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Effect of Circuit Training, Interval Training and Body Mass Index For Increase the VO2 Max

Trisaptono, Sumintarsih

Universitas Pembangunan Nasional Veteran Yogyakarta
E-mail address trisaptono79@gmail.com; E-mail address sumintarsih@upnyk.ac.id

Abstract

This study aims to determine: 1) the difference in the increase in VO2 Max ability between high and low body mass index. 2) differences in the effect of the circuit training method and interval training on increasing the VO2 Max Ability of Volleyball Players. 3) the difference in the VO2 Max ability of Volleyball Players between the circuit training method for high body mass index and the interval training method for high body mass index. 4) the difference in the VO2 Max Ability of Volleyball Players between the low body mass index circuit training method and the low body mass index training interval training method. 5) the effect of the interaction between body mass index and training methods on increasing the VO2 Max Ability of Volleyball Players. This study used a 2x2 factorial design experimental method. The population of Volleyball Club players Balangan Student Association, Sleman Yogyakarta. The total sample was 24 athletes. Data analysis techniques using ANOVA. The results: 1) There is a difference in effect between the circuit training method with a mean of 2.716666667, interval training with a mean of 3.655833333, on the increase in the VO2 Max ability of the mean difference of 0.939166666. 2) There is a difference in the effect between low body mass index with a mean of 3.844166667, high body mass index with a mean of 2.528333333 on the increase in the ability of VO2 max selfish by a mean of 1.315833334. 3) There is a difference in the effect of circuit training on average low Body Mass Index 3.001666667, interval training for low Body Mass Index with a mean of 4.686666667 on the increase in VO2 Max ability, a mean difference of 1.685. 4) there is a difference in the effect of circuit training on high Body Mass Index with a mean of 2.431666667, interval training for Body Mass Index with a mean height of 2.626 on the increase in VO2 max, a mean difference of 0.193333333 5) Interaction between Body Mass Index and exercise methods 1.45530676.

Keywords: Circuit, Interval, BMI, VO2 Max

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I. INTRODUCTION

Volleyball is a sport that is very popular with all levels of society. This sport is played by two teams facing each other which is limited by the net, each team consists of 6 people. Volleyball matches are played for 3 winning sets with relatively short rest periods between sets. However, if in a match the positions win 2 sets each then the fifth set must be contested. Seeing the length of the entire volleyball match, it takes a physical condition. The component of the physical condition required for players to be able to compete for a very long time is the ability to endure the heart-lung, so the VO2 Max ability must be good.

The application of physical condition training must be programmed systematically, directed, and continuously so that the achievement of the target physical condition of the players in a team is achieved effectively and efficiently, it is necessary to choose the right training method.

Body Mass Index is a simple index that is useful for determining a person's weight status, if the weight status is ≥ 23 kg / m2 then the person is overweight or obese. Body Mass Index can be used to calculate the prevalence and risks arising from obesity (WHO et al, 2000). Overweight and obesity are major health problems in both developed and developing countries. One-third of the country's population is obese (Hubbard, 2000; Seidel et al, 2011). Lifestyle changes, dietary irregularities, and physical activity contribute to the emergence of overweight and obesity (Sallis et al, 2012).

II. LITERATURE REVIEW

Calculation of the body mass index of Asian people, including Indonesia, as follows:

- Lack of weight Body Mass Index □ 18.5
- Normal body weight Body Mass Index 18.5 - 22.9
- Overweight Body Mass Index 23.0 - 24.9
- Experiencing Obesity Body Mass Index □ 25.0

Body Mass Index is calculated based on weight (kg) divided by body height (meter) squared. The results of the Body Mass Index can be used as a benchmark for whether a person is overweight or not. Suppose you weigh 60 kg with a height of 1.65m. How to calculate the weight of 60 kg divided by (1.65) 2 = 22.

II.1. Exercise Method

The training method is a procedure and how to choose the type of exercise and its arrangement according to the difficulty level of complexity and weight (Nossek, 1982: 15). Exercise is a sports activity that is systematic for a long time, progressively and individually which leads to the characteristics of human psychological and physiological functions to achieve the specified goals (Bompa, 1994: 10). The training process is much better, which must start early stages, and then be carried out continuously to compete at a higher level (Weinberg & Gould, 2007: 490). So it can be concluded that the training method is a systemized way of working to facilitate the provision or implementation of training to help children achieve the specified goals

II.2. Circuit Training Method

Circuit training is an exercise method that can simultaneously improve the fitness of the whole body, namely the components of motor components because the form of circuit training is a combination of all physical elements. According to Bompa (2015: 233) circuit training exercises can be carried out as follows: 1) training frequency three times per week, 2) circuits carried out 2-3 times per post, 3) consisting of 6-15 posts, 4) training intensity 60% - 80% of the maximum repetitions, 5) the number of repetitions at each post 75% - 100% of the maximum number that can be achieved while performing, and 6) the work period of 15-30 seconds and the rest period of 15-60 seconds.

In arranging the order of the exercise items it is best to work out the increased muscle target alternately. This means that the muscles that are given training load should alternate in each sequence of exercise items. In this study, the training sequence started from running in place, fence jumping, sit-ups, push-ups, back-ups, squat thrust.

II.3. Interval Training Method

Interval training is a method of training that is punctuated by intervals, intervals that act as breaks. Interval training is highly recommended because the results are very positive to increase the endurance and stamina of athletes. The form of training in interval training can be in the form of running (interval running) or swimming (interval swimming). Interval training is a method of training that is punctuated by intervals as rest intervals. Interval training is highly recommended because the results are very positive to increase endurance and athlete's stamina. The form of training in interval training can be in the form of running (interval running) or swimming (interval swimming).

Interval training is a series of strenuous exercises that are repeated punctuated by periods of rest and interspersed with periods of light training. Interval training is an exercise program consisting of periods of repetition of work interspersed with periods of rest (Fox, 1984: 59). According to Rushall and Pyke (1992: 208-211) interval training is divided into three categories:

III.3.1. Long interval training

Is a type of exercise that was originally discovered in the 1930s by German trainers, namely Gerschler and Rendell. It is specifically for activities that use the predominant energy system, the aerobic system. The characteristics of this long-interval training are as follows: work duration is 2-5 minutes, intensity reaches 85-90%, rest duration is 2-8 minutes, the ratio between work and rest is 1: 1 to 1: 2 reps 3 -12.

III.3.2. Intermediate interval training

This exercise is different from long interval training where the work period in this exercise is shorter and the work intensity increases. This type of exercise is intended for both aerobic and anaerobic resistance training. The characteristics of this exercise: work duration 30 seconds with intensity 90-95%, rest duration 2-6 minutes, the ratio between work and rest 1: 2 to 1: 3, reps 3-12

II.4. Short-interval training

This exercise is specially designed to increase the ability of muscle power. This type of exercise is mainly to increase the use of electric energy which is the use of the first energy system in the body system, namely the ATP-PC system. The characteristics of this exercise are 5-30 second duration, 95% work intensity, 15-150 second rest duration, 1: 3 to 1: 5 work-to-rest ratio, 5-20 reps.

The advantages of interval training are:
1) Prompt control over stress
2) A systematic day-to-day approach that lets us know
3) Faster progression of energy potential compared to other methods of formation.

II.5.VO2 Max capability

According to Sukadiyanto (2011: 83), VO2 Max's ability is the ability of the human respiratory organs to inhale as much oxygen as possible during exercise (physical activity). The simplest and easiest way to calculate VO2 Max is by running a certain distance or taking a certain time. There are three kinds of calculation methods, namely (1) by running for 15 minutes and calculating the total distance traveled, (2) by running a distance of 1600 meters and calculating the total travel time, and (3) by using a multistage fitness test, namely running back and forth. back for a distance of 20 meters. As in this study using the Bleep test or multistage fitness test.

II.6. Volleyball Playing Energy System

In volleyball, when viewed from the game, it is intermittent, namely the expenditure of energy using high-intensity power. The energy systems needed in volleyball games are: a) ATP-PC by 85%, b) LA-O2 by 10% and, c) O2 by 5%

III. RESEARCH METHODOLOGY

The type of research in this research is experimental. The research method used in this research is to use a 2 x 2 factorial design, namely a factorial experiment involving two factors, each factor consisting of two levels, using the initial test (pre-test) and the final test (post-test). Factorial experiments are experiments in which almost or all levels of a factor are combined or crossed with all levels of every other factor in the experiment (Sudjana, 2002: 148)

This research was conducted at the BSA Volleyball Club (Balangan Student Association) Sendangrejo Minggir Sleman Yogyakarta). This study was divided into 4 treatment groups. The frequency of meetings three times a week, namely on Monday, Wednesday, and Saturday was held at the BSA Volleyball Club. The duration of exercise is 120 minutes per meeting. A number of meetings 18 times. Training starts at 15.00 to 17.00 WIB.
The technique of collecting data with pre-test and post-test. In accordance with the variables, to retrieve research data the data collection instruments used are:
Body Mass Index data can be used to classify: a) samples that have a low Body Mass Indexability, b) samples that have a high Body Mass Indexability. VO2 Max ability is

measured by tests and measurements with the Multistage Fitness Test (Validation Sukadiyanto 2011: 87).

The data analysis technique used was the two-way analysis of variance (ANOVA) at α = 5%. If the F value obtained (Fo) is significant, the analysis is continued with the Newman-keels range test.

IV. FINDING AND DISCUSSION

The description of the results of the data analysis of the VO2 Max ability test performed according to the groups being compared is presented as follows:

Table 1.Volleyball Player VO2 Max Ability Test Result Data

Treatment	BMI	Statistic	Pre Test	Post Test	Value
Method Circuit Training	Low	Total	228,41	246,42	18,01
		Mean	38,06833333	41,07	3,001666667
		SD	5,379295183	4,977143759	1,493725767
	High	Total	217,1	231,69	14,59
		Mean	36,18333333	38,615	2,431666667
		SD	6,478322828	4,805137875	1,835559709
Method Interval Training	Low	Total	215,68	242,8	28,12
		Mean	35,94666667	40,63333333	4,686666667
		SD	4,029683197	4,754146261	1,371417758
	High	Total	221,15	236,9	15,75
		Mean	36,85833333	39,48333333	2,625
		SD	3,795004172	3,039846487	1,300842035

The results of the data from each variable are summed into one initial test data and this final test is used to determine the increase in the results of the initial and final tests, these results become test data for the VO2 Max ability.

The circuit training method and the interval training method have an effect on increasing the different VO2 Max capabilities. If the group of players who received the circuit training method and the interval training method was compared, it can be seen that the interval training method treatment group had an increase in VO2 Max ability by 3.655833333, higher than the circuit training method group.

If between the groups of players who have low and high Body Mass Index are compared, it can be seen that the group of athletes who have low Body Mass Index have an increase in VO2 Max ability by 3.844166667, higher than the group of players who have high Body Mass Index. Each cell (treatment group) has a different increase in VO2 Max ability. The value of the increase in the VO2 Max ability of each cell (treatment group) can be seen in the following table.

Table 2. Average Value of VO2 Max.

No	Treatment Group	The Value of increasing the VO_2 Max ability
1	A1B1	3,001666667
2	A1B2	2,431666667
3	A2B1	4,686666667
4	A2B2	2,625

Data analysis

Table 3. Summary of Two-Factor Variance Analysis Results

Source of variation	DK	JK	RJK	F_o	F_t
Treatment average	1	243,6525375	243,6525375		
A	1	5,2922042	5,2922042		
B	1	10,38850417	10,38850417	2,307577584	
AB	1	3,337604167	3,337604167	4,529734388	4,35 *
Nuclear	20	45,86805	45,86805	1,455306762	
Total	24	308,5389			

Table 4. Summary of Newman-Keuls Range Test Results.

		A1B2	A2B2	A1B1	A2B1	RST
	Average	2,431666667	2,625	3,001666667	4,686666667	
A1B2	2,431666667	-	0,193333	0,57	2,255	1,82383918
A2B2	2,625		-	0,376666667	2,061666667	2,213337024
A1B1	3,001666667			-	1,685	2,448272239
A2B1	4,686666667				-	

Note: Marked with * significance at P <0.05.
A1B1: Low Body Mass Index Circuit Training Method.
A1B2: High Body Mass Index Circuit Training Method.
A2B1: Low Body Mass Index Interval Training Method.
A2B2: Interval Training Method High Body Mass Index.

The results showed that the circuit training method had a different improvement from the interval training method. This is evidenced by the value of F count = 2.30757758 <F table = 4.35 at the 5% significance level. Thus the null hypothesis (Ho) is accepted, which means that the circuit training method has an increase no different from the interval training method, it can be accepted. The average increase of each is the interval training method 3.655833333 and the circuit training method 2.716666667.
The results showed that players who had a low Body Mass Index had a different VO2 Max increase from players who had a high Body Mass Index. This is evidenced by the value of F

count = 4.52973439> F table = 4.35 at the 5% significance level. Thus the null hypothesis (Ho) is rejected. This means that players who have a low Body Mass Index have a different VO2 Max increase from players who have a high Body Mass Index can be accepted.
From the follow-up analysis, it was found that players who had a low Body Mass Index had a better VO2 Max ability increase than players who had a high Body Mass Index, with an average increase in each, namely players who had a low Body Mass Index 3,844166667 and players who have

From further analysis to test two means with RST values, it was found that A1B1 (Circuit Training method for low Body Mass Index) = 3.001666667 and A2B1 (interval training method for low Body Mass Index) = 4.686666667 that the mean difference = 1.685 <RST = 1.823839168 at a significance level of $P \leq 0.05$, which means that the circuit training method for low Body Mass Index has an increase in VO2 Max ability which is different from the Interval Training method for low Body Mass Index. The Interval Training method for low Body Mass Index has a better VO2 Max ability than the low Body Mass Index circuit training method.

From further analysis to test the two means with the RST value, it was found that A2B2 (high Body Mass Index Interval Training method) = 2.625 and A1B2 (High Body Mass Index Circuit Training method) = 2.431666667 that the mean difference value = 0.193333333 <RST = 1,823839168 at a significance level of $P \leq 0.05$, which means that the high Body Mass Index Interval Training method has an increase in VO2 Max ability which is different from the High Body Mass Index Circuit Training method. The high body mass index interval training method has a better VO2 Max ability than the high body mass index circuit training method.

The results showed that the interaction between exercise methods and Body Mass Index was very significant because Fcount = 1.45530676 <Ftable = 4.35, at the 5% significance level. Thus the null hypothesis is accepted, there is no significant interaction between the exercise method and Body Mass Index.

The discussion of the results of this study provides a further interpretation of the results of the data analysis that have been stated. Based on hypothesis testing, the results are:
1. There are differences in the influence between the main factors in the study of the difference between the Circuit Training method and the Interval Training method on the increase in VO2 Max ability. From the numbers generated in the data analysis, it shows that the comparison of the average increase in VO2 Max ability generated by the Interval training method, the average value of 0.939166666 is higher than the Circuit Training method.
2. There is a difference between low Body Mass Index and high Body Mass Index in increasing VO2 Max ability. From the figures generated in the data analysis, it shows that the comparison of the average increase in VO2 Max ability in the group of players who have a low Body Mass Index is 1.315833334 higher than the group of players who have a high Body Mass Index.

3. There is a difference in the improvement of VO2 Max ability between the low Body Mass Index Circuit Training method and the low Body Mass Index Interval Training method. From the numbers generated in the data analysis, it shows that the comparison of the average increase in VO2 Max ability in the group of athletes using the interval training method I low body mass index is 1.685 higher than the group of players in the circuit training method, low body mass index.

4. There is a difference in the increase in VO2 Max ability between the Circuit Training High Body Mass Index method and the High Body Mass Index Interval Training method. From the numbers generated in the data analysis, it shows that the comparison of the average increase in VO2 Max ability in the group of players with the Interval Training method of high Body Mass Index is 0.193333333 higher than the group of players in the Circuit Training method of high Body Mass Index.

5. There is an interaction between the main factors in the form of a two-factor interaction, between the training method and the Body Mass Index to increase the VO2 Max ability.

Table 5. The Effect of Interaction of Factors, A, and B on VO2 Max Ability.

Factor		A= Training Method			
B = IMT	Level	A1	A2	Average	A1-A2
	B1	3,001666667	4,686666667	3,844166667	1,685
	B2	2,431666667	2,625	2,528333333	0,193333333
Average		2,716666667	3,655833333	3,18625	0,939166666
B1 –B2		0,57	2,061666667	1,315833334	

V. CONCLUSION AND FURTHER RESEARCH

Based on the results of the research and the results of the data analysis that has been carried out, the following conclusions can be obtained:

1. There are differences in the effect of the Circuit Training method and the Interval Training method on the VO2 Max ability. The effect of the Interval Training method is better than the Circuit Training method.
2. There is a difference in influence between players who have a low and high Body Mass Index. The increase in VO2 Max ability in players who have a low Body Mass Index is better than players who have a high Body Mass Index.
3. There is a difference in the effect between the low Body Mass Index Circuit Training method and the low Body Mass Index Interval Training method. Increasing the ability of VO2 Max using the Interval Training method with low Body Mass Index is better than the Circuit Training method for low Body Mass Index.
4. There is a difference in effect between the circuit training method for high Body Mass Index and the interval training method for high Body Mass Index. Increasing the VO2 Max ability of the high Body Mass Index interval method is better than the high Body Mass Index circuit training method.

5. There is an interaction effect between exercise methods and Body Mass Index on increasing VO2 Max ability. If a player has a low Body Mass Index, the Interval Training and Circuit Training methods can increase their VO2 Max ability.

Based on this conclusion, if male volleyball players have a low Body Mass Index using the Interval Training and Circuit Training methods, they can improve their VO2 Max ability. What if the sample is a girl? it is necessary to have further research using a sample of female volleyball players

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