

The Effect of High Intensity Interval Training on the Cardiovascular Endurance of Futsal Players at SMAN 1 Dompu in 2023

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Abstract

This study aims to determine the effect of high intensity interval training on the cardiovascular endurance of SMAN 1 Dompu futsal players in 2023. This study is a quasi-experimental study using a variety of HIIT exercises to improve cardiovascular endurance with a design of "one group pre test post test design" which is to provide pre test to the team and treatment and end with a post test to find out the results. The population in this study was the SMAN 1 Dompu futsal team which amounted to 15 participants. The sample from this study was taken from the entire population. The instruments used HIIT workouts. Data analysis using t-test. The results of the t-test analysis show: There is an effect of HIIT training on the cardiovascular endurance of futsal players of SMAN 1 Dompu, because $t_{\text{calculate}} | -6,213 | > t_{\text{table}} = 2.14$ and significance level of $0.000 < 0.05$. Based on the results of this study, it can be concluded that cardiovascular endurance training using HIIT provides an increase in cardiovascular endurance of SMAN 1 Dompu futsal players.

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1. INTRODUCTION

Sport is a systematic activity to encourage, foster, and develop physical, spiritual, and social potential (Destriana, 2012:26). Futsal is one of the most popular sports on the planet today. Nearly every country or region plays futsal. Futsal is a competitive game, with many individuals and young people today participating in it as a means of achieving success. Achieving ideal performance requires excellent physical, strategic, specialized, and mental abilities.

Futsal is a game played by two groups of five players each playing on the field, each group tries to get the ball into the opponent's goal and keep the enemy from scoring, moreover futsal is a team sport that requires many physical demands including endurance, speed, strength, and agility to change direction quickly and in an organized manner (Patta Rawut Khaosanit, 2018:210-219).

As pointed out by Justinus Lhaksana (2011: 17) to carry out the basic methods of futsal, extraordinary conditions are required, the different parts of the conditions that a futsal player must have are (1) perseverance, (2) strength, (3) speed, (4) agility, (5) strength, (6) adaptability, (7) accuracy, (8) coordination, (9) balance (equilibrium), and (10) (reaction). Of the ten parts, perhaps the most interesting part is the perseverance part because in the game of futsal players are expected to continue moving in a fast rhythm and for quite a long time.

Good endurance can be trained, maintained, and even improved by performing specific exercises. Players are required to have good endurance to be able to perform techniques and tactics

well until the end of the match. Endurance in the world of sports is known as the ability of an athlete's body to resist fatigue during activity or work. Athletes with good endurance are able to work longer and don't tire quickly. Furthermore, athletes with good endurance are able to recover quickly. Endurance training affects the quality of the cardiovascular, respiratory, and circulatory systems. People with good endurance (aerobic and anaerobic) also have good condition of all these systems, so that their energy needs are met smoothly. (Deny Sumiyarsono, 2006: 25).

However, in reality, during futsal training sessions at SMAN 1 Dompu, some participants lacked endurance. Several factors contributed to this lack of endurance. The coaches' lack of understanding of how to improve and maintain player endurance, and the lack of training variations led to athletes feeling bored during training, leading many to underestimate the importance of training.

During futsal games, coaches sometimes don't always pay attention to or focus on the athlete's endurance. They only focus on providing training materials during training. The athletes' training sessions are often undirected and unstructured, making them monotonous. Endurance is fundamentally important in basketball, as players with good endurance are able to perform their duties on the court until the end of the match.

In this study, researchers will conduct training to improve players' endurance. Several types of physical training were provided to players to improve endurance using the High Intensity Interval Training (HIIT) method. Based on the background, this study is entitled "The Effect of High Intensity Interval Training on Cardiovascular Endurance of Futsal Players at SMAN 1 Dompu in 2023."

2. METHOD

The research design used was a "One Group Pretest-Posttest Design," a research design that includes a pretest before treatment and a posttest after treatment (Sugiyono, 2007: 64). This study will compare the pretest and posttest results of the cardiovascular endurance abilities of futsal players at SMAN 1 Dompu in 2023.

To further clarify the research process that will be carried out, the research design can be described as follows:

Figure 1. Research Design Chart



Information :

P : Population

S : Sample

Pre Test : Initial test before the subject receives treatment

KT : Treatment

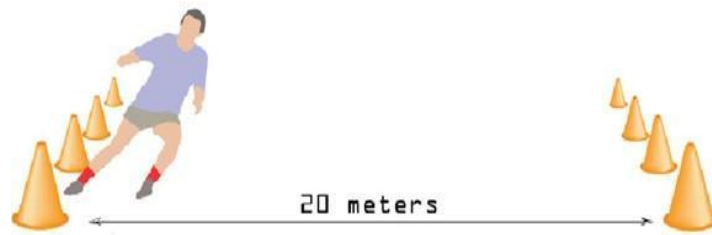
Post Test : Final test after treatment

In this study, the test was conducted twice: before and after the treatment. The difference between the pretest and posttest was assumed to be the effect of the treatment, thus allowing for more accurate results. In this study, the first test was administered to untreated samples (a pretest), followed by a pre-test for a specified period. The post-test was conducted to determine whether cardiovascular endurance had improved or not. The pre-test and post-test were compared to determine the extent of the differences resulting from the experimental variables.

The population in this study was 15 futsal players from SMAN 1 Dompu in 2023, and the sample in this study was the entire population. The research instrument used for the initial measurement (pretest) and final measurement (posttest) was a multistage test. The test implementation began with a warm-up, followed by a multistage test, which was carried out according to the "tut" sound in the audio during the test.

The test instrument image will be described in figure 3.1 below:

Figure 1. Multistage Fitness test



The data collection process in research is crucial because the results obtained from measurements can reveal the symptoms or developments occurring in the sample being studied. This study used a multistage test as the data collection technique. The data collected in this study were pretest and posttest data on cardiovascular endurance.

After the data is collected, the next step is to analyze the data. Data analysis in this study uses the t-test technique, namely by comparing the average (mean) between the initial test (pretest) and the final test (posttest). The normality test is actually a test for the normality of the distribution of the data to be analyzed. The test is carried out depending on the variables to be processed. The normality test for data distribution uses the Kolmogorov-Smirnov Test with the help of SPSS 23. In addition to testing the distribution of the values to be analyzed, a homogeneity test is needed to ensure that the groups that form the sample come from a homogeneous population. The homogeneity test is sought by the F test from the pretest data in both groups using the SPSS 23 program. Hypothesis testing uses the t-test using the SPSS 23 program, namely by comparing the mean between the initial data (pretest) and the final data (posttest). If the calculated t value is greater than the t table, then H_a is accepted. Hypothesis testing in this study the researcher used the SPSS 23 program.

3. RESULTS AND DISCUSSION

Data collection used a multistage test. The pretest aimed to determine reliability and compare it with the posttest results. Thus, data was obtained from conducting the multistage test during the pretest and posttest. The results can be seen in the following table:

Table 1. Multistage Test Pretest and Posttest Results Data

NO	Results Multistage Test		
	Pretest	Posttest	Improvement
1	25.40	28.30	2.90
2	26.20	28.30	2.10
3	25.60	31.40	5.80
4	33.60	35.35	1.75
5	25.00	27.95	2.95
6	25.60	33.36	7.76
7	31.80	37.10	5.30
8	31.80	33.60	1.80
9	24.60	28.70	4.10
10	31.80	33.60	1.80
11	24.80	35.35	10.55
12	26.00	35.35	9.35
13	25.20	35.35	10.15
14	31.80	36.82	5.02
15	31.80	35.35	3.55
Rate-Rata	28.0067	33.0587	4.9920
SD	3.46053	3.27921	3.11187
Minimal	24.60	27.95	1.75
Maximum	33.60	37.10	10.55
Amount	421.00	495.88	74.88

The results of the study are described using descriptive statistical analysis as follows, for the pretest results the minimum value = 24.60, the maximum value = 33.60, the average (mean) = 28.0067 with a standard deviation (std. Deviation) = 3.46053 while for the Posttest the minimum

value = 27.95, the maximum value = 37.10, the average (mean) = 33.0578 with a standard deviation (std. Deviation) = 3.27921. In detail, it can be seen in the following table.

Table 2. Pretest and Posttest Results of HIIT Exercise

Statistics	Pretest	Posttest
N	15	15
Rate – Rate	28.0067	33.0578
Std. Deviation	3.46053	3.27921
Minimum Value	24.60	27.95
Maximum Value	33.60	37.10
Amount	421.00	495.88

To do the test, in order to better understand the implementation of the test, there must be norms for the implementation of the test.

Table 3. Norma Multistage Fitness Test

Age	Very poor	Poor	fair	avarage	good	Very good	Excelle nt
11-12th	<3/3	3/4-5/1	5/2-6/4	6/5-7/5	7/6-8/8	8/9-10/9	>10/9
14-15th	<4/7	4/7-6/1	6/2-7/4	7/5-8/9	8/10-9/8	9/9-12/2	>12/2
16-17th	<5/1	5/4-6/8	6/9-8/2	8/3-9/9	9/10-11/3	11/4-13/7	>13/7
18-25th	<5/2	5/2-7/1	7/2-8/5	8/6-10/1	10/2-11/5	11/6-13/10	>13/10
26-35th	<5/2	5/2-6/5	6/6-7/9	7/10-8/9	8/10-10/6	10/7-12/9	>13/9
36-45th	<3/8	3/8-5/3	5/4-6/4	6/5-7/7	7/8-8/9	8/10-11/3	>11/3
46-55th	<3/6	3/6-4/6	4/7-5/5	5/6-6/6	6/7-7/7	7/8-9/5	>9/5
56-65th	<2/7	2/7-3/6	3/7-4/8	4/9-5/6	5/7-6/8	6/9-8/4	>8/4
>65	<2/2	2/2-2/5	2/6-3/7	3/8-4/8	4/9-6/1	6/2-7/2	>7/2

(<http://www.brianmacco.uk/bleep.html>)

Data analysis is used to answer the proposed hypothesis. Before data analysis is conducted, prerequisite analysis tests, namely normality and homogeneity tests, are necessary. The results of the prerequisite and hypothesis tests are shown below:

The normality test is intended to determine whether the variables in the study have a normal distribution or not. The calculation of this normality test uses the Kolmogorov-Smirnov Z formula, because the sample is less than 50, with processing using the computer program SPSS 23. The results are as follows.

Table 4. Normality Test
One-Sample Kolmogorov-Smirnov Test

		pre test	post test
N		15	15
Normal Parameters ^{a,b}	Mean	28.0667	33.0587
	Std. Deviation	3.46053	3.27921
Most Extreme Differences	Absolute	.305	.224
	Positive	.305	.175
	Negative	-.260	-.224
Test Statistic		1,182	.869
Asymp. Sig. (2-tailed)		.122	.437

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

From the results of the table above, it can be seen that the data *pretest* And *posttest* has a p-value (Sig.) > 0.05 , then the variable is normally distributed. Because all data is normally distributed, the analysis can be continued.

The homogeneity test is useful for examining sample similarity, that is, whether the variances of samples taken from a population are uniform. The homogeneity rule states that if $p > 0.05$, the test is considered homogeneous; if $p < 0.05$, the test is considered inhomogeneous. The results of this study's homogeneity test can be seen in the following table:

Table 5. Homogeneity Test

Levene Statistic	df1	df2	themselves.
.976	1	28	.332

The table above shows a sig. p value of $0.332 > 0.05$, indicating that the data is homogeneous. Because the data is homogeneous, data analysis can be continued with parametric statistics.

Data analysis is used to answer the proposed hypothesis. The t-test is used to test the first hypothesis which states "There is an effect of HIIT training on cardiovascular endurance", based on the results of the pre-test and post-test. If the analysis results show a significant increase, then Push HIIT training has an effect on increasing cardiovascular endurance. The conclusion of the study is declared significant if the sig. value is smaller than 0.05 (Sig < 0.05). Based on the results of the analysis, the following data were obtained:

Table 6. T-Test Results of Pretest and Posttest
Paired Samples Test

		Paired Differences			T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower Upper			
Pair 1	Pretest -	-		-			
	Posttest	4,99200		3,26871			
		3,11187	,80348	-6,71529	-6,213	14	,000

From the t-test results, it can be seen that t count is -6.213 and t table = 2.14 with a significance value of 0.000. Because $t \text{ count } | -6.213 | > t \text{ table } 2.14$, H_0 is rejected, and from the significance level of $0.000 < 0.05$, it can also be concluded that H_a is accepted. Because H_0 is rejected and H_a is accepted, it can be concluded that there is an effect of HIIT training on cardiovascular endurance. This means that HIIT training has a significant effect on the endurance of futsal players at SMAN 1 Dompu in 2023. From the pretest data, the average was 28.0067, then at the posttest the average reached 33.0587. The magnitude of the change can be seen from the difference in the average value, which is 4.9920.

4. DISCUSSION

This study aims to determine the effect of high-intensity interval training on the cardiovascular endurance of futsal players at SMAN 1 Dompu in 2023. This study was conducted in several locations or futsal fields at SMAN 1 Dompu. The time used for this study was when the futsal players at SMAN 1 Dompu in 2023 were training regularly according to the schedule provided by the coach. Therefore, the training can run smoothly without exception.

Training is a systematic process of activity carried out regularly, planned, and continuously using a specific system. This process is inseparable from the principles of training applied and implemented, with the objectives and tasks determined by the coach. The goal of training is to improve an athlete's performance, including fitness, skills, and energy capacity. Several crucial factors are crucial in the game of basketball: physical, technical, tactical, and mental.

In basketball, endurance is one of the factors that contributes to a team's success in winning a match. Endurance is often the most difficult thing for athletes to do during training, as the process is often tedious. Therefore, athletes with good endurance will be the best in basketball.

A basketball game lasts 40 minutes, consisting of four 10-minute quarters. Good endurance is essential for playing basketball. Good endurance plays a crucial role in ensuring good performance during a match.

Good endurance can be trained, maintained, and even improved through specific exercises. Players are required to have good endurance to be able to perform techniques and tactics well until the end of the match. Endurance in sports is known as the ability of an athlete's body to resist fatigue during activity or work. Athletes with good endurance are able to work longer and don't tire quickly. Furthermore, athletes with good endurance are able to recover quickly. Endurance training affects the quality of the cardiovascular, respiratory, and circulatory systems. People with good endurance (aerobic and anaerobic) also have good health, so their energy needs are met smoothly (Sumiyarsono 2006).

This study examines the influence of *Latihan High Intensity Interval* High Influence of HIIT on Cardiovascular Endurance of Futsal Players of SMAN 1 Dompu in 2023, consisting of 15 athletes. This study aims to determine the effect of HIIT training on the cardiovascular endurance of futsal players of SMAN 1 Dompu. The analysis was carried out using a t-test to determine the effect of HIIT training on the cardiovascular endurance of futsal players of SMAN 1 Dompu. Based on the analysis, it shows that the training method has a significant effect on the cardiovascular endurance of futsal players of SMAN 1 Dompu.

High-intensity interval training (HIIT), also known as high-intensity interval training (HIIT), is a cardiovascular exercise strategy that alternates short periods of intense anaerobic exercise with less intense recovery periods, until fatigue is too great to continue. While there is no universal HIIT session length, these intense workouts typically last less than 30 minutes, with the time varying based on the participant's current fitness level. HIIT training provides improvements in athletic capacity and conditioning, as well as improved glucose metabolism.

The treatment used to support maximum results in this study was jogging stride, where jogging was carried out on a basketball court with athletes performing this treatment according to their endurance capabilities. Factors that influenced the results of the study were the sampling technique, the athletes' seriousness in carrying out the treatment, the athletes' ability to carry out endurance tests, and the training program provided. Another factor that influenced the results of the study was the athletes' good adherence to the treatment activities, which was seen from the athletes' adaptation to training, which showed improvements every day. Changes in the athletes' endurance and seriousness in carrying out training. No athletes anymore underestimated the ongoing training process. When initially undergoing treatment, athletes felt unable to perform, but over time, athletes were able to adapt well so that the training process from start to finish ran smoothly.

Following the completion of this research, the futsal training regimen at SMAN 1 Dompu introduced new variations to improve endurance. The coaches provided training plans and variations to keep the athletes engaged. The athletes, meanwhile, developed a fighting spirit and a stronger personality, embracing endurance training. They believe that endurance is crucial for achieving success and can inspire other athletes in Dompu Regency.

Alternating between high-intensity and recovery intensity allows the body to effectively generate and utilize energy derived from the anaerobic system. The addition of intervals helps eliminate metabolic waste from the muscles during rest periods while the body is performing high-intensity interval training. This alternating training period helps the body increase oxygen consumption during exercise at maximum volume and capacity (VO₂ Max) during exercise (Kolt, 2007: 18). More oxygen is used during high-intensity interval training than during non-interval training.

Based on the results of the t-test, it can be seen that t count is -6.213 and t table = 2.14 with a significance value of 0.000. Because t count $|-6.213| > t$ table 2.14, H₀ is rejected, and from the significance level of $0.000 < 0.05$, it can also be concluded that H_a is accepted. Because H₀ is rejected and H_a is accepted, it can be concluded that there is an effect of HIIT training on cardiovascular endurance. This means that HIIT training has a significant effect on the cardiovascular power of futsal players at SMAN 1 Dompu. From the pretest data, the average was

28.0067, then at the time of the posttest the average reached 33.0587. The magnitude of the change can be seen from the difference in the average value, which is 4.9920.

Factors influencing the results of the study were the athletes' commitment to the treatment, their ability to perform endurance tests, and the training program provided. Another factor influencing the results was the athletes' adherence to the treatment, as evidenced by their daily adaptation to the training. This was evident in the athletes' endurance and commitment to the training. No athletes underestimated the training process. Initially, athletes felt inadequate, but over time, they adapted well, enabling the training process to run smoothly from start to finish.

These results can also be attributed to the selection of a training program in accordance with training principles. The progressive increase in load and the dosage of exercises are measured and the training is sustainable. *High Intensity Interval Training* (HIIT) is good for increasing VO₂max. Basketball is a fast-paced game, characterized by attacks, defense, and control, including controlling the tempo, finding space, breaking down the opponent's defense, and managing stamina. Each exercise has different variations to prevent athletes from quickly becoming psychologically exhausted. *High Intensity Interval Training* (HIIT) uses a variety of exercises to avoid boredom. In this case, interval training and high-intensity training *High Intensity Interval Training* (HIIT) is effective in increasing VO₂max in all sports.

The Effect of High Intensity Interval Training (HIIT) on VO₂ Max, according to Arifuddin's research (2016: 24) High Intensity Interval Training (HIIT) affects cardiovascular endurance, this exercise can also strengthen the respiratory muscles so that it provides great benefits for maintaining heart and lung fitness. With continuous exercise without rest breaks that use the aerobic system so that more oxygen is needed. So the heart of someone who does regular exercise is larger. Thus the blood volume per beat (stroke volume = SV) will increase.

With increased blood volume, the heart doesn't need to pump as frequently to meet oxygen needs and remove carbon dioxide. Consequently, the heart rate decreases, allowing the heart to have a higher heart rate reserve (HRR).

High intensity interval training (HIIT) includes a recovery phase that helps flush out metabolic waste from the muscles during the rest period during high-intensity interval training. This alternating training period helps the body increase its oxygen consumption during exercise. This is because cells consume the least oxygen when muscles are at rest (ACSM, 2014: 56).

Training *High Intensity Interval Training* (HIIT) has an impact on the body, especially blood pressure, hormones, blood glucose, lactate levels, and the autonomic nervous system. In the cardiovascular system, HIIT can cause physiological thickening of the left ventricular myocardium, increasing the strength and ability of the heart to pump blood with each contraction, reducing the number of beats per minute. The decrease in sympathetic nerve activity caused by HIIT will reduce cardiac activity, norepinephrine and endothelin-1 production, and increase nitric oxide production, thereby increasing blood vessel dilation and reducing vascular resistance. HIIT is also effective in reducing blood pressure in hypertensive patients because it improves endothelial function and insulin sensitivity.

Research conducted by Fleg (2016: 7) found that an increase in VO₂ max resulted in increased skeletal mitochondrial function and pulmonary oxygen uptake. VO₂ max is believed to be an important indicator of cardiovascular disease mortality. Cardiorespiratory fitness (CRF) is a measure of how well the body can deliver oxygen to the muscles during prolonged exercise, and also how well the muscles can absorb and use oxygen to produce adenosine triphosphate (ATP) energy through cellular respiration. CRF is measured through a VO₂ max test, a test to measure the maximum amount of oxygen that can be consumed to produce energy at the cellular level.

In addition to improving cardiorespiratory fitness, HIIT training also induces structural changes in the heart. Increasing the thickness of the ventricular walls and the strength of the heart muscles also means that the volume of blood filling the ventricles during diastole increases. This effect also results in a greater stroke volume. Another factor contributing to increased stroke volume is increased myocardial contractility (the ability of the heart muscle to contract). This increased ability of the heart muscle to contract is related to ATPase activity within the heart muscle or increased extracellular calcium availability, which leads to increased interaction with

the contractile elements. HIIT can also lower systolic and diastolic blood pressure by 10 mmHg and 6 mmHg, respectively.

Based on the research results and also several descriptions, it can be interpreted that HIIT training has an effect on increasing cardiovascular endurance, especially for futsal players at SMAN 1 Dompu in 2023, thus HIIT training is one of the effective and efficient exercises to increase cardiovascular endurance.

5. CONCLUSIONS AND SUGGESTIONS

Based on the results of data analysis, description, testing of research results, and discussion, the following conclusions can be drawn:

There is an influence of training *High Intensity Interval Training* Regarding the Cardiovascular Endurance of Futsal Players at SMAN 1 Dompu in 2023, the t value was obtained $t_{count}=6.213$ while the t_{table} is 2.14. So it can be concluded that in the research there is an influence training *high intensity interval training* on the cardiovascular endurance of futsal players at SMAN 1 Dompu in 2023. Based on the research conclusions above, there are several suggestions that can be conveyed, namely: (1) For trainers, it can be used as a guideline for compiling physical training programs in terms of increasing endurance. (2) Further research needs to be conducted by adding other variables and better development related to the training created by researchers.

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