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The Effect of Circuit Training Method Training on the Cardiovascular Endurance of Karate Athletes Lemkari Citimall Baturaja

Grace Kharisma Tambunan[1*], Muhammad Malik Legowo[2], Bayu Iswana[3], Jujur Gunawan Manullang[4]
[*1,2,3,4] Fakultas Keguruan dan Ilmu Pendidikan, Universitas PGRI Palembang, Indonesia
gracetbn19@gmail.com
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Abstract

This study aims to analyze the effect of circuit training method training on increasing cardiovascular endurance in Lemkari Citimall Baturaja karate athletes. Cardiovascular endurance is an important component that supports performance in the sport of karate which demands intensive physical activity for a long time. This study used a pre-experimental design with a one-group pre-test and post-test design approach, involving 22 kumite athletes determined through purposive sampling techniques. Data collection instruments in the form of bleep tests were used to measure VO_2max as an indicator of cardiovascular endurance. The training intervention was carried out 16 times with a variety of circuit training exercises, including shuttle runs, squat jumps, ladder drills, side to side cone reach, and climbing and descending stairs. The results of the analysis using the Wilcoxon test obtained a significance value of < 0.001 with Z calculated = -3.880, showing a significant effect of exercise on increasing VO_2max from an average of 33.209 to 38.118. Thus, it can be concluded that the circuit training method is effective in increasing the cardiovascular endurance of Lemkari Citimall Baturaja karate athletes.

Keywords– *Circuit Training, Cardiovascular Endurance, VO_2max, Karate Athletes.*

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1. Introduction

Sport is basically not only seen as a physical activity, but also a planned, systematic, and continuous educational process. According to (Adang Suherman, 2011) is an integral part of physical education which aims to develop human potential as a whole, including physical, mental, emotional, social, and moral aspects. This perspective places sports as a strategic instrument in shaping a whole and balanced individual personality.

As stated by (Conceptual et al., 2009) (Soly Deo Hutagalung, 2024), sports treat humans as a total unit of holistic beings that cannot be separated between their physical and mental qualities. This approach is in line with the concept of "whole person education" which prioritizes a balance between the development of the body and the soul, so that sports not only build muscle strength or physical endurance, but also educate attitudes, shape character, and instill noble values.

Sport has an important role in shaping the character and mentality of individuals. Sports activities teach sportsmanship, cooperation, discipline, and respect for the rules. This can be observed in various sports activities that demand obedience to the rules of the game and respect for opponents and referees. In line with that, sports are also an effective medium in fostering a sense of solidarity and togetherness, where each individual learns to put aside personal interests for the sake of a group or team (Mutohir, T. C., & Maksum, 2007).

In addition to individual benefits, sport also plays a significant role in building social cohesion. Through exercise, individuals learn about the importance of tolerance, respect differences, and foster empathy. These values are very relevant in heterogeneous social life, so that sports can be seen as a vehicle to strengthen the unity and unity of the nation (Cahyono, 2024).

Circuit Training is a training system that is systematically designed to develop physical fitness as a whole, including various components of physical conditions such as endurance, strength, flexibility, power, muscle endurance, agility, speed, and other motor elements (Harsono, 2017). This method combines

different types of exercises that are placed at specific stations, where each station presents a specific type of exercise according to a predetermined purpose. Circuit Training is carried out in the form of a series of several stations, which are passed sequentially by an athlete (Purba et al., 2024). This series is only said to be completed when all stations have been worked according to the set training dose, both in terms of intensity, volume, and implementation time.

In the context of physical fitness, one of the fundamental components that is very crucial is endurance. (Anugra et al., 2024) defines endurance as a person's ability to perform moderate to strenuous activities, involving most of the body's muscles for a relatively long duration of time. More specifically, cardiovascular endurance is defined as the ability of the heart, lungs, and circulatory system to support muscle work for a long time without experiencing excessive fatigue. This aspect is often also called respiratory-cardio-vasculatoir-endurance. Efforts to increase endurance are closely related to the aerobic energy system, which involves adaptations to skeletal muscles, the nervous system, and skeletal bones, known as the primary secondary ergosystem.

In karate, especially in the kumite aspect, the demands on cardiovascular endurance are very high. Kumite literally means "meeting of hands", and in practice is a training method that combines attack and defense techniques in the form of controlled fights with opponents (Zebua et al., 2021). Kumite training involves basic techniques of punching, parrying, and kicking, which are progressively taught ranging from kihon kumite (basic fighting), kihon ippon kumite (one-technique fighting), to jiyu kumite (free fight) (Manullang et al., 2024) (Purba et al., 2024). Intense kumite activities require excellent physical condition, including optimal cardiovascular endurance to sustain attack speed, technique accuracy, and the ability to survive for a relatively long time (Manullang et al., 2021).

Various studies and empirical reports show that athletes' performance is not only influenced by technical and tactical factors, but also highly determined by the readiness of the overall physical condition. These physical conditions include

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endurance, strength, speed, flexibility, coordination, balance, agility, and good reaction ability (Jamaludin, 2019) (Mahyuddin et al., 2024). An athlete with a trained physical condition will be able to perform explosive movements, maintain speed, and minimize the risk of premature fatigue which can negatively affect the quality of technique and tactics when competing.

The latest literature also reinforces the importance of cardiovascular endurance in supporting athletic performance. Research by (Rizhardi et al., 2021) emphasizes that the circuit-based physical conditioning approach significantly increases VO2max, which is an indicator of the body's maximum capacity to consume oxygen which is closely related to cardiorespiratory endurance. A similar study by (Tahan et al., 2020) even found that circuit training programs designed with the progressive overload principle not only increase VO2max but also improve pulse recovery after maximum activity.

Based on this description, it can be emphasized that the quality of cardiovascular endurance has a very vital position in supporting the performance of a karate athlete, both during training and matches. Therefore, a targeted exercise program is needed to optimize this physical component. Circuit Training is one of the alternative methods that is effective, considering its comprehensive nature in developing various components of physical condition simultaneously, including cardiovascular endurance. Thus, this study focuses on further exploring the Effect of Circuit Training Method Training Exercises on Cardiovascular Endurance of Lemkari Citimall Baturaja Karate Athletes.

2. Method

This study uses experimental researchers. This study uses a one group pre-test-post test design, which is a research design that provides a pre-test before a method or action is applied and after applying a method or action will be given a final test (post test. The population in this study amounted to 111 karateka. The sampling technique in this study uses purposive sampling, which is a sample

determination technique with certain considerations (Sugiono, 2017). The research sample that met the criteria amounted to 22 kumite athletes.

The data collection technique was carried out by a running test using a multi-stage (bleep test). The data collected through the form that has been provided and collected in one master table, will then be processed by computer using the SPSS program version 26. Hypothesis testing using the Wilcoxon Test with the help of IBM's SPSS Version 30.0 program by comparing the mean data obtained from the initial test (pretest) and the final test (posttest) of significance of 5% or 0.05 using SPSS Version 26.

3. Result and Discussion

This study is to determine the effect of the circuit training method on the cardiovascular endurance of Citimall Baturaja karate athletes. The results of the study are described using descriptive statistical analysis as follows:

Table 1. Posttest Pretest Frequency Distribution

	N	Minimum	Maximum	Mean	Median	Modus	Std. Deviation
PreTest	22	25.7	49.9	33.209	31.4	35	6.2781
PostTest	22	32.9	50.4	38.118	36.9	34.6	4.4891
Valid N (listwise)	22						

Based on the results of the study, it can be seen that the Circuit Training method training has a positive effect on increasing the cardiovascular endurance of karate athletes. This is shown by the increase in the mean from 33.209 in the pretest to 38.118 in the posttest, which reflects an increase in general endurance after being given the exercise treatment. In addition, the median increased from 31.4 to 36.9, indicating that the median value of data distribution after treatment was also higher. This median increase confirms that more than half of the study subjects experienced improved cardiovascular endurance after the Circuit Training program. In terms of modes, although there was a slight decrease from 35 to 34.6, this was not significant because the mode only showed the most frequently appearing values, while the overall trend remained increasing. Interestingly, the standard deviation decreased from 6.2781 to 4.4891. This

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suggests that after treatment, the posttest results data were more concentrated around the mean (more homogeneous), indicating an equalization of endurance levels among the athletes. In other words, exercise not only increases the average score but also helps reduce variation between individuals, so that their endurance abilities become more evenly distributed.

The research hypothesis can be said to have an influence if Ho is rejected if Wa<Wo or Za are not in the range of ±1.95996. with a significance level of 0.05. The results of the nonparametric Wilcoxon test in the study are as follows:

Table 2. Wilcoxon Nonparametric Test

			Ranks	
		N	Mean Rank	Sum of Ranks
PostTest - PreTest	Negative Ranks	3a	2.33	7.00
	Positive Ranks	19b	12.95	246.00
	Ties	0c		
	Total	22		

From the results of the calculation above, it is obtained that, Wa or Whitung = 7 and Wo or Wtabel = 65 (for n=22). So Wa<Wo, Ho was rejected, which means that there is a significant effect of the Circuit Training method on the cardiovascular endurance of karate athletes.

Table 3. Statistical Test

Test Statistics[a]	
	PostTest - PreTest
Z	-3.880[b]
Asymp. Sig. (2-tailed)	<,001

From the results of the calculation above, it is obtained that, Za or Zcal = -3.88 and Ztabel = -1.96 with a value of Sig (two-tail) = -1.645 or <0.001. So it can be said that Zhitung is not in the range of ±1.96, so Ho was rejected which means that there is a significant effect of the Circuit Training method training on the cardiovascular endurance of lemkari citimall baturaja karate athletes.

Circuit Training is a method of physical condition training that integrates various forms of training at a number of training points (posts or stations)

arranged in a structured series. At each station, individuals perform a specific exercise with a set duration of time or number of reps, then immediately move to the next station with a relatively short rest break. After completing the entire station, one cycle or circuit lap is said to be complete. Usually the exercise is done in as many as two to three rounds depending on the training objectives, the intensity set, and the fitness condition of the participants (Bompa, T. O., & Haff, 2019).

From a physiological perspective, the circuit training method is designed in such a way as to spur the simultaneous work of various body systems, including the neuromuscular, cardiovascular, and metabolic systems. Unlike the single-component training model (for example, only focusing on strength or endurance), circuit training combines several elements of physical fitness to provide a more holistic stimulus. According to (Adi Putra Susilo et al., 2021), circuit training in general aims to develop the main physical condition components such as endurance, muscular strength, flexibility, speed, and agility in a single training program. Therefore, this method is often used as a means of total body conditioning that can improve overall physical fitness.

Circuit training is considered to have high time efficiency because it is able to train various physical aspects in one training session. This is in accordance with the opinion (Aigenbaum et al., 2012) which affirms that circuit training can maximize aerobic capacity while developing an anaerobic component through a combination of resistance training and cardiorespiratory training with controlled intervals. Thus, circuit training not only contributes to an increase in VO_2max, but also supports the adaptation of the muscles and energy systems that underlie sports performance.

Several recent studies confirm the effectiveness of circuit training in increasing the working capacity of the cardiovascular and respiratory systems. Research by (Achmad, 2018) showed a significant increase in VO_2max in sports coaching students after participating in a circuit training program for eight weeks. Similarly, a study by (Ratamess, 2012) found that load-progression-based circuit

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training was able to improve the speed of pulse recovery, which indicated an improvement in the efficiency of the work of the heart and lungs.

In addition, circuit training also provides metabolic stimuli that support the formation of physiological adaptations, such as increasing mitochondrial density in skeletal muscle, increasing oxidative enzyme activity, and increasing the number of muscle capillaries. This adaptation will directly increase the body's capacity to transport and use oxygen during physical activity, making it particularly relevant in the context of developing cardiovascular endurance (Kenney et al., 2019).

Circuit training can be seen as a comprehensive training method that is effective in improving physical fitness through the simultaneous development of various components of physical fitness. This approach is not only beneficial for athletes in sports that require a combination of endurance, strength, and agility, but it is also important in general fitness programs to improve quality of life and cardiometabolic health.

4. Conclusion

This study concludes that the Circuit Training training method is significantly able to increase cardiovascular endurance in Lemkari Citimall Baturaja karate athletes. These exercises not only increase an individual's aerobic capacity, but also help to even out the level of physical fitness between athletes so that they are better prepared for the demands of the game. Therefore, circuit training can be recommended as an integral part of the training program to optimize fitness and support the achievement of karate sports achievements.

Based on the results of this study, it is suggested that coaches can make the Circuit Training method an important part of the training program to improve the cardiovascular endurance of karate athletes. Athletes are expected to run this program in a disciplined and sustainable manner so that physical adaptation can be achieved optimally. In addition, researchers can further develop studies by

considering other variables such as diet, psychological factors, and involving a longer duration of exercise or a larger sample count so that the results can provide a broader picture and can be used as a guideline in sports coaching.

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