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The Differential Effects of Circuit Training and High-Intensity Interval Training (HIIT) Methods on VO_2Max Improvement in Pencak Silat Athletes at SMA Negeri 2 Taruna Pamong Praja, East Java

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ABSTRACT

This study aims to compare the effectiveness of Circuit Training and High-Intensity Interval Training (HIIT) methods in improving cardiorespiratory endurance capacity (VO2Max) among pencak silat athletes. The research employed a quasi-experimental approach using a two-group pretest-posttest design. The sample consisted of 30 athletes divided into two experimental groups: the first group received Circuit Training, while the second group underwent HIIT. Data were collected through VO2Max tests conducted before and after the intervention. Data analysis included normality and homogeneity tests, paired sample t-tests, and N-Gain analysis. The results showed that both training methods significantly improved VO_2Max ($p < 0.05$). However, HIIT produced a higher average increase than Circuit Training, as evidenced by the higher posttest means and N-Gain scores. The calculated t-value of 9.645 exceeded the t-table value (2.045), with a p-value of 0.00, indicating a statistically significant effect. Therefore, it can be concluded that both Circuit Training and HIIT are effective in increasing VO2Max, but HIIT is superior in terms of efficiency and outcome. The results of this study are expected to serve as a reference for coaches in designing more optimal training programs to support the performance of pencak silat athletes at the school and regional levels.

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INTRODUCTION

Sports represent a structured, systematic, and regular set of activities aimed at enhancing both physical and mental health. Beyond its health benefits, sports also serve as a medium for individuals to explore and develop their potential in the pursuit of achievement, carried out in a positive and enjoyable spirit. Engaging in physical activity revitalizes both the body and mind, fostering a sense of well-being and vitality. When practiced correctly and consistently, sports contribute significantly to building a healthier and stronger physique, which underscores the importance of physical education in society. Therefore, aligning the type of physical activity with an individual's

capabilities is essential to fully realize its benefits. In essence, sports play a fundamental role in daily life and overall human development. (Manoarfa et al., 2022).

Pencak silat is an indigenous martial art form that traces its roots to Indonesia. Historically, it was practiced primarily as a method of self-defense, particularly against dangers posed by wild animals. Despite its long-standing presence in Indonesian culture, the exact origins of pencak silat including when, where, and how it first emerged remain unclear due to the limited availability of historical evidence. Nevertheless, various historical accounts indicate that pencak silat gradually expanded and developed across different regions of the archipelago. (Nurjaman & Rohmat, 2018) . In recent times, pencak silat has evolved beyond its traditional roots to become a structured and competitive sport. It is now widely integrated into school curricula across Indonesia, reflecting its educational and cultural value. Furthermore, pencak silat holds a prestigious place in national sports, having been included in major events such as the National Sports Week (PON), which is held every four years. At the international level, pencak silat has also gained recognition as a competitive discipline in Southeast Asia's premier multi-sport event, the SEA Games. This transformation highlights pencak silat's enduring relevance and growing importance both as a cultural heritage and a modern sport. (Setyawan et al., 2024).

Pencak silat competitions are not only held at major levels but also begin at local events in Bojonegoro Regency. In this region, the Bojonegoro Regency National Sports Committee (KONI) collaborates with the Indonesian Pencak Silat Association (IPSI) of Bojonegoro to organize inter-school pencak silat tournaments. These events are participated in by contingents from various schools and are held every two years. Additionally, there is the Bupati Cup, another biennial pencak silat competition. The Bojonegoro Chief of Police also plays an active role in developing pencak silat athletes by organizing the annual Kapolres Cup as a form of support for advancing regional sports achievements.

In preparing for pencak silat competitions, athletes are required to possess adequate physical and mental qualities. Speed, agility, strength, power, dexterity, and endurance are essential elements that pencak silat athletes must have. This is particularly important in the youth category, where matches last for 2 minutes per round across a total of 3 rounds. To reach the finals, an athlete must compete in 4 to 7 matches. Therefore, the total duration of competition an athlete may face can reach up to 42 minutes, calculated from 2 minutes per round in 3 rounds across 7 matches. As a result, biomotor components such as strength and endurance significantly affect performance on the field. Additionally, coordination, flexibility, and the ability to cope with fatigue also play supportive roles. To enhance aerobic endurance, coaches commonly implement outdoor jogging sessions lasting 30 to 60 minutes. Although this method is effective, the repetitive and monotonous nature of such training can lead to boredom among athletes during the training process.(Setyawan et al., 2024).

The level of fitness is a comprehensive system formed by interrelated and integrally connected components. In both development and management, physical condition is an

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inseparable unity of various mutually supportive elements. An athlete must possess agility in movement and good body coordination. Physical fitness training programs are developed systematically and progressively, aiming to improve and enhance the overall function of the body systems, thereby supporting optimal performance enhancement. (Munandar et al., 2023). Developing an athlete's physical abilities is the main goal of improving physical condition, so that it can support performance in sports activities and help achieve optimal accomplishments. (Pambudi, 2022). Types of fitness programs such as circuit repetition training and high-intensity interval training gradually enhance *VO2Max* endurance. Both methods are commonly used forms of exercise to optimize *VO2Max* capacity.

Circuit training is a physical training method that integrates elements of strength training and cardiovascular (aerobic) exercise. This training pattern is characterized by a high number of repetitions and minimal rest between sets. Empirical findings suggest that implementing a circuit training program over a period of 8 to 20 weeks can result in a 4–8% increase in participants' lung capacity. This improvement in lung capacity is often used as a key indicator of an individual's physical fitness level. Typically, the program utilizes light bodyweight exercises such as push-ups, squats, and sit-ups combined with aerobic activities like running or cycling. This type of training is often conducted outdoors and is divided into several workout stations. At each station, the main focus is on strength exercises with specific repetitions, followed by aerobic exercises lasting from a few seconds to several minutes before moving on to the next station. (TL. Pamungkas, 2021).

Intense Intermittent Exercise Sessions is considered to have greater advantages compared to low- or moderate-intensity exercise, as recommended by the World Health Organization (WHO). This is due to its efficiency in terms of shorter training durations while still delivering significant health benefits, particularly in cardiovascular health. HIIT has also been proven to significantly improve speed, agility, and cardiovascular endurance capacity (*VO2Max*). In addition, HIIT effectively enhances overall physical performance. This form of training is widely recognized for its efficiency in maximizing physical fitness capacity and improving cardiovascular system function.. (Wajib et al., 2022). Intense Intermittent Exercise Sessions (High-Intensity Interval Training) is a method consisting of a series of exercises structured around phases of high-intensity activity followed by periods of active recovery. In this method, the body's response can vary between individuals, particularly among athletes. (Kardianus et al., 2020).

Although many studies have discussed this method in the general population, research specifically comparing the effectiveness of physical training that incorporates a series of sequential movements at several stations (known as circuit training) and Intense Intermittent Exercise Sessions (High-Intensity Interval Training) in improving *VO2Max* among pencak silat athletes in Indonesia remains very limited. Therefore, this study aims to evaluate the comparative effectiveness of these two training methods in pencak silat athletes at SMA Negeri 2 Taruna Pamong Praja, East Java. The researchers' interest in the martial art of pencak silat stems from the lack of scientific studies

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available in this field. The selection of this school as the research location was based on the reality that the athletic achievements of its pencak silat athletes are relatively behind compared to other schools with similar extracurricular activities. Specifically, athletes from SMA Negeri 2 Bojonegoro have not demonstrated optimal competitiveness at the provincial level. This is evident from their limited participation in internal school competitions, with only one athlete qualifying for the Kejurprov team and the Porprov team selection of Bojonegoro Regency. Through this study, it is hoped that findings can contribute positively to physical education teachers, coaches, and trainers in designing more effective training strategies to improve the performance of pencak silat athletes at the school. This effort is important considering that the achievement level of pencak silat at SMA Negeri 2 Taruna Pamong Praja East Java still needs improvement in order to compete at the regency level.

METHODS

This study falls under the category of quasi-experimental research. The experimental method is used to describe cause-and-effect relationships between one variable and another. One of the main characteristics of experimental research is the provision of a treatment to the research subjects. The research design employed is a two-group experimental design with pretest and posttest measurements this design involves two measurements: an initial measurement before the treatment is administered and a final measurement after the treatment. This approach enables researchers to compare results before and after the intervention, thereby yielding more accurate data. In this study, the design was used to compare the effectiveness of two types of training methods: physical training that combines a series of sequential movements at several stations (known as circuit training) and intense intermittent exercise sessions (High-Intensity Interval Training). (Bobby Lauren Malau, 2016). Thus, the researchers can determine the extent of improvement achieved after the treatment by comparing the observations from the initial test (pretest) and the final test (posttest). (Setyawan et al., 2024). The research design used consists of the following stages: sample selection, implementation of the pretest, administration of the treatment to the two experimental groups, and implementation of the posttest :

- Experiment I: received treatment in the form of Circuit Training.
- Experiment II: received treatment in the form of High-Intensity Interval Training (HIIT).

RESULTS AND DISCUSSION

Since each sample has different characteristics, a descriptive analysis needs to be conducted first. This analysis includes several indicators, such as the number of data points, range, highest value, lowest value, mean, and standard deviation. The results of this analysis are presented in the following table :

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Table 1.
Descriptive Test Data Results

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Pretest Circuit Training	15	51	54	105	69,93	16,837
Postest Circuit Training	15	46	81	127	95,93	13,499
Pretest HIIT	15	50	54	104	70,40	17,755
Postest HIIT	15	49	88	137	109,93	17,351
Valid N (listwise)	15					

Based on the results of the descriptive analysis, it was found that in the pretest of Circuit Training with a sample size of 15 participants, the score range was 51, with a minimum value of 54, a maximum value of 105, a mean of 69.93, and a standard deviation of 16.837. After the posttest was conducted with the same number of participants, the score range was 46, with a minimum value of 81, a maximum value of 127, a mean of 95.93, and a standard deviation of 13.499. Meanwhile, in the pretest for High-Intensity Interval Training (HIIT) using the shuttle run model and a sample of 15 participants, the score range was 50, with a minimum value of 54, a maximum value of 104, a mean of 70.40, and a standard deviation of 17.755. In the posttest for the same HIIT training group using the shuttle run model and the same sample size, the score range was 49, with a minimum value of 88, a maximum value of 137, a mean of 109.93, and a standard deviation of 17.351. Based on this data, it is evident that posttest scores tend to be higher than pretest scores, indicating an improvement as a result of the treatment given during the training process.

A normality test was conducted to determine whether the distribution of *VO2Max* and agility data originates from a population with a normal distribution. The Shapiro-Wilk test was used to assess data normality. Data are considered to be normally distributed if the significance value (sig.) is greater than 0.05(Abdillah et al., 2022). The results of the normality test can be seen in Table 2 below :

Table 2.
Results of the Normality Test

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	Df	Sig.	Statistic	Df	Sig.
Results	Pretest A (Circuit Training)	,235	15	,025	,849	15	,017
	Postest A (Circuit Training)	,215	15	,061	,893	15	,075
	Pretest B (HIIT)	,235	15	,025	,830	15	,009
	Postest B (HIIT)	,153	15	,200*	,912	15	,145

Each group showed that the significance values (sig.) from the normality test analysis for both the pretest and posttest were above 0.05 ($p > 0.05$). Based on these findings regarding the understanding of concepts and scientific attitudes in each research group, it can be concluded that the data come from a population with a normal distribution, and therefore, the analysis can proceed to the next stage.

One of the validity checks for research assumptions is the homogeneity test, which must be conducted before proceeding to the hypothesis testing stage. Testing for data homogeneity is a crucial initial step, and this analysis is carried out using Levene's test

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to ensure that the variances between groups are uniform. The Levene's test is used to compare the variance of data across each variable being studied. In making decisions based on this test, if the significance value (p-value) exceeds 0.05, it can be concluded that the variances between data groups are homogeneous or not significantly different. (Wibowo et al., 2023). The results of the homogeneity test are presented in Table 3.

Table 3. Results of the Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	1,083	1	28	,307
	Based on Median	1,359	1	28	,253
	Based on Median and with adjusted df	1,359	1	27,995	,253
	Based on trimmed mean	1,208	1	28	,281

In Table 3, the results of the homogeneity test show that the significance values (sig.) for both pretest and posttest in each variable are greater than 0.05 (p > 0.05). This indicates that the data variances for each variable are homogeneous. With both assumption tests satisfied, the hypothesis testing process in this study can be continued.

The next stage is the testing of the first hypothesis, which is presented in the form of a table showing the results of an analytical technique used to measure changes within a group across two observation times. To compare the mean differences between two related data sets specifically, the test results before and after the treatment a paired sample t-test is used. (Rustiawan & Rohendi, 2021). This test was conducted on the groups that received treatment in the form of physical training, which combined a series of sequential movements across several stations (known as circuit training) and high-intensity interval training, as presented in Table 4.

Table 4. Results of the Paired Sample T-Test

T	Df	Sig. (2-tailed)
-21,349	29	,000

Based on the results of the paired sample t-test shown in the table, the significance value (sig. 2-tailed) was 0.00 < 0.05, with a degree of freedom (df) of 29. In this test, the improvement in *VO2Max* endurance was determined through the 2-tailed significance value, which showed a result of 0.00 < 0.05. The analysis indicates a significant difference between the initial and final measurements. The statistical significance result with a p-value < 0.05 leads to the rejection of H_0 and the acceptance of H_a, indicating that the variables studied had a real effect. Therefore, it can be concluded that the implementation of Circuit Training and High-Intensity Interval Training (HIIT) has a statistically significant impact on improving *VO2Max* endurance in pencak silat athletes at SMA Negeri 2 Pamong Praja, East Java.

Table 5.
Results of t-Test Calculation

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-20,887	9,562		-2,184	,037
	Postest	,885	,092	,877	9,645	,000

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Table 6.
t-Distribution Table

df	One-Tailed Test						
	0,25	0,10	0,5	0,025	0,01	0,005	0,001
	Two-Tailed Test						
	0,50	0,20	0,10	0,05	0,02	0,01	0,002
24	0,684	1,318	1,711	2,064	2,492	2,797	3,467
25	0,684	1,316	1,708	2,060	2,485	2,787	3,450
26	0,684	1,315	1,706	2,056	2,479	2,779	3,435
27	0,683	1,314	1,703	2,052	2,473	2,771	3,421
28	0,683	1,313	1,701	2,048	2,467	2,763	3,408
29	0,683	1,311	1,699	2,045	2,462	2,756	3,396
30	0,683	1,310	1,697	2,042	2,457	2,750	3,385

The results of the paired sample test revealed a p-value of 0.00 and a calculated t-value of 9.645, indicating a statistically significant and strong relationship. Since the p-value is lower than the significance threshold and the calculated t-value exceeds the critical value from the t-distribution table (t = 2.045), the findings support the rejection of the null hypothesis. Consequently, it can be concluded that the implementation of a physical training approach that combines circuit-based sequential movement routines with high-intensity interval training produces a significant improvement in the endurance performance of pencak silat athletes at SMA Negeri 2 Pamong Praja, East Java.

Table 7.
Results of the N-Gain Data Test

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	30	-8,25	4,22	,4601	2,72808
Valid N (listwise)	30				

Descriptive analysis of the normalized gain (N-Gain) scores revealed that the total sample size consisted of 30 participants. The observed N-Gain values ranged from a minimum of -8.25 to a maximum of 4.22. The mean score was 0.4601, accompanied by a standard deviation of 2.72808. While positive N-Gain values reflect improvements in performance following the intervention, the presence of some negative values indicates that a few participants either experienced a decline or did not exhibit measurable progress. Despite this variation, the overall positive mean suggests that the training intervention consisting of circuit-based sequential physical exercises combined with high-intensity interval training had a generally beneficial effect on improving the endurance capacity of pencak silat athletes at SMA Negeri 2 Pamong Praja, East Java.

CONCLUSION

Based on the theoretical framework, data analysis, and interpretation of the research findings, it can be concluded that both Circuit Training and High-Intensity Interval Training (HIIT) are effective training variations for enhancing physical performance, particularly *VO_2Max* endurance. Overall, there is a notable difference in the impact of the two methods. The discussion results indicate that while both methods

significantly contribute to improved endurance, High-Intensity Interval Training (HIIT) is considered more effective and efficient in increasing *VO_2Max* compared to Circuit Training.

In light of the research findings, High-Intensity Interval Training (HIIT) is recommended as a primary method for enhancing VO_2Max endurance, especially for pencak silat athletes and other high-aerobic sports. Coaches should design structured, measurable training programs to maximize results. Future studies are encouraged to explore alternative or combined training approaches to better understand their effectiveness across various dimensions of athletic fitness.

REFERENCES

Abdillah, F. A., Kinanti, R. G., Andiana, O., & Abdullah, A. (2022). Pengaruh Latihan High Intensity Interval Training (HIIT) dengan 2 Menit Berlari dan 2 Menit Berjalan terhadap Kadar MDA (Malondialdehide) pada Atlet Lari Jarak Jauh PASI Kota Malang. *Sport Science and Health*, *4*(11), 1015–1020. https://doi.org/10.17977/um062v4i112022p1015-1020

Bobby Lauren Malau. (2016). *Perbedaan Pengaruh Antara Circuit Training Dan Fartlek Training Terhadap Peningkatan Vo2max Dan Kelincahan Atlet Jujitsu Puslatda Yogyakarta*. *4*(1), 1–23.

Kardianus, K., Suyatmin, S., & Atmaja, N. M. K. (2020). Pengaruh Interval Training Terhadap Vo2 Max Pada Ekstra Kurikuler Pencak Silat Persaudaraan Setia Hati Terate Rayon Khusus Smkn 1 Nanga Pinoh. *Jurnal Pendidikan Jasmani Kesehatan Dan Rekreasi (Penjaskesrek)*, *7*(1), 7–16. https://doi.org/10.46368/jpjkr.v7i1.265

Manoarfa, R., Duhe, E. D. P., Hidayat, S., & Pulungan, K. A. (2022). Pengaruh Latihan Hollow Sprint Dengan Latihan Shadow Fight Terhadap Daya Tahan Atlet Pencak Silat. *Jambura Sports Coaching Academic Journal*, *1*(1), 1–7. https://doi.org/10.37905/jscaj.v1i1.16068

Munandar, R. A., Hidayat, T., Pratama, S. A., & Susila, L. (2023). Pengaruh Tabata Training Dan Suttle Run Terhadap Kelincahan Mahasiswa. *Jambura Journal of Sports Coaching*, *5*(2), 117–125. https://doi.org/10.37311/jjsc.v5i2.20684

Nurjaman, Z., & Rohmat, D. (2018). Perbandingan Metode Latihan Tcssm Dan Plyometric Terhadap Peningkatan Power Tungkai Atlet Pencak Silat. *Jurnal Kepelatihan Olahraga*, *10*(1), 85–98. https://ejournal.upi.edu/index.php/JKO/article/view/16282%0Ahttps://ejournal.upi.edu/index.php/JKO/article/download/16282/9132

Pambudi, N. A. (2022). Pengaruh Latihan Dengan Metode Fartlek Deep Water Dan Fartlek Terhadap Peningkatan Daya Tahan Dan Kecepatan Atlet Rubby. In *Jurnal Kepelatihan Olahraga* (Vol. 9).

Rustiawan, H. R., & Rohendi, A. (2021). Dampak Latihan Push-up Bola Bergulir dan Push-up Tubing Pada Hasil Peningkatan Daya Tahan Otot Lengan. *JOSSAE : Journal of Sport Science and Education*, *6*(1), 74. https://doi.org/10.26740/jossae.v6n1.p74-86

Setyawan, T., Pawitra, P. R. A., Yahya, A., & Budiono, D. (2024). Pengaruh Pola Latihan Sirkuit Training dan Lari Fartlek Terhadap Daya Tahan Aerobik Atlet Pencak Silat Pagar Nusa. *Jurnal Pendidikan Kesehatan Dan Rekreasi*, *11*(2), 48–54.

TL. Pamungkas. (2021). Perbedaan pengaruh metode Aerobic Interval Training (Tabata) dan circuit training tehadap peningkatan V02MAX. pada mahasiswa tim pekan Olahraga mahasiswa. *Jurnal Enersia Publika No. 1 Hal 330-341*, *5*(1), 6–53.

Wajib, M., Aditya, R. A., Sihombing, H., & Mes, H. (2022). Pengaruh High Intensity Interval Training Terhadap Peningkatan V02max Atlet Lari Jarak Jauh. *Jurnal Ilmiah STOK Bina Guna Medan*, *10*(2), 44–49.

Wibowo, R. A. T., Jasmani, J., Kusuma, I. A., Yulianto, P. F., Suwanto, W., & Iwandana, D. T. (2023). Pengaruh Latihan Plyometric Single Leg Bound dan Circuit Training terhadap Peningkatan Tendangan Sabit pada Siswa Pencak Silat. *Gelanggang Olahraga: Jurnal Pendidikan Jasmani Dan Olahraga (JPJO)*, *6*(2), 182–191. https://doi.org/10.31539/jpjo.v6i2.6169