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The Effect of Circuit Training on The Students' Physical Fitness at PGRI University Pontianak

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Abstrak

Tujuan penelitian ini adalah untuk melihat Pengaruh Sirkuit Training terhadap kebugaran jasmani mahasiswa Universitas PGRI Pontianak. Metode penelitian yang digunakan adalah metode pre-experimental. Subjek penelitian terdiri dari 20 mahasiswa prodi Pendidikan Jasmani Angkatan 2023. Alat pengumpul data menggunakan *Bleep Test*. Teknik analisis data yang digunakan yaitu dengan melakukan analisis deskriptif, test normality, uji-t, dan *effect size*. Pada analisis deskriptif ditemukan bahwa mean score pre-test sebesar 47.55 dan mean score posttes sebesar 51.40. Kemudian data terdistribusi normal dengan nilai 0,963 untuk pretest dan posttest 0.440. Pada hasil uji t diperoleh nilai t hitung (6,956) > t tabel (1,729), dan nilai effect size sebesar 6.67. Maka dapat disimpulkan bahwa latihan Sirkuit Training memberikan efek yang signifikan terhadap kebugaran jasmani mahasiswa. Hasil penelitian ini mengimplikasikan bahwa penerapan latihan sirkuit dapat dijadikan dasar bagi dosen dan pelatih dalam merancang program latihan yang lebih sistematis dan terukur di lingkungan perguruan tinggi.
Kata kunci: sirkuit training, kebugaran jasmani, mahasiswa

Abstract

This study was to examine the effect of circuit training on the physical fitness of students at Universitas PGRI Pontianak. The research employed a pre-experimental method. The subjects are 20 students from the Physical Education study program year 2023. Data were collected using the Bleep Test. The data analysis techniques included descriptive analysis, normality testing, t-test, and effect size analysis. The mean score of pre-test was 47.55, and the post-test score was 51.40. The data were normally distributed, with normality values of 0.963 for the pre-test and 0.440 for the post-test. The results of the t-test were 6.956, which is greater than the t-table value 1.729, with an effect size of 6.67. Therefore, it can be concluded that circuit training has a significant effect on students' physical fitness, and the implementation of circuit training can serve as a basis for lecturers and coaches in designing more systematic and measurable training programs in higher education settings.
Keywords*: circuit training, physical education, students*

INTRODUCTION

Physical fitness is a multidimensional construct that reflects the body's ability to perform physical activities efficiently and effectively without undue fatigue. From the muscular perspective, physical fitness encompasses several fundamental components: speed, flexibility, agility, balance, and coordination. These elements interact dynamically to support functional movement and athletic performance. Meanwhile, from the metabolic perspective, physical fitness involves two major energy systems—aerobic power and anaerobic power—which together

determine an individual's endurance capacity and physiological efficiency during prolonged or high-intensity activities.

Among these various components, aerobic endurance plays a crucial role in determining overall physical fitness. In sports and exercise physiology, endurance is commonly divided into muscular endurance and cardiorespiratory endurance. Cardiorespiratory endurance, often referred to as cardiopulmonary fitness, represents the ability of the heart, lungs, and circulatory system to deliver oxygen efficiently to working muscles during sustained physical activities. According to Wilmore and Costill (2004), maintaining optimal cardiovascular and respiratory function is essential for both athletic performance and daily health, as it allows individuals to engage in prolonged physical tasks without excessive fatigue or physiological strain.

A key indicator of cardiorespiratory endurance is the maximum aerobic capacity (VO2Max), which reflects the highest rate at which oxygen can be taken up and utilized by the body during intense exercise. VO2Max is widely recognized as one of the most reliable predictors of aerobic power and overall physical performance. As stated by Iyakrus (2016), VO2Max not only signifies aerobic endurance but also represents a critical determinant of life quality and productivity—particularly for physical education students who are required to demonstrate optimal physical capacity during both instructional and practical activities.

Three major factors influence the level of VO2Max: (1) the musculoskeletal composition of the body, including muscle mass, bone density, and body fat percentage; (2) the functional efficiency of the cardiovascular, circulatory, and respiratory systems; and (3) the neuromuscular response, which encompasses flexibility, strength, speed, and stamina. A balanced interaction among these factors contributes to higher endurance levels and better adaptation to physical exertion.

Physical fitness is a multidimensional construct encompassing neuromuscular, metabolic, and cardiorespiratory components that collectively determine an individual's capacity to perform physical activity efficiently (ACSM,

2022). Among these components, cardiorespiratory endurance—commonly assessed through maximal oxygen uptake (VOMax) is considered a central indicator of aerobic capacity, health status, and functional performance, particularly for physical education students who are expected to maintain high physical readiness (McArdle, Katch, & Katch, 2023). Contemporary training theories emphasize that integrative exercise models, such as circuit training, are effective in simultaneously stimulating aerobic and anaerobic systems through structured, high-efficiency workloads (Bompa & Buzzichelli, 2019; Silva et al., 2021).

However, recent literature also highlights that the effectiveness of circuit training is highly context-dependent, varying according to training design, participant characteristics, and institutional settings (ACSM, 2022). Despite growing global evidence supporting circuit training, empirical studies examining its impact on VOMax and overall physical fitness among Indonesian university-level physical education students—particularly within local higher education contexts—remain limited, creating a clear need for context-specific experimental research to inform evidence-based training practices.

However, empirical evidence indicates that many university students, particularly those in physical education programs, exhibit suboptimal levels of physical fitness. An observation conducted in September 2023 during the admission of new Physical Education students at IKIP PGRI Pontianak showed that the average physical fitness score was only 54.05%, classified as very poor (Daryanto & Cahyadi, 2024). Approximately 250–300 students participated in the fitness assessment, highlighting a concerning gap between expected and actual fitness levels among future physical educators. This issue underscores the need for structured and evidence-based interventions to enhance students' endurance and overall fitness.

One of the most effective and time-efficient training methods to address this concern is circuit training. Circuit training involves a series of exercise stations—typically ranging from 1 to 15—each designed to target specific muscle groups or fitness components (Robiansyah & Amiq, 2018). This method integrates

both aerobic and anaerobic exercises, thereby promoting cardiovascular endurance, muscular strength, and coordination simultaneously. Through its repetitive and systematic structure, circuit training enhances the efficiency of oxygen transport and utilization, strengthens the heart, and optimizes the body's metabolic processes.

According to Silva et al. (2017), regular circuit training improves cardiovascular endurance by promoting smoother blood circulation and efficient oxygen delivery to muscles. Enhanced circulation not only supports thermoregulation but also ensures a continuous supply of nutrients throughout the body, contributing to improved recovery, performance, and overall well-being. Therefore, implementing circuit training as part of a structured exercise program is expected to significantly improve VO2Max levels and physical fitness among physical education students, equipping them with the stamina and health foundation necessary for their academic and professional responsibilities.

METHOD

This study employed a One-Group Pretest–Posttest Design, in which the research subjects are tested before (pretest) and after (posttest) the treatment is administered. This design allows for a more accurate assessment of the intervention's effect, as it enables researchers to compare results before and after the treatment within the same group (Sugiyono, 2019; Cohen, Manion, & Morrison, 2018). The comparison of pretest and posttest results indicates whether there is a significant improvement or change in the dependent variable after the treatment. To clarify the flow of this research process, the research design is illustrated in Figure 1.1.:

Treatment Group	Pretest	Treatment Circuit Training	Posttest

Figure 1 The Design of Experimental Study

The subjects of this study were fifth-semester students of the Physical Education, Health, and Recreation (Penjaskesrek) program from classes A, B, C,

and D (morning sessions), totaling 100 students. The sample used in this study was 20% of the total population, resulting in a sample size of 20 students. The research was conducted at PGRI University Pontianak. The study employed a physical fitness testing method known as the Bleep Test.

The procedure of the Bleep test is described as follows:

1. The students were asked to run in 20m distance back and forth
2. The students start to run at the first bleep sound and stop at the next bleep sound
3. The students run to the rhythm of the beep, where the speed of the 'beep' will increase at each level, forcing participants to run faster

The steps taken in data analysis included testing the prerequisites through a normality test and a linearity test. The normality of the data will be examined using the Shapiro–Wilk test, which is appropriate for small sample sizes and is widely recommended for assessing data normality in experimental and pre-experimental research. The use of the Shapiro–Wilk test ensures that the distributional assumption required for the t-test is properly evaluated. Meanwhile, the hypothesis testing technique utilized was the Paired Sample T-Test, aimed at determining whether there was a significant difference between pretest and posttest results after the intervention.

FINDING AND DISCUSSION

The pretest results of the physical fitness of fifth-semester Physical Education students at PGRI University Pontianak showed a minimum score of 40.25, a maximum score of 54.50, a mean (average) score of 47.55, a median score of 47.68, and a standard deviation of 3.97. There is no mode value because no value appears more than once exactly. The description of these research results can be categorized as follows:

Table 1 The Description of the Research Results on the Pretest

Interval	Category	Absolut	%

> 45,21	High	3	**15**
40,21 – 45,21	Adequate	13	**65**
< 40, 21	Low	4	**20**
Total		**20**	**100**

When presented in the form of a diagram, it can be seen in the figure below:

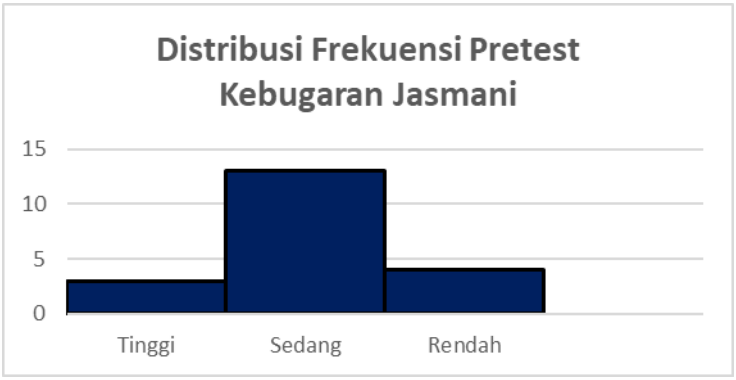

Figure 2. Diagram of the Pretest Results

Based on the table and figure above, the pretest results of the physical fitness of fifth-semester Physical Education students at PGRI University Pontianak show that 20% (4 students) were categorized as having low physical fitness, 65% (13 students) were in the moderate category, and 15% (3 students) were in the high category.

These results indicate that the majority of students demonstrated a moderate level of physical fitness prior to the intervention. The relatively small proportion of students in the high category suggests that their overall aerobic capacity and endurance had not yet reached optimal levels. This finding highlights the need for systematic and targeted training programs, such as circuit training, to enhance students' *cardiovascular* endurance and overall physical fitness, ensuring they meet the expected standards for physical education students who are required to maintain good physical performance in both academic and practical settings.

The posttest results of the physical fitness of fifth-semester Physical Education students at PGRI University Pontianak showed a minimum score of 42.51, a maximum score of 56.65, a mean (average) score of 51.40, a median

score of 52.10, and a standard deviation of 3.70. In the post-test, no value appears more often than the others. The description of the research results can be categorized as follows:

Table 2. Description of the Research Results on the Students' Physical Fitness (Posttest)

Interval	Categories	Absolute	%
> 46,10	High	8	**40**
42,19 – 46,10	Adequate	11	**55**
< 42, 19	Low	1	**5**
Total		**20**	**100**

These findings indicate a notable improvement in students' overall physical fitness following the implementation of the circuit training program. The increase in the mean score from the pretest to the posttest suggests that the training intervention had a positive impact on students' aerobic capacity and endurance levels. The relatively consistent standard deviation also implies that improvements were fairly uniform across participants, reflecting the effectiveness and adaptability of circuit training for students with varying initial fitness levels.

Overall, the posttest data demonstrate that circuit training contributed to enhancing the students' cardiorespiratory endurance and general physical performance, aligning with previous research that highlights circuit training as an efficient and holistic method for improving multiple components of physical fitness, including strength, stamina, and cardiovascular health.

When presented in the form of a diagram, it can be seen in the figure below:

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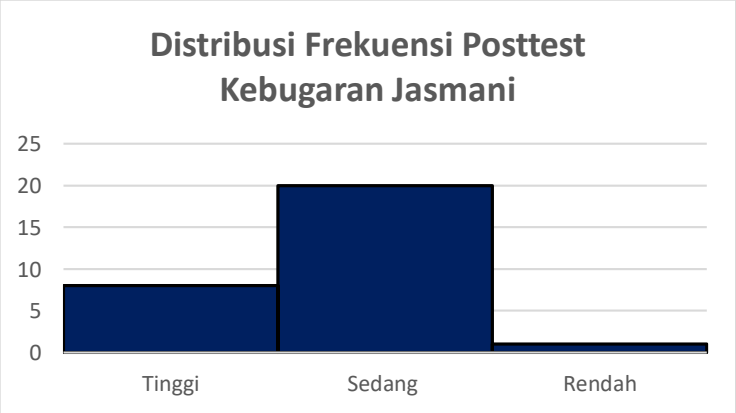

Figure 3. Diagram of the Posttest Results of Physical Fitness among Fifth-Semester Physical Education Students at PGRI University Pontianak (Posttest).

Based on the table and figure above, the posttest results of the physical fitness of fifth-semester Physical Education students at PGRI University Pontianak show that 5% (1 student) were in the low category, 70% (14 students) were in the moderate category, and 25% (5 students) were in the high category.

These findings demonstrate an improvement in students' physical fitness levels after participating in the circuit training program. Compared to the pretest results, there was a noticeable decrease in the proportion of students in the low fitness category and a marked increase in those achieving high fitness levels. This suggests that circuit training effectively enhanced the students' aerobic endurance, muscular strength, and overall physical capacity.

The data imply that the implementation of structured and progressive circuit training sessions can produce measurable improvements in physical fitness among university students. Such findings align with previous studies indicating that circuit training not only develops cardiovascular endurance but also promotes comprehensive physical conditioning suitable for physical education students who are required to maintain high physical performance standards.

Before testing the hypothesis, a normality test needs to be conducted. in a pre-experimental design, such as a one-group pretest–posttest design, the sample size is often relatively small, and there is no control group. Under these conditions,

checking normality helps ensure that the statistical inference is appropriate and that the observed differences are not due to distributional abnormalities.

Table 3. normality test of pre-test and post-test

Variabel	*p* value	df	Sig. *p* value	Criteria
Pre-test	0.963	19	0.05	Normally distributed
Post-test	0.440	19	0.05	Normally distributed

Since the p-value is greater than 0.05, it can be concluded that the pretest and posttest data are normally distributed. This indicates that the data meet the normality assumption required for the application of parametric statistical tests, particularly the paired-sample t-test. Therefore, the use of the t-test in this study is statistically appropriate and justified.

The t-test was conducted to determine whether there was a significant effect of circuit training on physical condition of the physical fitness of students at PGRI University Pontianak. The results of the t-test can be seen in the following table:

Table 4. Hypothesis Testing Results (t-Test)

Pretest – Posttest	*Df*	ttabel	thitung	P	Description
Physical Fitness B	**19**	**2,093**	**29.81**	**0,000**	**There is an effect**

Ased on the results of the t-test, the calculated t-value (t-count = 6.956) was greater than the critical t-value (t-table = 1.729), and the p-value was less than 0.05. These results indicate that the null hypothesis (H_0) was rejected, meaning that there is a significant effect of circuit training on the physical fitness of PGRI University Pontianak students.

This finding suggests that the circuit training program had a measurable and positive impact on improving students' overall physical fitness levels. The significant difference between the pretest and posttest results demonstrates that systematic and structured circuit training effectively enhances students' cardiorespiratory endurance, muscular strength, and aerobic capacity. These results are consistent with previous research emphasizing circuit training as an efficient method to develop multiple components of physical fitness through

varied and sequential exercises that engage both aerobic and anaerobic energy systems.

Based on the findings, it can be interpreted that circuit training is an effective method for improving physical fitness among university students. This effectiveness is primarily attributed to the comprehensive structure of circuit training, which integrates multiple components of fitness, including strength, endurance, power, flexibility, coordination, agility, speed, reaction time, and balance. Such multidimensional exercises stimulate both aerobic and anaerobic energy systems, thereby improving cardiovascular efficiency and muscular performance simultaneously (Martínez-Rodríguez et al., 2023).

Regular engagement in circuit training allows the body to adapt progressively to training loads, resulting in physiological improvements such as increased oxygen uptake, enhanced muscular endurance, and improved metabolic efficiency (Siahkouhian & Asadmanesh, 2021). These adaptations are essential for maintaining overall physical fitness, particularly among university students who require optimal fitness levels for both academic and extracurricular activities.

In addition to hypothesis testing, an effect size analysis will be conducted to determine the magnitude of the treatment effect. While the t-test indicates whether a statistically significant difference exists, the effect size provides information about the practical significance of the intervention by showing how strong the effect is. In this study, the effect size helps to interpret the extent to which the treatment influences the measured outcome, thereby offering a more comprehensive understanding of the research results beyond statistical significance alone.

Table 5. Effect Size Testing Results

N	Mean of pre-test	SD Pretest	Mean of Posttest	SD Posttest	Mean Differences	*Cohen's d*	*Effect Size Categroy*
20	47.55	4.03	51.40	3.70	3.85	6.67	large

The effect size analysis revealed a Cohen's d value of 6.67, which indicates the magnitude of the treatment effect. According to Cohen's criteria,

values of 0.20 represent a small effect, 0.50 a medium effect, and 0.80 a large effect. Therefore, a Cohen's d of 6.67 falls into the category of a very large effect, suggesting that the treatment had a substantial and practically significant impact on the measured outcome. This result demonstrates that the observed difference is not only statistically significant but also meaningful in practical terms.

The results of the t-test demonstrate that circuit training had an effect on the physical fitness of students at PGRI University Pontianak, as indicated by the calculated t-value exceeding the critical value and a p-value below 0.05. This finding confirms that the students' physical fitness observed after the intervention was attributable to the circuit training program. Recent training theory emphasizes that exercise interventions designed with systematic sequencing, controlled intensity, and repeated exposure can effectively stimulate adaptive responses across multiple physiological systems (Bompa & Buzzichelli, 2019). Circuit training fulfills these criteria by providing structured workloads that progressively challenge the body, making it an effective approach for improving physical fitness in university populations.

The significant difference between pretest and posttest scores suggests that circuit training positively influenced students' cardiorespiratory endurance and overall aerobic capacity. Contemporary research in exercise physiology highlights that mixed-modality training, which integrates resistance and aerobic elements within a single session, enhances cardiovascular efficiency and oxygen utilization more effectively than single-mode training (Hickson & Rosenkoetter, 2022). The continuous and repetitive nature of circuit training promotes sustained cardiovascular engagement, leading to improved endurance and functional fitness, which are essential components for physical education students.

From a physiological adaptation perspective, the effectiveness of circuit training can be explained through recent models of metabolic and neuromuscular adaptation. High-density exercise formats increase metabolic demand and stimulate improvements in mitochondrial function, energy system coordination, and muscular endurance (Gibala et al., 2021). Additionally, repeated movement patterns performed under moderate to high fatigue conditions enhance

neuromuscular efficiency, motor coordination, and strength-endurance capacity (Behm et al., 2021). These adaptations collectively contribute to improved physical fitness and better tolerance to physical workloads among students.

The effect size analysis further supports the practical significance of the intervention, with a Cohen's d value of 6.67 indicating a very large effect. Current methodological perspectives stress that effect size provides critical insight into the real-world relevance of training interventions beyond statistical significance alone (Lakens, 2022). The exceptionally large effect observed in this study suggests that circuit training is not only effective but also highly impactful in improving physical fitness among university students. Therefore, circuit training can be considered a powerful and practical training strategy for enhancing student fitness levels within higher education settings.

CONCLUSION

This study shows that circuit training has a significant and strong effect on physical fitness of Physical Education students at PGRI University Pontianak, as indicated by significant t-test results and a very large effect size. The improvement from pretest to posttest demonstrates that structured circuit training effectively enhances cardiorespiratory endurance and overall physical performance. Practically, these findings suggest that lecturers and coaches can use circuit training as an efficient and systematic training method within physical education programs. Theoretically, this study contributes empirical evidence supporting the effectiveness of circuit training in the university context, particularly in Indonesian higher education. Future research is recommended to involve larger samples, control groups, and variations in training intensity and duration to strengthen and extend these findings.

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