improve the physical fitness of elementary school students.

MATERIAL AND METHODS

This study employs a quantitative approach using a quasi-experimental design. According to Isnawan (2020), a quasi-experimental design is a type of research design in which participant selection is not random because the class has already been determined and participants are selected based on convenience (the group is already formed). The research design applied is the One-Group Pretest–Posttest Design, which involves a single experimental group without a control group. This design was used to test the effect of implementing the circuit training method on students' physical fitness levels by comparing measurement results before (pretest) and after (posttest) the intervention. This approach was chosen because it allows the researcher to observe changes occurring directly in the research subjects after they received the instructional intervention.

The population in this study consisted of all 35 fifth-grade students at SDN Inpres Sampungu, Soromandi Subdistrict, Bima Regency. The sampling technique used was purposive sampling, which is a method of selecting a sample based on specific criteria (Mukti, 2021). The research sample consisted of 15 male students who met the study criteria. Male students were selected to obtain a more homogeneous sample, thereby minimizing variations in physical ability influenced by gender differences during the growth period. Thus, the observed changes in physical fitness levels were expected to better reflect the effects of the circuit training program rather than differences in biological characteristics between the sexes.

The data collection technique in this study utilized testing and measurement methods. The instrument used to measure students' physical fitness levels was the Indonesian Physical Fitness Test for ages 10–12. This instrument was selected because it has been nationally standardized and possesses good validity and reliability in measuring the components of physical fitness among elementary school students. The Indonesian Physical Fitness Test used in this study follows the official guidelines for the Indonesian Physical Fitness Test for the 10–12-year-old age group published by the Ministry of National Education. This instrument has been widely used to measure the physical fitness of school-aged children in Indonesia because it has content validity developed by physical education experts and adequate reliability to consistently measure components of physical fitness.

The test items in the Indonesian Physical Fitness Test include: (1) a 40-meter run to measure speed, (2) a bent-elbow hang to measure arm muscle strength, (3) sit-ups for 30 seconds to measure abdominal muscle strength, (4) a vertical jump to measure lower-body

muscle power, and (5) a 600-meter run to measure cardiorespiratory endurance (Ten Elevanta, 2025). The circuit training program was implemented as part of the Physical Education curriculum, consisting of 8 sessions held twice a week, with each session lasting approximately 60 minutes, adjusted to fit the school's schedule.

Table 1. Indonesian Physical Fitness Test Instruments and Treatment Duration

No	Indonesian physical fitness test items	Components of Fitness	Test Time	Treatment Integration
1	40-meter dash	Speed	± 5 minutes	Trained through sprint posts
2	Hanging with bent elbows	Arm strength	± 5 minutes	Strength training station
3	Lying down and sitting up	Abdominal strength	30 second	Core training post
4	Vertical jump	Leg explosive power	± 5 minutes	Plyometric station
5	600-meter run	Durability	± 6-8 minutes	Endurance post

The circuit training program consists of five exercise stations designed based on the components of physical fitness measured by the Indonesian Physical Fitness Test, namely: (1) short sprints to train speed, (2) modified push-ups/elbow-bent hang to train arm muscle strength, (3) sit-ups to train abdominal muscle strength, (4) squat jumps to improve lower-body explosive power, and (5) shuttle runs to improve cardiorespiratory endurance. Each station was performed for 30–45 seconds with a 20–30-second rest period between stations. Exercise intensity was maintained at a moderate to high level according to the students' abilities. During the exercise, the physical education teacher and the researcher ensured that each student completed the entire exercise series with proper technique before proceeding to the next station.

One training session consists of two to three rounds, depending on the students' progress. A warm-up of approximately 10 minutes is conducted before the session, followed by a cool-down of approximately 10 minutes afterward. All activities are carried out under the supervision of the physical education teacher and the researcher, with due attention to student safety. During the first four sessions, students performed two rounds of exercises to help them adapt to the training regimen. Subsequently, during the next four sessions, the number of rounds was increased to three while maintaining the duration of each station. The training volume was increased gradually in accordance with the principle of progressive overload so that students could adapt without increasing the risk of injury.

The research procedure was conducted in several stages. The first stage involved administering a pretest using the Indonesian Physical Fitness Test to determine the students' initial level of physical fitness. The second stage involved implementing the circuit training method in Physical Education classes over eight sessions, held twice a week, with each session lasting approximately 60 minutes. Each session consisted of several exercise stations designed to comprehensively train the components of physical fitness, such as strength, endurance, agility, and motor coordination. The intensity of the exercises was adjusted to the students' abilities to ensure safety and effectiveness. The final stage involved administering a posttest using the same instrument as the pretest to determine changes in the students' physical fitness levels following the intervention.

This study received approval from the principal of SDN Inpres Sampungu. Before the study began, the researcher provided information regarding the study's objectives and procedures to school officials and obtained consent from the students' parents or guardians. All training activities were conducted under the supervision of the physical education teacher and the researcher, with due consideration for the students' safety.

The pretest and posttest data were analyzed using descriptive statistics to determine the mean, standard deviation, minimum score, maximum score, and physical fitness categories. Next, a normality test was conducted as a prerequisite for analysis to ensure that the data were normally distributed. To test the research hypotheses, a paired-sample t-test was used to determine differences in students' physical fitness levels before and after the intervention. To strengthen the interpretation of the research results, the effect size was calculated using Cohen's d for paired samples (paired-samples Cohen's d) so that the magnitude of the change occurring after the intervention could be interpreted more comprehensively. Decision-making was based on a significance level of 0.05. If the p-value was < 0.05, the circuit training method was deemed to have a significant effect on students' physical fitness levels.

RESULTS

This study aims to determine the effect of circuit training on the physical fitness levels of fifth-grade students at SDN Inpres Sampungu. The data analyzed consists of the pretest and posttest results of the Indonesian Physical Fitness Test for 15 students.

1. Descriptive Statistics

The results of the descriptive analysis of the pretest and posttest data on students' physical fitness levels, as measured using the Indonesian Physical Fitness Test, are presented in Table 2.

Table 2. Descriptive Statistics for the Pretest and Posttest

	N	Missing	Mean	Median	SD	SE	Minimum	Maximum
Pretest	15	0	10.7	10	1.05	0.270	9	13
Posttest	15	0	20.1	20	1.33	0.345	17	22

Based on the results of the descriptive analysis in Table 2, it was found that the mean score for students' physical fitness showed a significant increase, from 10.7 on the pretest to 20.1 on the posttest. The median score also increased from 10 to 20, indicating that the improvement was not limited to a small subset of students but was widespread across the majority of the sample. In addition, the standard deviation increased from 1.05 to 1.33, indicating a slight increase in data variation after the treatment, but still within relatively homogeneous limits. This indicates that the circuit training method had a consistent positive impact on all students. To clarify the differences between the pretest and posttest results, a bar chart is presented in Figure 1 below.

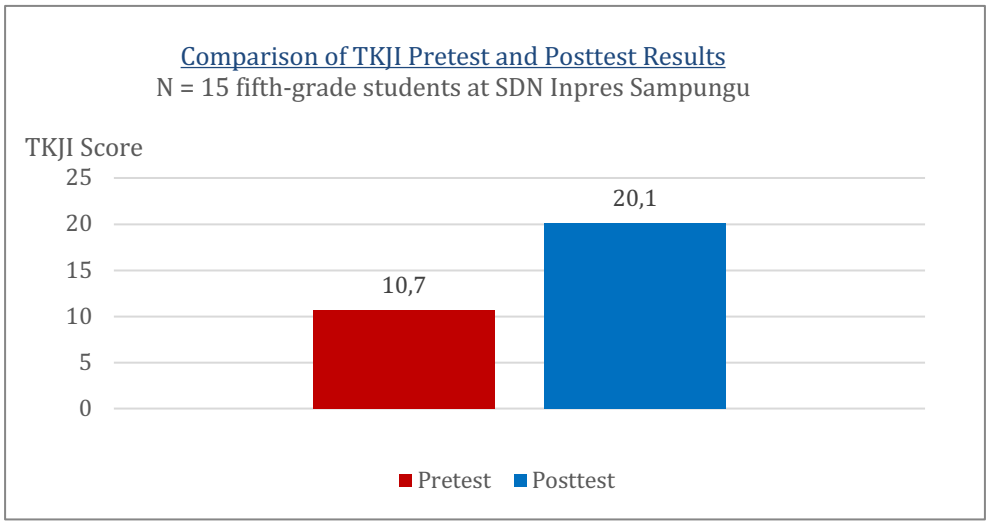

Figure 1. Comparison Chart of the TKJI Pretest and Posttest

Figure 1 shows a consistent increase in students' physical fitness scores following eight sessions of circuit training. The pretest mean score of 10.7 increased to 20.1 on the posttest, representing an increase of 9.4 points. This increase indicates that nearly all students demonstrated improvements in physical ability across the components of physical fitness

measured by the Indonesian Physical Fitness Test, including speed, arm muscle strength, abdominal muscle strength, lower-body explosive power, and cardiorespiratory endurance. The bar chart also shows that the posttest scores were significantly higher than the pretest scores, thereby reinforcing the indication that the circuit training method has a positive effect on improving the physical fitness of fifth-grade students at SDN Inpres Sampungu.

2. Normality Test

A normality test was conducted using the Shapiro-Wilk test to determine whether the data were normally distributed, as required for parametric tests. The results of the normality test are presented in Table 3.

Table 3. Results of the Normality Test (Shapiro-Wilk)

			W	p
Pretest	-	Posttest	0.896	0.082

The results of the normality test using the Shapiro-Wilk test showed a significance value of p = 0.082 (> 0.05). This indicates that the data are normally distributed, thus satisfying the assumption required for a parametric test. Since the assumption of normality is met, the analysis proceeded using a paired-sample t-test to test the research hypothesis.

3. Hypothesis Test (*Paired Sample T-Test*)

A hypothesis test was conducted using a paired t-test to determine the difference in physical fitness levels before and after the intervention. The test results are presented in Table 4.

Table 4. Results of the Paired-Sample T-Test

								95% Confidence Interval		
			statistic	df	p	Mean difference	SE difference	Lower	Upper	Effect Size
Pretest	Posttest	Student's t	-36.9	14.0	< .001	-9.40	0.254	-9.95	-8.85	-9.54

Based on the results of the paired-sample t-test in Table 4, a t-value of -36.9 was obtained with df = 14 and p < 0.001. A significance level far smaller than 0.05 indicates that there is a highly significant difference between the pretest and posttest results. The mean difference of -9.40 indicates a very large increase in physical fitness scores after the intervention. Additionally, the 95% confidence interval ranges from -9.95 to -8.85, all of which are negative values.

Based on the results of individual student analyses, all study participants showed an increase in physical fitness scores after participating in the circuit training program. No students experienced a decrease in scores on the posttest. Most students showed an increase of between 8 and 11 points compared to their pretest results. This indicates that the circuit training method had a relatively uniform effect on the entire study sample. This improvement occurred because each student received the same exercise stimulus at every station of the circuit training, which was designed to train various components of physical fitness in an integrated manner. This confirms that the improvement was consistent and not due to chance. The magnitude of the t-value obtained indicates that the effect of the circuit training method is not only statistically significant but also has a very high effect size in improving students' physical fitness.

Discussion

The results of the study indicate an increase in students' physical fitness levels after participating in the circuit training program. This improvement is evidenced by a rise in the average score from 10.7 on the pretest to 20.1 on the posttest, as well as the results of a paired-sample t-test, which revealed a statistically significant difference ($p < 0.001$). These findings indicate that the implementation of circuit training can significantly and measurably improve students' physical fitness.

The observed improvements can be explained by the fact that circuit training involves various forms of exercise performed sequentially at several stations, thereby simultaneously training various components of physical fitness, such as strength, endurance, speed, and muscular power. In this study, each exercise station was designed in accordance with the components of the Indonesian Physical Fitness Test, thereby providing specific and targeted training stimuli to improve the students' physical abilities.

The improvement in physical fitness observed in this study can be explained based on the fundamental principles of exercise. The circuit training program applied the principle of progressive overload by gradually increasing the training volume from two to three rounds, thereby providing sufficient stimulus to improve the students' physical capacity (Hia et al., 2026). Additionally, the principle of specificity was applied by designing each exercise station to align with the fitness components measured in the Indonesian Physical Fitness Test, ensuring that the exercises directly targeted the desired abilities. The improvement in results also

reflects the process of adaptation—the body's ability to adjust to repeated exercise stimuli. Furthermore, the variety of exercise forms at each station demonstrates the application of the principle of variation, which helps boost students' motivation and engagement during the learning process.

The results of this study are consistent with the findings of Sihotang (2021), which showed that circuit training is an effective exercise method for improving physical fitness in school-aged children. Research by Haristiyanto et al. (2026) indicates that circuit-based training can significantly improve cardiorespiratory endurance and muscle strength because it involves repetitive physical activity at a controlled intensity. Furthermore, a study by Majdin et al. (2025) also showed that physical education instruction using a circuit training approach is more effective than conventional methods in improving student participation and fitness.

These findings are further supported by a study by Nazarudin et al. (2025), which shows that circuit-based training can improve overall physical fitness in children and adolescents. A study by Tarigan et al. (2025) found that circuit training programs significantly improve cardiorespiratory fitness and body composition in school-aged children. This is due to the nature of the training, which combines aerobic and anaerobic activities in a single sequence, thereby providing more optimal physiological adaptations.

In addition to the physiological aspects, circuit training also has a positive impact on students' psychological well-being. A varied and dynamic training model can boost students' motivation, interest, and active engagement in learning. This aligns with the findings of Djaelani et al. (2025), who state that variety in physical education activities can significantly reduce boredom and increase student participation. As student engagement increases, the intensity of physical activity also rises, ultimately leading to improved physical fitness.

Based on the average difference of 9.40, the observed improvement falls into the "very high" category. This indicates that the circuit training method is not only statistically effective but also has strong practical significance in the context of elementary school education. In other words, this method can bring about tangible improvements in students' physical fitness in a relatively short period of time—specifically, over the course of eight sessions.

However, this study has limitations, namely the absence of a control group for comparison, so the resulting effects cannot yet be directly compared with other learning methods. In addition, the relatively small sample size and the fact that only male students were involved also limit the generalizability of the study's results. Therefore, future research is

recommended to use a stronger experimental design, include a control group, and involve a larger and more diverse sample.

Overall, the results of this study reinforce the empirical evidence that the circuit training method is an effective physical education learning strategy for improving the physical fitness of elementary school students. The planned and systematic implementation of this method can serve as a solution to address low levels of physical fitness among students, particularly in school settings with limited opportunities for physical activity.

CONCLUSION

The results of the study show that after participating in eight sessions of a circuit training program, there was a significant improvement in the physical fitness levels of fifth-grade male students at SDN Inpres Sampungu, as measured by the Indonesian Physical Fitness Test. These findings suggest that circuit training has the potential to serve as an alternative approach in Physical Education (PJOK) that can be systematically implemented to support improvements in the physical fitness of elementary school students. However, these results must be interpreted with caution because the study employed a one-group pretest–posttest design without a control group, involved a relatively small sample size, and consisted solely of male students, thereby limiting the generalizability of the findings. Therefore, future research is recommended to use a stronger experimental design that includes a control group, a larger sample size, and both male and female students to obtain more comprehensive empirical evidence regarding the effectiveness of circuit training in physical education.

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